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SOIL SCIENCES

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TESTING KINETIC OF NUTRIENTS RELEASE FROM COMPLEX MINERAL FERTILIZERS COATED WITH CO-POLYESTER FILMS FROM PET WASTE RECYCLING AND EFFECT ON SOIL CHEMICAL PROPERTIES

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Abstract

The paper presents researches carried out in order to test complex mineral fertilizers coated with biodegradable co-polyester films using as raw material the polyethylene terephthalate (PET) waste, such as plastic bottles for food. Achieving of biodegradable coatings, based on polyethylene terephthalate, requires modifying the chemical structure of aromatic polyester (PET) with dicarboxylic acids (aromatic and / or aliphatic), and / or other polyols, to create a biodegradable capsule for prolonged release mineral fertilizers. In order to highlight capacity of complex mineral fertilizers coated with co-polyester films, to releasing nutrients in the soil in an extended time period, unlike common complex mineral fertilizers, a green house experiment was organized. Soil material used was collected from two contrasting soil types in terms of physico-chemical characteristics, namely Luvic Phaeozems, and Calcaric Fluvisols. The experimental variants were set up in vegetation pots of about 20 kg soils / pot capacity, in which fertilizer materials were introduced, namely co-polyester films coated complex mineral fertilizers ($N_{15}P_{15}K_{15}$) and regular granular complex mineral fertilizers. The crop was very early PR39D81 hybrid corn with excellent resistance to drought (hybrids belonging to the group FAO 200). Soil samples were collected during the plant vegetation, especially in the flowering stage and maturity stage (at harvest) for analyzing of the main chemical properties: soil reaction, organic carbon content, humus content, total nitrogen and nitrates contents, mobile phosphorus and potassium content in different fertilization variants. Data obtained in this experiment have been shown that the use of mineral fertilizers coated with co-polyester films in the proposed formula was beneficial for ensuring soil nutrients over a longer time, and thus, to be available to plants along the most vegetation period.

Keywords: *co-polyester films, mineral fertilizers, polyethylene terephthalate, slow-release, soil.*

INTRODUCTION

Replacement of natural resource use by the appearance and development of plastics, lightweight and very resistant, has become one of the most serious environmental problems because of the durability of these materials, which leads to accumulation of huge amounts of waste. In this case, nature, single, can not solve the problem, its huge self-cleaning capacity is no longer useful because most waste plastics can not be degraded by microorganisms.

In the middle of the 9th decade of last century, worldwide production of polymer materials was estimated to be approximately 150 million, with an average yearly consumption of 80–100 kg per capita in industrialized countries [17, 21]. An estimated 40% of this total production has been discarded into landfills [16]. In addition, plastic products and derivatives are now ubiquitous in the natural environment, being present even in marine environments, including sediments [6, 8, 18, 19, 22].
Recycling as an alternative to storage is limited by high costs included, and potential

hazards such as dioxin emissions from incineration [13, 11].

Aromatic polyesters such as polyethylene terephthalate, so-called PET shows excellent properties, which caused him to be marketed worldwide, often as packaging for liquids. However, until now, these polymers are considered resistant to microbial attack, so there is biodegradable, which is a huge disadvantage [9, 1, 10]. Starting from a desire to meet both biodegradability and superior properties of plastic materials, tests were performed on biodegradability co polyester monomers containing both aliphatic and aromatic [24]. Biodegradability of a plastic is implying the possibilities of living organisms to use it as a food source, by transforming its chemical structure within a reasonable period of time. The organisms which having this metabolic ability are microorganisms. Primary (or partial) biodegradability is altering the chemical structure resulting in loss of specific properties of polymers while the final (or total) biodegradability is total mineralization and assimilation of the resulting material by microorganisms [4, 3, 5]. The material is fully degraded by microorganisms to produce carbon dioxide or methane, water, mineral salts and biomass [15, 2]. The time period involved is usually several weeks to several months.

Because of the insolubility and large size of polymers molecules, microorganisms are unable to transport polymeric material directly to their cellular structure, where most biochemical processes take place. Thus, microorganisms must first release extracellular enzymes that catalyze the depolymerization of polymers outside the cell walls. If and when the molar mass of polymer is reduced enough to generate water-soluble intermediates, they can be carried inside the organisms, and placed in appropriate metabolic circuit.

The physicochemical flexibility of branched polyesters achieved through simple modification of the polymer systems, making them very usefully for the development of a variety of drug delivery vehicles in biomedical industry. The polymers' modular design is advantageous for the encapsulation of a wide range of drug compounds [7].

To avoid problems caused by dissolving of fertilizers in soil moisture at a speed higher than its absorption in the plant, many types of slow-release active substance fertilizers were designed. One method to obtain such products involves creation of "core / shell" type microcapsule, where *shell* consists in a polymeric film with low water permeability and the *core* is the active substances. If the polymer used for encapsulation is biodegradable, fertilizers are released slowly as a result of polymeric film biodegradation [11].

To obtain biodegradable coating materials, from polyethylene terephthalate, was performed modifying of the chemical structure of aromatic polyester (PET) by including of dicarboxylic acids and / or other polyols, thus resulting a co polyester structure. This co-polyester presents molecular weight high enough to ensure formation of a flexible and resistant to moisture continuous coating film proper for producing encapsulated fertilizers; able to provide controlled release of fertilizers, mainly by biodegradation, and which can being decayed to a convenient and measurable period of time under the influence of environmental factors.

Soil parameters such as humidity, temperature, pH, salinity, presence or absence of oxygen and nutrient supply level exerts a powerful effect on microbial degradation of polymers, so these conditions must be taken into account when testing biodegradability of polymers .

The most common methods of testing the biodegradability of polymers in the soil are: soil burial test, the so-called "controlled composting test" [14, 20, 22], and spreading the field simulation test "landfill" [12].

MATERIAL AND METHOD

In order to highlight capacity of complex mineral fertilizers coated with co-polyester films, to releasing nutrients in the soil in an extended time period, unlike common complex mineral fertilizers, a green house experiment was organized, using soil material collected from two contrasting soil types in terms of physical-chemical characteristics, especially argyle content, namely Luvic Phaeozems, and Calcaric Fluvisols.

Experiment carried out in greenhouse, in vegetation pots with capacity of 20 kg of soil material / pot, with 5 repetitions for each variant, with those two different types of fertilizers: regular complex mineral fertilizers ($N_{15}P_{15}K_{15}$), and complex mineral fertilizers ($N_{15}P_{15}K_{15}$) coated with co-polyesters films, according to following experimental scheme:

Treatment code	Soil type	Treatment
V1	Luvic Phaeozems	Control - unfertilized
V2		Regular complex mineral fertilizers ($N_{15}P_{15}K_{15}$)
V3		Complex mineral fertilizers ($N_{15}P_{15}K_{15}$) coated with co-polyesters films
V4	Calcaric Fluvisols	Control - unfertilized
V5		Regular complex mineral fertilizers ($N_{15}P_{15}K_{15}$)
V6		Complex mineral fertilizers ($N_{15}P_{15}K_{15}$) coated with co-polyesters films

The crop was very early PR39D81 hybrid corn with excellent resistance to drought (hybrids belonging to the group FAO 200).
During the plants vegetation, especially in the flowering and maturity (at harvest) stages, soil samples were collected and analyzed in the laboratory to determine the reaction (pH in aqueous solution), total nitrogen content by Kjeldahl method, accessible phosphorus and potassium contents (soluble in the ammonium- acetate- lactate solution at pH 3.7) by UVIS spectrometry (phosphorous) and flame-photometry (potassium), and the nitrates content in order to establish how are released the minerals elements from the four types of granular fertilizer coated with co polyesters films. Analytical methods are in accordance with national (STAS) and international (ISO) standards. Data were statistically processed using standard analysis of variance (ANOVA).

RESULTS AND DISCUSSIONS

Soil reaction was not influenced by the type of fertilizer applied, differences in values being generated by the different native reactions of two soils used for experimentation (Fig. 1). The importance of this aspect is that the obtained data prove that the co polyester film used for covering the complex mineral fertilizers does not change the soil reaction, without having to impose any limitations in the utilization of this type of fertilizer for strongly acidic or alkaline soils.

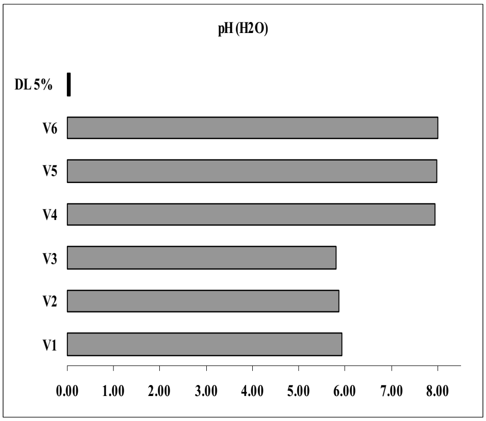

Fig. 1. Effect of fertilizer type on soil reaction

Humus content did not present variation in the experimental variants, except those generated by different native qualities of the two types of soil used, Luvic Phaeozems having, naturally, a higher organic matter content as compared with the Calcaric Fluvisols, soil poor in clay and with a high sand content (Fig. 2).

Total nitrogen content. Besides the inherent differences existing between the two soil types, the total nitrogen content in Luvic Phaeozems fertilized with complex mineral fertilizers coated with co polyester films was significantly reduced as compared with the variant in which regular fertilizers have been applied (Fig. 3). The analysis results have shown that at flowering stage of maize plants, nitrogen from the mineral fertilizers coated with co polyester film not been fully released, remaining still a reserve available for further plant vegetation period.

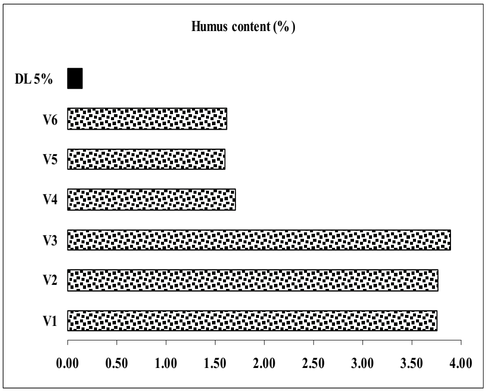

Fig. 2. Effect of fertilizer type on soil humus content

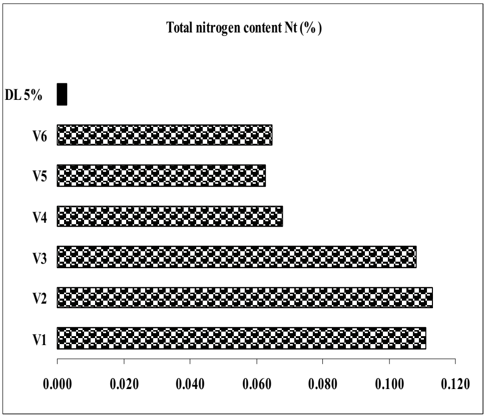

Fig. 3. Effect of fertilizer type on soil total nitrogen content

The nitrates content, nitrogen chemical form most useful for plant nutrition, shows significantly lower values in fertilized variants, as compared with the control, in Luvic Phaeozems.

It was noticed a significant difference between the two types of applied fertilizers, thus in the variant with complex mineral fertilizers coated with co polyester films, nitrates content reported was lower (Fig. 4).

The same situation has been repeated in variants carried out on the second soil type, Calcaric Fluvisols respectively.

Considering that the soil analysis were performed in a stage of high metabolic activity of corn plants, in the flowering period, the explanation may be that in the mineral fertilized variants, plants have had a greater capacity to absorb this nutrient from soil, hypothesis that can be confirmed by their phenological aspect. In the mineral fertilized variants in both fertilization and soil types, the plants were clearly more vigorous.

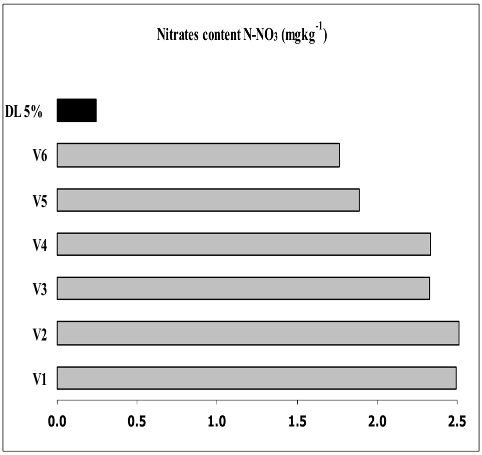

Fig. 4. Effect of fertilizer type on soil nitrates

Mobile phosphorus content, chemical form available for the plant nutrition, shows very significant differences between variants (Fig. 5).

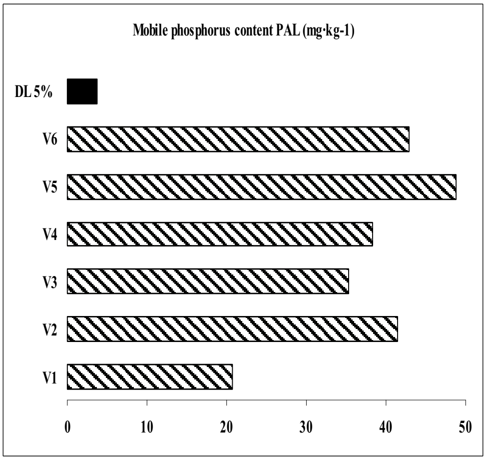

Fig. 5. Effect of fertilizer type on mobile phosphorus content

As it was expected, for the both types of soil, mobile phosphorus content, determined in mineral fertilized variants are higher than control variants, applied phosphorus being found, but, also for the both soils, the contents are significantly higher in variants fertilized with regular complex mineral fertilizer, compared with those fertilized with mineral fertilizers coated with co polyester films

The data clearly show that the time required for release of this chemical element from the co-polyester capsule is prolonged, compared with the period recorded for nitrogen releasing.

Mobile potassium content presented a dynamic, somewhat similar to that recorded in cases of total nitrogen and nitrates contents, shows significantly lower values in fertilized variants, as compared with the control, in Luvic Phaeozems. That means the corn plants more efficiently used this nutrient from fertilized variants, moreover, entailing even natural reserve of soil potassium, especially in Luvic Phaeozems case (Fig. 6).

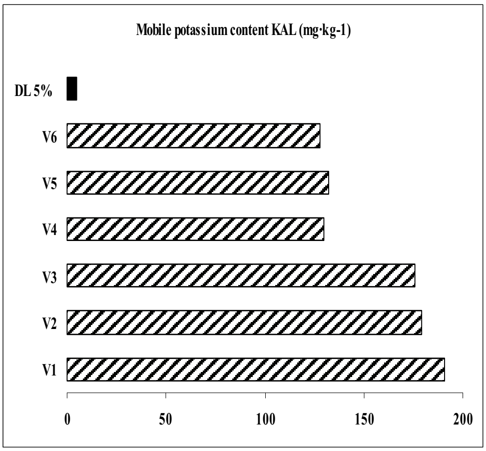

Fig. 6. Effect of fertilizer type on mobile potassium content

CONCLUSIONS

Experimental data clearly shows the beneficial effects of complex mineral fertilizers with NPK application, both in regular formula, but also in that of mineral fertilizers coated with co polyester films.

Data obtained in this experiment have shown that the effects generated by the use of complex mineral fertilizers coated with co polyester films, in the formula proposed in this research, have been beneficial to provide soil nutrients over a longer period to be available to plants.

Use of complex mineral fertilizers coated with co polyester films in formula proposed in this research did not induced toxicity aspects for soil microorganisms which would implicitly leads to breakdown of the bio-geo-chemical circuits, which are the foundation of soil fertility.

Our research highlighted that the use of PET waste for production of co polyester films with applicability in production of complex mineral fertilizers, in prolonged release formulation, is a real and extremely useful possibility for recycling of this waste which has been accumulated in the environment in huge quantities.

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CONTRIBUTION OF SOIL INVERTEBRATES TO THE STABILITY OF ERODED SOILS IN THE SOUTH OF THE REPUBLIC OF MOLDOVA

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Abstract

The role of invertebrates and their contribution to the functioning of eroded soils is discussed. The edaphic fauna of the ordinary chernozem located in the southern zone of the Republic of Moldova has been investigated in dependence on the degree of erosion, the type of agricultural uses and the method of tillage. The highest values abundance and biomass of invertebrates were registered in the soils with a normal profile as well as in the soils with a truncated profile in conditions of the multiannual fallow under natural vegetation. The fallow soil is characterized by a greater diversity of invertebrates. In addition to the Lumbricidae family, in samples of invertebrates, there were found the species of the Arthropoda and Lucanidae classes, Chrysomelidae, Forficulidae, Formicidae, Gloremidae, Attelabidae, Tenebrionidae, Scarabaeidae families as well as other ones. The biomass of the edaphic fauna is represented predominantly by the Lumbricidae family. Their number amounts to 71.9-75.9% of the total number of invertebrates. The diversity of invertebrates in the arable and especially in the eroded soils decreases sharply. Representatives of only 2-5 families, usually Lumbricidae, Pyralidae, Scarabaeidae and Araneae families inhabit the eroded chernozems. The number of Lumbricidae family constitutes 60.5% of the total number of invertebrates in chernozem with a normal profile and 42.4-60.7% in eroded soils respectively. Research carried out during tree years show that, application of disking on eroded soils have been more efficiently for vital activity of the edaphic fauna in comparision to "no – till" technique.

Keywords: *diversity, eroded soils, invertebrates, tillage.*

INTRODUCTION

Soil invertebrates are an important trophic level in the ecological chain nutrition of the biocenosis. Invertebrates have a great importance for biological processes in soil, increase the fertility and humus formation by mechanical decomposition of plant residues and the formation of water-stable soil structure [4, 5, 10 and 14].
The primordial importance of the biodiversity for the environment maintaining stability and the stable development of communities is reflected in the Convention on Biological Diversity [7]. Invertebrates' diversity is one of the most important evaluation criteria of soil ecosystems, resistance to different forms of degradation [8, 10].
In some ecosystems, the local diversity of soil fauna may be more enormous, then the diversity of different groups of aboveground plants or animals [9]. Excessive reduction of the soil biodiversity, especially the loss of keystone species and/or species with unique functions may have some cascading ecological effects, which lead to the long-term deterioration of soil fertility and the loss of agricultural productive capacity [4].
Soil biodiversity also can have indirect effects as to whether soil functions as a carbon sink or source. It has been demonstrated that invertebrate's biodiversity affects the erodibility of the soil due to different mechanisms.
This is important with regard to climate change as it has been shown that soil erosion can turn soil from carbon sink to a carbon source [6].
A considerable deterioration of the physical and chemical properties of eroded soils has been observed in the southern zone of the Republic of Moldova [2, 15].
Biota of eroded soils is subjected to the action of several factors that limits their vital

activity: the low organic matter content, compaction, unfavorable hydrothermal conditions. In order to survive in the extreme conditions of the eroded soil invertebrates produced specific adaptation mechanisms that facilitate the maintenance of their vitality and functioning of the soil as the ecological system.

This is manifested in the accelerating lifecycles, changing of daily and seasonal activities and the use of large quantities of the green food by phytophagus, the increase of the heat-loving species and the migration to the underlying soil horizons.

Soil biota needs an easily available carbon with a simultaneous optimization of moisture, aeration, chemical and physical parameters of habitat. This may be achieved by leaving the eroded soils to self-recover with the help of natural fallow [11, 12] and/or by environmental technologies that are based on the use of soil conservation tillage technologies.

Thus is created the basis for the resolution of the problem of creating the soil medium with the resistance to the impact of erosion processes, with the high level of biodiversity and metabolic activities and the long-dated restoration of eroded soil quality.

The purpose of this research is the evaluation of the state of invertebrates in the ordinary chernozem in dependence on the degree of erosion, the type of agricultural uses and the tillage technique to enhance of edaphic fauna contributions to the stability of eroded chernozems.

MATERIAL AND METHOD

Experimental site. The experimental site is located in the southern zone of the Republic of Moldova, on the South Plains steppe area, in the district no. 13 of ordinary and calcareous chernozems of the South Bessarabian steppe plains, in the Ursoaia village of the Lebedenco district and in the Tartaul de Salchie village, Cahul region (photo 1). The experiment with the conventional and no-tillage systems was replicated three times by split-plot design. The area of plots was 1000 m^2.

Photo 1. Fragments of natural and agricultural landscapes located in the southern zone of the Republic of Moldova

Researches were carried out during the period of time between 2008 and 2012.

Soils. The soil of the site is an ordinary chernozem. Arable chernozems with different degrees of degradation caused by erosion processes (slightly, moderately and severely eroded) have been compared to the chernozem with a normal profile under arable and 55-years-old fallow land and the eroded soil which was under 58-years-old fallow.

Status of invertebrates. The state of invertebrates was identified from test cuts by manually sampling the soil layers to the depth of soil fauna occurrence by Gilyarov and Striganova's method [14]. The identification of invertebrate's diversity at the level of families and species, and also their classification according to nutrition was conducted by standard procedures [3, 13 and 14].

Soil chemical properties. The humus content was analyzed by the dichromate oxidation method and calculated using the coefficient of 1.724 [1].

Moisture of soils and the dry matter of each soil sample were determined as a weight loss of the pattern after drying at 105^0C to constant weight for 6h.

RESULTS AND DISCUSSIONS

Impact of different land management and erosion processes on soil invertebrates. Ordinary chernozems in conditions of the fallow land have the sharp differences from the arable soils according to faunal indices. Invertebrate's abundance in soils under natural vegetation was significantly higher than in arable soils. The chernozem with the normal profile in conditions of a long-term fallow (55-yesr-old) is characterized by a higher number and biomass of soil invertebrates in comparison with eroded chernozems which are as fallow as arable (Fig. 1). The number of invertebrates is reached to 448 ex m^{-2}, *Lumbricidae* family – to 340 ex m^{-2}, and its biomass – to 84 and 74.8 g m^{-2} accordingly. The share of earthworms in the total abundance of invertebrates constitutes of 71.9-75.9 % and their biomass – 89.1-91.2 % in fallow soils.

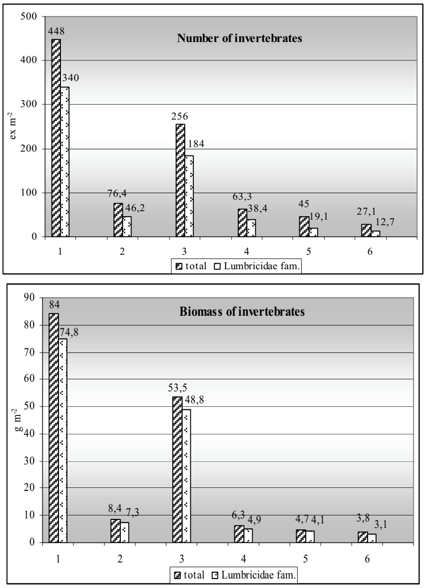


Fig. 1. The abundance of invertebrates in the ordinary chernozem in the dependence of the land uses and erosion degrees (mean values)

The weight of one exemplar of *Lumbricidae* family in fallow soils constitutes 0.22-0.27 g, in the arable chernozem with normal profile – 0.16 g, in arable eroded chernozem – 0.13-0.25 g. It should be noted that the average weight of earthworms increases with the growth of the erosion degree that indicates on the survival of big representatives of this family in eroded soils.

Indices of invertebrates' number and biomass decreased in slightly, moderately and severely chernozems by 16.9-72.5 % and 25.0-57.5 %.

Invertebrates diversity at the class level in ordinary chernozems of the southern zone of the Republic of Moldova is represented by the clases of the *Olighocheta* – 65.7 %, *Insecta* – 17.9 %, *Miriapoda* – 15.7 % and *Arachnida* – 0.7 % (Fig. 2).

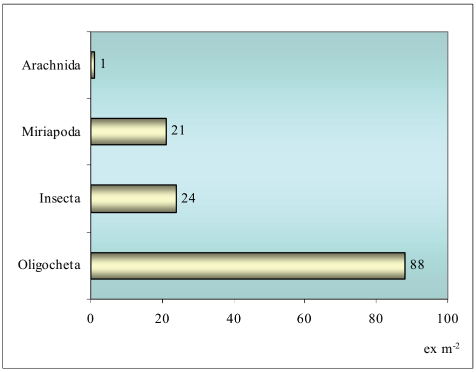


Fig. 2**.** Diversity of invertebrates (on the class level) in ordinary chernozems of the southern zone of the Republic of Moldova

Olighocheta worms are the most abundant class among all edaphic invertebrates. Their number is the highest in the fallow soils: 422 ex m^{-2} in the chernozem with normal profile and 204 ex m^{-2} in the eroded chernozem.

Arable soils contains the class of Oligochaeta significantly less, their number are reduced in 8,3-17,6 times (Fig. 3). Significant differences in the amount of oligochaetes between soils with different degree of erosion were not observed. This may be due to the fact that number of the biodiversity samples was less than of amount and biomass samples.

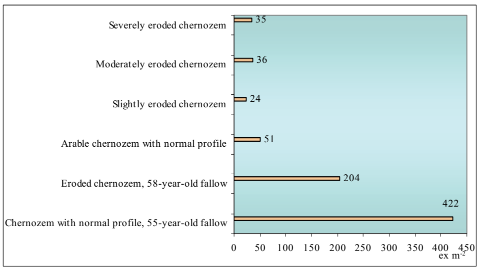


Fig. 3. Populations of the *Olighochaeta* class in the ordinary chernozem in the dependence of the land use management and erosion degrees

The diversity of invertebrates in the arable and especially in the eroded soils decreases sharply. The fallow soil is characterized by a greater diversity of invertebrates. In addition to the *Lumbricidae* family, in samples of invertebrates there were found, the species of the *Arthropoda* and *Lucanidae classes, Chrysomelidae, Forficulidae, Formicidae, Gloremidae, Attelabidae, Tenebrionidae* and *Scarabaeidae* families as well as other ones (Table 1). In general, the soil under natural vegetation contains 5-7 families of invertebrates, while eroded soils – only 2-5. The slightly eroded chernozem contains five families of the edaphic fauna, moderately and severely eroded chernozems – only two families. It should be noted that in faunal cuts of the eroded soil under 58-year-old fallow families of invertebrates, which are not met in the chernozem with normal profile, have been found. These are *Attelabidae, Tenebrionidae, Scarabaeidae* and *Siliphidae* families. But *Chrysomelidae* and *Forficulidae* families were found in the fallow chernozem with normal profile. The abundant presence of the *Formicidae* family represents is observed as in the fallow chernozems so in the eroded ones and with the normal profile.

Saprophagous predominate in the all investigated soils (Fig. 4). Their contribution to the total number of invertebrates is quite substantial and constitues 60.0-87.6 %. The share of saprophagous in the faunal complex of fallow soils constitues 79.7-87.6 % while in arable soils – 60.0-76.1 %. The contribution of phytophagous to the total number of invertebrates is significantly less and increase from fallow chernozems to arable chernozems, constituting 0.9-18.8 % and 10.1-40.0 %. Invertebrates with the mixed nutrition type in fallow soils amount to 1.6-4.9 %, in arable soils – 11.1-20.3 %. Zoophagous were found only in the chernozem with normal profile – 5.1 %, and predators in the amount of 11.1 % in the arable eroded chernozem.

Ecological pyramids in fallow chernozems are characterized by a higher stability in comparison with arable chernozems.

Lumbricus terrestris specie is the most typical representative of the *Lumbricidae* in the all soils of the southern zone. *Pyrochroa serraticornis, Ropalopus macropus, Maloë violaceus, Gnorimus nobilis, Pyransta nubilalis* and *Pieris napi* species were represented everywhere in the soils. *Lucanus cervus* was found rarely in eroded chernozem under 58-year-old fallow. Differences between the type of land management were more substantial than those between the degrees of erosion.

Table 1. Diversity of soil invertebrates (on the family's level) in ordinary chernozems of the southern zone of the Republic of Moldova, ex m^{-2}

Nr.	Family	Chernozem with normal profile, 55-year-old fallow	Eroded chernozem, 58-year-old fallow	Arable chernozem with normal profile	Slightly eroded chernozem	Moderately eroded chernozem	Severely eroded chernozem
1	Lumbricidae	338	184	35	20	36	35
2	Glomeridae	84	20	16	4	0	0
3	Attelabidae	0	36	0	0	0	0
4	Tenebrionidae	0	8	0	0	0	0
5	Scarabaeidae	0	4	0	4	0	5
6	Siliphidae	0	4	0	0	0	0
7	Elateridae	0	0	8	0	0	0
8	Pyralidae	0	0	16	4	24	6
9	Carabidae	0	0	4	0	0	0
10	Araneae	0	0	0	4	0	0
11	Chrysomelidae	4	0	0	0	0	0
12	Forficulidae	22	0	0	0	0	0
13	Formicidae	+	+	0	0	0	0
Total		448	256	79	36	60	46

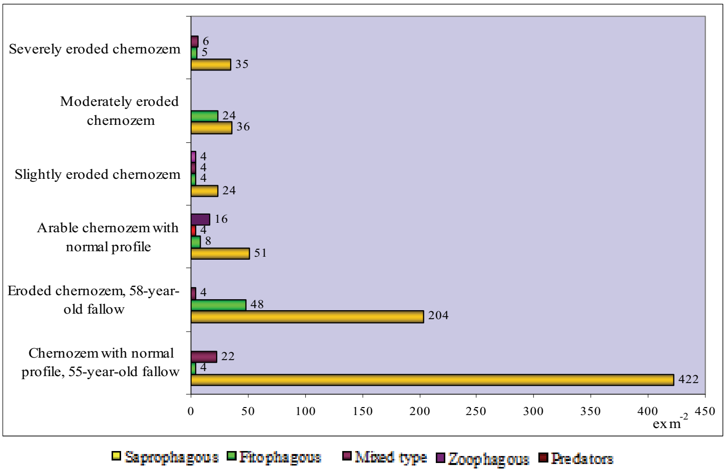
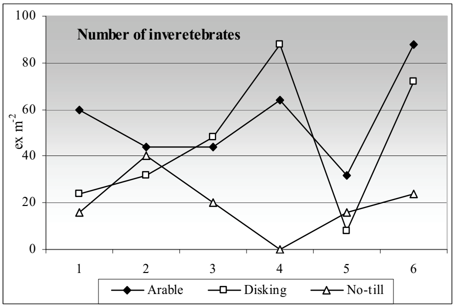


Fig. 4. The composition of invertebrates on the mode of nutrition

Influence of the different soil tillage on invertebrates in the slightly eroded chernozem. The tillage system for the eroded soil has represented one of the main elements of reclamation technology, which, as was supposed, will be restored the invertebrates abundance.

The number and biomass of total invertebrates and *Lumbricidae* family varied in the wide limits in the dependence of the selection dates, the moistness and the organic matter content (Fig. 5). The maximum values of indices were fixed in the spring, when the moisture content constituted 19.0-20.9 %. The minimum values were registered in the autumn. The content of moisture during some periods constituted 11.2 %.

Differences between treatments manifested to the third year of the research. The conventional tillage (arable on 20-25 cm) and disking 15 cm contributed to the improvement of the vital activity of earthworms. Their number constituted 78-88 ex m^{-2}, while the variant with the no-tillage system contained 24 ex m^{-2}. The application of disking on eroded soils have been more efficiently for the edaphic fauna as compared to “no – till” technique during the three years of investigations.



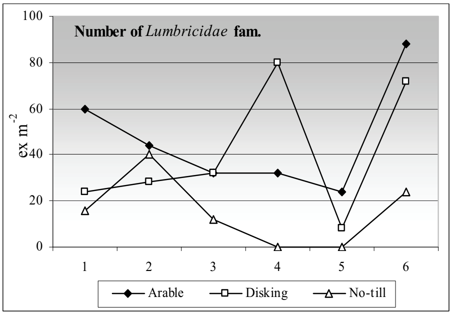


Fig. 5. The effect of different methods of tillage of the slighyly eroded chernozem on the number and biomass of invertebrates: 1-6 – selection dates (2010-2012)

The humus content did not differ significantly depending on the type of treatment.

CONCLUSIONS

The long arable utilization of soils and erosion processes has been rendered disastrous effects on the soil invertebrates of the southern zone of the Republic of Moldova. The highest values abundance and biomass of invertebrates were registered in the soils with a normal profile as well as in the soils with a truncated profile in conditions of the multiannual fallow under natural vegetation. The fallow soil is characterized by a greater diversity of invertebrates. Ecological pyramids in fallow chernozems are characterized by a high stability in comparison with arable chernozems.

The catastrophic loss of biomass, of the edaphic fauna diversity represents a particularity of arable eroded chernozems. Differences between the types of the land management were more substantial than those between the degrees of erosion.

The application of disking on the eroded soils has been more efficient for vital activity of the edaphic fauna in comparison to the no-till technique.

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LONG TERM HEAVY METALS SOIL POLLUTION CAUSED BY EMISSIONS FROM THERMAL POWER PLANT DOICEŞTI

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Abstract

Some of the most complex polluters of the environment are Thermal Power Plants that are using coal as energy source. There are two types of environmental pollution sources: the main are baskets exhaust gases of coal combustion, so called high sources, and the secondary sources that are ash dumps resulted from the coal combustion activities, so called low sources. Thermal Power Plant Doicesti, located in the area of Sub-Carpathian hills, on Ialomiţa Valley, is a major source of environment pollution with sulfur, since 1952 when was built. By geographically point of view, the studied territory can be included into Sub-Carpathians' Curvature, more specify in the Prahova's Sub-Carpathian subunit. Pedogenesis factors: rock, topography and parent material, have led the evolution of isolated, lythomorphic soils. In the investigated territory four soil classes: Luvisols, Cambisols, Vertisols and Protisols were identified, each of them with types and subtypes mentioned in the paper. The subject of this paper is to analyze the loading degree of sulphur of the soils affected by emissions from Thermal Power Plants Doiceşti. Soil samples collected from 23 soil profiles distributed in all cardinal directions, were analyzed for total, organic and mobile sulphur contents. In the investigated area, sulphur pollution of soils, caused by sulphur emissions from Thermal Power Plant Doiceşti, were recorded. The sulphur pollution phenomenon gathering way by changing the normal content of soil, plant, and consequently, could affecting the health of the inhabitants of this territory.

Key words: *heavy metals pollution, soil, Thermal Power Plant (TPP).*

INTRODUCTION

Thermal Power Plant Doiceşti is the oldest power plants in Romania, dating since 1952. Those 57 years of its operation left their mark on the characteristics of soils developed in the area of influence of emissions.

Sulfur from the burning gases reach the final on soils and vegetation in the form of aerosols or acid rain. Up to date, expeditionary field researches, performed in the areas of the main power stations could not show significant changes in soil reaction caused by emissions from coal thermal power plants. This fact is due to large height of exhaust baskets of burned gasses, which allows distribution of gaseous pollutants in large territory. Secondly, many of the soils developed in the influence area of emissions are buffered by carbonates which prevent leaching and depletion of bases processes.

Fig. 1. Dâmboviţa County

Generally, the sulfur content in the form of SO_4^{-2} is less than 450 $mg \cdot kg^{-1}$ in unpolluted soils. Determination of sulfur loading degree is very difficult, because each soil is a separate entity characterized by specific chemical properties. However, large quantities of sulfur present in burned coal is often found in the A horizon of soils located in the area of influence of power plants emissions. The thermal power plant Doicesti is located in the Carpathian hills, on Ialomita Valley. South of town Pucioasa valley enlarges its width exceeding 2 km in Doicesti area. Doiceşti, Cornetu and Brăneşti Hills have different sizes and orientations, their height varying between 375-518 m. Most of the ridges have heights lower than those of Thermal Power Plant basket exhaust gases, its superior part can be seen from the side Forest Balteanu located on the second line of hills behind the Doiceşti Hill [1].

MATERIAL AND METHOD

Development of the present study needed field investigations field to collect soil samples and observations on materials constituting slopelands and terraces surrounding the Doiceşti and Rovinari thermo-electric power stations. Sampling was made on the 0-20 cm and 20-40 cm depth. Soil sampling points were located on the map. 24 soil samples have taken, from Doiceşti and 40 soil samples from Rovinari they being subject to the following set of analyses: pH and copper [1].

In order to facilitate the interpretation of loading degree of potential pollutants and make a comparison between the contamination intensities of each pollutant element, an excessive coefficient of maximum normal content (Cn), proposed by Lăcătuşu 1995 and Florea 2003, has been calculated for each individual element. This Cn coefficient is defined as the ratio between the respective element content and the maximum normal content of that element. As concerns the potential polluting substances, the reference contents established by the Ministry of Waters, Forests and Environmental Protection (Order No. 756/1997) have been applied [4].

The value 1 of this coefficient means the lack of a contamination, according to the official rules. Sub-unitary values mean a low geological background for the respective element, while the over-unitary values may mean a contamination with the respective element due to the pollution source, so much the higher as the value of this coefficient is higher.

To be able to evaluate the pollution degree, similarly, the coefficients corresponding to the thresholds of "warning" and "triggering", briefly called warning coefficient (Ca) and triggering coefficient (Ci) for each potential pollutant, dividing the value corresponding to warning level and triggering level by the maximum normal content of the respective pollutant.

As the exceeding coefficient of normal content (Cn) of each element is coming nearer to the warning coefficient (Ca) or the triggering coefficient (CI), so the contamination or the pollution of the respective site is more intensive, of course, depending on these values, the adequate measures are taken, consequently.

These relative values for the above mentioned coefficients permit a light comparison of pollution intensities of different chemical elements.

RESULTS AND DISCUSSIONS

The study of pollution of soils in the Doiceşti thermoelectric power station area required further larger analysis of soil properties because the soils form a complex mantle caused by the diversity of relief, groundwater, rock and parent material conditions.

Within the area influenced by the Doiceşti thermoelectric power station, soil samples were taken from 24 profiles, mostly located on both sides of the Ialomiţa river, between the Pucioasa and Târgovişte municipalities and to the west of the Dâmboviţa river between the Izvoare and Drăgăeşti-Ungureni localities.

Location of soil profiles from the Doiceşti thermoelectric power station is as follows: on the Ialomiţa valley at 0.8 to 9.5 km N, 0.8 to 6.7 km E, 1.7 to 6.3 km S-SSE , on the left of Dambovita to the Târgovişte 1.6 to 9 km S-SW-V, and 6.9 to 9.1 km, respectively.

About 50% of the soil profiles are on meadow, Alluviosols (AS) (Aseu mostly and the remaining - Entic, Prundic, Gleyic Alluviosols). The rest of soils are Cambisols - 17.65% (Typical, Lithic and Spolic Eutricambisols), Luvisols - 17.65% (Typical and Reddish Preluvisols, and Typical and Stagnic Luvisols); Regosols - 8.82%;

Chernisols I - 2.94% (Cambic Rendzins) and Pelisols - 2.94% (Eroded Typical Vertosols) [4].
Further each pollutant will be separately examined.
A characteristic of soils in the Doiceşti thermoelectric power station area is the low-moderate supply with humus, but the coal dust, very rich in organic carbon, has a direct influence on its content in soils in the area affected by emissions. Although, the humus content is generally used to characterize the state of soil supply with organic matter as, in this particular case, I found impossible to use this parameter as a means of comparison.
This feature is determined by the processes of bioaccumulation which, for various reasons, did not allow accumulation of large amounts of humus. Climatic conditions and natural vegetation do not favor the accumulation of large amounts of plant residues on the soil surface and in the soil profile. Many of the soils in the studied territory are affected by erosion processes that have as effect the soil material transport from the upper part of soil profile. All these soils, under natural conditions, may have no more than 1.8 to 3.0% humus. The organic carbon content varied widely in the investigated profiles, from 0.89 to 4.78%.
The behavior of any chemical element is influenced by soil reaction. There is a relationship of proportionality between the level of soil acidity and the sulfur mobility. In the investigated area, the analyses revealed a variation of pH values from 6.09 to 8.17, i.e. a variation from slightly acid to slightly alkaline soil.
The subject of this paper is, however, the assessment of the soil load degree with heavy metals from the Doiceşti thermoelectric power station. Soil samples have been collected from 24 soil profiles in all the cardinal directions. These soil samples have been analyzed for copper, zinc, lead and cadmium.
As concerns the copper content, it exceeds the normal content within the whole territory in the Ialomiţa floodplain - between the south alignment Teiş-Anina, Brăneşti in the north part and Lăculeţe valley in east part. Maximum values can exceed the normal content of 10 to 20 mg·kg-1 content (20 mg·kg^{-1}), but well below the alert threshold, so there is threshold, that is there is a slight contamination (loading). In a single site (13 km NNW from the Doiceşti thermo-electric power station), in the 20-40 cm layer, the copper content reached 141 mg·kg^{-1}, that is, exceeded the alert threshold, probably as the result of the plant protection treatments applied in grapevine, or a local geochemical anomaly (site ignored in the data interpretations).
Coefficient values exceeding the maximum normal content vary between 0.6 and maximum 2.4, being no pollution with copper. The coefficient corresponding to the alert threshold (4.76) is not exceeded.
As regards the territorial distribution (Fig. 2), a coefficient exceeding two times the normal maximum content of more than 2 is observed on a reduced area to east of the Doiceşti thermoelectric power station and on an area located along the Ialomiţa valley with this coefficient of 1.25 to 2 which extends to north up to 5 km, and to the south in the dominant wind direction up to 7.5 km.
The exceeding coefficient between 1 to 1.25 times occurs in the whole south region up to beyond the Târgovişte at Dragomireşti, and to the north along the river up to beyond Pucioasa, more than 3.5 km, In the rest of the territory contamination does not occur, the coefficients being sub unitary. Due to the high relief, in the west and east of the Ialomiţa valley, the contamination in the respective regions is not observed.

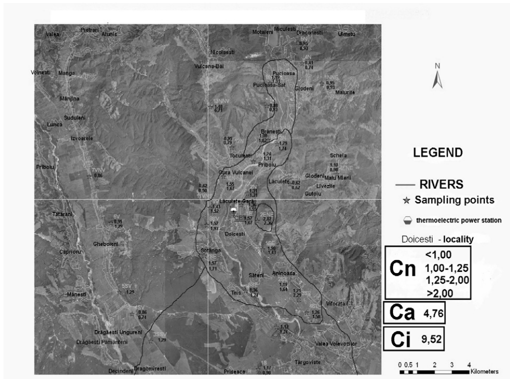

Fig. 2. Distribution of exceeding coefficients of the normal maxim content of copper in the area influenced by the Doiceşti thermoelectric power station

As concerns the zinc, a behavior similar with that of copper is observed, the areas with some loading following the river and Lăculeţe Valley. Maximum value of 160 mg·kg[1] is also recorded in 13 NNW site, exceeding by 60% the normal of content 100 mg·kg^{-1}, but well below the alert threshold, this value being accidental.

In case of the 3 SSV site with 160 mg·kg^{-1}, the possible source of pollution is COS Târgovişte, because higher contents are observed in the north of the city of Târgovişte (south-east 4 and 5 sites).

Excepting the values of coefficients that seem abnormal of 1.59 near Drăgăeşti and 1.65 near Vulcan, the rest of values shows no exceed of the normal content, this ratio being much subunitary, excepting the site 1SE south of Doiceşti. The very close variation with the distance of the coefficient values for zinc (Fig. 3) highlights, actually, the absence of contamination with zinc.

For the most part of the region exceeding the normal maximum content coefficient is predominantly less than 0.6, but along the Ialomiţa valley higher values of normal content exceeding coefficient between 0.6 to 1 occur, which could be attributed to the influence of the Doiceşti thermoelectric power station emissions. The extending area of this element is also far to the south (approximately 5.5 km) as compared to the north part (about 3.5 km).

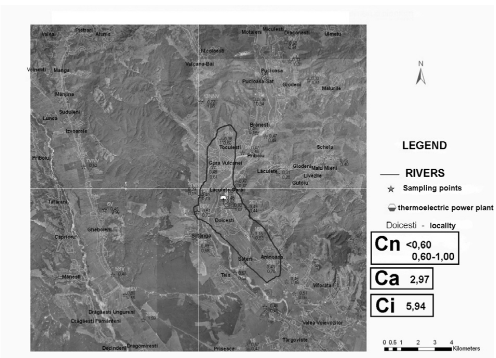

Fig. 3. Distribution of exceeding coefficients of the normal maxim content of zinc in the area influenced by the Doiceşti thermoelectric power station

Generally, the lead presents normal to *slight-moderate* pollution content (loading), maximum value being recorded at the1N (0-20 cm layer) site with 55 mg·kg^{-1} and the 1E (20-40 cm layer) site with 75 mg·kg^{-1}, respectively.

As concerns the influence of the Doiceşti thermoelectric power station due to the contamination with lead, this is more difficult to specify as distribution due to the interference with the lead pollution caused by vehicles.

Coefficient values exceeding the normal content exceed all over the values 1 that shows a lead contamination throughout the land area; a decrease of value is observed as the distance from the source increases. Values exceeding the alert coefficient occur only in a reduced area located mainly in the south, west and east of the Doiceşti thermoelectric power station (Fig. 4). Values exceeding the intervention coefficient did not occur. Coefficient values exceeding the normal content between 1.7 and 2.4, that is, to a certain extent to alert coefficient (Fig. 3) are observed along the Ialomiţa valley.

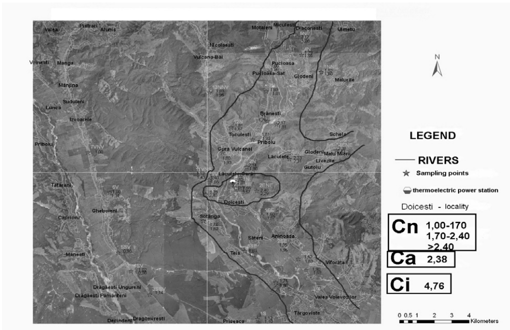

Fig. 4. Distribution of exceeding coefficients of the normal maxim content of lead in the area influenced by the Doiceşti thermoelectric power station

The cadmium has concentrations included in the normal-slight loading range in 1E and 8V, respectively, sites, and the values in other sites are approximately equal to the normal value. Values of exceeding coefficient of normal maximum content that decrease with distance exceed the value 1 only along the Ialomiţa valley to the north and south of the the Doiceşti thermoelectric power station, extending 5 km to the north and 9 km to the south. These values are between 1 and 1.7, much lower than the alert coefficient (2.73).

In the rest of area, values remain subunitary not being influenced by emissions, except for a small area at Pucioasa that could likely have a local cause (Fig. 5).

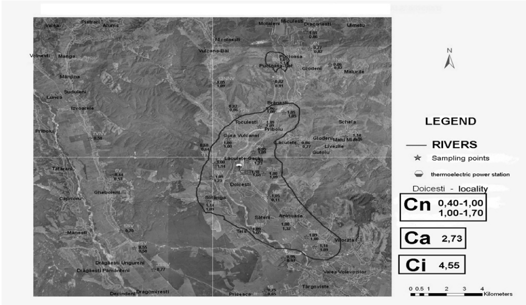

Fig. 5. Distribution of exceeding coefficients of the normal maxim content of cadmium in the area influenced by the Doiceşti thermoelectric power station

CONCLUSIONS

The area affected by the Doiceşti thermoelectric power station is located in the Prahova Subcarpations, in the Ialomiţa floodplain wide of 2 km in south part and 1 km north part, respectively.

Pedogenetic factors determined the occurrence of various soils, the most common being Fluvisols, followed by the Eutric Cambisols and Luvisols.

Most soils have a neutral-slightly alkaline reaction, being resistant to pollution with acid contaminants. The soils in the central-eastern area evolved on more acid materials (e.g. the Typical Luvisol site - 5 SE).

• General formation conditions determined an evident accumulation of small quantities of humus, receiving to some extent organic carbon derived from coal dust, fact illustrated by the C/N ratio, slightly higher than that of normal conditions.

• The Doiceşti thermoelectric power station polluted area which extends along the Ialomiţa river south-north direction having as as boundaries Teiş-Săteni, Aninoasa in south; and Brăneşti in north and Glodeni in East. Within the above mentioned territory, soils that are sightly polluted with Zn and Cu, and moderately-strongly polluted with coal dust and ash, which changed the humus content and texture.

• The area of maximum influence of these particulates is located around the Doiceşti thermoelectric power station where the soil particle size distribution are drastically changed on the soil profile. In the area, south and west of Târgovişte the zinc pollution is observed due to other sources.

• Self-purification processes are insufficient to ensure the environmental protection. In order to reduce the atmosphere pollution degree, the following recommendations are given:

- to improve the combustion;
- to reduce the sulfur content of fuels and increase the degree of retention of emitted sulfur;
- to increase height of chimneys and improvement of emission conditions;
- to improve capture of pollutants emitted in the form of dust and gas;
- to establish the special protection areas and warning areas.

These measures lead to the reduction or soil mantle contamination or pollution control.

• Technologically depleted dumps should be reclaimed especially for forestry, as a measure for the protection of environment and people health.

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STUDIES ON SOIL COVER AND LAND SUITABILITY TO VARIOUS AGRICULTURAL USES, IN THE SOUTH/EAST OF THE OLT COUNTY

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Abstract

Researches start on the hypothesis that the soil is a natural body, that in terms of rational use improves its productive capacity, and can be characterized by the particularities of the natural environment in witch forms it and determines its suitability for various agricultural uses. Pedogenetical processes leading to formation of the five classes of soil in the Plapcea hydrographical basin, Olt county are especially influenced by the climate and hydrographic network. Based on the study of the landscape and the soil cover in estimation of its suitability for agriculture it considered the fact that most part of soil, about 75, belong to Luvisols class (Romanian System of Soil Taxonomy), land suitability is good till the hard limitation.[2]. These limitations, determined by the power of restricting factors, produce the structure of agricultural production and settle the boundaries of areas on the suitability classes, namely: 4.96% good suitability (class II), 54.2% middle suitability (class III), 34.4% hard limitation (class IV) and 6.5% with very hard limitation (class V). Although the land fertility is very low, the land use is predominantly agricultural and surfaces with grains grown at a rate of 77%.

Key words: *fertility, production capacity, soil, suitability.*

INTRODUCTION

In this research we studied the natural factors of the valley basin Plapcea, county Olt, in order to know objectively the potential of soil cover and thus their suitability to various agricultural uses.
Soil and its qualities are known by the natural features in winch it formed and evolved.
A fundamental factor of the soil genetically processes is climate which by its elements expresses and other components of the environment, like hydrographic network.
The focus is on land, because no other natural component has more implications not then this, which is increasingly thought like a complex territorial subsystem, imposing new ethics on soil resources and partnership relations between soil and society, as the basis for their sustainable use.
In this connection, Florea N., defines the ground, "complex territorial system with variable organization both vertically (pedon) and laterally, in space (geographical package of soil cover)" [1].
This set of soil genetically factors specifically Plapcea basin have led to a formation of complex soil cover in which are present a number of clearly differentiated types and subtypes, most of whom belong to the class Luvisols (77%).

MATERIAL AND METHOD

For the study undertaken were conducted analysis and interpretation of data obtained from conducting research in the south-eastern Olt county.
Soil type studied is albic luvisol, which occupies the largest area in the studied region.
Documentation is a key element that is brought current soil genetically processes and phenomena setting challenges to agriculture, due to the natural environment.
Methods used in the classification of soils, into classes were made according to Methodology on development soil studies [9].
By using the map scale 1:200.000 have identified 14 soil taxonomic units in the old system, plus variants affected by different degrees of erosion and soil associations.

Statistical analysis highlighted Luvisols class rule, almost three quarters of the area studied (77%).
The analysis of topographic maps and longitudinal profiles show that the investigated basin Plapcea inclined, as well as the entire area of Piedmont Cotmeana from north to south [3].
Note of evaluation on uses and cultures product obtained by multiplying by 100 product of the 17 coefficients of the indicators taken into account in determining the note of evaluation for each culture, then made their average.
For arable land, note of evaluation is calculated as the arithmetic average of the grades for eight basic crops (wheat, corn, sunflower, sugar beet, potato, soy, peas beans, alfalfa) which shows the highest favorability, into the field considered unit. Weighted average scoring was performed on the plots for arable land and crops: wheat, corn, sunflower, sugar beet, potato, soybean, peas/beans and alfalfa.

RESULTS AND DISCUSSIONS

The concept on soil fertility has been addressed by various authors, including Stephanie, who defines it as "a natural ability to balance their accumulation processes underlying the formation of organic-mineral complex, with the balance of nutrients for vegetative cover" [8].
The soil, used in agriculture as a means of production, wear physical and moral even if it is used rationally, but has the property that when it is used in appropriate circumstances not to wear, but rather to improve so that the production power [6].
The investigated area is located in the south of the country, in Getic Piedmont and has over 25.000 hectares. From the administrative point of view, this territory belongs to the Olt County.
Under the influence of simultaneous and associated influence of factors and pedogenesis processes in Plapcea basin formed a relatively wide range of soils, which the Romanian System of Soil Taxonomy - 2003, belonging to classes Protisols, Cernisols, Cambisols, Luvisols and Hydrisols.
Luvisols class includes soils that have the diagnosis of a Bt horizon rich in clay migrated, and morphologically recognizable by the presence of clay films enveloping surface structural aggregates.
Luvisols are most widespread in the region (76.90%) and are represented by types, preluvosoil and Luvisol.

Albic stagnic luvisols
Due to special pedogenetic conditions especially climate, vegetation and relief, soils are in an advanced stage of degradation, albic luvisol, representing the most advanced period of development of Luvisol.
These soils, occur on high crawling of Plapcea Mica, south of Scornicesti (about 530 ha), under a flat relief such as fluvial deposits.
Albic luvisols have a morphology type Ao-Ea-EBw-Btw-Ca.
Ao horizon level and Bt horizon level also is often subdivided in at least two sublevel.
Clay content of these soils is around 17-25% in the first 30-40 cm, and almost three times higher in the iluvial level Bt horizon (55-64%). Extremely low bulk density Ao horizon level (<1.00 g/cm^3) corresponds to a state of very strong aeration (<-18) and a low resistance to penetration (20-25 kgf/cm^2).
Wilting coefficient has low values (6.0% to 8.2%) at the surface, medium-large at the profile (13-16%), the opposite of field capacity (26-28%) in horizon Ao and under 26% in Bt horizon) [7].
In terms of useful water capacity, it is high and even extremely high (18-22%) (Table 1).
Permeability expressed by hydraulic conductivity is high on the surface than in the first 25-30 cm and very low in Bt horizon.
The reaction of these soils is strongly acid to the surface (4.9 to 5.1) and moderate acid-neutral in the rest of the profile (Table 2).
As the organic matter content is found in larger quantities only in the forest use (10-18%), while in cultures only reaches 2.5% and consists of fulvic acids (that is lower quality).

Table 1. Hydro- physical data on Albic stagnic luvisols

Soil horizon	Depth (cm)	Composition size				Bulk density g/cm^3	Total porosity %	Degree of soil compaction %	CO %	CC %	CU %	Hydraulic capacity (mm/h)
		< 0.002 (mm)	0.002-0.02 (mm)	0.02-0.2 (mm)	0.2-2.0 mm							
Ao	0-15	25.0	44.8	30.2	0.0	0.90	64.0	-29	8.2	27	18.8	18.1
Ea	20-31	21.9	42.8	35.3	0.0	1.04	61.2	-17	6.6	28	214	27.5
EBw	31-41	38.8	35.4	25.8	0.0	1.41	47.4	9	1.5	25	11.5	2.4
Bt_1w	60-80	53.6	33.6	12.8	0.0	1.42	47.0	12	15.1	26	10.9	0.3
Bt_2	120-140	64.2	25.1	10.7	0.0	1.52	43.3	19	15.3	25	9.7	0.3
B/C	158-170	53.8	32.6	13.6	0.0	1.60	40.2	25	13.2	24	10.8	1.8

Table 2. Chemical data on Albic stagnic luvisols

Soil horizon	Depth (cm)	pH - meter	Organic matter (%)	T (me/100 g sol)	V (%)	Mobile phosphorus (ppm)	Mobile potassium (ppm)
Ao	0-15	5.1	2.5	20.43	34.1	7	62
Ea	20-31	4.9	1.1	11.76	19.5	4	50
EBw	31-41	5.6	0.7	13.25	33.3	-	-
Bt_1w	60-80	5.7	0.5	35.34	58.9	-	-
Bt_2	120-140	6.9	-	39.63	71.9	-	-
BC	158-170	-	-	-	-	-	-

% - degree of base saturation; T% = hydrolytic acidity

Often contain quantities of mobile aluminum which are toxic to crop plants and may be phenomena of phosphorus immobilization by formation of aluminum phosphate and insoluble iron.

Luvisols Albic stagnic are part of the soil with low fertility and that because of the physical, chemical and trophicity less favorable. To these is added and defective air hydric regime. With low permeability, water from rain often remains above soil.

Grain (wheat, rye, oats and corn) production obtained in these soils is poor.

Better results are obtained only from areas where organic fertilizers were applied (30-40 t/ha) and nitrogen and phosphorus fertilizers. The study of the natural framework and soil cover allow the evaluation of suitability of these lands for agriculture.

An important feature of the valley basin Plapcea is the flatness piedmont (below 3%) which allows mechanization and agro chemical treatment in good condition especially for grain uses.

However, farming land is hampered by imperfect soil drainage, excessive wetting, which mostly takes between 15-60 days.

All agriculture crops suffer heavily, the sensitive in most years.

Also, the movement of agricultural machinery causes compaction on arable land, increasing the risk of standing water and inefficient use of nutrients by plants and their loss in depth, issues and other researchers observed [4].

The increased state of compactness and strength, soil requirement to work increase, leading to reduced fertility and productivity.

Soil reaction which in Plapcea basin is moderately acidic (4.5 to 5.8) affects more than 8000 hectares of surface, in their most typical luvisol and albic stagnic luvisol and organic matter reserves are not satisfactory.

This land is predominantly agricultural used, although soils are not sufficiently capable by their qualities to meet the needs of development of any plant.

Cereals are grown on 77% of the land, wheat and corn occupying more than 50% of the grain surface.

For agricultural land conditional evaluation is to determine grades and classes of favorability for different cultures and classes of quality agricultural land uses: farmland, vineyards, orchards, pastures and meadows.

Table 3. HEO (environmentally homogeneous area) unit no. 6 Stagnic luvosols
(note of evaluation - 32 grade IV / a)

INDICATOR	**CROPS**							
	Wheat	**Corn**	**Sunflower**	**Potato**	**Beet**	**Soy bean**	**Peas/Beans**	**Alfalfa**
Mean temperature	1.0	1.0	1.0	0.8	0.9	0.9	1.0	1.0
Mean precipitation	0.9	0.9	0.9	0.7	0.9	0.9	0.9	0.9
Gley process	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Stagnogley process	0.8	0.7	0.7	0.5	0.6	0.7	0.7	0.6
Salinization and alcalisation	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Texture in Ap	1.0	1.0	1.0	0.9	0.9	1.0	1.0	1.0
Edafic volum	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Polution	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Slope	1.0	0.9	0.9	0.9	0.9	0.9	1.0	1.0
Land slides	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Grownd water	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Inundability	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Humidity	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total porosity	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Calcium carbonate	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Reaction in Ap	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.8
Organic matter	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0
Note evaluation	0.52	0.41	0.41	0.16	0.28	0.37	0.40	0.38
Mean HEO	32							

Knowing the notes of evaluation can be calculated yields per hectare.

Yields the main crops is determined by multiplying the evaluation notes with the equivalent in kg of a point of evaluation, according to the details of rent calculation stipulated in OM 126/20.06.1994 (Table 4).

Depending on the evaluation notes, HEO units (homogeneous ecological area) representative of the studied area are incuded into several classes of soils: Protisols (regosols, fluvisols), Cernisols (Phaeozem), Cambisols (eutricambosol), Luvisols (Preluvosol, Luvisol) and Hydrisols, retaining attention Luvisols.

Table 4. Equivalent in products for a point of evaluation

Equivalent in products of a point of evaluation	CROPS					
	Wheat	Barley	Corn	Sun flower	Potato	Beet
Kg/point	40	45	52	36	200	280

Area in hectares and percentages of total area studied on quality class is presented in table 5.

Table 5. Surfaces on quality class

Quality class	Soil	Surface (ha)	%
II	Phaeoziom	1325.0	4.96
III	Eutricambosol, Preluvosol	14447.0	54.2
IV	Luvosol, Regosol, Fluvisol	9157.7	34.4
V	Stagnosol	1737.5	6.5
Total		26667.2	100

In Plapcea basin were distinguished according to the suitability of the arable land following classes of land:

• Class II surface area of 1.325 ha, good land suitability, the low limitations due to soil texture and compaction; here falls flat land, represented by calcareous faeozems;

• Class III surface area of 14.447 hectares, land suitability middle, with moderate limitations that reduce the structure of crops in rotation;

• Class IV in the area of 9.157,7 ha land with low suitability, requiring severe restrictions, with considerable limitations of field crop; deficiencies relate to soil characteristics, land and comprehensive drainage;

• Class V surface aria of 1.737,5 ha land with severe limitations, useless for arable without interfering with soil hydrological improvement development works.

Of great importance in achieving production results bear in mind that in rainy years, considerable land surface water reaches the soil cover up to 50-60 days. This explains the weaker productions of the land (Fig. 1).

Land use creates such opportunities perceived as risks or degradation phenomena, which may cause damage or injuries by reducing agricultural production.

Wheat and corn production in this area is diminished by more than 65% compared to the national production [10].

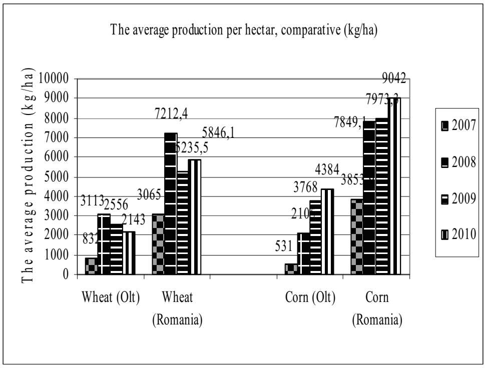

Fig.1. Comparison of average production Olt county and Romania (kg/ha)

CONCLUSIONS

Due to complex physical and geographical conditions of the basin Plapcea was formed and evolved a wide range of soils classified in several classes: Protisols, Cernisols, Cambisols, Luvisols and Hidrisols.

Preluvosols are represented by a large variety of subtypes: typical, mollic, stagnic, representing 46.44% and luvisols occupy second ranks in area (30.36%) and includes subtypes stagnic, albic and albic stagnic.

Grouping into categories of suitability to arable land is made regarding the nature and intensity of limiting factors for production, in this case, the land is included in most in the quality class III (54.2%) and class the fourth (34.4%), where it is found mainly in the studied soil type - Luvisol.

Harvests in this area are 3 times lower than the national average for the main crops: wheat and corn.

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MODIFICATION OF MAIN SOIL AGROCHEMICAL INDICATORS UNDER DIFFERENT FERTILIZATION SYSTEMS APPLIED IN GREENHOUSE FOR MAIZE AND OATS YIELDS

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Abstract

The main objective of this study was to monitor the effect that different systems of fertilization have on maize and oats yields. The research aims to find technological solutions to increase salinity tolerance in plants by application of different fertilization systems in specific conditions of soil and plant. In this context, the paper presents the results obtained after the first year of research concerning the influence of fertilization on the agrochemical indicators of soil. The fertilization system consisted in applying different doses of fertilizers on alluvial Gleyic Solonchak from Traian, Braila. The experiment has been organized in vegetation pots (Mitscherlich type) with a capacity of 20 kg soil. Therefore, a trifactorial experiment A (plant) x B (organic fertilizer) x C (foliar/mineral fertilizer), in four repetitions has been established. Fertilization system consists in organic fertilization, by applying manure, and in mineral fertilization, by applying foliar fertilizers and complex fertilizers (N, P, K). In parallel with the effect of fertilizers on agrochemical main indicators: pH, humus, total nitrogen, available phosphorus and potassium, the effects of fertilizer on maize and oats yields were also studied. For the assessment of agrochemical indicators, soil analyzes at the establishment of experience, and after the first research year was done. The results were interpreted according to the actual soil study methodology. For a better analysis of the agrochemical indicators, the experiment is carried out in the same circumstances in 2012 also, on soils affected by salinization.

Key words: *agrochemical indicators, fertilization system, soil, maize, oats.*

INTRODUCTION

The applicative character of Agro-chemistry results from the development of solutions for proper soil fertilization, plant and soil protection against negative effects that are caused by excess or deficiency in certain elements or chemicals required by crops to obtain increased yields.

In order to highlight the changes that occur in the agrochemical state of soil, and in its fertility state, under the influence of various agricultural technology systems, specific indicators were selected as follows: soil reaction, organic matter content or humus content and the content of main macronutrients: nitrogen, phosphorus and potassium [2].

This paper aims at presenting the results obtained in the first year of research on the influence of fertilization on soil characteristics and production.

MATERIAL AND METHOD

Researches aim to find technological solutions to increase plant tolerance to salinity by application of different fertilization systems in soil and plant specific conditions.

Therefore, an experiment was carried out in the green house of INCDPAPM-ICPA Bucharest, with a fertilization system represented both by organic fertilization, by applying manure, and mineral fertilization, by applying liquid fertilizers and foliar complex mineral fertilizers (N, P, K).

The experiment was organized in Mitscherlich pots vegetation type, with a capacity of 20 kg soil. The soil is Gleyic luvic Solonchack from Traian, Braila county. The study crops are maize and oats.

A trifactorial experiment, A x B x C type, four repetitions hab been carried out (Fig. 1):

A Factor	a_1	- oats
(plant)	a_2	- maize
B Factor	b_1	- without
(organic fertilizer)	b_2	- 30 t/ha manure
	b_3	- 60 t/ha manure
C Factor	c_1	- without
(foliar/mineral fertilizer)	c_2	- 3 foliar treatments with “Amino-fert NPK”
	c_3	- $N_{100}P_{80}K_{60}$

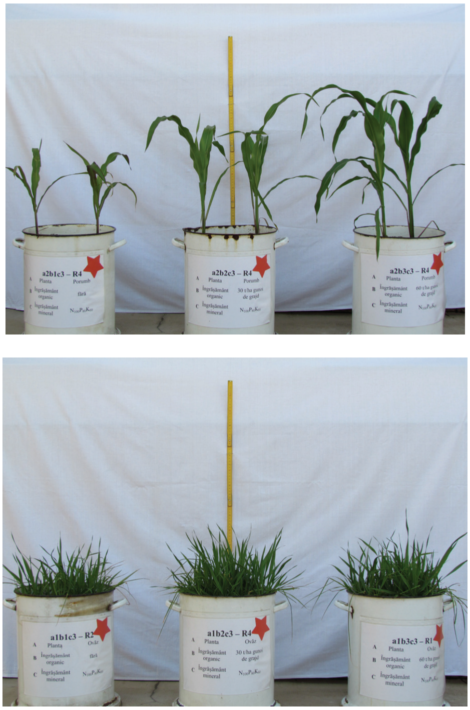

Fig. 1. The experiment in the green house

The organic and mineral (N, P, K) fertilizers were incorporated into the soil at the beginning of the experiment, while the foliar one was used during the growing season.

To assess the impact of different fertilization systems on soil and yields, soil samples were collected from vegetation pots for different analysis and soil characterization, and for highlighting the effects of soil type, plant and fertilizer type on the final yields.

Soil samples were analysed at the beginning of the experiment (Benchmark) and at the end of growing phase of oats and maize for the first year of research.

The analytical data were interpreted according to "Methodology of soil survey studies", Volume III [1].

RESULTS AND DISCUSSIONS

Some soil characteristics for the soil samples will be described and characterized here:

- *pH variation:* soil reaction ranges from 8.08 to 8.23 for maize and 8.24 - 8.31 for oats, being moderate alkaline (Fig. 2). There is a decrease in pH values comparing to the Benchmark values (8.36, a value that falls in the class of strong alkaline pH), resulting from fertilization system chosen;

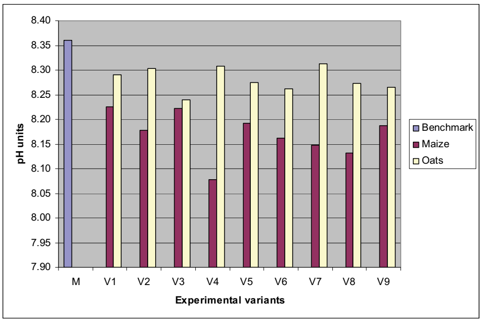

Fig. 2. pH variation

- *Humus content variation:* humus content ranges from 1.59 to 1.86% for maize and 1.64 - 2.15% for oats crop, being small to medium (Fig. 3). There is an increasing variation of humus content compared to the Benchmark (1.68%), approximately in the same class. For some specific variants, it passes in the next class, with a medium supply with humus, explained by different manure doses applied in the first moment of the experiment;

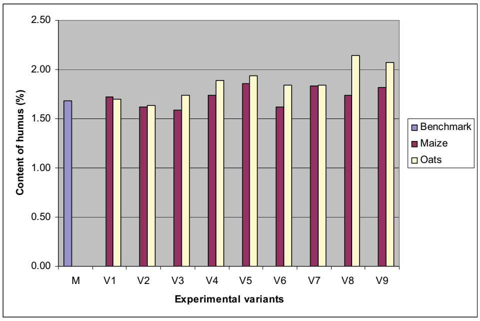

Fig. 3. Changes in humus content

- *Total nitrogen content variation:* total nitrogen content is very low, ranging from 0081 to 0097% for maize and from 0091 to 0107% for oats (Fig. 4). There is an increase in total nitrogen content values compared to the benchmark (0.054%), provided by the nitrogen from the organic fertilizer;

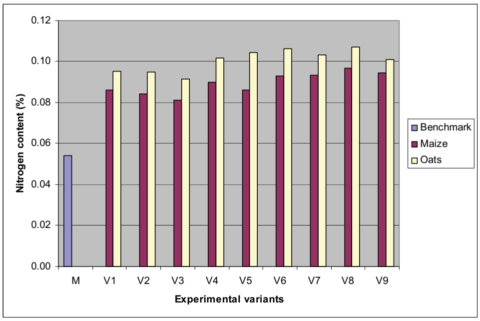

Fig. 4. Changes in total nitrogen content (Nt)

- *Mobile phosphorus content variation*: it is small to medium and varies from 13 to 36 ppm for maize and 10 to 36 ppm for oats (Fig. 5). There is an increasing mobile phosphorus content compared to the benchmark (10 ppm), passing from the low supply class to the medium one, due to the chosen fertilizer system;

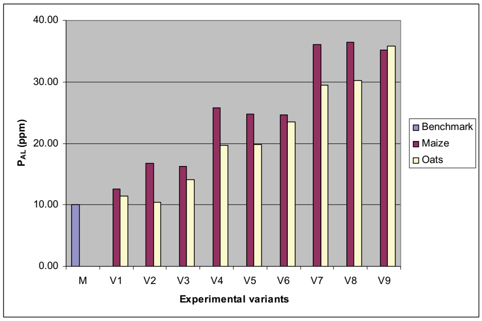

Fig. 5. Changes in mobile phosphorus content (P_{AL})

- *Mobile potassium content variation:* it is small to medium and ranges from 117 to 170 ppm for maize and 119 to 164 ppm for oats (Fig. 6). There is an increasing content of mobile potassium comparing to the benchmark, from the low supply class to medium supply class, due to the chosen fertilizer system;

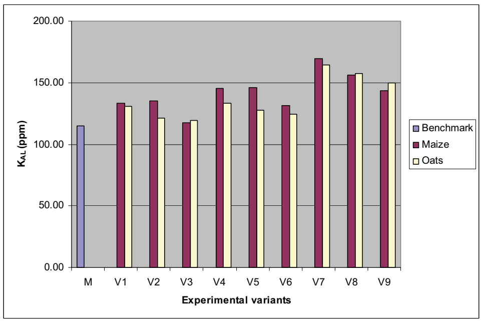

Fig. 6. Changes in mobile potassium content (K_{AL})

- For maize, there is noticed a significant increase of yield comparing to benchmark, for variants V_3 = 7532 kg/ha (only mineral fertilizer $N_{100}P_{80}K_{60}$ was applied), V_6 = 9302 kg/ha (30 t/ha manure and $N_{100}P_{80}K_{60}$ were applied) and V_9 = 11292 kg/ha (60 t/ha manure and $N_{100}P_{80}K_{60}$ were applied) (Fig. 7).

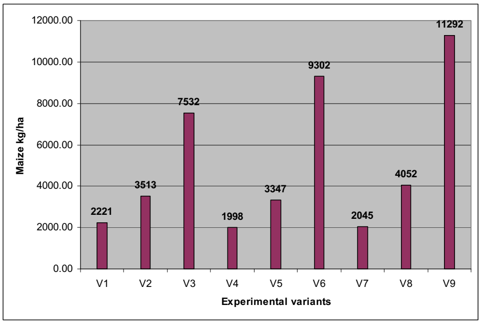

Fig. 7. Changes in maize yields

For oats, there is noticed an increase of yield comparing to benchmark, for variants V_6 = 2795 kg/ha (30 t/ha manure and $N_{100}P_{80}K_{60}$ were applied), V_8 (60 t/ha manure and 3 foliar treatments with Amino-fert NPK were applied) and V_9 = 11292 kg/ha (60 t/ha manure and $N_{100}P_{80}K_{60}$ were applied) (Fig. 8).

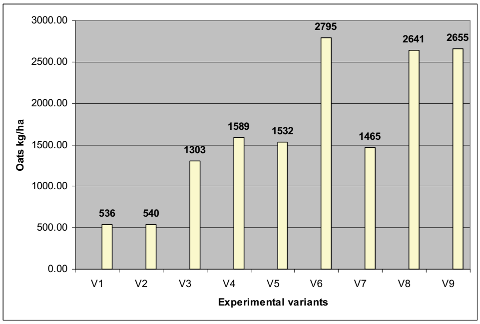

Fig. 8. Changes in oats yields

CONCLUSIONS

After the first year of experiment in green house, the evolution of agrochemical state of the Gleyic luvic Solonchack was studied, and we can say that all indicators had a positive development track, due to the applied fertilizer. It is found that the highest yields were obtained for both crops in V9 variant, when the highest dose of manure and mineral fertilizer (60 t/ha manure and N100P80K60) have been applied.

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AGROECOLOGY PROBLEMS BY MAINTENANCE OF FERTILITY SOIL

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Abstract

Soil is the main natural wealth of the Republic of Moldova and requires special attention to carrying out agricultural work, considering the composition and particularities of soil, including humus and nutrient value. Land use provides, first of all return losses of humus and nutrients used by plants. Therefore measures required to improve soil fertility. The essence of the research was to highlight the role of worm's compost improve the soil. To this end, in ETS "Maximovca" was organized an experiment that included three groups (two - experimental, to fund worm's compost and one - control the natural background). Observations on soil fertility have been conducted over three years. The soil samples were collected by usual methods determined values of organic matter and humus. As a result of analyzes it was found that the soils of worm's compost fund lots organic matter value surpassed that of the corresponding control group by 10,3% -22,0% and 11,4% -18,4% humus. Therefore, worm's compost incorporated in dose of 3-4 tonnes / ha over three years, improved soil fertility.

Key words**:** *worm's compost, organic fertilizer, soil, humus, fertility.*

INTRODUCTION

Soil degradation means reduction or loss of biological or economic productivity, caused by land use (anthropogenic factor) or natural processes. Natural and anthropogenic conditions favoring expression moldavian soil degradation processes are: construction of geological topography, climate, and anthropogenic activity. Dehumification of soils arising as a result of their use in arable and stop which is a global process. Is there a risk in coming decades humus content in arable soils of to decrease on average by 10-25 percent, with very harmful effects on the physical soil microorganisms in the soil even biodiversity. The most significant loss of humus in the soil is recorded on land subject to erosion. The annual loss of topsoil on all agricultural land due to erosion, causing a significant decline in agricultural crops.
Integrated analysis of the factors of degradation of land resources of the Republic of Moldova to support a finding that the quality status of the soil cover during intensive operation over 30 years has worsened: increased soil erosion areas affected by landslides, damaged anthropogenic-saline soloneţizate, degraded as a result of irrigation, clogged with deposits humifere weak, dirt, etc. Under the influence of agrotechnical works has increased the deterioration of soil structure and compaction. With deficit minerali and organic fertilizers, humus and nutrient balance was negative. However as a whole continues to have reduced fertility of soil resources and soil degradation diversity [6].
The fertilization and the technological system developed should be directed toat preventing degradation of physical, chemical and biological properties of soil. In systems that are developed need to include procedures for maintaining soil fertility and to stabilize and increase the humus content. Here is an essential management procedures that stabilize organic fertilizers and increased soil organic party content. An effective fertilizer for compost worm's address this issue, one of the final products obtained as a result of organic conversion process organic waste through worm's cultivation (organic waste processing

by using size, in particular, the California Red Hybrid rhyme) [1, 2, 3 and 4].
Amount of humus content in soil is one of the main indices of soil fertility. Humus has many side influence on agricultural chemistry, hygro-physical activity, thermal, biological technology and soil. In humus are concentrated up to 98% nitrogen reserves, 60% phosphorus, 80% sulfur, essential quantities of other micro - and macro elements [3].
Bioconversion of organic wastes by worm's cultivation new direction as the science and practice agrobiological deserves special attention to fundamental research [4]. Sciance and rescarch conducted worldwide practice directed towards reducing harmfulsubstances influence negative organisms,with particular attetion to issues worm's cuitivation organic wastes. [4]. The purpose of this biotechnology is getting green organic fertilizer, worm's compost.
Recent years have consisted of reducing the amount of humus in the soil. The annual loss of humus in the soil is 0,5 to 0,7 t / ha. To bring the balance of humus without difficulties (zero) should be incorporated into the soil each year, about 6,3 t / ha of simple compost.
In natural conditions resulting accumulation of humus in the soil very slowly. To form a layer one inch of soil is required to pass a period of 100 years. With anthropogenic influence on this process may take only 3-5 years [2]. Incorporation of compost into the soil usually is ineffective and costly, because a ton of compost is formed only 20 kg of humus. Instead a ton of worm's compost contained the 270-300 kg of humus. Therefore use worm's compost allow the essential reduction of completing period of the deficit the humus in the soil, resuscitation of soil fertility and increasing resistance from alluvial and wind erosion.
According to research conducted found that incorporation of worm's compost in the soil not only increases the amount of nutrients and soil biological activity. Also worm's compost reduces soil density (from 2.70 up to 2.67 g/cm3), maintain soil humidity.
The bioconversion process of organic wastes is implemented in the Experimental Section of the Scientific and Practical Institute of Biotechnologies in Animal Husbandry and Veterinary Medicine.
The research result shows that worm's compost in ETS "Maximovca" incorporated into the ground, at a dose of 3-4 tons/ha of improved soil fertility, increasing the amount of organic matter and humus, while diminishing the content of nitro compounds.
Therefore, the experiment was established the role of worm's compost in improving soil fertility.

MATERIAL AND METHOD

For the determination of role worm's compost to improve soil fertility in ETS "Maximovca" was organized an experiment in field conditions. The experiment used three groups (two experimental and one control group), with a surface would. The experimental groups, before sowing, was built worm's compost (because of 3 tons/ha - group I, and 4 tons/ha - experimental group II), organic fertilizer, obtained the result of bioconversion of organic wastes by worm's growing (Table 1).

Table 1. Scheme of the experiment

No	Groups	Conditions of experiment
1	I - experimental	worm's compost - 3t/ha
2	II - experimental	worm's compost - 4t/ha
3	III- control	Natural background

Before incorporating the fertilizer into the soil was determined the quality of worm's compost and also in each group were taken soil samples from surface and the depth of 15 cm for determine the value of organic matter and humus in the first year of action of fertilizer.
Research methods: worm's compost and soil quality was assessed according to the methods set out in manual of E.Petuhova and Standard GOST 26213-84. Soils.

RESULTS AND DISCUSSIONS

Investigations were conducted to determine the role of worm's compost to improve soil. At the initial stage of the experiment was determined quality worm's compost used as organic fertilizer. Kosolapova A.I et all. [6] showed, that the special feature of the viermicompost quality is the C:N correlation. In the worm's compost are concentrated important quantities of ferments, vitamins, growth stimulators, non-pathogenic flora. The worm's compost is an organic, ecological and natural fertilizer, composed of granules of different sizes, color dark brown, odorless, hygroscopic, long acting [Photo 1].

Photo 1. The worm's compost obtained from cattle manure

The worm's compost has an essential role in developing ecological agriculture. Some authors [1, 2, 5, 6], confirming that worm's compost has a well-balanced macro and micro-elements content, which allows the diminishing of the absorbtion dose in the soil, which is 8-12 times smaller, in comparison to the dose of the traditional compost. It has been ascertained that a tone of worm's compost contains 270-300 kg of humus. This allows for the period of completing the quantity of humus in the soil to be diminished, that way being reestablished the fertility and the resistance of the soil in case of wind and alluvial erosions. In the table 2 are exposed quality indices of worm's compost obtained as a result of bioconversion of organic wastes by worm's cultivation.

Table 2. Quality indices of worm's compost obtained form cattle manure

No.	Indices	Values of worm's compost, (M±m)
1.	Active acidity (pH), units	7.18 ± 0.01
2.	Organic mater, %	32.29 ± 0.15
3.	Total nitrogen, %	2.32 ± 0.01
4.	Potassium, (K_2O), %	1.20 ± 0.03
5.	Magnesium, %	1.88 ± 0.02
6.	Phosphors, (P_2O_5), %	1.57 ± 0.08
7.	Calcium , %	0.62 ± 0.02
8.	Humus, %	30.16 ± 1.20
9.	Non-pathogenic acterial flora, colonies/g	$2x10^{12}$

On this basis for incorporation into the soil used two doses of fertilizer: the experimental group I - 3 tons / ha, the experimental group II - 4 t/ha. In the control group was kept natural background.

In first year at the initial stage of worm's compost and three months after incorporation of compost worm's each lot, from the surface and the depth of 15 cm, soil samples were taken for determination of soil elements (value of organic matter and humus).

In result of research (Table 3) were found the soil samples collected from experimental groups I and II surface, the organic matter which exceeded that of the initial stage, correspoding to 5.4% and 5.7%. In samples collected from a depth of 15 cm this value was 6.2% in group I and 7.5% in samples collected from group II. The humus in the soil samples collected from experimental groups I and II from surface, three months after the incorporation of worm's compost, surpassed that of samples collected at the initial stage corresponding to 14.3% and 15.2%.

Table 3. he content of humus and organic matter in soil fertilized with worm's compost

No.	Nutritive elements	The sample collection	Conditions of experiment					
			Experimental group I , worm's compost - 3 tone/ha			Experimental group I worm's compost - 4 tone/ha		
			Initially	After incorpo-ration of fertilizer	Compared to initial,%	Initially	After incorporation of fertilizer	Compared to initially, %
1	Organic matter,%	Surface	4.59±0.26	4.84±0.10	105.4	5.08±0.10	5.37±0.02	105.7
		15 cm	5.17±0.10	5.49±0.02	106.2	4.91±0.10	5.28±0.11	107.5
2	Humus,%	Surface	3.50±0.08	4.00±0.15	114.3	3.30±0.12	3.80±0.01	115.2
		15 cm	3.50±0.01	4.10±0.07	117.1	3.40±0.07	4.00±0.15	117.6

The quantity of humus in samples collected from groups I and II at 15 cm depth varied insignificantly from one batch to another, but exceeded that of soil samples collected at the initial stage, corresponding to 17.1% and 17.6%. The results obtained on organic matter and humus values of samples collected at levels above the experimental groups compared with samples collected from the control group were also different(Table 4).

Table 4. The content of humus and organic matter in soil fertilized with worm's compost compared with control group

No.	Nutritive elements	The sample collection	Conditions of experiment			Compared to control group, %	
			Control group,with natural background			Group I	Group II
			Initially	After incorporation of fertilizer	Compared to initially %	After incorporation of fertilizer	After incorporation of fertilizer
1	Organic matter, %	Surface	3.58±0,07	4.40±0,03	107.5	110.0	122.0
		15 cm	4.43±0,09	4.45±0,02	100.5	123.4	115.1
2	Humus,%	Surface	3.20±0,12	3.30±0,07	103.1	106.1	118.4
		15 cm	3.30±0,15	3.30±0,07	100.0	125.2	121.2

In samples collected from soil in the experimental group I, after incorporation worm's compost, organic matter and humus amount surpassed that of the control group sample, corresponding to 10.0% and 6.1%, and those collected from depth of 15 cm – 23.4% and 25.2%. The same regularity was found in samples of soil investigation result of collected from the surface and at depth of 15 cm of the experimental group II. In these samples, three months after incorporation of worm's compost, the organic matter was appropriately 22.0% and 18.6%, and humus with -15.1% and 21.2% higher than in samples increased collected from the control group.

From this we may conclude that in result of bio compost worm's conversion of organic wastes by worm's cultivation, used as organic fertilizer in the first year of action influenced the revival of increasing soil organic matter and humus values.

Therefore, in research result of has been found that incorporation of worm's compost improved soil fertility, increasing amount organic matter and humus.

CONCLUSIONS

Incorporating of worm's compost in soil experimental groups I and II, that has helped to increase by 5.4% and 5.7% (surface) and 6.2% - 7.5% (at 15 cm depth) the organic matter and by 14.3% and 15.2% (surface) and by 17.1% and 17.6% (to a depth of 15 cm) humus value, compared with their content at the initial stage.

The results of the investigations, to determine the values of organic matter and humus samples collected from surface and depth 15 cm exceeded that of the sample control group to 10.0% - 6.1% and 23.4% - 25.2% in experimental group I and 22.0% - 18.4% and 15.1% - 21.2% in experimental group II.

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RESEARCH CONCERNING THE ORGANIC CARBON QUANTITY OF NATIONAL PARK PIATRA CRAIULUI AND THE C/N RATIO

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Abstract

In our country we have 25 National and Natural Parks of 552,174.80 ha area. Piatra Craiului National Park has a surface of 14,800 ha. The total protected areas surface has 1,234,710 hectares, representing 5.18% of the country. We have analysed, in this paper, 10 profiles of 31 horizons, the soil samples being collected from the National Park Piatra Craiului. The following parameters were analyzed: pH, organic C, total N. The pH was electrochemically determined in calcium chloride, and the carbon and the nitrogen have been analysed by the dry Dumars combustion method. The results have shown that the mountain forest soils are strongly acidic, with a pH between 2.5–5 in saline extract, except the 5 horizons with a pH between 6.2-7.2. The soils are richest in organic carbon and nitrogen. Regarding the C/N ratio values, their correlation with altitude showed a degree of normal fertility.

Keywords: *C/N ratio, forest soil, organic carbon, nitrogen.*

INTRODUCTION

Climate change is one of the most important phenomena facing mankind at the present time and viable solution to these is represented by carbon dioxide retention in forest vegetation. Quantification of carbon captured in the forest ecosystems has become an important issue since the entry into force of the Kyoto Protocol, and to increase the amount of carbon stored in these ecosystems, have an important role for afforestation.

As a result of climate change, increasing atmospheric CO_2 concentration has the ability to alter the chemical composition of litter, may influence the cycle decomposition and C/N in forest ecosystems. Studies on C and N content in the first centimeters of the soil profile showed less effect of tree type [9]. Influence of trees on soil nutrient content is detected first in the litter, while the mineral soil differences are found later [11].

The main pools are forest sequestration and other vegetation, which removes carbon dioxide through photosynthesis. Forestry is an important repository for carbon, as well as agriculture [8].

Another important parameter is the soil total nitrogen. Recently the amount of soil nitrogen and C/N are used as indicators of soil carbon sequestration expression [1, 5]. Variability in the amount of nitrogen and C/N in the soil can be correlated with the type of stand [7].

Soil organic carbon is generally natural carbon that is contained in the matter live or dead, in various stages of processing. Organic carbon is the most important component because it is key to energy transformations in nature and directly influences all the qualitative properties of soil [8].

Estimates of organic carbon stored in forest soils have applications in studies of soil quality, carbon capture technologies and carbon trading. These estimates are used to establish long-term carbon flows to manage natural resources and to design strategies for carbon sequestration [2].

Forest soil in Europe store roughly 1.5 time more carbon than treea [5]. Inventory and analysis of soil organic carbon are required for soil quality assessments [10].

Globally, forests store large amounts of carbon sequestered from the atmosphere and retained in living and dead biomass and soil [12].Most (2/3) of terrestrial carbon is found in the surface soil (soil and roots) estimated 1,500 Gt of C organic world, a much more protected from decomposition. C below the reserve forest land, permanent pasture and other permanent ecosystem (mountain areas) remains nearly intact ecosystem does not suffer as long as changes. In our country there are 25 national parks and natural area of 552,174.80 ha. Piatra Craiului National Park has a surface of 14,800 ha. The total area of protected areas is 1,234,710 hectares, representing 5.18% of the area of the country

MATERIAL AND METHOD

Research has been conducted in 10 research areas namely: Valea Podurilor, Coltii Chiilor, Magura, Casa Folea, Predelut, Curmatura, La Table, Coltii Ghimbav, Brusturet, Valea lui Ivan, research areas are located in National Park. The soil samples were harvest of the 10 research points with 3 repeated for each point, the following standard depth 0-10 cm, 10-20 cm, 20-40 cm, > 40 cm. The methodology for soil sampling is: the soil samples were gathered on genetic horizons, after digging the soil pits. For each horizon, 1 kg of soil was gathered. Two samples from different depths were gathered for the horizons that are larger than 20 cm. Preparation of soil samples is based on the ISO 11464 method [6].

Collected samples should be transported to the laboratory as soon as possible and be air dried or dried at a temperature of 40 °C. They can then be stored until analysis [3].

All analyzes were performed according to the manual on Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of air pollution on forests – Sampling and Analysis of Soil [13]. pH was determined electrochemically in calcium chloride, readings being made with a Thermo Orion3 pH meter; Carbonates were determinants with calcimeter Scheibler.

Organic carbon is analyzed by dry combustion method Dumars, using Tru Spec CN analyzer (LECO type).

Total soil nitrogen was determined by wet digestion method and dosage titration - Kjeldahl method ammonia is distilled into boric acid and excess catch titrated with sodium hydroxide solution. The equipment used consists of mineralized and distiller type Gerhardt.

RESULTS AND DISCUSSIONS

In the 10 areas of Piatra Craiului National Park from which rose and soil samples were used to determine and calculate the C/N.

The results indicated that mountain forest soils are strongly acidic, with pH between 2.5 - 5 in the saline extract, except for five horizons with a pH between 6.5 and 7.2.

In the first horizon of mineral soil profile, the organic carbon stored quantity is increased due to the litter rich and gross in lignin. Since the profiles are located natural areas, without human activity. The soils are richest in organic carbon and nitrogen. Regarding the C/N ratio values, their correlation with altitude showed a degree of normal fertility.

C/N is included in class 9 surface normal fertility investigated on lypointtofit Magura low fertility class.

Table 1.The amount of Corg and total N in the soils analyzed

Location	Type soil	Horizont	Depthcm	Ct%	Nt%	C/N
Valea Podurilor	Districam bosol	Aou	0-10	14.01	1.173	11.95
		AB	10-20	8.61	0.363	
		Bs1	20-40	5.65	0.223	
		Bs2	>40	5.72	0.168	
Coltii Chiilor	Rendzina	Am	0-20	12.01	1.005	11.95
		AR	20-40	5.50	0.391	
Magura	Districam bosol	Aou	0-10	8.40	0.476	17.66
		AB	10-20	1.91	0.112	
		Bv1	20-40	0.70	0.056	
		Bv2	>40	0.37	0.028	
Casa Folea	endzina	Am	0-20	16.21	1.120	14.48
		A/Rm	20.40	5.60	0.419	
Predelut	Districam bosol	Ao	0-10	4.85	0.363	13.36
		Bv1	10-20	1.01	0.111	
		Bv2	20-40	0.47	0.055	
		Bv/R	>40	0.59	0.084	
Curmatur a	Districam bosol	Ao	0-10	12.60	0.806	15.63
		Bv	10-20	3.59	0.334	
		Bv/R	20-40	1.66	0.168	
La Table	Districam bosol	Ao	0-10	5.70	0.445	12.81
		Bv1	10-20	2.40	0.139	
		Bv2	20-40	1.06	0.084	
		Bv3	>40	0.59	0.028	
Coltii Ghimbav	Rendzina	Am	0-20	7.34	0.723	10.15
		A/Rm	20.40	5.28	0.500	
Brusturet	Rendzina	Am	0-20	6.62	0.582	11.37
		A/Rm	20.40	3.43	0.361	
Valea lui Ivan	Districam bosol	Ao	0-10	5.53	0.529	10.45
		Bv1	10-20	3.39	0.250	
		Bv2	20-40	1.48	0.140	

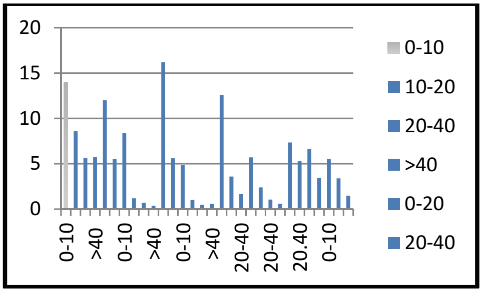

Fig.1. Evolution of organic carbon in deep

CONCLUSIONS

Even though the soil types of the 10 areas are not too large differences (districambosol andrendzina) in terms of soil nutrients are considerable differences, such as: Increased amount of organic C districambosol under a stand of coniferous (spruce fir) districambosol unlike under deciduous trees (beech and oak), due to abundant litter and lignin rich in the first case; Leaf carbon content has the highest values in surface Casa Folea, recorded here a correlation between the content of this element both in leaves and soil.

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THE STATE LAND QUALITY IN THE VINEYARDS OF REPUBLIC MOLDOVA

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Abstract

There are identified the main causes that conduct to the degradation state of land quality in vineyards. These are the subject of natural and anthropogenic factors, leading to varying qualitative and quantitative of soil indicators. Reforms in agriculture led to the extension of the forms of soil degradation of vine plantations. The worst and most widespread form of soil degradation is erosion by water (surface and depth, with various intermediate stages). Anthropogenic factors favoring the growth rate of erosion processes are: irrational land parceled, excessive exploitation, deforestation of erosion protection forest belts, and abandonment of anti-erosion complex works. The paper reflected the soil protection measures in vineyards. The erosion protection is based on organizational, agro-technical, phyto-technical and hydro- technical measures. The direct effect of this system is reduced leakage and erosion processes, increase the soil water reserves and productivity of vineyards. One of the most effective phyto-ameliorative measures of soil erosion protection in the vineyards is grassing the spaces between vines rows.

Key words: *degradation, measures, protection, soil quality, viticulture*

INTRODUCTION

On January 1st, 2011 Moldova's total area was 3384.6 thousand ha, including: 2498.3 thousand ha (73.8%) of agricultural land, of which 1812.73 thousand ha (72.6%) - arable land, 298.8 thousand ha (12.0%) - perennial plantations, 352.55 thousand ha (14.1%) - meadows and pastures, 34210 ha (1.4%) - fallow land. From the total agricultural land, in the management of agricultural land owners were 2008.7 thousand ha (80.4%), including 115.8 thousand ha of vineyards [2].
In Moldova the viticulture is one of the most important branches of agriculture. The main importance of viticulture is superior capitalization of land, production value achieved per hectare, equivalent to that obtained on 5-10 hectares of cereal crops, efficient use sloping land, low productivity, unsuitable for other crops, serves as a base material premium economy, source of income and food, jobs for the rural population [3, 4].

Land reform in Moldova, in result of inappropriate strategies, has not created conditions for increasing soil fertility in vineyards, sustainable land use, increasing agricultural production, exerting therefore a negative impact on the economy. The main causes leading to aggravation of the situation in agriculture are general, and with particular consequences for the viticulture sector:
• Irrational plots of agricultural land and liquidation of techniques units through privatization of former farms (kolkhozes, sovkhozes, agricultural state institutions - schools, colleges, universities etc.)
• Significant decrease of soil fertility in the vineyards due to lack of funds to combat soil erosion, to compensate the loss of nutrients;
• Abandonment of over 50 thousand ha of vineyards because of low yield (2.0 to 2.5 t/ha of grapes) and lack of financial funds, state subsidies for their deforestation (about 4-5 thousand MDL/ha);
• Excessive spread of many species of harmful herbs for vine culture, as a result of unsatisfactory work of plantation land, deficit

of manpower and financial resources to purchase herbicides;
• Relocation of new industrial vine plantations (over 20 thousand ha of the country's total of 30 thousand ha) from typical vine growing hills (with old vineyards) to land of valleys, meadows, alluvial soils with clay texture;
• Soil pollution of vineyards with pesticide (Cu^{+}, Cu^{2+}, Fe^{2+}, etc.) and herbicides residues;
• Increasing soil salinization threat of vine nurseries (over 22 licensed businesses in this area) as a result of use of local water from unconditional resources, with high mineralization, excessive use of sprinkler irrigation method;
• Diminishing of soil fertility in vine plantations caused by preparation due to cleaning without fertilization included in projects to create new ones;
• Frequent loss of multiples areas of vineyard land, once used successfully to create plantations of perennial crops (including grapes) because of the development of swampy process (recurrence of coastal springs, surface water, reed bushes).
• Deforestation of erosion protection belts on the considerable areas, leading to increased wind and soil erosion on land with grown fruit plantations.

RESULTS AND DISCUSSIONS

Land reform has radically changed the structure and use of land ownership, ensures land solvency, increased number of participants in land relations, led to a variety of many forms of land ownership and management. However, these and other land changes have not created conditions for increasing soil fertility and increase agricultural output, which fell during the agrarian reform 2 times (Table 1).
Concomitant there is an adverse change in the structure of agricultural uses. The total area of perennial plantations in 2000 compared with 1989 decreased by 112.1 thousand ha (orchards and vineyards was clearing by new land owners). At the same time appeared 7.8 thousand ha of fallow, arable land area increased by 68.5 thousand ha, pastures - with 38.4 thousand ha. Irrigation systems have been damaged over an area exceeding 200 thousand ha of irrigable previous, inclusive in viticulture [3, 4].

Table 1. Comparative situation of land use in 1989 (up to land reform), in 2004 (after the land reform) and present - 2011

Category of land	1989		2004		2011	
	Thous. ha	%	Thous. ha	%	Thous. ha	%
Total land	2578.9	76.4	2528.3	74.9	2498.3	73.8
Arable	1819.7	53.9	1845.4	54.5	1812.7	53.6
Perennial, including:	410.4	12.2	298.0	8.8	298.8	8.8
Orchards	190.7	5.7	134.8	4.0	133.3	3.9
Vineyards	182.1	5.4	153.0	4.5	149.6	4.4
Meadows	3.7	0.1	2.8	0.1	2.2	0.1
Pastures	345.1	10.2	374.1	11.1	350.4	10.4
Fallows	-	-	8.0	0.2	34.2	0.9

Small agricultural land management in terms of an economic crisis does not allow owners to carry out protection, improvement and rational use of land, including vineyards. Dynamic of vineyard surfaces [1] is presented in table 2.

Table 2. Dynamic of vineyards surfaces

Years	Surface, thousand ha
1945-1950	98.5
1951-1960	83.0
1961-1965	233.8
1966-1970	237.8
1971-1975	259.0
1976-1980	275.8
1981-1985	236.2
1986-1990	202.6
1991-1995	169.4
1996-2000	156.0
2001-2005	143.8
2006-2010	152.6

Unclogging soils
For vineyard founding is made obligatorily unclog soils. Currently, the total land area with unclogging soil on depth of 50-60 cm is 550 thousand ha (Table 3).

Table 3. Dynamic of unclogging and anthropic transformed soil surface, thousand ha

Soil/years	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**	**2010**
Unclogs	376	423	474	502	526	546	550
Antropic transformed	0.5	1.4	5.5	13.5	20.8	33.4	176

Unclog land for vineyards led to disruption of natural stratification of genetic horizons and surfacing weak humifer underlying horizons with high carbonates content. Erosion resistance of soils as a result of unclogging and removing on the surface of loess clays is very low. The soil cover in vineyards located on sloping land, during spring - summer period is unprotected state of black field, in the early years is subject to very intensive erosion processes. Therefore, preparations of land for the establishment of vineyards on the slopes have made the general direction of the slope contour.

Handling capacity of agricultural machinery in vineyard is low, leading to their passage on one and the same way, forming areas with increased soil compaction as a result of reduced water permeability, while increasing soil erosion and drainage on the slopes. The deterioration of soil structure and secondary compaction spreads all over the surface included intensive agro-technical works in vineyard plantations.

The antierosion organization of arable land and vineyards the relief conditions are often ignored. Roads, soles and areas of land are located along the slopes; the result is formed gullies and ravines. Frequently, the conditions for concentration leakage is created as various irregularities of the soil surface - potholes, incorrect leveling of longitudinal roads, transversal plowing along the upper litter of forest bands, divided furrows, which comprising water runoff from areas located above and moving it to a second tilt at a distance of 300-400 m in a gullies, which then formed ravines.

It required constant supervision of soils surface in vineyards, in order to carry out the appropriate order to avoid concentration of water flow and increase their fertility. Also, be made uniform dispersion of flow water without damage by forest belts, buffer strips of grass for water discharge and other plantings protection. Surface runoff must be regulated both during rainfall, and after heavy rains, preventing formation of gullies, gutters, leading to initiation of ravines [2, 4].

Damaged soils of vineyard are not announced in the inventory lists. This does not allow being estimated losses of organic matter and nutrients from soil, processes of soil compaction and secondary deterioration of the structure. The annual losses of fertile soil and nutrients in perennial plantations caused by erosion processes are presented in table 4.

Table 4. Annual losses of soil nutrients in perennial plantations caused by erosion, thousand tons

Zone	Area	Fertile soil	Humus	N	P_2O_5	K_2O	Production
North	84	893	12,3	0,9	0,6	9,1	14,3
Central	127	1220	32,7	2,4	2,2	24,2	19,0
South	26	251	7,2	0,5	0,5	4,7	3,7
South East	114	1401	38,6	2,7	2,7	25,5	19,7
Total	351	3765	90,8	6,5	6,0	63,5	56,7

Unclogging soils have a very different fertility compared to soils with integrity profile. Fertility of unclogging soil used for field crops is lower on average by 10-20% compared with similar natural soil fertility.

Unclogging soil properties are varying widely, depending on soils and horizons origin. Content in different particle size fractions (sand, dust, clay), humus, nutrients, pH values, density, etc. appear as weighted averages values of the characteristics of mixed types or subtypes horizons. To assess the conditions and quality state of unclog and anthropogenic damaged soil in vineyards it is necessary to conduct special investigations to establish the rational exploitation and mitigation measures for their fertility within the Soil Quality Monitoring [2].

The average weighted rating note of agricultural land is currently equal to 65. This index has an essential downward trend. According to the results of evaluation works conducted at the beginning of the ‘70 years, the average weighted rating note of agricultural land was equal to 70 points. Now, for some districts the rating note was reduced by 10 points. Fertility decline is caused primarily by increased soil degradation processes: erosion, solonetization, salinization processes, swampy, landslides [1, 3].

Agricultural crops, according to their physiological particularities, react differently to the decrease of soil fertility, and change their physical and chemical properties.

For example, the field crops productivity level is reduced proportionately of erosion, and the vineyards on these soils develop normally and give good harvests. To assess soils used in vineyards, and location of these plantations was developed another level of evaluation, which takes into account the reaction of vine to different properties of soil. The calcareous chernozem clay-loam that has 100 points is considered as standard soil. According to this scale the evaluation note of soil quality status for the location of the vines is considered high [4]. The average weighted rating note of soils used in vineyards is 70 points (Table 5).

Table 5. The weighted average rating note of arable and vineyards on the climatic zone

Pedoclimatic Zone	Arable	Vineyards
North	76	70
Central	64	69
South	64	62
South East	69	67
R. Moldova	68	67

Average reduction of productive capacity of soils as a result of the degradation factor action – unclogging land and use it's for field crops is 5-10%. Damage as a result of using of these soils in the field crop rotations is equal on average to 200 MDL/ha and 35 million MDL for the entire area used for arable sloppy. The weighted average annual yield losses of eroded land in perennial plantations with an area of 139, 6 thousand ha are 30%. Damage caused by erosion, in cash, on land occupied by perennial plantations (139,6 thousand ha) is - 1350 MDL/ha. The distribution of vineyard surfaces depending on the soil erosion degree is presented in table 6.

Table 6. Distribution of vineyards in dependence of soil erosion degree

Erosion soil degree	Vineyard	
	Thousand ha	% from multiannual plantation
Non eroded	68.6	3.7
Weakly eroded	39.8	2.2
Moderately eroded	22.0	1.2
Highly eroded	6.8	0.4
Investigated surface of agricultural land, total	137.2	7.4

Suitability of soil resources of Republic Moldova in terms of use in vineyards in perspective extends to 755 ha or 31.0% of the land. Nowadays the arable land and vineyards areas are in decline. Currently, the 10-15% of the vineyard plantations are located in depressions (valleys, meadows); have high content of carbonates in the soil, more than 17%; high soil density, greater than 1,5 kg/cm^3; high clay content, more than 60%; pH less than 6.5; presence of groundwater closer to 1.5 m above ground (Table 7).

Table 7. The surface of agricultural land and perennial plantation during 2009-2011

Category of land	2009		2010		2011	
	thous. ha	%	thous. ha	%	thous. ha	%
Agricultural land, from which:	2504	74.0	2501	73.9	2498	73.8
arable	**1821**	**53.8**	**1817**	**53.7**	**1813**	**53.6**
Perennial plantations, from which:	303	8.9	301	8.9	299	8.8
vineyards	**156**	**4.6**	**154**	**4.5**	**159**	**4.4**

Agropedoclimatic zones and land suitability for agricultural use

Affiliation of the most territory of Moldova to the under humid zone with frequent droughts during the growing season of plants requires a total adaptation of the agriculture to the dry conditions taking into account the peculiarities of each agroclimatic area [2].

Northern Zone of Moldova I - includes North Moldavian Plateau. Main zonal soils are grey soils, chernozem clay-alluvial and leached. Soils are characterized by high fertility, can be used for: apple plantation, potatoes, vegetables under irrigation, sugar beet, sunflower, grain, vegetable crops (soybeans), rape, etc. *Soils are not suitable to vine.* Factors limiting production capacity of soils are erosion, coastal swamps, degradation of structural stability and secondary compaction recently arable layer (0-25cm) and post arable (25-35cm) as a result of agro-technical tillage, destructuration, dehumification, low content of humus and mobile phosphorus.

Northern Zone of Moldova II - comprises the Moldavian Northern Plain and Dniester Hills. Mainly soils are typical and leached chernozem, grey soils, clay-loamy texture. Relief fragmentation leads to natural vertical setting of the soils. On the terraces of rivers Dniester and Prut, located less than 150 m attitudes are spread the ordinary chernozem

with clay or clay-loamy texture. These lands are suitable for use, primarily for irrigation.
Soils are characterized by very high fertility and are recommended for the following uses: sugar beet, irrigated vegetables, cereals, sunflower, vegetable crops (soybeans), apple and pear, nuts; on the lower terraces of Dniester and Prut - for watering gardens, *vineyards* and orchards. The restrictive factors of productive capacity of soils are: erosion, swamps, salting processes, dehumification, low content of phosphorus, compaction.
Central Zone of Moldova II - divided into two zones. However, within the zone there is pronounced the vertical soil natural setting. At altitudes up to 200 m dominate ordinary chernozem, between 200 – 300 m - typical and leached chernozems, above 300 m - brown and grey soils.
Zone "Codri" (II) occupies the Central Moldavian Plateau at altitudes of 300-400 m, mainly zonal soils are gray and brown. The landscape is highly fragmented. Soil fertility is medium and low. Soils are recommended for use primarily *for vineyards* and orchards, meadows and forests. The area is an extremely favorable ecological niche for the most precious vine varieties, useful for high quality fine wines. The main problem of zone is combating surface and deep erosion processes.
Central Zone of Moldova (II), (steppe and forest-steppe) occupies the hilly outskirts of Central Moldova Plateau and large terraces of rivers Dniester, Prut, Raut Ichel, Bic Botna, Lapusnita, at an altitude of 50-250 m. Main zonal soils are chernozem ordinary, sometimes typical chernozems (at altitudes greater than 200 m). Soils are characterized by good fertility. Due to more arid climate the land of this area can be used for: *vineyards,* orchards, grain, irrigated vegetable crops etc. Limiting factors are: erosion, coastal hydromorphism, salinization in meadows, gleyzation, primary and secondary compaction, and dehumification.
South Zone of Moldova (III), occupies the South Plain and Tigheci hills of Moldova at altitudes of 50-250 m. The main soils are ordinary, southern and carbonate chernozem. The landscape is moderately fragmented. This is the most dry and driest area requiring irrigation of agriculture. Soils are characterized by a good and moderate fertility and are recommended for *precious vine varieties,* cereals, stone fruit orchards, meadows, etc. Irrigation land presents the main measure to intensification of agriculture in this area. For the south zone is characteristic the natural setting of the vertical soil and climate:

- Southern chernozems, occupies river terraces Ialpug and its tributaries up to altitudes of 140 m. Land recommended to be irrigated by drip or other method and used for gardens, orchards of peach and apricot, varieties of grape.
- Ordinary chernozem, occupies hills of altitudes between 140-200 m. These lands are suitable for all varieties of vines, winter cereals, irrigated vegetables, plants to produce essential oils, etc.
- Typical and xero-forest chernozem occupies small areas at higher altitudes Tigheci peaks of 200 m. These lands are the most suitable for orchards and winter cereals.

The main restrictive factors of soil productive capacity of South Zone are: drought, erosion, sodium enrichment, salinization and compaction, dehumification.
Agricultural land use in accordance with the potential of soil and climate of each agropedoclimatic zone will contribute to adapt agriculture of Moldova to drought conditions and ensure food security of the country.

Soil protection in vines plantations [3, 4]
The geomorphologic conditions of Moldova determines location of perennial plantations on sloping land, after their suitability for these cultures are, in most cases, higher plane upper land. In these conditions it is necessary to develop measures to protect soil against erosion and deterioration. To achieve this goal were developed and implemented the most effective protective measures that favors water retention and soil fertility conservation of the upper layers.
Developed erosion protection system is based on the application of organizational, agro-, phyto- and hydrotechnical measures. The direct effect of this system is reflected by reducing leakage and erosion, increase soil water reserve

and increase productivity of vineyard perennial plantations.

Antierosion measures in the vineyards placed on slopes with inclination of 2-5^0 are:

• Vine plots are designed with the long part transversal to slope at 1.5 to 2^0;
• Water evacuation channels are set as terraces with inclination opposed to 3-4^0;
• Distance between channels is determined by the volume of water discharged;
• Leakage control strips have width of 3 m;
• Deep loosening of each 3rd row at a depth of 50-60 cm;
• Grassing of each 6 to 8-th row;
• Grassing outlets and road network with mixed gramineous.

For the vine plantations located on slopes with an inclination of 5-12^0 is recommended:

• Vine plots are designed with the long part transversal to slope of 1.5 to 2^0;
• Water evacuation channels are set as terraces with inclination opposed to 3-4^0;
• Distance between channels is determined by the volume of water discharged;
• Leakage control strips have width of 3 m;
• Cracking soil at a depth of 18-20 cm during June to August;
• Grassing of each of the 4-5-th row;
• Grassing road network and drainage sites;
• Deep loosening of each 2nd row at a depth of 50-60 cm;
• Planning diffuser leakage.

For plantations of vines situated on the slopes with inclination of 12-15^0 provides:

•Drainage channels and leakage control strips;
•Deep loosening of each 2nd row at a depth of 50-60 cm;
• Cracks between rows of 3-4 times between June to August;
• Grassing each 3rd row with a mixture of grasses;
• Grassing network roads and drainage sites;
• Planning diffuser leakages.

In the highly eroded soils are necessary to apply mineral and organic fertilizers, compost, to improve fertility and structure. Quantity of mineral fertilizer requirements to founding vineyards are presented in table 8.

Table 8. Industrial fertilizers needs to founding vine plantations [3]

Years	Surface, thousand ha	Tones, active substance			
		total		average annual	
		P_2O_5	K_2O	P_2O_5	K_2O
North Zone					
2011-2015	1.4	560	560	112	112
2016-2020	1.0	400	400	80	80
Central Zone					
2011-2015	16.8	6720	6720	1344	1344
2016-2020	12.4	4960	4960	992	992
South Zone					
2011-2015	16.8	6720	6720	1344	1344
2016-2020	12.4	4960	4960	993	992
Republic of Moldova					
2011-2015	35.0	14000	14000	2800	2800
2016-2020	25.8	10320	10320	2064	2064

CONCLUSIONS

Implementing new processes and technologies in sustainable agriculture of Republic Moldova, including viniculture sector, requires solving all impediments hampering efficient whole complex of vines and horticultural based on maximum mechanization of agro technologic processes.

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PROCESSES AND TYPES OF AGGREGATE ORGANIZATION OF A TYPICAL MODERATED HUMIFEROUS CHERNOZEM IN CONDITIONS OF VARIOUS NO-TILL MODELS

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Abstract

Efficiency of no-till technology is appreciated both based on obtained crops and the cost of the unit production or on the basis of agrochemical indices (humus content, grade of mineral nitrogen (NO_3, NH_4), mobile phosphorus, exchangeable potassium, etc. With regrets about the meaning and evolution of the physical characteristics, the conclusions are drawn based on field observations aimed at incorporating soil water by measuring the wetted layer thickness, resistance of penetration that is determined using a simple method of metal rings in soil etc.

Key words: *no till, genetic profile, soil ecosystem, chernozem.*

INTRODUCTION

No-till farming technologies in the literature are known as procedures that ensure enlarged reproduction of soil ecosystem and this because from exterior in their impact on the soil is reduced only the pressures exerted of the tillage process during planting, crop protection and harvesting. Under these conditions the impact is reduced primarily through mechanical pressure exercised by the farm equipment these being, in greater or lesser attenuated by organic mulch layer covering the soil surface. Therefore, the loosening-compaction dynamic is determined preponderantly by natural forces resulting from wetting-drying, freezing-thawing, expansion-contraction [1]. Under this the self-reproduction processes require self-loosening and self-structuring. On the other hand maintaining annually the organic debris in the arable layer, preponderantly in the first 10-20 cm, that system ensures the reproduction of organic matter in soil:

Humic substances → accumulation→ progressive accumulative evolution profile humus formation ↘

Organic debris → humiferous detrit ↗ ↘ →

Labile organic matter → migration → expansion process → pedogenesis on the profile ↗

→ evolution of genetic profile → development of soil ecosystem → ecosystem function → extended reproduction of the soil ecosystem (Jigău et al., 2012).

A challenging element of this technology compared with other technologies is the increasing (by approx. 1.5 times) the quantities of plant protection products, primarily herbicides used to protect crops. This implies the risk of a negative impact on soil biota.

Regretfully particular investigations in this area have not been conducted. However in the field our applied research showed that the number of earthworms in the top 0-30 cm in dry periods of 2010-2012 is 3-4 times higher compared with cultivated land under conventional technologies, and about two times higher than within the treatment with paraplow technologies and loosening deep without furrow turning, that fact is determined, in our opinion by more attenuated dynamics of hydrothermal regime of soil under no-till condition but also by increasing soil organic matter reserves. Even under these conditions we consider that the issue in question requires special investigation. This issue is important because the practice of no-till technologies in Republic of Moldova is increasing year by year. In addition, to this fact that follows from several factors, during the dry period 2007-2012, the cumulative effect of the pedological and hydrological drought, no-till technologies have ensured a stable harvest crops (wheat, barley, maize, sunflower, soybean, rapeseed, peas, etc.). This implies the need for further studies related to the functioning mechanisms of the soils in these technologies.

MATERIAL AND METHOD

The research was carried out in agricultural unit "Civea-Agro" Edinet district where on the total area of 2640 ha from 2002 to 2006 inclusive was practiced agricultural system Mini-Till reduced version and since 2007 are practiced No-Till farming system. In the investigated area the soils are represented by typical moderated humiferous chernozems clay loam formed on the loamy clays. The physical clay content varies in a large range of values (45-60%). In the composition of particle size fraction is dominated very fine sand (0.05-0.01mm) and fine clay (<0.001 mm). On the profile the particle size is relatively homogeneous. In the arable layer there was a slight clay disruption by the wind blowing on surface soil. The analyzed soils have a high potential for aggregate organization. The structuring granulometric index constitutes about 100%. This potential is supported by the humus content comprised predominantly between 4 and 5%, calcium content in adsobtiv complex more than 80% and the degree of base saturation is 100%.

Frequently in the literature the efficiency of no-till technology is appreciated both based on obtained crops and the cost of the unit production or on the basis of agrochemical indices (humus content, grade of mineral nitrogen (NO_3, NH_4), mobile phosphorus, exchangeable potassium, etc. With regrets about the meaning and evolution of the physical characteristics, the conclusions are drawn based on field observations aimed at incorporating soil water by measuring the wetted layer thickness, resistance of penetration that is determined using a simple method of metal rings in soil etc.

The present paper is a first synthesis that assessing the aggregate organization processes in different soil models by using no-till technology:

1. No-Till classic model based on maintaining organic remains on the soil surface.
2. The No-Till model with the intermediate crops.
3. No-Till model with the inclusion of lucerne in cropping patterns.

In the studies we started from the concept that the soil structure as the soil feature is the integrated product of all the formation processes, integration and organization of the soil mass.

Through this prism of ideas is understood the mode of organization structure of elementary particles that contribute to the soil formation and the structural elements (aggregates) and the shape, size, stability, porosity and other properties of these structural elements. In this paper we will refer only to the composition of aggregate according to the size and form of aggregates. Structural separation of elements size classes and structural species was performed by dry fractionation, through sieving carried out at natural moisture content of the soil.

RESULTS AND DISCUSSIONS

1. Aggregate composition of typical moderated humiferous chernozems under conditions of No-Till classic model

No-Till classic model involves practice version which provides accumulation from year to year and the restoration system of organic mulch of organic matter in the soil. Organization aggregate in this case involves physical and mechanical processes determined by wetting-drying, freeze-thaw, expansion-contraction, chemical and physico-chemical processes caused by coagulation, agglutination and partly determined by improvement of biological processes of organic matter in the soil system

(increasing activity of soil biota, primarily earthworms, development of more vigorously root system and etc.).
All this, together, lead to the formation of a structure in which valuable agronomic is predominant.

Table 1. Indices of aggregate organization of typical moderated humiferous chernozems (without crop rotation of lucerne)

Depth (cm)	Apparent density (g/cm³)	Total porosity (%)	Aggregate composition. Species structure			
			Boulder (%)	Grain (%)	Clod (%)	Powdery (%)
Profile 9. Typical moderated humiferous chernozems (wheat crop)						
0-10	1.19	53	10	70	15	5
15-20	1.26	50	10	70	15	5
30-40	1.43	44	20	60	20	-
50-60	1.45	44	20	60	20	-
60-70	1.43	43	20	45	35	-
Profile 10. Typical moderated humiferous chernozems (wheat crop)						
0-10	1.22	52	10	65	25	-
15-20	1.22	52	10	65	25	-
30-40	1.48	42	20	45	35	-
50-60	1.50	41	30	30	40	-
60-70	1.54	40	40	30	40	-
Profile 12. Typical moderated humiferous chernozems (soy culture)						
0-10	1.21	52	10	65	20	5
15-20	1.20	50	10	60	25	5
30-40	1.34	47	10	60	30	-
50-60	1.46	43	20	56	30	-
60-70	1.49	42	20	30	50	-

The data from the Table 1 shows that, despite affirmation, after 6 years of no-till practice against a background of four years of agrotechnics preparation the typical moderated humiferous chernozems comprises a problematic state of structural-aggregate organization.
From the table we see that in all cases active agricultural layer is divided into two overlapping substrates with residual layers and arable farming from previous stage.
This implies that for about 6 years is sufficient for the initiation of processes to restore the structural condition of the soil, but is insufficient for decompactation of structural aggregates, restoring aggregate porosity and pore space continuity.

2. State aggregate indices in the model with the inclusion of lucerne cropping patterns

According to the work concept lucerne in the evaluated model was grown as a crop rotation component that required for expanded reproduction of stored organic matter in the soil surface long covered with vegetation. At the same time, is recognized the lucerne root systems helps improve soil aggregate composition.

Table 2. Recovery effect of aggregate organization indices of typical moderated humiferous chernozems under No-Till by cultivating lucerne

Depth (cm)	Wheat			Lucerne			Soy		
	Apparent density (g/cm³)	Aggregate organization (%)		Apparent density (g/cm³)	Aggregate organization (%)		Density apparent (g/cm³)	Aggregate	
		Ball	Grain		Ball	Grain		I	II
0-10	1.27	-	20	1.09	40	60	1.23	40	60
30-40	1.48	10-20	20-30	1.27	20	80	1.41	40	60
50-60	1.59	20	<10	1.29	10	90	1.50	60	30

The data presented in the Table 2 shows that lucerne helps to the soil decompactation and to the formation of a homogeneous active agricultural layer in which apparent density values remain within the optimal range for chernozems with fine medium size composition.
Probably decompaction under the influence of lucerne root system involves the fragmentation grinding of soil mass.
Evidence is the fact that after three years of cultivation of lucerne the grains aggregate content in 30-60 cm layer forms 80-90%. At the same time the land with wheat grains aggregated content constitutes only 20-30%.
Even though, in the case of soya culture there is a situation relatively improved in the aggregate organization, however agro-physical profile involves layers with different values of apparent density and structural aggregate content.
We mention that research presented above belongs to a confined space and only by the one subtype of chernozems.
In this particular case it must be concluded that the involvement of lucerne in crop rotations in the
No-Till structure that creates preconditions for substantial intensification of biological processes in the case of integrated process of structuring the soil and contribute to a more accelerated recovery of aggregate mass organization in no-till soil practices.
The research has established that the ameliorative effect derived from lucerne cultivation period is therefore lucerne cultivation of three years that provide favorable aggregate state a longer period than is provided by agronomic measures (Table 3).

Table 3. Aggregate structural indices of typical moderated humiferous chernozems under post-cultivation lucerne

Depth (cm)	**Apparent density (g/cm^3)**	**Total porosity (%)**	**Aggregation organization (%)**			
			Ball	**Grain**	**Bulk**	**Powder**
Profile 11. Wheat 3 years after rape						
0-10	1.21	52	30	20	45	5
15-20	1.50	41	55	-	45	-
20-25	1.35	47	15	40	45	-
25-30	1.36	47	15	35	50	-
30-40	1.46	43	20	10	70	-
40-50	1.52	41	10	10	80	-
50-60	1.47	43	-	15	85	-
60-70	1.48	43	-	10	80	-
Profile 12. Wheat 3 years after lucerne						
0-10	1.14	55	10	60	10	10
15-20	1.16	54	10	70	20	-
20-25	1.19	53	-	85	15	-
25-30	1.20	53	-	80	20	-
30-40	1.38	46	-	70	30	-
40-50	1.29	43	-	70	30	-
50-60	1.37	47	-	40	60	-
60-70	1.45	43	-	35	65	-
Profile 12a. Sunflower 3 years after lucerne						
0-10	1.05	57	10	40	20	30
15-20	1.27	50	-	80	20	-
20-25	1.23	51	-	80	20	-
25-30	1.30	49	-	70	30	-
40-50	1.37	46	-	60	40	-
50-60	1.35	48	-	55	45	-
60-70	1.40	46	-	40	60	-

Specified in the table we find that three years after lucerne culture the agro-physical profile of soil, bearing common features with profiles that are not subject works. In addition soil structure with few exceptions, represented by the aggregate grains are part of the valuable agronomic structure.

Fact that the structures remains practically untouched three years after lucerne culture which requires the idea that the process of hydrostatic structural organization aggregate are formed.

3. Aggregate composition of typical moderated humiferous chernozems under intermediary crop practice

Another No-Till model practiced in Republic of Moldova is the model that includes intermediary cultures. Intermediary crops for cultivation involve covering the soil surface with permanent vegetation that ensures a relatively constant hydrothermal system by reducing physical evaporation and erosion risk mitigation. At the same time they are cultivated as fresh organic matter in the soil. Frequently used for such purposes yellow mustard.

The data from the Table 4 indicates that even a short period of growing mustard was sufficient to ensure the regime which favors hydrothermal processes that forming aggregates grains.

Table 4. Recovery effect of (rape culture predecessor) indices of aggregation of typical moderated humiferous chernozems under No-Till the intermediary culture of mustard

Without intermediate culture					**With intermediate culture**			
Depth (cm)	Apparent density (g/cm^3)	Aggregation organization (%)			Apparent density (g/cm^3)	Aggregation organization (%)		
		Boulder	Grain	Ball		Boulder	Grain	Ball
0-10	1.27	10	60	30	1.23	10	70	20
20-35	1.49	-	55	45	1.41	-	70-80	10-20
35-60	1.64	5	45	50	1.47	-	60	40
75-90	1.52	20	40	40	1.46	10	60	30

Approximately the same ensure the intermediate facile culture (Table 5). We mention that investigations were conducted under conditions of drought when water reserves under conventional technologies were at an appropriate level hygroscopicity of the soil.

Table 5. Recovery effect of the state of typical moderated humiferous chernozems under No-Till the intermediary culture of facile

Without intermediate culture					**With intermediate culture**			
Depth (cm)	Apparent density (g/cm^3)	Aggregate organization (%)			Apparent density (g/cm^3)	Aggregate organization (%)		
		Boulder	Grain	Ball		Boulder	Grain	Ball
0-10	1.14	10-15	20-25	65-70	1.28	-	< 20	>80
20-35	1.64	80-90	10-20	-	1.48	-	10-20	80-90
45-55	1.50	70-55	20-30	10-15	1.48	5	15-20	80
65-75	1.60	60-85	30	10-15	1.53	20-15	20-25	60

CONCLUSIONS

Transfer from the classic to no-till tillage of soils requires not only practice-oriented technologies that reduce pressures on soil (variant Mini Till reduced works), but also the obligatory measures for management of agroecosystems by soil organic matter reserves.

No-Till classic is insufficient to recover the state of the aggregate organizationa chernozems with high degree of modification of agro-physical profile. In this context systemic measures are required based on practice culture structures capable of providing agroecosystems similar to natural ecosystems.

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CONSIDERATIONS REGARDING THE EVOLUTION OF CHERNOZEMS IN THE CARPATHO-DANUBIAN-PONTIC REGION UNDER AGRICULTURAL REGIME

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Abstract

Contemporary pedogenesis in the Carpathian-Danubian-Pontic region is determined by the evolution of natural pedogenetic factors (climate, geology, biology) in terms of increasing human impact on the overall system of factors ← soil. This means a new stage in the evolution of natural-anthropic soils that we propose to call anthropogenesis. The basic components of anthropogenesis are: 1. Anthropisation of the constitution and functioning processes of the soil as a body and physical system, especially the processes that are aggregate organization and settlement indices, 2. Modification of humus profile (organic matter) which is materialized into color changes, depth, content and composition of humus; 3. Transformation of the carbonates in the soil profile that is materialized into changes related to thickness, depth of accumulation, new formations of carbonates and the migration processes character, 4. Formation of the anthropical new horizon: arable, subarable, pedological metamorphosed 5. Modification in the structural organization of the pedologenetical layer that is evidenced in the shape deformation, the packaging and inter-aggregate organization, compactation, etc., 6. The transformation manner of how is placed the soil mass, reflected in the bulk density, porosity etc.

Key words: *agriculture regim, inter-aggregate organization, ecosystem, pedogenesis.*

INTRODUCTION

The anthropization problem on soil still remains unclear. The fact is that, as a result of industrial development, transport, energy and intensification of agriculture the human impact on the environment increases, that leads to the tehnogenesis of the natural background and therefore are affected the pedogenetic process, respectively ecosystems. As a consequence, the Carpathian-Danubian-Pontic region is facing with a number of serious environmental problems such as: reduction and accelerated degradation of water resources, degradation of soil biota, biodiversity loss and degradation of soil quality, etc.

The highest serious consequence is the biogeochemical flow modification of substances by reducing the bioproductive of the ecosystem function.

All of these in turn lead to the amplification of human intervention processes in the pedogenesis process. At the same time, the attempts to maintain agroecosystems bioproductivity by enhancing agricultural systems also lead to the increase of anthropogenesis levels in the pedogenesis process.

MATERIAL AND METHOD

The investigations refers to geographical area heaving clear borders whithin which the soil science natural laws regarding the genesis and evolution of the soil are realising. Departing from this statement, the evolution of agro-soils should be investigated only through „soi-environmental factors” system approach. In line with this methodological principle, the agro induced changes of soils are inherent and implies rational management of soil resources. The sustainability of soil resources can be assured when the mechanisms of soil evolution - the direction and the intensity of changes - are well known. The methodological support within the mentioned investigations is secured by the principle of actualism.

RESULTS AND DISCUSSIONS

The functional-genetical approach of the anthropic pedogenesis, as phenomenon is considered an integrating natural processes (tipogenetical zone) and tehno-anthropical process induced through the inclusion of soil in the agricultural use (Table 1). The contemporary processes of soil under anthropogenic regime are examined through the concepts, which are integration processes and organizational structure of the ecosystem soil functioning [1, 2, 3, 4, 5].

The anthropization processes of constitution and functioning of soil in his quality as a body and physical system, in special of the processes that determine the aggregate organization and settlement indices (Table 2).

Table 1. Contemporary evolutionary processes of soil

Natural			Agrogene (pedo-morphological)			Degradation	
Bioclimatic (conserva-tion)	Sin-evolution (process - regime)	Functional (reproduction)	Morto-turabtional	Regime - turabtional	Functional - turabtional	Abraded	Destructive
Formation and accumulation of humus Structuring Migration of carbonates	Elluviation Leaching Debasification Clay losses Substances differentiation	Decomposition-synthesis of organic substances Decomposition-synthesis of mineral substances Biological accumulation of substances	Stratification Compaction Destruction Stylization	Compactation Crimping Aridity Degradation of porous space Hydro-morphosis	Dehumification Depletion Exhausted Biodegradation	Erosion Deflation	Landslides Flooding Cover laying with pedolit

Table 2. Anthropogenesis elements for organization of aggregate in the typical chernozems moderate humiferous

The soil model used	Depth, cm	Content of aggregates, %			Aggregate stability, %		
		>10 mm	10- 0,25 mm	<0,25 mm	> 5 mm	5- 0,25 mm	<0,25 mm
Uncultivated, Celery	0-10	6.3	85.6	8.1	27.0	52.0	21.0
	10-20	8.7	84.0	7.3	21.0	59.6	19.4
	20-30	11.3	79.2	9.5	23.6	58.2	17.6
Cultivated, 53 years	0-10	13.9	73.6	12.5	7.4	53.0	39.6
	10-20	19.7	65.0	14.3	4.4	49.0	46.6
	20-30	31.7	58.2	10.1	11.8	41.9	46.3
	30-40	30.3	56.9	12.8	10.7	44.4	44.9
	40-50	17.8	69.8	12.4	10.9	52.0	37.1
Cultivated, 47 years	0-10	12.5	68.0	19.5	7.7	52.0	40.3
	10-20	19.4	68.5	12.1	6.1	47.0	46.9
	20-30	30.7	58.0	11.3	9.7	42.0	48.3
	30-40	30.3	56.9	12.8	10.3	41.5	48.2
	40-50	14.7	73.0	12.3	9.1	47.9	43.0

- Modification of humus profile (organic matter) which is materialized into color changes, depth, content and composition of humus
- Transformation of the carbonates in the soil profile that is materialized into changes related to thickness, depth of accumulation, new formations of carbonates and the migration processes character
- Formation of the anthropical new horizon: arable, subarable and pedological metamorphosed
- Modification in the structural organization of the pedologenetical layer that is evidenced in the shape deformation
- The transformation manner of how is placed the soil mass, reflected in the bulk density, porosity etc.

Starting from these, it should be complemented the new Dokuchaev triad "factors – processes - characteristics" with an identical formula "anthrofactors - agrogene processes - agrogene characteristics" and considering the previous publications, it is necessary to render the contemporary pedogenesis evolution through the relationship:

Factors ← Regime ← Processes ← Characteristics

Anthrofactors ← Anthroporegimes ← Anthroprocesses ← Agrocharcteristics

Regard as the contemporary pedogenesis interpretations are taken into consideration in all direct and indirect implications of the meaning that offer an integrated process of pedogenesis. In compliance with this formula, the anthropogenesis processes begins with the first soil impacts on the surface layer, accompanied by the disturbance of natural settlement that leads to the significant modifications in air-water regimes and hydrothermal fluid, as in biological reactions, air composition, etc. As a consequence, become operational coordinated processes by the mass modification that resulting as attenuation in the soil which leads to more or less to the natural characteristics and new characteristics.

Into this background, the integrated anthropogenesis includes several types of anthropogenesis:

- Anthropogenesis that is based on the agro-turbation on the elementary processes (anthropogenesis, agro-turbation), that is implying the movement and mixing of soil mass.
- Destructive anthropogenesis is the most common form that involve intensification of natural processes, fulvitization and dehumification of humus composition, disaggregation, restructuring and compaction; hydrological aridity and intensification of natural process.
- Abraded anthropogenesis, that is determined by the combining agro-pedogenetic processes against to the opposite of erosion.
- Sin-lithogenic anthropogenesis determined by the agro-pedogenesis processes and the accumulation of eroded material.
- Morphogenesis determined by the agro-pedogenesis processes of destruction and agrogen.

Of the latter, more important are physical degradation processes that change the composition of the soil profile morphology, even up to full replacement of natural features with new features anthropo-technogenic.

- Agro-irrigation-pedogenesis - is determined by the combining typo-genetic processes amended as a result of intervention of a new moisture regime and the destructive processes inherent to irrigation.
- Agro - tehnogenesis - includes agropedogenesis processes caused by tillage activities and processes derived from special agrotechnical measures taken in order to create a exploited agrogen layer.
- Agro-hydro-pedogenesis - include the agro-processes determined by pedogenesis and drainage works and soils with an excess of moisture.

In all cases agro-techno-pedogenesis leads to the formation of a layer in the upper segment of the agrogen profile that consists of arable and subarable horizon.

Depending on the processes taking place in the arable horizon, respectively, of its state, it can be (According to the processes which are realized within the arable horizon and respectively, of its state, it can be):

- agro-chernozem - chernozem retain basic traits;
- agro-ocric – humus content < 3 %, report Ah: Af <1.7;
- agro compacted - bulk density = 1.30-1.45 g/cm^3, total porosity 50-40%, resistance to penetration 20-30 kg/cm^2;
- agro-compact - bulk density >1.45 g/cm3, total porosity 30-40%, resistance to penetration from 30-40 kg/cm^2;
- agro-illuvial consolidated - bulk density > 1.55 g/cm3, total porosity < 30%, resistance to penetration > 40 kg/cm^2;
- agro – metamorphosed – aggregate content from 10-0.25 mm in 30 %, bulk density > 35 g/cm^3;
- agro-turbational - formed at the account of 2-3 genetic horizon. It is characterized with the ocric color inhomogeneous;

- Agro - abraded - is characteristic to highly eroded soil and is formed at the account of poorly humiferous horizon of profiles;
- agro-sin-lithogenic - formed at the result of mixing the initial ground material with the contribution through the process of diluvium.

A common characteristic of all arable horizons is partially caused by clays losing in the deflation in the period when the soil is unprotected. Sub arable horizon is distinguished by the high density, prismatic structure, and reduced total porosity. To a lesser extent is determined by processes such as bio-pedogenesis, the greater extent have the mechanical processes. Depending on the state subarable horizon, it may be: deformed and consolidated. Depending on the structure it can be: prismatic, polygonal, etc.

The research implies that the anthropogenesis is achieved by stages: in the first stage, pedogenesis processes arising predominantly and are involving the zonal tipogenetic process. There is found only slightly modified in the pedogenesis process and at beginning of the agrogen process. In the second stage under intensive processes caused by the degradation of organic systems and related dehumification processes are intensified (especially aggregation). The third stage involves maximal intensity of the physical degradation processes with agrogen layer formation.

Researches show that their conduct is needed for several decades. Basic processes in soils that are resulting under natural regime and processes which are performed are reversible.

Step four, involves the developing and simplifying of the agrozioms soil ecosystems (Fig. 1).

The evolution processes of chernozems under agricultural regime follow the hierarchy.

At ion-molecular level the tehno-anthtopic processes are materialized within the meaning and intensity of interphase processes (ion exchange, leaching (dilution) - soil solution concentration, migration and substances differentiation), but quantitative values are expressed in pH, cation exchange capacity, content substances etc. At elementary particle level, determining roles have the evolving processes of mineral colloids, organic and organo - mineral soil. The evolution of organic colloids is determined by the dehumification processes of soil plasma due to the significant decrease of the intensity of humification process, in line with intensification of the mineralization process of organic matter. Dehumification involves that removing of organic matter from the mineral particles surface, leading to their energy centers activation. Therefore is increasing the dispersion degree of hydrophilic fine mineral constituents. It occurs by increasing up to 2-3% clay content in the water and also in the internal soil specific area. At the same time, administration of fertilizer mobilizes acids condition about 0.4 -1.2 % that is contained by fine clay fraction composition which is comprised in the clay aggregate. Aridity of agrogen segment leads to fulvization of humus. Specified modifications are affecting the potential of soil structure - aggregation and create prerequisites for reorganization of soil structure. At micro-aggregates level the anthropization processes of pedogenesis are materialized in increasing partially the clay non-aggregation content. Therefore, there is highlighted a slight increase of the dispersion factor, and also the reduction of structuring factor. Aggregation indices, practically does not undergo any changes.

The structural-aggregate of soil state are affected by significantly change, which is materialized in the values of structural-aggregate parameter and mechanisms of structuring process. In anthropogenesis the evolution of structural-aggregate state is determined by the mechanical processes of rocks and scatter structure they are materialized in increasing the content of aggregates > 10 mm and for the most part <0.25 mm. In the composition of valuable agronomic aggregate fraction, the gaunt aggregates content is reduced, thereby increasing the share of rough aggregates along with the evolution of quantitative state and structural changes unit in the technical crop rotations that implies qualitative changes caused by compaction, predominantly, irreversible structural aggregates.

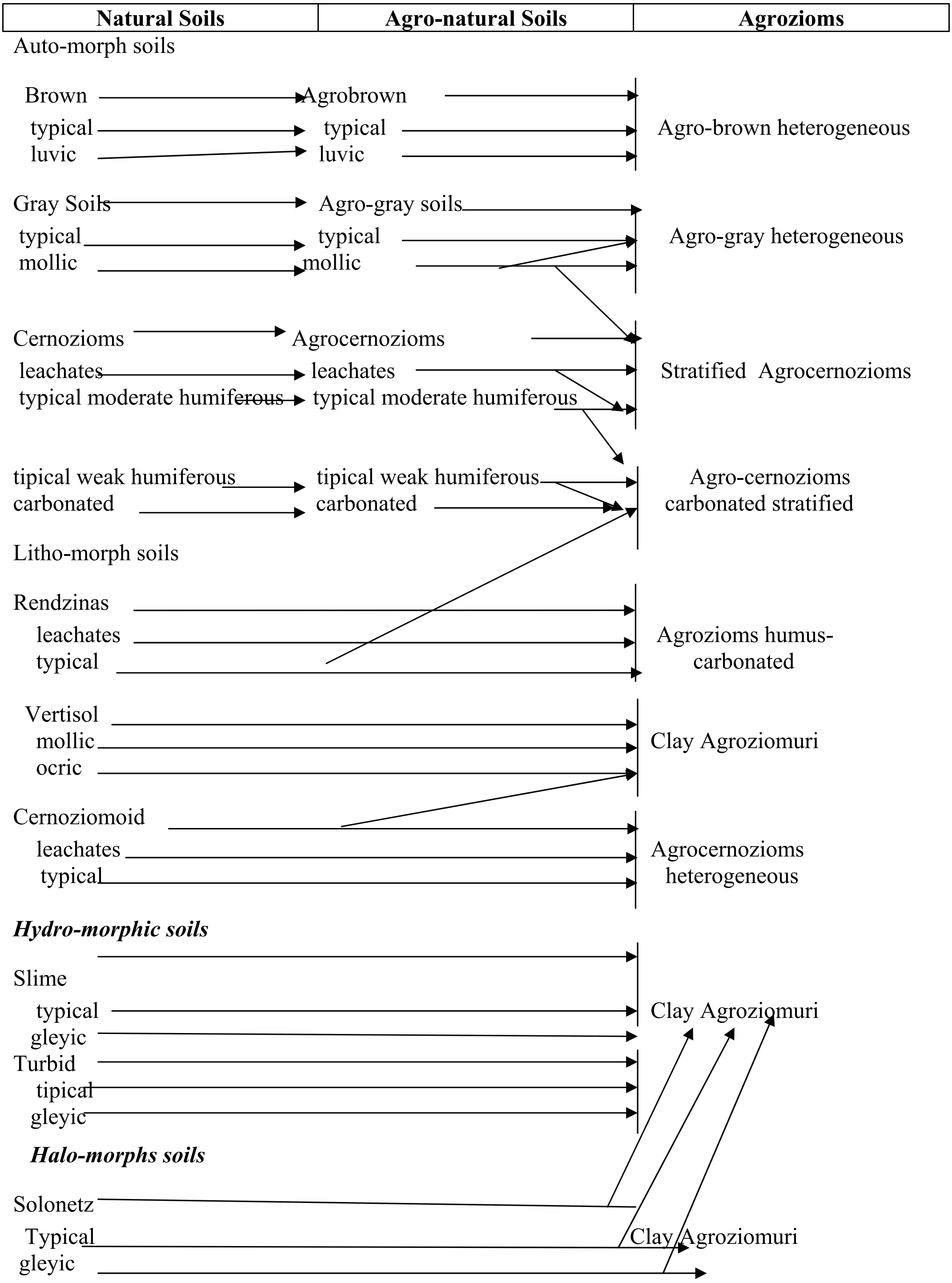

Fig. 1. Agrogene transformation scheme of the main types of soil

Aggregates with size > 10 and 10-7 mm are affected by compaction in small measure. Aggregates 7-5 mm are already affected by compaction. In the strongest manner are affected aggregates with sizes < 5 mm. Aggregate compaction is achieved at the expense of aggregate pore texture, due to reducing of their diameter and leads to the formation of pseudo - aggregate.

In the structuring mechanisms of soils under anthropogenic regime that increases considerably the role of physical-mechanical and physic-chemical processes are reduced by weight. The physical and mechanical processes are favored by cumulative aridity agrogen layer in the technical cropping, and also by contrast and hydrothermal regime character. In this context, an important role is given to structural aggregates cracking, leading both to the mechanical cohesion reduction and hydro – stabilities of aggregates.

Research at some long standing showed that the mineral fertilization causes disintegration of the soil mass The same research showed that the proportions of such a decomposition are so significant that organic fertilization (140t/ha of manure during the rotation of 7 cultures) is insufficient to compensate for its effects. The reduced effects of manure are also caused by low efficiency of organic fertilizer and also the background of ambience that is unfavorable for hydro-physical degradation caused by soil. Another important factor that influences the structure is under anthropogenic soil cultivation. Our research showed that early plowing vegetation provides structural condition - very good unit. This, however, remains in the ground a short time. Already, in June there is a clear tendency to reduce the content of agronomically valuable aggregates. At the end of vegetation valuable agronomic aggregates content is more than 15% lower than at the beginning of vegetation. In the deep loosening (40-50 cm) without turning furrow, shows the same trend but with much lower quantitative expression. In the minimal tillage systems, the structural unit status during the vegetation is changing much more and natural degradation processes are significantly reduced. The level of genetic horizon integrates changes from previous hierarchical level. Changes in the structural-aggregation state leads to the spatial distribution changing of solid constituents. Quantitative expression values of this redistribution are bulk density and pore space characteristics.

In the seasonal dynamics there is a steady reduction of the total porosity at the end of vegetation. Following the soil mass concentration, there takes place moisture pore diameter reduction and also their changes in the soil ecosystem functions. They are materializing in the pore volume moisture protective increased and conductors pore moisture reduction. Therefore, during the vegetation moisture deficit effect is amplified with adverse implications on the development of plants and crops. The changes that occur in the pore due to both regimes, that resulting as an intensive process of humus formation and mineralization of it. Share the latter are higher because the evolutionary trend is oriented in the sense of dehumification. The stratification of the tehno-agrogene profile affects the cellular space. In this connection is reduced the thickness of the plants root system of exploited layer. The specified changes involve significant changes in the soil ecosystem (Table 3).

CONCLUSIONS

Prolonged use of agricultural land involves a new phase of the development of soil cover in the Carpathian-Danubian-Pontic which characteristics is to simplify the soil ecosystem, convergence at higher taxonomic levels and divergence at lower levels.

Table 3. Indices of functionality of soils under technical crop rotation through physical degradation losing condition

Agro ecosystems Function	Processes that influence it	Specifications
Exploitation, conservation and water supply	Destruction Stratification	The degradation of porous space and reduction of water permeability by reduction of the quantity of water stored in the soil. Formation of surface spills that increase erosion. Reduction of capacity for water and water disposal capacity by plants.
Filtration	Compaction. Destruction Clogging. Significant dust rate pores Profile stratification	Disturbance in the continuity of the porous space. Reduction of hydraulic conductivity and leaching depth of the profile. Auto-pollution by nutrient soil, bio-products, etc. Geo and pedogenesis. Accumulation of toxic substances.
Gas exchange, renewal of soil air	Crustificarea Compaction Destruction Clogging Significantly dusty pores Profile stratification	Poor gas exchange. Reducing of the oxygen content and increasing of carbon dioxide content. Accumulation of iron and manganese, but also of gas (NH_3, H_2S, etc.) in the toxic quantities. Soil exhaustion.
Development environment of radicular system	Compaction Profile stratification	Limitation of radicular layer thickness. Increasing the vulnerability of plants to atmospheric drough.
Environment for plant growth	Compaction Destruction Profile stratification	Insufficient ensuring with water of plants, air and nutrition. Deficiencies of micronutrients.
Ecological niche	Compaction Clogging Significantly dusty pores	Disturbance hydrothermal regime. Biodiversity degradation of soil biota. The complete disappearance of some species organisms that is associated with steppe plants. Increasing mass saprophytic biota.
Environment degradation - transformation of substances and the formation of Biogeochemical cycles	Compaction Clogging Significantly dusty pores	Disturbance hydrothermal regimes, air-fluid, oxidation-reduction and biological. Modifications in the process of formation and accumulation of humus. Intensified humification.

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STATE QUALITY MONITORING OF THE GREY SOILS FROM WARM MODERATELY NORTH ZONE OF THE REPUBLIC MOLDOVA

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Abstract

In result of quality monitoring of zonal soils has been found that arable Grey soils from moderately warm semi- humid zone of North part of Moldova, compared with fallow Grey soils, are characterized by moderate degradation of soil properties as a result of dehumification, destruction and considerable decrease of humus and nutrients content. Eluvial horizons of virgin and arable Grey soils have unfavorable physical and chemical properties – excessive compaction, acid reaction, low content of humus and nutrients. The presence of eluvial compact horizons in profile of Grey soils leads to decrease the water permeability, which are regularly influenced by temporarily excess of humidity, have a low stability for erosion processes and low fertility. In the arable Grey soils decreased acidity, leading to the stopping of eluvial processes. Using in continue the Grey soils without fertilizers application will lead to decreasing soil quality state. The necessary measures to maintain fertility of arable Grey soils are: increasing organic matter content by applying chemical and organic fertilizers, vegetal wastes and residues; implementation of zonal crop rotation; improvement the tillage system.

***Key words**: degradation, evolution, Grey soils, monitoring, soil quality.*

INTRODUCTION

The main zonal soils area of agricultural land in Republic Moldova are Chernozems (1 mln 500 thousand ha or 77.8%) and Grey soils (123.7 thousand ha or 6.7% from the total surface). Grey soils from semihumid warm moderate zone of Moldova's north part occupy the Moldova's Northern Plateau. This geo-morphologic district is characterized by slow forms of relief, which makes manifestation of weakly erosion processes. Absolute altitudes are 250 - 300 m. Horizontal fragmentation in valleys - 1.5 to 2.0 km/km^2. In the west part the average vertical fragmentation is 50-100 m, in the fossil reefs chains - up to 150 m.

Grey soils were formed under deciduous forest vegetation in conditions of temperate climate (sum of temperatures >10°=2700-2800°, annual amount of precipitation - 550-650 mm, moisture coefficient, K=0.7-0.9). As a result of deforestation in different historical periods these soils were used in arable. The largest areas of deciduous forest have been cleared and restored to agricultural land in the last 100 years. Parental materials are loess, which are characterized by a clear difference of profile texture [1, 3].

MATERIAL AND METHOD

To determine changes in quality status of arable Grey soils from Northern zone of the Republic Moldova in comparison with the virgin Grey soils, was located two monitoring polygons: no.24 on the arable farmland and no.25 in the forest on the horizontal surface of a large heights [1].

RESULTS AND DISCUSSIONS

Polygon no. 24, profile of arable Grey soils

Destination of the polygon is to make periodic observations of changes in quality status of typical arable Grey soils under agriculture influence. The soil profile of polygon no.24 is located on the horizontal surface of a large peak on the North Plateau of Moldova (on the territory of Alexandreni commune, Edinet district). Absolute altitude - 234 m, mainly soil profile coordinates: latitude - 48°08.517', longitude - 27°17.856'. Polygon date location (beginning observations) - 11.10.2007.

Northern Plateau of Moldova is a primary denudation area formed in Pliocene period. Surface rocks are composed of loam-clay loess wind provenance (thickness - 1-2 m), under which are located the Pliocene sandy-clayey deposits with large fragments of calcareous rocks. The polygon is located in the moderately warm semihumid climate zone. Solar periods (sunny days) - 280-290. Isolation duration - from 2000 to 2050 hours. Average annual temperature - 7-8°C. Amount of t°>10° - 2700-2800°. Annual amount of precipitation - about 600 mm. Evaporability potential – 650 – 700 mm. Hydrothermal coefficient by Ivanov-Vâsoţkii - 0.8 to 0.9. Vegetation period - 166-167 days [2,4].

The soil cover of arable land consists from arable Grey soils moderate humifer with semi profound humus profile, clay 0-35 cm and clay-loam 35-100 cm. Arable land is used in field crops (Photo 1).

Photo 1. Location of polygon no. 24 – large height on the low wave plateau of Northern Moldova with arable Grey soils

The natural degradation factors are: eluvial-alluvial soil textural differentiation, excessive compaction of alluvial underlying layer.

Anthropogenic factors of soil degradation are: dehumification, destruction of arable layer and compacting secondary post arable soil layer in result of irrational farming.

The investigated of arable Grey soils is characterized by profile type: Ahp1 - Ahp2 - Bhtw - Btw - BCtw - 1CRk. Soil profile has a depth of 120 cm. At the 100 cm of depth appears the underlying rock composed from yellowish unconsolidated sandy-clayey rock material with large fragments of sandstone (Photo 2).

Photo 2. Profile no.24 - grey soil, arable

After land deforestation and use on the arable, as a result of hydrothermal regime change and biological cycle of substances modification, the eluvial - alluvial processes in the profile of these soils has ceased [1,2]. Statistical average data on arable Grey soils on the polygon no. 24 are presented in tables 1-5.

Polygon no. 25, profile of virgin Grey soils

Polygon destination - the absolute standard for comparing and assessing properties changes of arable Grey soil in result of anthropogenic impact.

The polygon is located on the horizontal surface of a large peak of North Moldavian Plateau, in the primary forest in the south part of arable land that was located polygon no. 24 (Photo 3).

Photo 3. Location of monitoring polygon no. 25 – virgin Grey soil, deciduous forest on the plateau

Table 1.Texture of arable Grey soil with whole profile on the monitoring polygon no.24

Horizons and depth, cm	Limits of granulometric fractions, mm; content, % g/g						
	1-0.25	0.25-0.05	0.05-0.01	0.01-0.005	0.005-0.001	<0.001	<0.01
Ahp1 0-24	2.2	23.6	31.2	9.6	13.2	20.2	43.0
Ahp2 24-35	2.4	23.4	31.1	9.2	13.9	20.0	43.1
Bhtw 35-53	2.1	21.7	28.3	8.2	12.5	27.2	47.9
Btw 53-71	1.6	21.5	27.8	8.7	10.8	29.6	49.1
BCtw 71-80	2.4	22.2	26.3	8.4	10.9	29.8	49.1
BCtw 80-100	2.8	26.4	23.0	9.7	10.1	28.0	47.8
1CRk 100-120	9.7	63.7	9.2	5.1	5.3	7.0	17.4

Table 2. Average statistical parameters (X ± s) of structural composition on the genetic horizons of arable Grey soil

Depth, cm	The content of structural elements (size, mm) determined by dry sieving (numerator) and water stability aggregates (denominator), % w/w				Quality structure (dry sieve)	Hydrostability structure (wet sieve)
	>10	< 0.25	Sum 10 – 0.25	Sum >10 + < 0.25		
Ahp1 0-12	23.8±8.0 / -	8.5±5.6 / 64.6±3.5	67.7±3.9 / 35.4±3.5	32.3±3.9 / 64.6±3.5	good	low
Ahp1 12-25	39.6±1.6 / -	4.3±0.7 / 64.1±3.3	56.2±2.0 / 35.9±3.3	43.9±2.0 / 64.1±3.3	favorable	low
Ahp2 25-35	34.5±6.1 / -	3.5±2.2 / 69.4±4.7	62.3±7.5 / 30.6±4.7	38.0±7.5 / 69.4±4.7	good	low
Bhtw 35-53	22.3±5.3 / -	2.9±0.8 / 64.9±2.8	74.9±4.6 / 35.1±2.8	25.2±4.6 / 64.9±2.8	good	low

Table 3. Average statistical parameters (X ± s) of physical properties on genetic horizons of arable Grey soil

Horizons and depth, cm	Thickness of horizons, cm	Fractions, %g/g		Hygroscopicity	Hygroscopicity coefficient	Density	Apparent density	Total Porosity, % v/v	Compaction degree % v/v
		<0,001 mm	<0,01 mm	% g/g		g/cm^3			
Ahp1 0-12	12±1	20.2	43.0	4.1±0.6	5.2±0.6	2.60±0.02	1.30±0.02	49.9±0.9	0±2
Ahp1 12-25	13±1	20.2	43.0	4.1±0.6	5.2±0.6	2.60±0.02	1.45±0.03	44.4±1.1	11±2
Ahp2 25-35	10±1	20.0	43.1	3.8±0.7	4.9±0.7	2.62±0.01	1.52±0.05	41.2±0.7	17±2
Bhtw 3 5-53	18±1	27.2	47.9	3.5±0.5	4.6±0.8	2.66±0.01	1.61±0.02	39.5±0.6	22±1
Btw 53-71	18	29.6	49.1	3.6	5.5	2.68	1.61	39.9	22
BCtw 71-80	29	29.8	49.1	3.4	4.8	2.69	1.62	39.8	22
BCtw 80-100	29	28.0	47.8	3.0	4.3	2.69	1.61	40.1	21
1CRk 100-120	-	7.0	17.4	0.8	1.3	2.68	1.51	43.8	6

Table 4. Average statistical indexes of chemical properties on genetic horizons of arable Grey soil

Horizons and depth, cm	pH	$CaCO_3$	P_2O_5 total	Humus	N total	C : N	Mobile forms, g/100 g soil		Hydrolytic acidity, me/100g soil
		% g/g					P_2O_5	K_2O	
Ahp1 0-25	6.4±0.1	0	0.104±0.003	2.28±0.12	0.114±0.007	11.6±0.5	2.0±0.4	14±2	3.6±0.4
Ahp2 25-35	6.3±0.1	0	0.086±0.008	2.07±0.09	0.107±0.007	11.2±0.2	1.7±0.2	12±1	3.2±0.4
Bhtw 35-53	6.5±0.1	0	0.059±0.004	1.44±0.13	0.077±0.007	10.8±0.3	1.2±0.3	10±1	2.4±0.5
Btw 53-71	6.8	0	-	0.84	-	-	-	-	-
BCtw 71-80	7.0	0	-	0.43	-	-	-	-	-
BCtw 80-100	7.2	0	-	0.37	-	-	-	-	-
1CRk 100-120	8.0	9.7	-	0.17	-	-	-	-	-

Table 5. Average statistical parameters (X ± s) of exchangeable cation content of arable Grey soil

Horizons and depth, cm	Exchange cations, me/100g soil		
	Ca^{++}	Mg^{++}	Sum (Ca^{++} + Mg^{++})
Ahp1 0-25	22.6±2.0	3.3±0.2	25.9±1.7
Ahp2 25-35	21.3±1.5	3.2±0.3	24.5±1.7
Bhtw 35-53	22.1±1.0	3.2±0.3	25.3±1.1
Btw 53-71	22.6	3.0	25.6
BCtw 71-80	22.4	3.0	25.4
BCtw 80-100	21.8	3.0	24.8
1CRk 100-120	15.5	2.6	18.1

Absolute altitude - 239 m, mainly soil profile coordinates: latitude - 48° 08.283 ', longitude - 27°17.566'.
The climate and relief conditions, the surface and underlying rocks are similar to those of no.24 polygon. The soil cover consists by humifer virgin Grey soils, has a moderate humifer profile, clay 0-26 cm and clay – loamy 26-120 cm.
The profile of virgin Grey soil is characterized by profile type: Aht - AEh-BEhtw - Bhtw - Btw - BCtw - CRk (Photo 4).

Photo 4. Profile no. 25, virgin Grey soil

Profile in the primary forest is located vis-à-vis the profile no. 24, 100 m south of the northern limit of arable land. Effervescence - beginning at a depth of 120 cm. Carbonates at the depth of 120 appears as pseudomycelia and veined small and medium-sized fragments of sandstone [2, 4].
Comparative properties characteristic values of arable and virgin Grey soils on the depths and standards layers are presented in table 11. Larger information in this regard can be obtained in the comparison result of statistics parameters of average properties of these soils presented in tables 1 - 5 for arable Grey soils and tables 6 - 10 for virgin Grey soils.
The data of tables 1 - 11 confirms that the texture of virgin and arable Grey soils is practically analogical - loamy in the upper and loam-clay in the illuvial or illuviale-cambic profile horizons.
In the recent condition of structural state of these soils the loamy texture of arable layer can be considered as good in terms of soil tillage. Due of clay texture the arable layer is working easier; plowing is less cloggy, than in case of fine textured soils (clay-loam, loam-clay, clay), lumps are fragments comparatively easier.

Table 6. Texture of virgin Grey soil on the monitoring polygon no. 25

Horizons and depth, cm	Granulometric fraction limits, mm; content, % w/w						
	1-0.25	0.25-0.05	0.05-0.01	0.01-0.005	0.005-0.001	<0,001	<0,01
Ahţ 0-9	1.1	23.3	32.9	11.0	12.4	19.3	42.7
AEh 9-26	0.7	22.9	32.8	10.8	12.0	20.8	43.6
BEhtw 26-37	0.9	22.4	30.2	10.2	11.3	25.0	46.5
Bhtw 37-54	1.0	22.7	28.9	9.9	10.0	27.5	47.4
Btw 54-72	0.8	22.8	27.4	9.9	10.9	28.2	49.0
BCtw 72- 100	1.1	28.1	23.7	9.5	9.9	27.7	47.1
BCtw 100-120	2.4	31.3	20.7	9.1	8.9	27.6	45.6
1CRk 120-140	1.5	55.2	18.5	5.7	6.3	12.8	24.8

Table 7. Average statistical parameters (X±s) of structural composition of virgin Grey soil on the polygon no. 25

Depth, cm	The content of structural elements (size, mm) determined by dry sieving (numerator) and the hydrostabile aggregate (denominator),% g/g				Quality structure (dry sieve)	Hydrostability structure (wet sieve)
	>10	< 0.25	Sum 10 – 0.25	Sum >10 + < 0.25		
Ahţ 0-9	7.2±1.1	9.3±1.8	83.5±2.0	16.5±2.0	very good	very high
	-	26.1±1.6	73.9±1.6	26.1±1.6		
AEh 9-24	9.5±2.4	5.2±1.8	85.2±2.2	14.7±2.2	very good	very high
	-	17.8±1.5	82.2±1.5	17.8±1.5		
BEhtw 24-35	31.0±2.6	3.6±0.6	65.4±2.1	34.6±2.1	good	high
	-	23.7±3.2	70.2±12.3	23.7±3.2		
Bhtw 35-53	46.1±11.4	4.7±3.3	49.2±11.8	50.8±11.8	moderate	high
	-	33.5±2.3	66.5±3.5	33.5±2.3		

Table 8. Average statistical parameters (X ± s) of the physical properties of virgin Grey soil on the polygon no. 25

Horizons and depth, cm	The thickness of horizons, cm	Fractions, %g/g		Hygrosc-opicity	Higros-copicity coefficient	Density	Apparent density	Porosity total, % v/v	Compaction degree % v/v
		<0.001 mm	<0.01 mm	% g/g		g/cm^3			
Ahţ 0-9	9±1	19.3	42.7	5.2±0.4	6.3±0.5	2.51±0.01	1.19±0.02	52.8±0.7	-6
AEh 9-24	15±2	20.8	43.6	4.2±0.3	5.3±0.3	2.59±0.04	1.27±0.01	51.1±0.6	-2
BEhtw 24-35	11±1	25.0	46.5	3.9±0.4	5.3±0.4	2.65±0.003	1.42±0.02	46.2±0.9	8
Bhtw 35-53	18±1	27.5	47.4	4.1±0.3	5.6±0.3	2.67±0.02	1.63±0.03	39.1±1.1	23
Btw 53-72	19	28.2	49.0	5.1	6.3	2.69	1.67	37.9	25
BCtw 72- 100	48	27.7	47.1	5.6	6.8	2.70	1.66	38.5	24
BCtw 100-120		27.6	45.6	5.3	6.5	2.70	1.62	40.0	21
1CRk 120-140	-	12.8	24.8	2.5	3.7	2.71	1.51	44.3	12

Table 9. Average statistical index of chemical properties of virgin Grey soil on monitoring polygon no. 25

Horizons and depth, cm	pH	$CaCO_3$	P_2O_5 total	Humus	N total	C : N	Mobile forms, mg/100g soil		Hydrolytic acidity me/100g soil
		% g/g					P_2O_5	K_2O	
Ahţ 0-9	6.4±0.4	0	0.147±0.011	6.16±0.72	0.272±0.22	12.9±0.4	7.6±2.6	39±4	2.4±1.3
AEh 9-24	5.6±0.5	0	0.095±0.017	3.14 ±0.22	0.153±0.004	12.2±0.2	3.1±0.4	17±3	6.3±1.7
BEhtw 24-35	5.5±0.4	0	0.075±0.013	2.12±0.23	0.112±0.012	11.5±0.3	2.1±0.2	14±3	5.4±1.1
Bhtw 35-53	5.6±0.2	0	0.057±0.005	1.25±0.11	0.067±0.006	10.9±0.4	2.2±0.2	12±1	3.9±1.0
Btw 53-72	5.6	0	-	0.75	-	-	-	-	-
BCtw 72- 100	5.6	0	-	0.37	-	-	-	-	-
BCtw 100-120	6.1	0	-	0.32	-	-	-	-	-
1CRk 120-140	7.5	4.5	-	0.15	-	-	-	-	-

Table 10. Average statistical parameters (X±s) of exchangeable cation content of virgin Grey soil, polygon no. 25

Horizons and depth, cm	Exchange cations, me/100g soil		
	Ca^{++}	Mg^{++}	Sum (Ca^{++} + Mg^{++})
Ahţ 0-9	27.9±2.4	2.9±0.1	30.8±2.4
AEh 9-24	19.7±2.2	3.1±0.2	22.8±2.0
BEhtw 24-35	18.8±1.7	3.2±0.2	22.0±1.7
Bhtw 35-53	19.1±1.2	3.3±0.3	22.4±1.4
Btw 53-72	19.3	4.0	23.3
BCtw 72-100	20.8	4.0	24.8
BCtw 100-120	20.0	4.0	24.0
1CRk 120-140	16.0	3.0	19.0

The texture of illuvial horizons (illuvial - cambic) Bhtw and Btw is loam-clay. The medium-fine texture and monolithic structure led to excessive compaction of these horizons and forming in them an unfavorable quality physical status [2]. Arable layer structure of Grey soils is moderate qualitative, and aggregates water stability - is small. So, a favorable state of physical quality for the arable layer can be created only by regular soil works over the entire life growing crop plants.

The upper horizons Aht, AEh, BEhtw of virgin soil are characterized with very good structure of formed by water stability aggregates. Therefore, use on the arable has destroyed the initial favorable structure of virgin Grey soils. Structural destroyed processes essential lowered the resistance to compaction of this layer. Towards the end of the vegetation period the apparent density of the arable layer reach values 1.4 to 1.5 g/cm^2, and the underlying layer post arable - more than 1.5g/cm^2, which creates unfavorable conditions for plant growth. The illuvial horizons Bhtw şi Btw of arable and virgin Grey soils are similar and are characterized by an almost monolithic structure, apparent density (1.61 to 1.66 g/cm^3) and high degree of compaction (20-24). Some remedy of physical quality status of illuvial horizon can perform only working under 40-70 cm of depth. The humus content of arable soil layer of 0-30 cm (2.23%), compared to the humus content in the same layer of virgin soil (3.84%), and decreased by 1.6%. Arable soils have lost up to 42% of the initial content of humus.

Table 11. Average statistic weighted parameters of the main characteristics of virgin and arable Grey soils on the standards depths (layers) important in terms of agronomic

Standard layers, cm	Fractions <0.001 mm	Fractions <0.01mm	CH*	D	AD	PT	CD	Humus, %	$CaCO_3$	pH	HA
Polygon 24. Grey soils moderate humifer, arable											
0-30	20.2	43.0	5.2	2.60	1.40	46.2	8	2.23	0	6.4	3.5
30-50	25.4	46.7	4.7	2.65	1.59	40.0	21	1.60	0	6.4	2.6
0-50	22.3	44.5	5.0	2.62	1.48	43.5	13	1.98	0	6.4	3.2
50-100	28.9	48.5	4.8	2.68	1.61	39.9	22	0.61	0	7.0	-
0-100	***25.6***	***46.5***	***4.9***	***2.65***	***1.55***	***41.5***	***17***	***1.30***	***0***	***6.7***	***-***
Polygon 25. Grey soils moderate humifer, virgin											
0-30	21.2	43.9	5.6	2.58	1.28	50.4	-1	3.84	0	5.8	5.0
3 0-50	26.9	47.3	5.5	2.66	1.58	40.6	20	1.47	0	5.6	4.3
0-50	23.5	45.3	5.6	2.61	1.40	46.3	8	2.89	0	5.7	4.7
50-100	27.9	47.8	6.5	2.69	1.66	38.3	24	0.57	0	5.6	-
0-100	***25.7***	***46.6***	***6.1***	***2.65***	***1.53***	***42.3***	***16***	***1.73***	***0***	***5.7***	***-***

***Note:** **CH** - coefficient of hygroscopicity, % g/g; **D** - density, g/cm^3 ; **AD** – apparent density, g/cm^3; **PT**- porosity total, % v/v; **CD** – compaction degree; **HA –** hydrolytic acidity, me/ 100g soil.

The soil dehumification and tillage, in turn, caused by destructural and compaction of arable Grey soil and worsening their physical quality. As a result of physical damage decreased the permeability and capacity to water, conductivity and water availability of arable Grey soil. The fallow Grey soil is characterized by a significant accumulation of biofile elements in the superficial horizons; the arable Grey soils - with a considerable decrease of the contents of these elements. The reaction of fallow Grey soil is acid (pH=5-6, hydrolytic acidity - 4-6 me), the reaction of the arable Grey soil - slightly acid (pH=6-7, hydrolytic acidity - from 2.5 to 3.5 me), which led to stopping the eluvial - illuvial processes in these soils.

CONCLUSIONS

Grey soil arable in the North zone of Moldova is characterized by moderate degradation characteristics as a result of dehumification, destructuration and considerable decrease of content of biofile elements.

The illuvial horizons of virgin and arable Grey soils are characterized by unfavorable physical chemical properties - excessive compaction, acid reaction, low content of nutrients.

In general, arable gray soils are relatively poor in humus and nutrients, the presence of compact illuvial horizons leads to lower permeability to water and, consequently, are regularly affected by temporarily moisture excess, have poor stability against erosion, their natural fertility is relatively low. The acidity of arable soils decreased significantly, leading to stop the illuvial - eluvial process, but still remained high. The pedoameliorative and agrotechnical measures necessary for amelioration of quality state of these soils are as follows: increasing content of organic matter in arable layer (chemical and organic fertilizers, green manure, sludge and organic waste), implementation of crop rotation, improving the soil tillage (once in 3-4 years to make plowing to 35 cm depth to granulate the compacted recent layer, periodically tillage with polished on 40-50 cm depth for partial loosening of natural illuvial extremely compact horizon). An effective measure for reducing acidity and promote microbial activity in grey soils may be the introduction of 10-15 t/ha of recently acquired defecated of sugar factories.

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EVOLUTION OF CHERNOZEMS LEACHED QUALITY UNDER INTENSIVE AGRICULTURE IN CENTRAL ZONE OF MOLDOVA

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Abstract

Studying the evolution of chernozem leached quality with whole profile used in intensive agriculture based on fertilization systems in field crop rotations in 1965-2010 period established, that arable leached chernozems is characterized by satisfactory values of the physical, chemical and biological properties. As a result of 45 years intensive used in agriculture the leached chernozems are affected by: dehumification of arable layer, caused by insufficient flow of organic matter in the soil; compaction of arable layer as a result of soil tillage; and soil destruction. Influence of mineral fertilizers in doses of N_{60-120}PK after a period of 10 years of farming land without fertilizers (1994-2004) did not lead to significant change of physical, chemical and agrochemical properties of soils. Quality status of leached chernozems should be maintained by administration of organically and mineral fertilizers in recommended optimal doses, shredding and incorporation in the soil the vegetal crop residues and secondary production, respecting crop rotation with introducing alfalfa and increasing surface of leguminous crops by 20-25 %; application of agrotechnical measures and mini tillage: cracking the depth of 35- 40 cm tillage depth alternating with periodic raising the surface of the compacted layer.

Key words*: chernozem leached, degradation, evolution, fertilization, quality status.*

INTRODUCTION

The purpose of monitoring observations on Polygon no. 35 - Chernozem leached (cambic) from Central part of Moldova - determining the evolution of quality state of leached chernozems used in intensive agriculture in function on the fertilization systems in field crop rotations in the 1964-2010 period.

Objectives:

• Review changes in humus content and nutrient regimes of leached chernozem under the influence of different doses of fertilizers and identify optimal level of field crop fertilization.

• Determine the influence of mineral fertilizers on the basic physical and chemical indices of leached chernozem.

• Develop of fertility evolution prognosis of leached chernozem depending on mode of using agricultural land.

Anthropogenic factors of soil degradation - dehumification, depletion of soil nutrients, distructuration, and secondary compact as result of agricultural overexploitation [1, 2].

MATERIAL AND METHOD

Monitoring polygon was founded in July of 2006. On the experience control variant "witness" was located a profile with 200 cm of depth and 4 semi profile, on the fertilized variants - 5 semi profile each of 30 cm depth. For soil profile was determinate morpho-metric indices of genetic horizons, was performed morphological description, determined apparent density and collected soil samples for laboratory analysis. Field and laboratory research results have been processed and systematized and presented in the tables.

RESULTS AND DISCUSSIONS

Profile no. 35 – Chernozem leached was placed on long-term experience variants with mineral fertilizers of the experimental station "Ivancea-Orhei". Absolute altitude - 181 m. Coordinates: latitude - 47°18.397', East longitude - 28°53.412' (Fig. 1).

Fig.1. Field that location of soil profiles no. 35

Fig. 2. Chernozem leached (cambic) moderate humifer clay-loam, arable (profile 35)

Experience variations used for monitoring are: Control; $N_{60}P_{60}K_{60}$; N_{120} $P_{60}K_{60}$; N_{300} $P_{60}K_{60}$.
Experience was founded in 1964 on quasi horizontal surface of a high terrace of rivulets Mota, tributary of the river Raut. Surface rocks are Quaternary loess deposits. In the years 1996-2005, from lack of fertilizers, soil fertilization on the variants was not made. The research was limited to studying soil fertilization post action ongoing for 30 years. In 2006 the introduction of fertilizers on the variants was resumed [1].
Investigated leached chernozem profile is characterized as: Ahp1 - Ahp2 - Ah - Bhw1-Bhw2 - BCk1 - BCk2 - Ck. Thickness of humus profile - 90 cm. Effervescence at 90 cm depth (Fig.2).

Texture and some physical properties
Chernozem leached is characterized by clay-loamy texture and high content of fine clay (35-36%), which favors the compaction of destructured soil. The high content of clay in horizons A and B is due to more intensive process of deterioration "in situ" of mineral part of soil in these horizons.
Hygroscopicity in leached chernozem profile decreases with depth from 4.1 to 4.2% in the arable layer up to 3.6 to 3.7% in carbonate BCk and Ck horizons (Table 1).

Table 1. Physical properties of leached chernozem

Horizons and depth, cm	Hygro-scopicity, %	Apparent density g/cm^3	Density g/cm^3	Size fractions, mm; content,%						
				1.0-0.25	0.25-0.05	0.05-0.01	0.01-0.005	0.005-0.001	< 0.001	< 0.01
Ap1 0-22	4.1	1.31	2.61	0.3	6.2	30.9	8.4	18.3	35.9	62.6
Ap2 22-36	4.2	1.46	2.62	0.2	6.4	31.0	9.4	16.9	36.1	62.4
Ah 36-51	4.1	1.53	2.62	0.1	4.5	32.4	8.3	19.0	35.7	63.0
Bhw1 51-71	3.9	1.54	2.63	0.1	6.0	33.1	8.2	17.6	35.0	60.8
Bhw2 71-90	3.8	1.53	2.65	0.2	6.9	32.6	8.9	17.5	33.9	60.3
BCk1 90-120	3.7	1.52	2.68	0.2	9.4	32.5	9.5	17.1	31.3	57.9
BCk2 20-160	3.7	1.52	2.69	0.2	12.0	31.8	9.8	16.0	30.2	56.0
Ck >160	3.6	1.44	2.70	0.4	13.9	31.4	9.8	15.4	29.1	54.3

Apparent density is 1.31 g/cm^3 in the recent arable layer and 1.46 g/cm^3 in the post arable layer, indicating the strong compaction of the under layer horizon. In the underlying horizons the apparent density increases up to 1.54 g/cm^3 in cambic horizon Bhw and then decreases up to 1.44 g/cm3 in the Ck horizon. Decreased resistance to compaction of arable layer and post arable is due it destructuration in the prolonged use of land in agriculture.

Structural composition
The structure of chernozem leached is good in Ahp2, Ahp1 horizons and very good in the unchanged with plowing of the Ah horizon (36-51cm). The structural hydrostability is moderate to good in all horizons (Table 2).

Table 2. Structural composition of arable layer of chernozem leached, profile 35 (numerator - dry sieving data, denominator - wet sieving data)

Horizon and depth	Content of elements,% w / w; size aggregates, mm											Coefficient of quality structure	Quality structure (dry sieving)	Hydro-stability structure (wet sieving)
	>10	10-7	7-5	5-3	3-2	2-1	1-0.5	0.5-0.25	<0.25	∑ 10 -0.25	∑ >10 +<0.25			
Ahp1 0-22 cm	21.24/-	8.66/-	8.14/4.6	11.68/3.0	9.32/3.0	22.24/17.0	7.44/19.0	5.72/14.0	5.56/39.4	73.20/60.60	26.8/39.4	2.73	Good	Medium to good
Ahp2 22-36 cm	27.74/-	7.72/-	13.88/2.2	19.20/3.6	10.76/4.8	10.78/22.8	3.32/15.2	3.38/12.4	3.22/39.0	69.04/61.0	30.96/39.0	2.23	Good	Medium to good
Ah 36-51 cm	15.28/-	7.74/-	9.12/-	30.86/0.4	18.58/2.0	13.24/16.8	1.68/21.6	1.60/19.6	1.90/39.6	82.82/60.4	17.18/39.6	4.81	Very good	Medium to good

Chemical and physic-chemical indices

Data on the chemical and physicochemical properties of profile 35 are shown in Table 3, and average statistical data of experience variants - in Table 4. Humus content of investigated soil profile is reduced from 3.3% in the arable horizon to 1.5% in horizon Bhw2 (71-90 cm). Total nitrogen in humifer Ah horizon is within 0.192 to 0.151%. The values of the C : N varies within 10.1 to 9.2. Carbonates occur in horizon BCk1 (90-120 cm) with increasing values from 12.9% in horizon BCk1 to 18.8% in horizon Ck.

Hydrolytic acidity is characteristic for layer 0-90 cm (genetic horizons from Ahp1 to Bhw2) with values from 2.10 *me* in horizon Ahp1 to 0.79 *me/100g soil* in horizon Bhw2.

Cation exchange amount vary in limits from 32 *me/100g soil* in humus layer up to 28 *me* in the horizons BCk and Ck. The ratio of Ca^{2+} and Mg^{2+} in layer 0-90 cm is about 7, which provides a favorable accessibility of nutrients for crops (Table 3).

Table 3. Chemical and physicochemical properties of leached chernozem, profile 35

Horizons and depth, cm	Humus, %	Nitrogen total, %	C:N	$CaCO_3$ %	pH	Hydrolytic acidity	Ca^{2+}	Mg^{2+}	$\sum Ca^{2+}+Mg^{2+}$	$\frac{Ca^{2+}}{Mg^{2+}}$
						me/100g soil				
Ahp1 0-22	3.3	0.192	10.0	0.0	6.7	2.10	32.6	4.8	37.4	6.8
Ahp2 22-36	2.9	0.167	10.1	0.0	6.8	1.93	32.0	4.6	36.6	6.9
Ah 36-51	2.4	0.151	9.2	0.0	7.0	1.49	31.5	4.1	35.6	7.7
Bhw1 51-71	1.7	-	-	0.0	7.3	1.05	30.5	4.1	34.6	7.4
Bhw2 71-90	1.5	-	-	0.0	7.4	0.79	30.1	4.0	34.1	7.5
BCk1 90-120	0.9	-	-	12.9	7.6	-	24.2	4.2	28.4	5.8
BCk2 120-160	0.5	-	-	18.3	7.9	-	23.4	4.7	28.1	5.0
Ck >160	0.4	-	-	18.8	8.0	-	23.0	4.9	27.9	4.7

Table 4. Statistical average indexes of chemical characteristics of the 0-30 cm layer of arable leached chernozem on the experience variants

Variant	pH	Hydrolytic acidity, me/100 g	Humus, %	Total forms, %		Mobile forms, mg/100 g		
				Nitrogen	Phosphor	$N\text{-}NO_3$	P_2O_5	K_2O
Control	6.8±0.1	2.5±0.0	3.3±0.1	0.192±0.01	0.109±0.004	0.12±0.04	0.8±0.3	21±2
$N_{60}PK$	6.7±0.1	2.7±0.1	3.4±0.2	0.195±0.01	0.129±0.003	0.17±0.03	2.1±0.5	22±2
$N_{120}PK$	6.6±0.1	2.9±0.2	3.4±0.1	0.205±0.01	0.120±0.003	0.24±0.16	1.5±0.4	19±2
$N_{300}PK$	6.5±0.1	3.4±0.2	3.4±0.1	0.209±0.01	0.121±0.003	0.18±0.06	1.6±0.4	20±3

According to average statistical data (Table 4) humus content in the layer 0-30 cm is 3.3% for control variants and 3.4% in fertilized variants. Value of pH is 6.8 in the control variant. In fertilized variants with increasing fertilizer dose, the pH values are in slight decline, from 6.7 to 6.5. Hydrolytic acidity increases with increasing dose of fertilizer: from 2.7 *me* in $N_{60}PK$ to 3.4 *me/100g soil* in $N_{300}PK$. Content total nitrogen forms in soil are practically equal in the control (0.192%) and $N_{60}PK$ (0.195%). Variants $N_{120}PK$ (0.205%) and $N_{300}PK$ (0.209%) indicate higher values of total nitrogen content compared to the control. The largest amount of total phosphorus was found in version $N_{60}PK$ - 0.129% (the control - 0.109%).

Agrochemical characteristics

Reserves of humus in the arable layer of leached chernozem are 154 t/ha, and the layer 0-100 cm - 319 t/ha. Total nitrogen content in the layer 0-50 cm of chernozem leached vary in limits from 0.192% (Ahp1) to 0.151% (Ah), nitrogen reserves are 12.1 t/ha.

Total phosphorus reserves in the arable layer of chernozem leached is 5.1 t/ha (content from 0.097% to 0.108%). Mobile forms of phosphorus content in soil profile depth decreases from 0.9 mg in arable soil layers to 0.2 mg/100 g soil of horizon Ck, mobile potassium, respectively, from 20 mg to 9 mg/100 g soil. Average statistical parameters of humus content in fertilized variants of soil demonstrates that the application of mineral fertilizers has not led to essential changes. After a 10 years period of intensive use of leached chernozem (1994-2004) without fertilizer, the phosphorus content was established at level 1.5 mg to 2.1 mg/100 g soil, the witness was of 0.8 mg/100 g soil. The content of mobile potassium in fertilized variants has returned to the level of "witness" variant (Table 5).

Table 5. Agrochemical characteristics of leached chernozem, control variant

Horizons and depth, cm	Humus		Total forms				Mobile forms, mg/100 g soil		
			Nitrogen		Phosphor				
	%	t/ha	%	t/ha	%	t/ha	$N\text{-}NO_3$	P_2O_5	K_2O
Ahp1 0-22	3.3	95.1	0.192	5.3	0.108	3.1	0.10	0.9	20
Ahp2 22-36	2.9	59.3	0.167	3.4	0.097	2.0	0.10	0.6	16
Ah 36-51	2.4	55.1	0.151	3.4	0.090	2.0	0.10	0.4	13
Bhw1 51-71	1.7	52.4	-	-	-	-	0.08	0.4	12
Bhw2 71-90	1.5	43.6	-	-	-	-	0.08	0.3	12
BCk1 90-120	0.9	41.0	-	-	-	-	0.08	0.3	10
BCk2 120-160	0.5	15.2	-	-	-	-	0.18	0.3	9
Ck >160	0.4	11.3	-	-	-	-	0.22	0.2	9

CONCLUSIONS

Arable leached chernozem used in intensive agriculture is characterized with satisfactory values of the physical and chemical characteristics. As a result of intensive farming the leached chernozem is affected by:

- Dehumification of arable layers due to insufficient flow of organic matter in the soil;
- Compaction of arable layer as a result of soil tillage, dehumification and destructuration;

Influence of mineral fertilizers application ($N_{60}PK$, $N_{120}PK$, $N_{300}PK$) after a 10 years period of land use without fertilizers (1994-2004) did not lead to significant changes in the indices of physical, chemical and agrochemical properties of soil.

Quality status of leached chernozem should be maintained by:

- Administration of organic-mineral fertilizers in recommended doses;
- Chopping, incorporation of vegetal residues and secondary production into the soil;
- Compliance of crop rotation with introducing alfalfa and crop leguminous up to 20-25%;
- Agrotechnical measures of tillage: crack in depth of 35-40 cm, alternating tillage with rising in the surface of the compacted layer.

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BIODEGRADATION OF PETROLEUM HYDROCARBONS IN A POLLUTED SOIL AS MEDIATED BY A NATURAL BIODEGRADABLE PRODUCT

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Abstract

The major part of soil petroleum hydrocarbon pollution is derived from the spillages related to the use and transportation of petroleum products. It is known that the main microorganisms consuming petroleum hydrocarbons are bacteria, so in this paper are presented the results obtained in a bioremediation laboratory experiment. A natural biodegradable product and bacterial inoculum was used for total petroleum hydrocarbon (TPH) removal from an artificial polluted soil. Soil polluted with 50000 mg/kg of TPH was treated with 50 g (0.25%), respective 100 g ECOSOL/20 kg polluted soil (0.5%) and/or bacterial inoculum to increase the biodegradability rate. Also, the soil contaminated with 100000 mg/kg of TPH was treated with 100 g (0.5%), respective 200 g ECOSOL/20 kg polluted soil (1%) and/or bacterial inoculum. The highest TPH removal was obtained with a treatment consisting in 100 g ECOSOL/20 kg polluted soil (0.5%) and bacterial inoculum in case of 5% TPH and 200 g ECOSOL/20 kg polluted soil (1%) and bacterial inoculum in case of 10% TPH, corresponding with the highest rates of microbial respiration and the greatest increases in bacterial counts. At each phase of the study, the natural biodegradable product was found to significantly enhance the biodegradation of petroleum hydrocarbons.

Key words: *biodegradation, petroleum hydrocarbons, polluted soil, a natural biodegradable product.*

INTRODUCTION

In recent years, bioremediation of soils polluted with petroleum hydrocarbons is a challenge in research [12]. Research has shown that the bioremediation is a superior method of soil remediation, effective and cheaper compared with physicochemical methods. Bioremediation is based on microorganisms activity to use of petroleum hydrocarbons as carbon and energy source. This method is considered to be most effective because no irreversible effects can on pedogenetical soil characteristics and low cost. Microorganisms such as bacteria, fungi and yeasts decompose these hazardous chemicals in non-toxic or less toxic compounds by the enzymatic complex [6].

Crude oil contains hydrocarbons whose molecular mass varies from 16 (methane) to about 1800. Is a complex mixture of gaseous or solids hydrocarbons dissolved in liquid hydrocarbons, and therefore likely to appear in the liquid state. Crude oil also contains organic compounds with oxygen (phenols, naphthenic acids), sulfur (thiophen, mercaptan), nitrogen (quinoline). Acyclic hydrocarbons are saturated hydrocarbons (alkanes or paraffins), cyclic saturated hydrocarbons (cycloparaffins or naphthenes) and aromatic hydrocarbons. These three classes of hydrocarbons are found in varying ratios in all types of oil. In crude oil are not unsaturated hydrocarbons [1, 10].

Accidental oil pollution has become nowadays a common phenomenon that can cause environmental and social disasters [3, 4].

Main sources of crude oil pollution are anthropogenic, but there are also some natural sources. In this category are leakages due to the crude oil deposits and organic matter degradation. There are some data that some organisms, such as high plants are able to synthesize hydrocarbons and can penetrate the soil. These sources have a low potential and do not cause excessive soil contamination [13, 14].

Biodegradation is the process by which organisms that are already commonly present in soil, degrade organic contaminants such as crude oil. The process occurs without intervention. However, degradation rates can be accelerated by plowing to mix with the soil contaminants, by adding chemical fertilizers to provide nutrients deficient, so the addition of organic matter such as manure to stimulate microbial action by aeration of the soil [8, 9]. Crude oils in warm soils, wetlands degrade, in a completely natural, half from the initial batch concentration during the first year and the residue decreases again, with half in each successive year [7].

Biodegradation of hydrocarbons can be converted partially or wholly by a number of microorganisms [5, 11]. Mostly hydrocarbons are not totally degraded by microorganism-mediated processes [2].

MATERIAL AND METHOD

It has been achived an experiment in Green House. The soil used in the experiment was cambic chernozem.

The chemical characteristics of the soil are presented in table 1.

Table 1 Chemical characteristics of the soil

Soil type	pH	C (%)	Nt (%)	C/N Ratio	P_{AL} mg kg^{-1}	K_{AL} mg kg^{-1}
Calcic chernozem	8.09	2.99	0.279	12.5	50	215

The chemical characteristics of the natural biodegradable product used in the experiment are presented in table 2. ECOSOL is an absorbent natural product, meant to facilitate quick and efficient biodegradation of hydrocarbons from contaminated soils. Accelerates biostimulation and favors the development of existing bacteria from the soil, with strong effects in crude oil biodegradation. This natural biodegradable product is obtained from vegetal fibers from celluloid waste, all treated and with additives, being used in order to bring soils back to normal fertility levels.

Table 2 Chemical characteristics of the natural biodegradable product ECOSOL

Natural biodegradable product	**Nt (%)**	**C (%)**	**P (%)**	**K (%)**	**Na (%)**
ECOSOL	0.935	23.72	0.39	3.32	4.97

The experiment has 11 experimental variants with soil polluted 5% and 10% crude oil, treated with 50g, 100g and 200g ECOSOL/20 kg polluted soil, inoculated and uninoculated with bacteria selected according to the following experimental scheme:

- ✓ V_1, control (unpolluted soil);
- ✓ V_2, polluted soil with 5% crude oil;
- ✓ V_3, polluted soil with 10% crude oil;
- ✓ V_4, polluted soil with 5% crude oil + 50 g ECOSOL/20 kg polluted soil (0.25%);
- ✓ V_5, polluted soil with 5% crude oil + 50 g ECOSOL/20 kg polluted soil (0.25%) + bacterial inoculum;
- ✓ V_6, polluted soil with 5% crude oil + 100 g ECOSOL/20 kg polluted soil (0.5%);
- ✓ V_7, polluted soil with 5% crude oil + 100 g ECOSOL/20 kg polluted soil (0.5%) + bacterial inoculum;
- ✓ V_8, polluted soil with 10% crude oil + 100 g ECOSOL/20 kg polluted soil (0.5%);
- ✓ V_9, polluted soil with 10% crude oil + 100 g ECOSOL/20 kg polluted soil (0.5%) + bacterial inoculum;
- ✓ V_{10}, polluted soil with 10% crude oil + 200 g ECOSOL/20 kg polluted soil (1%);
- ✓ V_{11}, polluted soil with 10% crude oil + 200 g ECOSOL/20 kg polluted soil (1%) + bacterial inoculum.

The experiment was set up by artificial pollution of a cambic chernozem with crude oil and treatment with different quantities of ECOSOL. After 21 days from pollution, the soil was inoculated with bacteria. The bacterial inoculum was developed from microorganisms that occur naturally in the soil like *Pseudomonas, Mycobacterium, Arthrobacter globiformis* and *Bacillus megaterium*.

In this research were used two technological methods, biostimulation and bioaugmentation, to improve the biodegradation process. In the first experimental year was observed an increase of biodegradability rate in accordance with the applied treatment, so the experiment continued. The beneficial effects of the treatments applied were observed in the development of maize plants grown in the second experimental year, that could develop only in the polluted variants with 5% crude oil. In pots polluted with excessive concentrations of 10% crude oil had a very severe phytotoxic effect, preventing total germination. In the second experimental year with plant, maize plants have sprung up in pots polluted with crude oil at both concentrations. Were observed very visible difference between plants affected by crude oil pollution and those developed on clean soil. Inoculation of soil polluted with bacteria selected in combination with soil treatments by 0.5% and 1% ECOSOL had a beneficial effect on maize plant vigor.

Analyses of variances (ANOVAs) were performed to statistically select the treatment with the high efficiency. Results (TPH concentration) were tested by using two-way ANOVA ($p < 0.05$). All calculations were performed with Prism 3.03

RESULTS AND DISCUSSIONS

The soil polluted with 5% and 10% crude oil, treated with different quantities of natural product, inoculated and uninoculated with bacterial inoculum determined a decrease of total petroleum hydrocarbons concentration in accordance with the applied treatment.

The results obtained shows that the biodegradation processes take time according to the existing literature data.

The evolution of total petroleum hydrocarbons concentration with time in experimental variant V_1 - unpolluted soil, V_2 - polluted soil with 5% crude oil and V_3 - polluted soil with 10% crude oil are used as control for treatments. The total petroleum hydrocarbons values were higher on experimental variants V_2 and V_3 suggesting the presence of crude oil.

The total petroleum hydrocarbons concentration decreases in time with 63.8%, respectively 65% in the polluted soil with 5%, respectively 10% crude oil. The evolution of total petroleum hydrocarbons concentration in the polluted soil with 5% crude oil treated with 50 g ECOSOL/20 kg polluted soil is presented in figure 1. The polluted soil with 5% crude oil treated with 50 g ECOSOL/20 kg polluted soil presented a total petroleum hydrocarbons decrease in time with 82.2% in the case of V_4 experimental variant and with 86.6% in case of inoculated variant V_5 (Fig. 3).

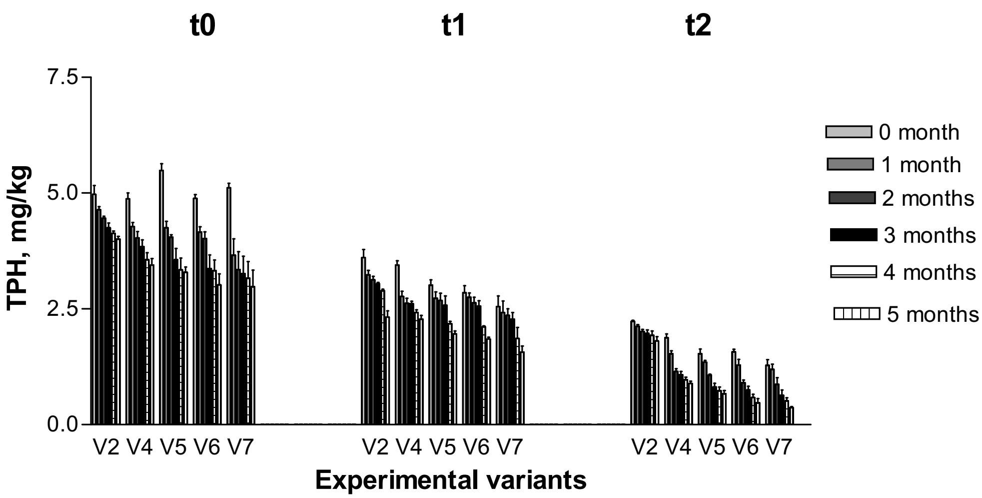

Fig. 1. The evolution of total petroleum hydrocarbons in soils polluted with 5% crude oil

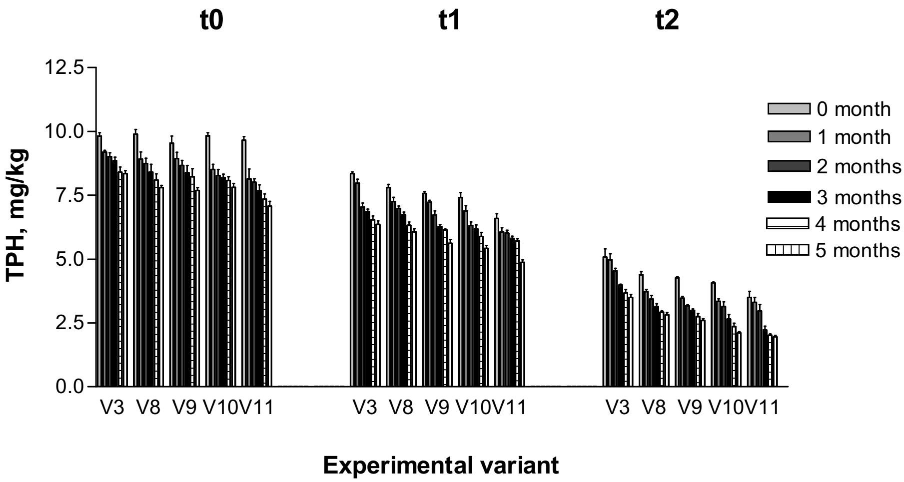

Fig. 2. The evolution of total petroleum hydrocarbons in soils polluted with 10% crude oil

The total petroleum hydrocarbons concentration decreases with 90.6% in V_6 experimental variant and with 92.6% in the inoculated variant V_7.

To remediate a soil polluted with 5% crude oil it is recommended the treatement with 0.5% ECOSOL and bacterial inoculum.

The evolution of total petroleum hydrocarbons concentration in the polluted soil with 10% crude oil treated with 100 g ECOSOL/20 kg polluted soil is presented in figure 2.

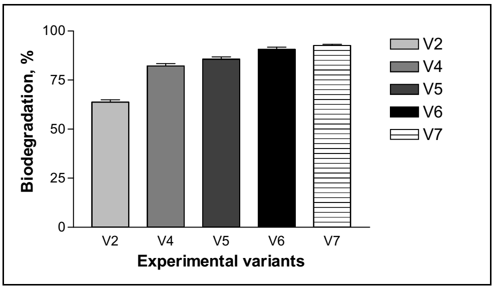

Fig. 3. Biodegradation of petroleum hydrocarbons in the polluted soil with 5% crude oil

As it can be observed, the polluted soil with 10% crude oil treated with 100 g ECOSOL/20 kg polluted soil presented a total petroleum hydrocarbons decrease in time with 71.8% in the case of V_8 experimental variant and with 74.1% in case of inoculated variant V_9.

The total petroleum hydrocarbons concentration decreases with 79% in V_{10} experimental variant and with 80.5% in the inoculated variant V_{11}.

In the experimental variants polluted with 10% crude oil, treated with 0.5% ECOSOL, respectively 1% ECOSOL, the decrease were by 71.8%, respectively 79%. In the experimental variants polluted with 10% crude oil, inoculated with bacteria, treated with 0.5% ECOSOL, respectively 1% ECOSOL, the decrease were by 74.1%, respectively 80.5% (Fig. 4).

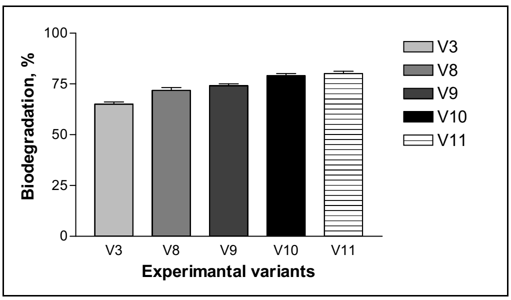

Fig. 4. Biodegradation of petroleum hydrocarbons in the polluted soil with 10% crude oil

The experimental variant recommended to remediate a polluted soil with 10% crude oil could be the one treated with 1% ECOSOL polluted soil and bacterial inoculum to increase the biodegradability rate.

CONCLUSIONS

According to the study achieved, for bioremediation in both groups of experimental variants proved that the soil treated with maximum dose of ECOSOL (0.5% for soil polluted with crude oil 5% and 1% for soil polluted with 10% oil) and inoculated with selected bacteria, the two links of bioremediation technology acting synergistically to remove the pollutant from the soil.

The results obtained leads to the conclusion that the treatment of the crude oil polluted soil with natural biodegradable product and bacterial inoculum determined a decrease of total petroleum concentration in time. The reduction of pollution degree in experimental variants is due to the intensification of biodegradation processes and the establishment of a favorable equilibrium from microbiological point of view.

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INFLUENCE OF DIFFERENT AMENDMENTS ON THE DYNAMICS OF MOLDS IN CHERNOZEM SOIL OF DOBROGEA

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Abstract

The aim of the current paper was to observe the effect of the application of organic and inorganic amendments on the dynamics the molds abundance. Research showed that the average total number of culturable molds ranged between 4.44-13.24x10^{5}CFU/g dry soil (Valu lui Traian). Molds density also increased significantly following the administration of specific biofertilizers (Biovin, BactoFil Professional, Mycos Green). Inorganic fertilizers have not a positive effect on microbial density values, which were more or less similar to those reported for the control.

Key words: *biofertilizers, humus, molds, soil fertility.*

INTRODUCTION

The researches conducted in the Turn of the Dobrogea (Valu lui Traian) aim to establish a pattern of chernozem soil biological reconstruction by applying various amendments aimed at stimulating molds abundance, with the targets:

- degradation and decomposition of organic matter;
- restoration of soil structure;
- recovery of the stock of humus.

MATERIAL AND METHOD

Experimental plot: 7 hectares of arable land outside the village Valu lui Traian, Constanta; Culture: wheat, Josef variety.
Time of experimentation: the agricultural year 2010-2011 both in different phases of the wheat growing season and after harvest.
Experimental versions: 7 variants.
Biovin fertilizers were administered for the first time in Dobrogea.
Biovin is produced through a technological process from grape kernels. 12 years of research proved the following: it aerates the soil, improves it (it contains up to 70% humus makers - 8x10^{7}CFU/g), it enriches the soil with microorganisms that create humus (8x10^9 aerobic microorganisms per gram) [1].

Table 1. Fertilizers administered

Experimental plots	Fertilizers administered
V1	100 kg/ha $N_{15}P_{25}K_{15}$ in autumn; 150 kg/ha NH_4NO_3 in early spring.
V2	Biovin 400 kg/ha; Biovin 30 de l/ha -½ at herbicide stage; -½ at flour stage.
V3	Manure - 15t/ha in autumn.
V4	Biovin 30 de l/ha -½ at herbicide stage; -½ at flour stage.
V5	Biovin 150 kg/ha - administered during sowing; NH_4NO_3 – 150 kg/ha: - 40 kg/ha in early spring; - 50 kg/ha at herbicide stage; - 60 kg/ha at flour stage.
V6	Biovin 375kg/ha; Biovin 30 l/ha - ½ at herbicide stage; - ½ at flour stage; 1mc Green Mycos; 1l Bactofil Professional.
V7	March – were not applied amendments.

Bactofil Professional is a product for improving the soil biological quality and contains nitrogen fixing bacteria 5.2x10^9CFU/ml, phosphate-solubilization bacteria, and heterotrophic bacteria that stimulates the decomposition of organic matter [5].

Green Mycos is a product containing arbuscular mycorrhizal fungi and a number of factors that stimulate the establishment of symbiosis, improving the soil quality up to 20 years [1].

Description of working methods:

The experiments have taken place on a 7ha, which was divided in 7 variants, each variant being administered a different type of fertilizer in different quantities and periods.

Quantitative determination of microbial abundance was done by decimal dilutions of soil followed by inoculation of known quantities on solid nutrient media Bergey's [2], Papacostea, P. [4]. For this purpose, after weighing the samples were inoculated on culture medium with a specific composition. Thus, to determine the number of total culturable molds it has been used nutrient:

- Czapek-Dox medium from Merck ($NaNO_3$ 3g; K_2HPO_4 1g; $MgSO_4$ 0.5g; KCl 0.5g; $FeSO_4$ samples; Saccharine 30g; Agar 17-20g; pH 5.5; it was sterilized for 30 min at 115°C);
- Sabouraud medium from Merck ($CaCl_2$ 0.5g; 0.1g K_2HPO_4; KH_2PO_4 0.1g; 10% MoO_3 0.1ml; 0.05ml $FeCl_3$ 10%; it was sterilized for 30 min at 115°C);
- Rose Bengal (glucose 20g; Agar 18g; Rose Bengal 33mg; potatoes extract 500ml; pH 6; it was sterilized for 30 min at 115°C), (prepared in laboratory);
- PDA (Potato Dextrose Agar) - Glucoză 20g; Agar 18g; potatoes extract 500ml; pH 5.5; it was sterilized for 30 min at 115°C; (prepared in laboratory) [3]. Three were inoculated Petri plates on each variant.

Soil samples were collected from about 15 cm depth in order to perform quantitative analysis of molds throughout the agricultural year 2010-2011, both in different phases of the wheat growing season and after watching his collection for development of microbial growth, depending on the variant.

The total number of molds per gram of soil was calculated by using the formula: no. molds = X colonies x dilution x 10 x 100/100-U, where X = average of colonies grown on culture medium, 10 = balancing coefficient of 0.1 ml of inoculum in the reporting of dilution soil U% = soil moisture [6].

RESULTS AND DISCUSSION

Microbial abundance was maximal in V_3 (manure), the only variant which showed an increase from 10.56x10^5CFU/g dry soil, in October to 14.43x10^5CFU/g dry soil, in August (Fig. 1).

V_6 (mycorrhiza, Bactofil Professional) shows the smallest decrease in abundance microbial from october 2010, 12.42 x10^5CFU/g dry soil, until august 2011, 6.58x10^5CFU/g dry soil, compared with other variants (Fig. 1).

V_1 (chemical) has not a positive effect on microbial abundance because it was observed a significant decrease from 23.02x10^5CFU/g dry soil in October, to 5.07x10^5CFU/g dry soil in August (Fig. 1).

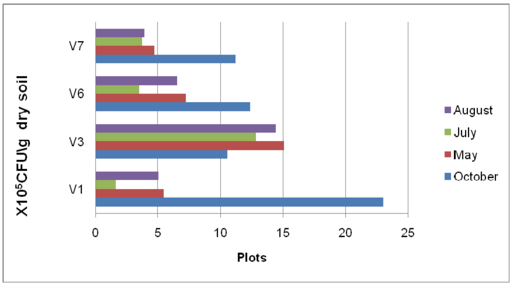

Fig. 1. Dynamic variation of monthly molds in the crop year 2010-2011

Microbial abundance was found:

- highest in October, V_4 (Biovin liquid) 14.89x10^5CFU/g dry soil, V_5 (Biovin, ammonium nitrate) 14.09x10^5CFU/g dry soil, decreasing in august V_4 (Biovin liquid) 1.46x10^5CFU/g dry soil V_5 (Biovin, ammonium nitrate) 2.8x10^5CFU/g dry soil; have similar values, superior version control V_7 3.96x10^5CFU/g dry soil, but insignificant in the dynamic abundance moulds (Fig.2);
- the lowest value was determined in october on the V_2, 9.99x10^5CFU/g dry soil after applying biofertilizers decreasing to 1.82x10^5CFU/g dry soil in August (Fig.2).

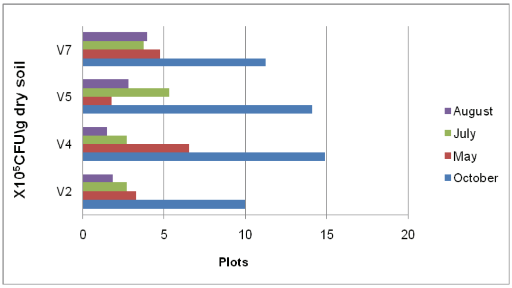

Fig. 2. Dynamic variation of monthly moulds in the crop year 2010-2011

Most microbial dynamics has occurred V_3 (manure), 13.24x10^5CFU/g dry soil and V_6 (mycorrhiza, Bactofil Professional), 7.45x10^5CFU/g dry soil (Fig.3).

Other experimental variants:

- V_5 (Biovin, ammonium nitrate) 6.74x10^5CFU/g dry soil, V_4 (Biovin liquid) 6.4x10^5CFU/g dry soil, showed the lowest abundance of molds, but with values superior version control (V_7) 5.93x10^5CFU/g dry soil.
- V_2 (Biovin solid, liquid) 4.44x10^5CFU/g dry soil, showed the lower values (Fig. 3).

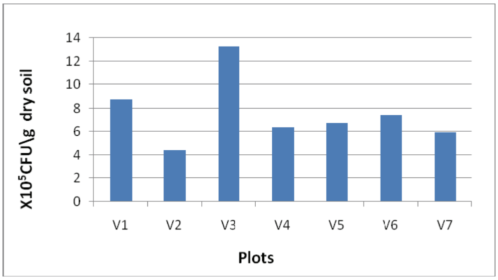

Fig. 3. Annual average change in the dynamics of molds whichever

CONCLUSIONS

We recommend as models for reconstruction of the soil:

- V_3 (manure) - the highest abundance of molds cultivation 13.24x10^5CFU/g dry soil (Fig.3); show an increase of 223% compared to the control variant 5.93x10^5CFU/g dry soil (Fig.3);
- V_6 (Biovin, Bactofil Professional; Green Mycos) – 7.45x10^5CFU/g dry soil (Fig.3), show an increase of 126% compared to the control variant 5.93x10^5CFU/g dry soil (Fig. 3).

Our preliminary data show that organic amendments with complex composition have a direct effect on the abundance and diversity of soil and influence indirectly the microbial metabolism and nutrient cycling rate.

Rather poor development of molds in Valu lui Traian, is due partly weather conditions, excessive drought.

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PEDOLOGIC EVALUATION OF THE EROSION DEGREE OF THE SOILS IN SLANIC (BUZAU) AND RAMNICU SARAT RIVER BASINS

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Abstract

The soil research carried out in the 2005-2009 period in the water basins of Slanic and Ramnicul Sarat have had in sight the geomorphological ununiformity of the relief, the diversity of soils and their chemical and physical characteristics, the soil parental material and the nature of the rocks under. All these were accomplished in the purpose of soil erosion evaluation and to suggest suiting measures for disputing and preventing the land degradation.

Key words: *degradation, erosion, slope.*

INTRODUCTION

The soil represents aan extremely valuable natural resource of high importance for food production, not only for nowadays society but also for future sustainable development. Its quality state is vulnerable to the action of natural factors but also human factors, so it appears the necessity of a very good understanding and inventory of this resource, especially in high risk areas. The most important soil degradation process are generated by erosion, which consists in removing the soil or even the un-cohesive under-rock by the water on move or through other versant processes, like land slides, collapses, mud flows etc.

The studied basins, Slanic and Ramnicu Sarat, are situated in the outer area of the Carpathians and the Curvature Subcarpathians (the eastern part of Buzau Subcarpathians and the western one of Vrancea Subcarpathians), an area with the highest medium specific mud flow in suspension in Romania, so with the most intense erosion processes in the Subcarpathian area [2].

The upper part of the two water basins grasps little in the mountain area of Buzau Mountains (Ivanetu Peak) and Vrancea Mountains (Furu Mountain), up to altitudes higher than 1200 m, but their highest development is in the Subcarpathian area.

The mountain area is represented by the morphology of Ivanetu Peak and Furu Mountain, deeply fragmented by the two valleys, Ramnic and Slanic and their teeming tributaries, in relatively narrow interfluves, with moderated to intense inclining versants and well covered by forests, but also with outcrops. Their structure embraces predominantly Paleocene formations, containing grindstone, conglomerates, disodils, menilites and also clay and bedrock intercalations, geared to the folding system oriented north-east to south-west, sliced and frequently brought to the stage of scales.

The Subcarpathians are over-posing the molasic unit, predominantly made out of folded bedrocks of grindstone clay and sands, most of the structure being simple andlarge, oriented east-west and north-east to south-west. At the outer margins there re also sand-clay formations, sands, gravels positioned in a large single-angle (dominantly in the Subcarpathian basin of Ramnicu Sarat) [3].

MATERIAL AND METHOD

In the undertaken research we kept in sight the knowledge of the maintenance state of soils which was reported to their grain-metric structure, their chemical characteristics and relief, the degree of forests or land and their use, the crop structure and the applied agro-technique. The mapping was made mainly at a 1:50.000 scale, by the complex soil study method and the grading system used was the ICPA one [11, 12].

The used analytic data were obtained as a result of the performed analysis over the soil samples in the Soil Service laboratories of the Geologic Research Institution inside ICPA. Considering these materials, new definitions were brought concerning the areas affected by erosion, the intensity of erosion, the actual stage of soil horizons etc. [10].

RESULTS AND DISCUSSIONS

The Carpathians and the Curvature Subcarpathians highlight themselves as geo-morphologic complex sub-units, not only under geologic report but also concerning the soils and relief. Therefore, there is a gutter of the Sub-Carpathian intern depressions immediately under the mountain. It has a hill like aspect (417-944 m), which embraces little relatively isolated depressions from the series Bisoca-Neculele-Soveja. To the south, the Subcarpathian hills rise, enrolled in the landscape through bold tops (600-900 m) covered by forests which mainly correspond to the grindstone formations. Next comes the line of inner hill depressions (Buda-Dumitresti), characterized by terraces and flat surfaces, with slopes in which the erosion and geo-morphologic processes have created an intense fragmented landscape of lining “badlands”, or have a wavy aspect generated by slides and mud flows [3, 4].

The outer and piedmont hills, with Villafranchiene formations, close the inner hill depression gutter to the south.

The soil parental material and the subiacent rocks consist of deluvial-coluvial deposits, rarely of eluvial nature, with a varied texture and an under-layer represented by loam, sand and clay bedrocks, and recent river like sediments in the meadows and on the terraces.

As for the climate, the two basins are situated in more than one agro-climatic areas: the mountain area and the intern Subcarpathians belong to the wet cold area, characterized by low thermal resources (the annual mean temperature is 3.0-6.0ºC; the sum of temperatures is over 0ºC, between 2000-2500) and high water resources (700-1000 mm); as for the wet cold area, the limits of which the annual mean temperature varies is between 6.0-8.5ºC, and the water resources goes under 700 mm.

As a consequence of the pedo-genetic conditions presented above, the soil cover of the two water basins is not uniform, this being also a consequence of the diversity of relief, parental material and intensity of the erosion processes.

As resulted from the soil map, in the territory were found protisoils, cernisoils, cambisoils, luvisoils, on modest surfaces salsodisoils and antrisoils (Fig. 1) [9].

Protisoils are represented by entic and eutric aluvio-soils found on the meadows of the two rivers and district regosoils with a widely spread, predominantly on the slopes of the Subcarpathian area.

The aluviosoils have a typical Ao-C profile, weakly moderated and a varied texture (sandy up to loam-clay). They have a low content of humus, base flattening degree and very different pH.

Regosoils are characterized by an Ao-C profile, the A horizon being kept close to the surface by the geologic erosion. They are also soils with a varied texture, weakly structured and poor in humus.

Cernisoils gather all the soils that have an A molic horizon (dark) and occupy restrained surfaces, represented by cambic cernosioms, argic cernosioms, greic faeosioms, rendzines and limestone faeosioms. They appear from Dedulesti and become predominant to the south, where they characterize a relief with reduced energy, on flat surfaces or slightly inclined.

They are texturally un-differentiated or weakly differentiated soils, well structured; they have a weak acid reaction, neutral and a low-middle humus content, except rendzines and limestone faeosioms, where it can go up to 10%.

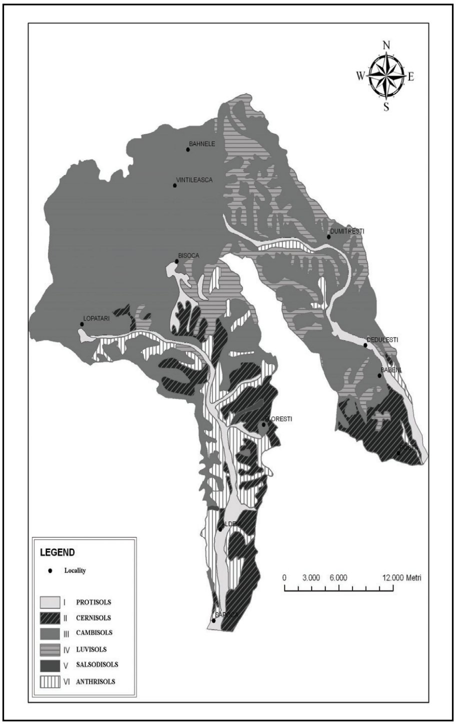

Fig. 1. Soil map of Slanic and Ramnicu Sarat basins (Carpathian – Subcarpathian sectors)

Cambisoils are the soils with the biggest weight in the area and embrace eutricambosoil and districambo-soil in a relatively wide range of sub-types. Eutricambosoils characterize the middle and inferior basins of Slanic and Ramnicu Sarat where they are frequently associated with other soils (eroded eutricambosoils, preluvosoils and luvosoils, or with gleiosoils on slopes and clinogleic faeosioms). Concerning the districambosoils, they are specific to the southern frame of Buzau Mountains, especially on the slopes frequently associated with eutricambosoils, prepodzols and litosoils.

They have a thick texture, from medium to fine, not differentiated on profile, weakly moderated developed grainy structure and low humus content (2.5-3.5). The pH reaction is weak, acid-neutral (in case of eutricambosoils) and acid (under 5) on districambosoils.

Luvisoils are the best represented in the limits of Subcarpathian hills covered with forests; they spread over the two depression gutters containing some preluvosoils and typical luvo-soils; locally they are associated with eroded luvosoils, holoacid luvosoils or districambosoils inside the Neculele and Vintila Voda depressions.

Typical luvosoils have a differentiated texture on profile (loam/sand – loam/clay), well developed grainy structure, low humus content (1.7-2.3), pH up to about 4 and a base flattening degree that can recede up to 13% (Table 1).

Table 1. Major chemical characteristics of luvosoils in Slanic (Buzau) and Ramnicu Sarat River Basins

Horizon	Depth	pH	Humus%	V%	N total %	P ppm	K ppm
Ao	3-19	4.5	2.3	13.1	0.652	39	337
Ea	19-28	4.9	1.7	17.5	0.110	7	62
EB	28-40	5.0	1.1	29.6	0.048	4	50
bE	40-55	5.0	0.7	50.7	0.036	1	114
Bt	55-90	5.7	0.8	91.3	0.036	4	159
Ck	90-150	8.4	-	100.0	-	-	-

Salsodisoils are locally spread and are represented only by solonceacs in the inferior basin of Slanic, north of Aldeni.

They are soils with a medium fine texture, unstructured, poor in humus (1-1.5%), rich in sodium salts (over 1-1.5%), depleted on bases (V=100%) and have a pH between 8.3-8.5 (Table 2).

Table 2. Major chemical characteristics of solonceac in Slanic (Buzau) and Ramnicu Sarat River Basins

Horizon	Depth	pH	Humus%	Na^+ % din T	V%	N total %	P ppm
Aosa	0-3 3-15	7.9 8.3	7.3 2.3	19.8 24.4	100 100	0.39 0.13	11 9
A/C	17-27 40-50	8.4 8.3	1.1 1.0	27.3 18.2	100 100	0.06 -	6 -
C	70-90 120-135	8.3 8.6	0.9 -	6.4 16.7	100 100	- -	- -

Antrisoils appear in a quite important percentage. They are found on extended areas in the middle and inferior Slanic basin and locally in Ramnic basin. They are represented by erodo-soils, associated in the most frequent cases with regosoils.

Erodosoils have varied profiles, depending on the erosion intensity. They have a sandy to clay texture, depending on the rocks that have reached the surface. They are very poor in humus and nutritive substances, depleted on bases and alkaline to acid and un-based.

Both chemic and physical soil characteristics vary depending on the soil type, as on the diversity of parental material, poor or rich in basic cations. The state of soil conservation and their vulnerability to erosion depends on their grain-metric relief constiturion (shape, slope, length and versant), the degree of coverage with vegetation and climate, without excluding the human factor. The soils with a fine texture, clay/loam contain colloidal clay which through watering increases its volume, lowering the porosity and infiltration. On soils with a sand/loam texture, rain with high intensity causes more intense flows than in case of clay.

In the mountain area, the soil texture is predominantly loam/sandy, loam and locally sandy. The texture is varied is inside the Sub-Carpathians limits, from sandy loam to loamy clay, clay (Fig. 2) [9].

As a consequence of the physical and hydro-physical properties of soil, the degree of land covered by forests, the land use, crop structure and applied agro-technical, the areas covered by the two river basins are at an advanced stage of degradation (erosion). The only area of land unaffected by erosion, but with the danger of alluvions and clogging concerns their inferior terraces and floodplains and (Fig. 3) [6].

There have been distinguished:

- lands with unappreciable erosion, representing 70% of the studied land. This refers mostly to the mountains, but also to the Subcarpathian areas covered by forests;
- lands affect by weak erosion, under 1% of the basins surfaces, occupying unimportant areas in the Subcarpathian gutters;
- moderately eroded lands, predominant in the Buda-Dumitresti depression gutter, affect 6% of the basin's surface, with an emphasising danger;
- lands intensely eroded affect 15% of the studied surface, on wide areas in the Subcarpathian hills, but also in the limits of the two depression gutters;
- very eroded lands represent over 8% and covering larger areas in Slanicului basin, in the Buda-Dumitresti depression gutter and in Ramnicu Sarat basin.

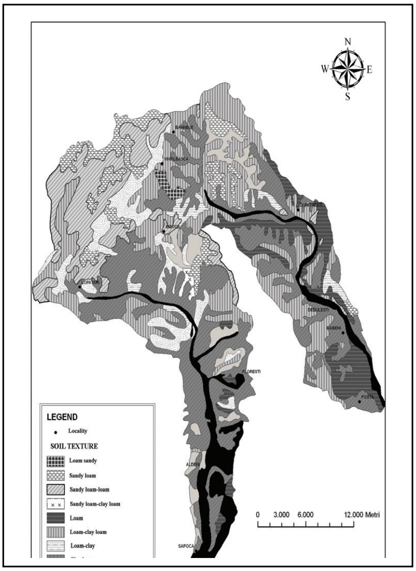

Fig. 2. Soil texture map from Slanic and Ramnicu Sarat basins (Carpathian – Subcarpathian sectors)

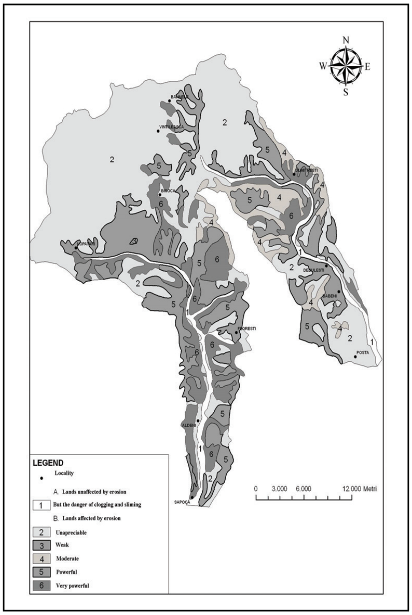

Fig. 3. Soil erosion map in Slanic and Ramnicu Sarat basins (Carpathian – Subcarpathian sectors)

CONCLUSIONS

Over the mountain area, with fixed rocks, soils with an incredibly varied texture and covered mostly with natural vegetation, especially forests, have a relatively slow erosion rate.

The depression gutters and hills represent the action field where soil erosion produces with all its intensity, affecting over 30% of the surface.

By replacing the natural vegetation with agricultural crops, the erosion rate has increased a lot because of soil works and reduced protection offered by the cropped plants.

Along with the surface erosion, in depth erosion intensely developed, together with numerous slides, soil fluxions and slumps.

The intensity of surface erosion between the two basins is estimated by the soil thickness or soil horizon, averaging between 30-45 t/ha/year.

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CHANGES IN THE PEDOLANDSCAPE OF THE ROMANATI PLAIN (THE FIELD OF DĂBULENI)

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Abstract

Recovery of sandy soils has always been a matter of strict necessity in the word. In Romania, soils also occur among several relief units, their areas totaling 439,000 ha, 381,000 ha of agricultural use, such as wind 272,000 ha. For the purpose of agricultural solis must have at least 50 cm thick (but usually more than 2 m) coarse texture (sandy or sandy loam), with less than 12% clay < 0.002 mm and a low humus content (often under 2%). As a prerequisite, in the exploitation of high wind undulating sandy land necessary to start implementation of development projects for their agricultural mechanization and the introduction of irrigation. The first intervantion of this kind in our country have been performed in Oltenia Plain, specifically Blahnita Plain and Plain Romanaţiului, respectively Dăbuleniului field. Fitting in irrigated sandy land in our country to increase agricultural production led to the total change in soil cover. He had less regard to the conservation of soil horizon or no education and land leveling pursued primarily to complete mechanization of agricultural operations in terms of uniform distribution of water on the surface leveled.

Key words: *Romanati Plain, pedolandscape, soils, irrigation.*

INTRODUCTION

The exploitation of the sandy soils has always been a problem of stringent actuality, both nationally and internationally. In the agronomic sense, these soils must be characterized on a growth of at least 50 cm (but most frequently on more than 2 m) by a coarse (sandy or sandy loam) texture, having thus less than 12% clay < 0.002 mm and a low humus content (frequently under 2%) [3]. In Romania, the sandy soils are spread within more relief units, grouped in 18 perimeters, where it totalizes 467,000 ha, out of which 381,000 have an agrarian function and only 321,000 are cultivated (Fig. 1, Table 1) [4, 5].

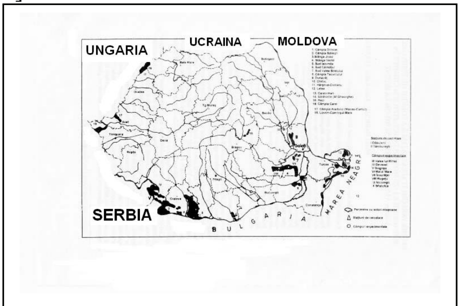

Fig. 1. Map spread of sandy soils in Romania

Table 1. The distribution of sandy soils in Romania

The geomorphologic unit and the perimeter it appears in	Total (thousand ha)	Forest (thousand ha)	Agrarian function (thousand ha)			Total agrarian land (thousand ha)
			Agrarian	Vineyards	Orchards	
I. **The Banato-Crişană Plain**						
a. Valea lui Mihai-Carei Plain	22.2	3.4	4.3	-	14.5	18.8
b. Mureş Plain	3.5	-	-	-	3.5	3.5
- Grindu Macea-Curtici	0.4	-	-	-	0.4	0.4
- Grindu Aranca	3.1	-	-	-	3.1	3.1
II. **The Romanian Western Plain**						
c. Blahniţei Plain	44.6	9.0	-	35.8	-	35.8
d. Băileştiului Plain	42.0	11.4	4.9	22.5	3.2	30.6
e. Romanaţiului Plain (on the left side of Jiu River)	79.6	3.7	1.0	51.0	23.9	75.9
III. **The Romanian Central and Eastern Plain**						
f. The Plain of Muntenia	32.5	3.6	0.3	16.3	12.3	28.9
- Burnasului Plain (on the left side of Vedea River)	1.7	0.1	-	-	1.6	1.6
- Mostiştei Heath (south of Ialomiţa)	3.3	0.5	0.1	1.3	1.4	2.8
- Ialomiţei Heath (south of Călmăţui)	27.2	3.0	0.1	14.8	9.3	24.2
- Brăilei and Râmnicului Plain (south of Siret Meadow)	0.3	-	0.1	0.2	-	0.3
- Tecuciului Plain	11.5	3.0	0.1	-	8.4	8.5

IV. **Braşov's Depression**						
g. Râu Negru-Reci Depression	2.2	0.3	0.3	-	1.6	1.9
V. **The Dobrogea Plateau**						
h. Murighiol Hills (Dunavăţ)	3.2	0.1	-	3.1	-	3.1
i. Casimcei Plateau (Hârşova-Ciobanu)	0.3	-	-	0.3	-	0.3
VI. **Danube's Meadow and Delta**						
j. Danube's Meadow between Calafat and Corabia	3.7	-	2.5	-	1.2	3.7
k. Danube Delta and the littoral plain	28.6	1.5	23.6	-	1.4	25.0
- Grindul Letea	8.8	1.3	7.1	-	0.4	7.5
- Grindul Caraorman	6.3	0.1	5.2	-	1.0	6.2
- Grindul Sărăturile	5.8	0.1	5.7	-	-	5.7
- Grindul Chituc	5.6	-	5.6	-	-	5.6
Total of sands and sandy soils developed on eolian deposits	272	36	37	129	70	236
VII. **Other Meadows**						
Sands and alluvial sandy soils	167	22	23	10	112	145

MATERIAL AND METHOD

Data regarding the sandy soils of Romania have been obtained when the soils map on the scale of 1:200,000 has been realized. Then, after 1976, the National Institute of Research and Development for Pedology and Agro-chemistry in collaboration with S.C.C.P.N. Dăbuleni carries out thorough researches (1:10.000-1:25.000) in all of the 18 perimeters with sandy soils. A great number of soil profiles have been described, on depths of 1 to 2 m, many soil samples being taken from the genetic horizons of the soils, on depths no bigger than 20 cm. Next, the samples tally-sheets with the suggested analyses (granulometry, humus content, pH reaction, base saturation value, etc.) that have to be performed were drawn up. At the same time, for each perimeter, besides the soil maps, interpretative maps (of grouping lands after the limitative factors of the agrarian production) have also been drawn up [2, 3].

At S.C.C.P.N., after the relief has been organised through levelling and modelling (eolian rolling), when most of the sandy soils have become anthropic protosoils, we have carried out new pedological researches. The identification and separation of such soils has been possible only having in mind a series of characteristics such as soil uncovering value, de depth immersion of some diagnostic horizons fragments, including thickness of these fragments, presence of fine material strips, carbonates and phreatic water depth apparition, thickness of the humus horizon, etc. [6].

Soil samples, for which we asked for special laboratory analyses, even mineralogical ones, have been taken. Of course, the interpretation of data has been done according to the ICPA methodology [11].

RESULTS AND DISCUSSIONS

From the very beginning, regarding the superior exploitation of the rolled sandy lands, the implementation of some works for organizing the land with the purpose of mechanization and introduction of irrigation are imposed as an obligatory condition.

These kind of interventions occurred for the first time in Oltenia's Plain (Blahniţei Plain, Romanaţiului Plain), hence also in Dăbuleni's Plain [1, 10].

Before the organization, Dăbuleni's Plain presented a eolian curly relief, made of a series of longitudinal dunes 3-9 m tall, and interdunes, oriented on the direction of the most powerful wind (the north-west one), not on the direction of the most predominant (the north-eastern one) (Fig. 2).

The soil cover contains a wide range of types, subtypes and varieties of soils such as protisoils, cernisoils, cambisoils, reddish preluvosoils, luvosoils, etc. (Fig. 3) [8].

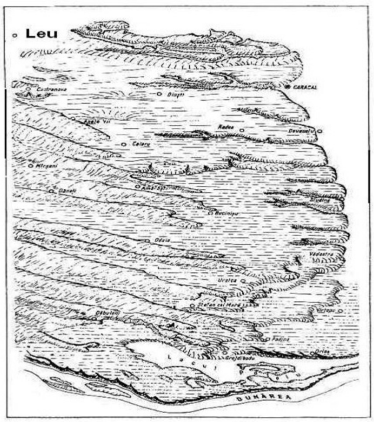

Fig. 2. Schematized block relief in Jiu-Olt (Romanaţiului) Plain

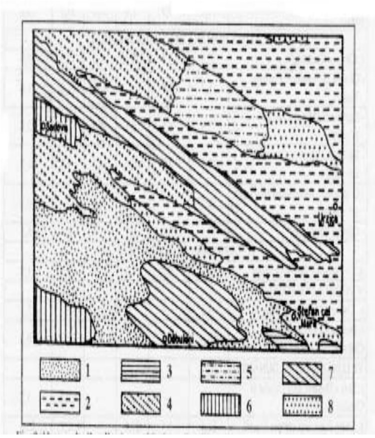

Fig. 3. The map of the soils from Sadova-Corabia system before organizing the soils through levelling and modelling works in order to introduce irrigation

1. Cambic chernozems on sands; 2. Cambic chernozems on loams and sandy loams; 3. Typical cambic chernozems on loess and loessial deposits; 4. Reddish preluviosoils and regosoils; 5. Reddish preluvosoils, including typical luvosoils on sands; 6. Typical luvosoils on reddish loams; 7. Regosoils on sands; sand, sandy regosoils and typical cambic chernozems on sands.

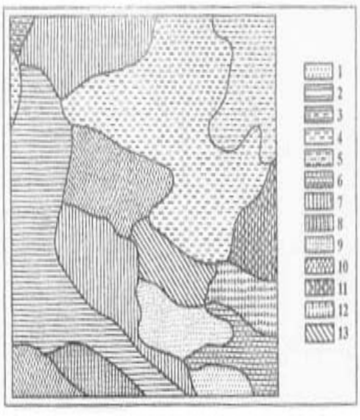

Fig. 4. The map of soils from the Sadova-Corabia system after the levelling and modelling works

1. Typical psamosoils, humidly phreatic; 2. Typical erodosoils with loess sublayer; 3. Cambic erodosoils, strong anthropic coverd; 4. Lamellar argic erodosoils, humidly phreatic; 5. Typical anthropic protosoils covering typical chernozems, humidly phreatic; 6. Typical anthropic protosoils, covering gleic molic psamosoils; 7. Typical anthropic protosoils, covering typical erodosoils, humidly phreatic; 8. Typical anthropic protosoils, covering cambic erodosoils, humidly phreatic; 9. Typical anthropic protosoils, covering gleic erodosoils; 10. Typical anthropic protosoils, covering gleic lamellar argiloluvial erodosoils; 11. Molic anthropic protosoils, covering gleic psamosoils; 12. Molic anthropic protosoils, covering typical erodosoils, humidly phreatic; 13. Molic anthropic protosoils, covering typical gleic erodosoils. In most of the case, the primary sequence of genetic horizons can still be noticed; the soil cover of the organized territory distinguishes by a wide range of blunted soils, their remains of horizons making impossible their categorization into a certain type of soil.

As they are tillage grounds, they present at the surface an Ap horizon that comes from B or C, AC or AB horizon, having less than 20 cm in thickness [5, 8]. The modification of the pedolandscape is also reflected in the chemical properties and the nutients' supply level of the soils. Thus, the reaction of the soils becomes moderately acid to low alkaline (5.4-8.2); 75% of soils end up presenting a low-very low to extremely low humus content (0.5-2.5%) (Fig. 5). The provision with nutrient substances becomes very low in total azote (0.036-0,070%), low in phosphor (11-17 ppm) and very low in potassium (Fig. 6, 7).

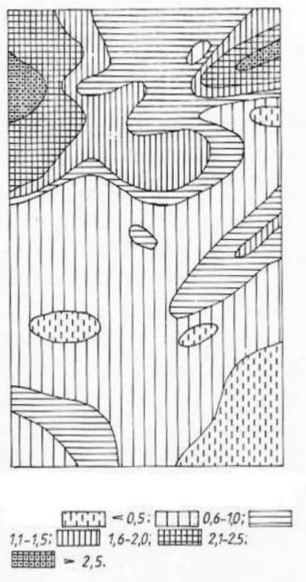

Fig. 5. Humus value (%) of anthropic sandy soils after modelling and levelling

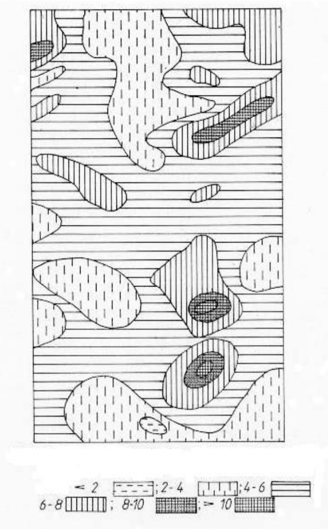

Fig. 6. Mobil phosphor value (ppm) of anthropic sandy soils after modelling and levelling

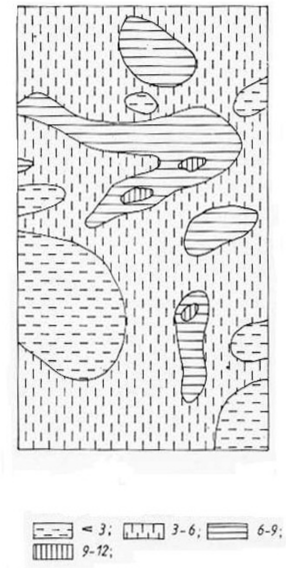

Fig. 7. Potassium value (ppm) of anthropic sandy soils after modelling and levelling

CONCLUSIONS

The preparations of sandy soils for introducing the irrigation system in our country in order to increase the agrarian production led to total change of the soil cover. The process had in view less or not at all the conservation of the superior A horizon of the soil, but the levelling of the lands with the purpose of complete mechanization of the agrarian works and the uniform distribution of water on the levelled surfaces.

The levelling of the sandy lands should start with the uncovering of the humifer material, respectively the superior horizon of soils, its depositing and restoration after the levelling operations, thus the values of soils fertility not only that are maintained at the initial value, but they are even enriched.

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STUDY ON THE IMPACT OF PRODUCT ON THE GROUND DUE TO OPERATION OF STATION ASPHALT GURENI GORJ

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Abstract

Sorting station and production of asphalt mixtures, the city-Peştişani Gureni activity is to dosing, heating and drying aggregates, followed by mixing them with bitumen and filler to obtain asphalt mixtures. The main sources of soil contamination inside the site are: storage and handling of fuels and fuel, particulate emissions from the manufacturing process technology mix asphalt and maintenance cars. To assess soil contamination with heavy metals in 2011 were collected and analyzed soil samples from the 0-30 cm depth in the following collection points: inside the station mixtures near the aggregate dryer and reservoir near fuel. The soil samples were chemically analyzed by semiquantitative emission spectral analysis method and were determined as indicators of As, Ba, Cd, Cr, Cu, Pb, Mn, Zn, Ni. Concentrations obtained were compared with normal values, alert thresholds and thresholds for intervention and results have been interpreted.

Key words*: soil pollution, heavy metals*

INTRODUCTION

Sorting station and production of asphalt mixtures, the city - Peştişani Gureni activity is to dosing, heating and drying aggregates, followed by mixing them with bitumen and filler to obtain asphalt mixtures.

Fig. 1. Location in the environment of the studied zone

The neighborhoods of location are: to the north, Gureni village, to the south, Peştişani village, to the east, Bistrița river and Frâncești village, to the west, Boroșteni village.
The ensemble of the station includes:
- current water providing ensemble;
- proper sorting station;
- sorts storehouse (the paddocks);
- asphalt station.

Current water providing ensemble: the water source neccesary to the sorting station activity is the Bistrița river and forms the recycled water.
Sorting station: aims to getting of different granulation sort (Fig. 2) and assures the processing of a 60 mc/h ballast volume for which is consumed a 120 mc/h water quantity.

Fig. 2. Sorting station

Sorting station is composed of:
- *Ballast receiving bunker*, it is provided at the top with a ramp for gross aggregate instalation supply. At the bottom is provided with shut and adjustment device of belt supplying.
- *Conveyor belts*, assure the transport of mineral raw material (ballast) in gross status from the supplying bunker to the proper sorting

station and of the sorts achieved by the station to the sort paddocks.
- *Separation sieve*, made of iron grill, it assures the cobble separation, that means the (1) 100 mm fractions, of the gross ballast.
- *Selection sieves*, made of perforated metal, make the ballast sortation on planned fractions, by vibration, under the stream of water.
- *Grainmeter*, directly supplied by a conveyor belt with coarse material obtained by sortation. In the grainmeter enter the coarse material where takes place the balbotage and from where results the small granulation material.
- *Sorts distribution and reception bunker* has 3 bins and spouts to the conveyor belts.
- *Screw feeders binder*, it is using for the exhaust and final washing of the 0-3 mm sort in the aggregate scrubbing stream. It is a steel profiles, board profiles and board-made construction, made of a snec (snail) mounted into a dish, provided with a drive group and a lower bearings. The material is introduced into the binder through the bottom of dish, the use being evacuated through the top. The washing residual water is eliminated through a drain pipe.
- *Storage belts*, consist of belts which transport the finished material, according to the sort dimension, to the storehouses furnished for storage.

Sort storehouses (paddocks). As a result of wet milling process of the ballast, the resulted sorts are stored on a concrete platform, in different paddocks for each grainmetric fraction and separated by concrete diaphragms for preventing their mixture and for easing their selective loading into the means of transport.

Asphalt station. Aims the production of asphalt mixtures (Fig. 3).


Fig. 3. Asphalt station

The asphalt station components are:
- *The aggregate predispenser*, is composed of a aggregate welded chassis and 4 storage bunkers for 4 aggregate granulations. It makes the volumetric predosage of the mineral aggregates with the natural moisture.
- *The conveyor belt*, has the role to download the aggregates from the collectors of the predispenser, in order to pick up and drain them into the loading hopper of the dryer.
- *Aggregate dryer machine*, makes the heating and the drying of the aggregates at the moisture and the temperature required by the asphalt mixture preparation technology.
- *Concrete mixing tower*, has the following functions: the download of the hot aggregates from the dryer and the lifting to the download level into the storage bunkers, the storage of the hot aggregates in 4 bunkers corresponding to the 4 sorts in order to enter them in the recipe, the weighing of a dose of filer, needed for a sharge, additional over the aggregates, the weighing of a bitumen dose for a sharge, the downloading of the bitumen into the mixer, the mixing of the components.
- *Bunkers with skip*, makes the reception of the mixture from the mixer of the mixing tower, the transportation and the downloading into the mixture storage bunker, as well as the downloading of the mixture into the mean of transport.
- *Dust filter*, is designed for the fume with high dust content, resulted from the drying process of the aggregates and of the sucked gases from the sieve bin of the mixing tower.
- *CAB command*, makes the technological cycle of preparation of the asphalt mixture in the automatic regime.
- *Aggregate drying injector*, works on the basis of G.P.L. or on the basis of easy fuel as C.L.U.
- *Bitumen tank*, has the following functions: storage, heating, loading, decanting, recirculation (bubbling) and delivering of the bitumen to the mixing tower.
- *Pneumatic installation*, includes all the motor circuits of the mixing tower mechanisms and of the dust filter.
- *Filter tank*, includes 2 storehouses of 60 t each, provided with electric engine powered vibrator.

- *GPL fuel tank*, has the following functions: storage, transition from liquide state to gaseous state of the fuel and its delivery to the asphalt station injectors.
- *Fuel homes*, has the following functions: storage and delivery of fuel (CLU) for the asphalt station burner and the diesel supply of the auto-equipments of the production base [1].

MATERIAL AND METHOD

Most part of the platform is covered with a fine sort aggregates layer originating from the dust depositions of the technological processes.
The sources of soil contamination from the enclosure of company location are: storage and handling of the fuels, particles emissions from the technological process of manufacture asphalt mixture and car maintenance.
Due to the rough handling of the fuels, at the platform surface highlighted traces of petroleum products from the fuel storehouse location.
From the point of litological and pedogenetic view, the soil vulnerability to pollution, and as well as of the groundwaters, is reduced. [1]
In order to evaluate the soil contamination with heavy metals, during the 2011 year, were harvested and analysed soil samples, from the 0-30 cm depth with the help of a carotier tube.
The samplings were made into the mixture station, i 2 points: by the aggregate dryer and by the liquid fuel tank (CLU) (Fig. 4).
The soil samples were chemically analysed by semiquantitative emission spectral analisys method and were determinated as indicators of As, Ba, Cd, Cr, Cu, Pb, Mn, Zn, Ni.


Fig. 4. The liquid fuel tank

RESULTS AND DISCUSSIONS

The concentrations obtained during the analysis were compared with the normal values, with the threshold alert, with the threshold of intervention (Table 1).

Table 1. Content of metals in soil in the year 2011

Metals analised	Normal values (ppm)	Threshold alert (ppm)	Threshold of intervention (ppm)	Determinated value (ppm)	
				Aggregate dryer	Liquid fuel tank
As	5	25	50	0	0
Ba	200	1000	2000	500	200
Cd	1	5	10	0	0
Cr	30	300	600	15	20
Cu	20	250	500	8	12
Pb	20	250	1000	14	18
Mn	900	2000	4000	300	400
Zn	100	700	1500	0	0
Ni	20	200	500	7	15

The results of determinations highlighted the followings:
- there was not recorded surpasses of the normal values in the point from inside of mixture station, except the Ba concentration.
- the thresholds alert are not surpassed for any determinated elements [2] .

CONCLUSIONS

Sorting station and production of asphalt mixtures, the city-Peştişani Gureni activity is to dosing, heating and drying aggregates, followed by mixing them with bitumen and filler to obtain asphalt mixtures.
The main sources of soil contamination inside the site are: storage and handling of fuels and fuel, particulate emissions from the manufacturing process technology mix asphalt and maintenance cars.
The results of determinations highlighted the followings:
- there was not recorded surpasses of the normal values in the point from inside of mixture station, except the Ba concentration.
- the thresholds alert are not surpassed for any determinated elements [3].

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SUSTAINABLE LAND MANAGEMENT IN AGRICULTURE - OBRENOVAC MUNICIPALITY (SERBIA) CASE STUDY

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Abstract

According to proposed EU Soil Directive, due to high variability in soil physical, chemical and biological state, site-specific soil degradation risk analysis is required. Important socio-economic drivers for agricultural soil degradation are also related to the local level (e.g. land use and land use change, farming practices, farming systems, holding structure, etc.) and must be taken into account in defining soil quality preserving measures. Having in mind these considerations, the authors in the paper analyze the agricultural land use and the state of the soil degradation processes in the Belgrade City municipality of Obrenovac. Pedological and geological structure of soils, climate and hidrology, intensive crop and livestock production in the urban fringe on the land exposed to erosion and landslides, underdeveloped hydro-melioration and waste water treatment systems and proximity of thermal power stations and lignite open-pits, produce serious obstacles for sustainable use of land and water in agriculture. The overall assessment of the soil degradation processes and its main drivers in the Obrenovac municipality enable definition of the set of soil conservation priority projects and measures for implementation at the local level.

Key words: *agricultural land use, soil degradation processes, sustainable land management, local community.*

INTRODUCTION

Soil degradation is a serious and increasing problem in Europe [5]. Soil degradation processes, such as erosion, soil organic matter decline, compaction, salinization, landslides and flooding (and at a national level: contamination, sealing, acidification and decline of soil biodiversity) are recognized in the EU legislation. The EU is adopted the Thematic Strategy on Soil Protection and proposed a Framework Directive as the best means of ensuring a comprehensive approach to soil protection whilst fully respecting subsidiarity and proportionality principles.[1]

Although the subsidiarity principle calls for common framework for actions to ensure a fair level playing field and to ensure that all Member States are tackling all threats to which soils are confronted in their national territory and do not address soil protection in a partial way, the proportionality principle left much scope to the Member States to identify the most appropriate specific measures at the most appropriate geographical and administrative level to ensure that the regional and local specificities as regards soil variability, land uses, local climatological conditions and socio-economic aspects can be properly taken into account. Integration of soil protection into sectoral policies and spatial planning is necessary, especially into agricultural and rural development policy documents [28].

Seven of the soil degradation processes commonly identified as matters of primary concern (water, wind and tillage erosion; decline of soil organic matter; compaction; salinization; acidification; diffuse contamination; and declining soil biodiversity) are closely linked to agriculture [3].

The prevention and mitigation of the effects of floods and landslides hazards need to be addressed in agriculture too. Sealing of agricultural land is becoming more intense as a result of urban sprawl and increasing non-agricultural land occupation.

Aspects of soil protection have been an integral part of EU Common Agricultural Policy. In the frame of overall CAP reform to 2020, the Commission proposed a further strengthening of the Good agricultural and Environmental Condition (GAEC) framework, particularly in relation with climate change. There is a clear case

[1] At the March 2010 Environment Council, a minority of Member States blocked further progress on the proposed Soil Framework Directive on grounds of subsidiarity, excessive cost and administrative burden. The proposal remains on the Council's table [5].

for a better protection of carbon rich soils, a general minimum land cover obligation and maintainance the soil organic matter level[2]. The new Rural Development proposal includes the objectives of the sustainable management of natural resources and climate action, including by means of improved soil management in agriculture [2].

Environmental legislation in Serbia is in the process of harmonization with the EU. Harmonization and decentralization of responsibilities was accelerated with the adoption of the Law on Amendments and Supplements to the Law on Environmental Protection in May 2009. In the area of soil protection and sustainable use, Law defines the measures of systematic soil quality monitoring, monitoring of risk assessment indicators for soil degradation and remediation of contaminated and degradated sites, as well as the obligation for seller to provide a soil status report for any transaction of land where a potentially contaminating activity has taken, or is taking place. The Government duty is to establish programme for systematic soil quality monitoring, indicators for risk assessment of soil degradation and methodology of creating remediation programmes [14].

National Programme for Environmental Protection contains sets of soil protection measures for the period 2010-2019 (establishment of landslides cadastre, systematic soil quality monitoring programme, inventory of contaminated sites and priority list of the sites for remediation, erosion control and definition of strategies and action plans and programmes for management of drought and land degradation and desertification, including awareness raising) and particularly agricultural soil protection measures (GAEC promotion, indicators of environmental impacts of agriculture, soil productivity evaluation, land capability monitoring, identification of nitrate vulnerable zones, nutrition balancing and monitoring of fertilizers and pesticide use, assessment of soil organic matter decline, land use change control, organic production and HNV area mapping, etc.) [13].

[2] This evolution should however be considered in conjunction with the development of the environmental legislation and with the definition of new, green direct payments [4].

The protection, consolidation and use of agricultural land in Serbia are directly regulated by the Agricultural Land Law [17]. Also, a number of obligations originate from ratified international conventions related to soil protection (UNCCD, UNFCCC and Kyoto Protocol).

The Law on agriculture and rural development defines direct, market oriented and structural incentives (including land protection measures) for agriculture and rural development. Producer payments are conditional on his compliance with environmental, public, animal and plant health, animal welfare and agricultural land protection standards [15].

Soil status analysis and conservation priority projects and measures for implementation at the local level are common parts of the local development strategies, especially rural development strategies.

This is in line with the EU Soil Strategy statement that risk acceptability and measures vary in response to the severity of the degradation processes, local conditions and socio-economic considerations [27].

Having in mind afore-mentioned, the authors in this paper analyze the agricultural land use and the state of the soil degradation processes in the Belgrade City municipality of Obrenovac, based on the research conducted in 2011, during the authors' work on the municipal strategy of rural development.

MATERIAL AND METHOD

Research was based on the statistical data and Serbian and EU legislation and projects' reports, on the results of the recent soil and water quality reports and studies and previous research of the authors in these fields, including above-mentioned work on municipal Rural Development Strategy. The overall assessment of the soil degradation processes and its main drivers in the Obrenovac municipality than enable definition of the soil conservation priority activities and measures that will be implemented at the local level.

In the discussion and conclusions formulating process, the SWOT analysis and analytic-synthetic scientific method were applied.

RESULTS AND DISCUSSIONS

The Obrenovac municipality is one of the Belgrade City municipalities and it lies in the south edge of the Panonian basin, on the left bank of Sava River.

Climate. Territory of Obrenovac municipality is mainly characterized by moderate continental climate, that is defined by warm summers and cold winters. The weather conditions within this area are strongly affected by the cyclones coming from Gulf of Genoa, which are moving across the valleys of Sava and Danube rivers and further to the Black Sea. Mentioned cyclones cause the maximum precipitation at the end of spring and beginning of summer, while the secondary maximum of rainfalls occurs in late autumn. During the period 1961-1990, the average amount of rainfall was 647.2 mm, where the rainiest month was June, with 84.4 mm.

Particularly, important element of climate for this area is wind. Annually there are on average 124 days with high wind (with strength of 6 and more by Beaufort scale). Ash landfills, located at the west and northwest, under the influence of western and north-western wind directly threaten great part of the municipality territory. No less dangerous is south-eastern wind, which usually blows (every third day) and has the highest average speed. It brings polluting substances from the lignite open pit mine on the whole territory of the municipality [1].

Hydrology. Obrenovac Municipality is rich as with surface, as well with ground waters. The rivers Sava in the north and Tamnava in the south form natural municipal boundaries, while across the middle of municipal territory flows Kolubara River, which is partly brought into the trough of its tributary, the Peštan River. Regulatory interventions caused the meandering watercourse and strong fluvial erosion. Kolubara River has in this part of its flow torrential character and represents a danger due to frequent flooding in the springtime.

Movement of ground water is caused by the terrain slope from south to north. Phreatic aquifer formed in this area represents part of spacious, hydraulically connected, phreatic aquifer of Mačva, Kolubara, Tamnava and Makiš, natural resource of immeasurable importance [1].

Relief and pedological structure. Territory of Obrenovac municipality belongs to the lowland agricultural area (terrains above 200 m msl occupy less than 8% of the whole territory, located at the easternmost of the municipality on the right bank of the Kolubara river). Within the geological structure dominate neogene sediments, which cause landslides on the slopes at the north-east and east [1].

About 70% of agricultural land belongs to I-IV soil quality class, suitable for cultivation (I class - around 6%, II – 14%, III - 27% and IV - 23%) [10]. There prevail developed, deep and potentially fertile lands, where, with the use of appropriate land ameliorative measures and good agricultural practice, could be achieved high yields of crops and fruits, before all: fluvisol and fluvisol on scraped humogley, humofluvisol and humogley soils in central part of the municipality and along rivers Sava, Kolubara, Tamnava and Peštan, as well as eutric cambisols and eutric cambisols luvic at the east and south-west. Pseudogleys (lowland and hillside type) are represented on the west and south-west, and diluvium at the east of municipality [7].

Land use. Arable land takes 88% of 31,826 ha of used agricultural land. Orchards occupy 5.3%, vineyards 0.2% and permanent lawns 6,2% (meadows 2.6% and pastures 3.6%) of mentioned area [19].

Crop and vegetable production are concentrated in central part of the municipality, especially on fertile alluvium and humogley in valleys of the rivers Sava, Tamnava and Kolubara. On nearly two-thirds of sown plowlands in 2010 there were cereals (mostly corn, wheat and in lesser extent barley and oat). After that came forage crops - alfalfa and clover, with the share in sown structure of 22%. Vegetables occupied 8%, and soybean, sunflower and sugar beet 5% of total sown areas.

In fruits growing the most represented were apple and plum plantations, and hills at the north-east, east and south-west are suitable for growing of other continental fruits and grapes.

Yields of green mass and hay from the meadows and pastures overcame the republic average and represent a good base for development of livestock production [23].

Intensive production of milk and pork has been developed on large farms in the central part of the municipality, while the cattle, sheep and goats breeding for the combined production of meat and milk is located on family husbandries in the livestock breeding-fruit growing region, east from the Kolubara river (Fig. 1).

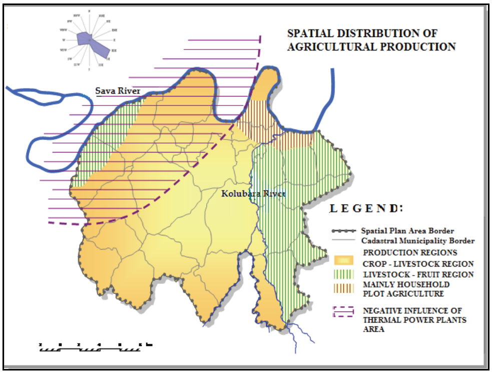

Fig. 1. Spatial Distribution of Agricultural Production (Source: LEAP, 2011, p. 106).

The number of livestock units at the end of 2006 was 58 LU/100 ha UAA, what is significantly above the national average, 31 LU/100 ha [25].

Most of the agricultural land is in private ownership. State owned about 3.425 ha - mostly plowlands (2.610 ha) and orchards (231 ha). Land owned by the state are usually subject to the lease. But, even 1.631 ha are out of this process (1.400 ha due to "differences between the legal and factual situation", i.e. fact that after the detal field insight is determined that it is not agricultural land and another 231 ha is in "co-owned relation with private persons" [20].

Family husbandries are small and estates are fragmented. The average size of used arable land at husbandries is 2.15 ha, what is more than the Belgrade level (1.72 ha), but less than the national average (2.46 ha). Farms usually have on disposal three separate parts of used land with average size of 1 ha (surrounded by other owners and composed of one or more parcels) [24].

The process of land consolidation has started 20 years ago and for this purpose is provided budget support from the city Program for protection, regulation and use of agricultural land in 2011 [10, 21].

Land use change. Used agricultural land, and what is particularly important, arable land, are reducing more slowly than the national and city of Belgrade average. This is not the case with orchards, although the development of this production is one of the priorities of agricultural development on the territory of Belgrade. In 2010 orchards occupied 10.2% less surface than in 2000, while in the same period at the city level there was recorded an increase of 8.9%. Areas under meadows and pastures have also increased in the same period [23, 26]. That is important because they have great role in protection of land endangered by intensive crop and vegetable production, development and revitalization of livestock breeding and preservation of biodiversity.

Besides continuous concern about the agricultural land preservation, particularly arable land from the unplanned transfer into the non-agricultural purposes, problem of land abandonment should be actively considered. Uncultivated surfaces of fertile agricultural land are increasing due to leaving of agriculture by young active population. One of extreme examples is the village Zabrežje where even 70% of arable land is abandoned [11]. This land is not maintained in good ecological conditions, and ragweed becomes a growing environmental and health problem.

Land protection. Pedological and geological structure of the terrain, applied agro-technical measures, emission of pollutants from thermal power plants, ash landfills and lignite open pit mines in surrounding, as well as certain infrastructure and socio-economic limitations are responsible for emergence of a number of land degradation processes, present in greater or lesser extent in this region: erosion, landslides, sealing, acidification, soil organic matter decline, contamination by heavy metals and pesticides and excessive use of nitrates and phosphates, compaction, salinization and flooding and soil biodiversity reduction.

Over the 80% of municipal territory is under the processes of mild and weak ***erosion***. Due to the loss of topsoil, the soil becomes less fertile and the aquatic ecosystem is contaminated. Expressed fluvial erosion processes are present along the relocated riverbed of the Kolubara. Fluvial erosion is also characterized for meanders of the Sava River near Obrenovac municipality. Application of anti-erosion measures are needed, such as specific tillage techniques (contour plowing, etc.), nurturing elements of so called environmental infrastructure (field-protection belts, hedges, etc.) and other anti-erosion measures envisaged by the

Law on agricultural land and Good Agricultural Practice.

Erosion in agricultural areas could result in undercut slopes which remove the slope base, causing ***landslides***. Active and mostly soothe landslides are connected to loose neogene sediments on the north-east and east of the municipality. Uncontrolled process of houses building, present in mentioned territory, is characteristic for the peripheral areas of big cities (urban sprawl) and like consequence has sealing of land and its additional destabilization. Within the ongoing construction of Corridor 11, on the section Umka-Barič is planned a stabilization of landslides "Umka" and "Duboko" [16].

Kolubara basin is one of the known locations with strongly acidic soil in Serbia. According to the analysis of the Institute of soil science, in the Obrenovac municipality acid soils are located in the south-west (pseudogley and cambisols luvic). Soils with stronger acidic reaction are characteristic for the eastern parts of municipality (cambisols and diluvium), while the land in wider area around the Kolubara River and central part of Obrenovac are medium to weakly acidic (alluvial, meadowlands), but they are intensively cultivated and fertilize, so during the the choice of mineral fertilizers have be taken into account about the prevention of acidification [7, 9].

Deposition of acidifying air pollutants (e.g. sulphur dioxide, nitrogen oxides) contributes to soil ***acidification.*** Nutrient leaching processes prevail in acidic environment. Increased acidity is neutralized by calcification but it accelerates the decomposition of organic matter what requires additional input of organic fertilizers.

By ***reducing of organic matter level*** the water-air regime is deteriorating and soil biodiversity is reducing. Factors that lead to decreasing of organic matter in soil are climate, constituent soil material, topography, vegetation, land use and applied agricultural practices. Preserving existing carbon stocks in the soil and fighting the depletion of humus (the most stable soil organic matter fraction) are of utmost importance for agriculture, environment and climate change mitigation. Southern Europe has a potential loss rate of less than 50 tonnes of carbon per hectare, due to the low actual content [6].

Land on the territory of Obrenovac municipality are medium to well stored with humus. Content of humus varied in range from 2.4% (hillside pseudogley and diluvium) to 4.3% (humogley), exept alluvium on scraped humogley (1.4%) [9].

Emissions of pollutants from thermal power plants, use of low quality water for irrigation and excessive use of fertilizers and pesticides are potential causes of agricultural land and water ***contamination*** with heavy metals, pesticide residues, nitrates and phosphorus.

Thermal power plants "Nikola Tesla A" and "Nikola Tesla B" are well-known emitters of sulphur-dioxide, nitrogen oxide and suspended particles. These plants annualy spent about 23 million tons of coal what make them as one of the global polluters. They have electro-filters for ash separation that is generated during the lignite combustion, but no equipment for desulphurization and removal of nitrogen oxides. Their instalation is expected no later than 2015. The ash is disposed at two landfill areas of 600 ha and 400 ha, that are the sources of ash wind erosion. Currently new technology is implementing, so called pneumatic transport and disposal of ash and slag, which will significantly reduce mentioned problem [10].

Soil analysis on the territory of municipality showed that presence of arsenic, mercury and cadmium in soil is below the maximally allowed concentration. Presence of lead exceeds standards only in small percentage of meadowland soil samples taken by road Draževac - Konatice. Increased content of nickel (21% of samples) has mainly geochemical origin (alluvial deposits within the Kolubara valley), although possible emission from thermal power plants and ash landfills haven’t be ignored [8].

In groundwater, as well as in the Save and Kolubara river was determined higher concentrations of iron ions. There is necessity for continuous monitoring of drainage systems, as well as control of quality of surface and ground water in areas of ash and slag landfills.

An important source of water pollution is the nutrients coming from untreated wastewaters. Discharge of wastewater into recipients without previous treatment, such is case in Obrenovac with the main sewer outfall on Kolubara river, near to estuary to Sava River, represents serious threat to water quality in the wider area.

From 353 samples of well water, which is used for irrigation, analyzed in 2010 on the territory that is not covered by the water supply network, 95% were rated as faulty. The usual cause of chemical incorrectness was higher content of nitrates and microbiological increased number of total coliform bacteria. Among polluters dominate sanitary unsecured septic tanks and manure warehouses, and nitrogen fertilizers [12].

One of the main sources of nitrate pollution of waters from diffuse sources in agriculture is excessive use of fertilizers and inappropriate manure management on the big livestock farms, as nitrate leaches through the soil into the water. Soil cover in general, and *catch crops*, in particular, reduce nitrate losses and thus have a positive impact on soil contamination.

Sustainable manure management requires investment in modern facilities and equipment that many small farms cannot provide without state support.

High concentrations of phosphorus were recorded in humogley on the north of municipality, as a result of intensive use of fertilizers in crop and vegetable production. Mentioned examination of well water quality showed the presence of low phosphate concentration [12].

Use of heavy machinery, especially in clay soils with compact structure leads to ***soil compaction,*** reduced degree of water infiltration, so ameliorative deepening of layer of arable soil has to be done to increase soil loosening and eliminate excess water.

Additional measures for water regime regulation are necessary especially in areas of pseudogley in the north-west and west parts of municipality, as well as in zone of heavier, clayey soils around the Obrenovac and valleys of the Kolubara and Peštan rivers (especially in part of unregulated flow of Kolubara, in zone Poljane-Draževac, endangered by ***floods***) [10].

Constructed drainage systems that have channel length of 267 km, are covering area of 21,000 ha, but in function is only 5,580 ha. There is necessity for reconstruction and upgrade of drainage system, as well as more than 20,000 ha need intensive irrigation [22].

Soils closer to the Sava River are with predominantly neutral and slightly alkaline reaction. High level of underground water and inadequate functioning of drainage systems on swamp soils in valley of Sava River emphasize processes of ***soil salinization and alkalization.***

On the soil reaction affects also emission of gases and particles from thermal power plants and ash landfills. Ash is generally alkaline, what is unfavorable for lands that are neutral or alkaline, and can be beneficial for acid soils (such as land around thermal power plant "Nikola Tesla B") [9].

It is recognized that ***soil biodiversity*** can be used as an indicator of soil quality and stable ecosystems. After analyzing the number of certain microorganisms and total soil microflora it was concluded that the larger soil biodiversity is characteristic of neutral soils and soils with slightly acid reaction, while in soils with acid reaction in eastern part, as well as at few locations in west part of municipality it is significantly reduced [8].

SWOT analysis. Favorable geographical position and relief, climate and hydrological characteristics, as well as preserved agricultural land fund with good characteristics and not too many limitations for agricultural production are the main ***potentials*** for sustainable land use within municipal agriculture.

Main ***weaknesses*** are the need for continual use of hydro and agro ameliorative measures on acidic, clayey and hydromorphic soils. That considers revitalization and improvement of hydromelioration systems, controlled application of fertilizers and pesticides and sustainable manure management. Diffuse pollution from mentioned sources burdens land and water. Small and fragmented estates of family farms in great number remain uncultivated. Also they are not maintained in good ecological conditions due to the abandonment of agriculture by younger and educated population, which is engaged in other economy branches.

Long-time ***threats*** to the preservation of agricultural land quality are: incomplete water supply and sewage system; sanitary unprotected wells and lack of system for waste water treatment; unreconstructed and incomplete system of drainage and irrigation; emission of pollutants from thermal power plants, ash landfills and pit mines; erosion, flooding and landslides and related to that uncontrolled residential building on unstable terrains, as well as inadequate waste disposal.

Establishment of the Fund for agricultural land at the Belgrade city level (2010), together with existing Fund for environmental protection and Environmental fund of Obrenovac municipality, will provide greater ***opportunities*** for successful implementation of planned activities and projects in the field of sustainable use, improvement and protection of agricultural land and environmental protection. To soil protection will contribute rehabilitation and upgrading of drainage and irrigation systems, reconstruction of bank fortification and sanation of landslides within the process of construction of XI Corridor. Implementation of agro-ecological measures for protection of soil from erosion and water pollution by nitrates in nitrate sensitive areas is expected during the EU pre-accession period. Agricultural extension service personnel is strengthened during the period 2011/2012 and ready to assist farmers in adopting the rules of good agricultural practices in land management.

Based on the above mentioned analysis it could be concluded that limitations for sustainable land management in agriculture have primarily infrastructural, socio-economic, market and institutional nature, what is in accordance with the marks that are given on country level [18].

Priority activities and measures. For removal of existing limitations in sustainable land management in agriculture next activities and measures have to be carried out: 1) *prevention of erosion and landslides sanation*; 2) *preservation and improvement of agricultural land fertility* (GAEC promotion, encouraging farmers to participate in the fertility control of arable land and use the extension service services, more efficient implementation of annual programs for land use, regulation and protection); 3) *enlargement and organization of agricultural estates and parcels, and prevention of uncontrolled occupation of agricultural land for non-agricultural purposes* (completion of land consolidation, grouping of parcels and regulation of field roads, land sale and rent market development, cadastre update, timely preparation of regulation plans for areas where conflict of interests are expected); 4) *prevention of agricultural land and water contamination with heavy metals, pesticide residues, nitrates and phosphorus* (improvement of the monitoring system for pollutants in the air, water and land; construction of wastewater treatment plant in Barič; upgrade of sewer system; sanitary protection of septic tanks and manure warehouses, as well as respect for the sanitary protection zone of wells); 5) *Prevention of negative impacts of agriculture on soil, water, climate, biodiversity and landscape* (controlled use of fertilizers and pesticides, together with the promotion of integrated method of their application, discourage of marginal land usage and fostering of environmental infrastructure); and 6) *revitalization and upgrade of drainage, irrigation and flood protection systems*.

CONCLUSIONS

Pedological and geological structure of soils, intensive crop and livestock production in the urban fringe on the land exposed to erosion and landslide, underdeveloped hydro-melioration and waste water treatment systems and proximity of the thermal power plants, as well-known emitters of sulphur-dioxide, nitrogen oxide and suspended particles, produce serious obstacles for sustainable use of land and water in agriculture of the Obrenovac municipality.

Timely engagement of local community on implementation of appropriate actions and measures can significantly contribute to sustainable land management and agricultural development in this area.

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REVIEW PROCESS OF WATER MOVEMENT IN SOIL IN THE SPRINKLER IRRIGATION SYSTEM USING A SIMULATION MODEL HYDRUS-1D

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Abstract

In the present study, how water moves in soils in the sprinkler irrigation system has been considered. According to preliminary soil and water information, soil physical and experimental parameters, cumulative amounts of input flow in upstream, Cumulative amounts absorbed by the roots and values of the cumulative output flow in downstream, have been estimated. Suction changes, moisture, hydraulic conductivity and flow depth at different times during the simulation have been determined by HYDRUS-1D Software. At the end, the soil moisture characteristics curve and Suction relationship with hydraulic conductivity was also determined.

Key words: *Simulation, Sprinkler System irrigation, Water movement, HYDRUS-1D.*

INTRODUCTION

HYDRUS-1D is one of the advanced models associated with one-dimensional movement of water, solutes and heat in the soil [3].
The mentioned model has been developed by (Simunek, et, .al) in American Soil Salinity Laboratory [9].
This model involves the numerical solution of Richards's equation for water movement in soil and release and transfer equations for heat and solute movement in soil.
Relevant equations in this model have been solved using finite difference.
This model can simulate root growth in terms of saturated and unsaturated conditions and has the ability to estimate soil hydraulic characteristics and solute transport with inverse method [1, 11].
Many of Subsurface water pollution problems are happened due to the simultaneous of water flow, solute, heat transfer and Bio chemical processes.
Models based on these processes can also be valuable tools for studying the movement of a wide range of organic and inorganic substances and pollutants from hydrologic and geochemical conditions [1, 7].
In water; soil and vegetation system, rainfall, irrigation and capillary rise are the unsaturated zone inputs.
Deep percolation and drainage are the outputs of unsaturated zone.
Evapotranspiration from soil and plants is also the output.
HYDRUS software has the ability to simulate water movement, salts, heat, carbon dioxide and water uptake by roots in both saturated and unsaturated zone.

Governing equations

One-dimensional motion of water in soil using numerical solution of Richards's equation in the model can be expressed as follows [8]:

$$\frac{\partial \theta}{\partial t} = \frac{\partial}{\partial x}\left[K(\theta)\left(\frac{\partial h}{\partial x} + \cos\alpha\right)\right] - S \qquad (1)$$

θ :Volumetric moisture
$K(\theta)$:Unsaturated hydraulic conductivity
h :Matrix suction
α :Angle between flow direction and the vertical axis

S :Water uptake by roots
x :Distance
t Time
HYDRUS-1D Model to simulate water movement in soil, Solves the Richards equation using linear finite elements model [1, 2].
In this model, to describe features such as hydraulic soil moisture curve and unsaturated hydraulic conductivity, numbers of relationships are defined.
Mualem-Van Genuchten (1980) is the most common relationship shown in follows (10):

$$\theta(h) = \theta_r + \frac{\theta_s - \theta_r}{\left[1+(\alpha h)^n\right]^m} \qquad m = 1 - \frac{1}{n}$$

$$n > 1 \qquad (2)$$

$$K(h) = K_s Se^l \left[1 - (1 - Se^{\frac{1}{m}})^m\right]^2 \qquad (3)$$

Where:
θr : Residual moisture
θs : Saturated moisture
α ،m ، n & l : Experimental parameters
Ks : Saturated hydraulic conductivity
Se: Relative saturation

Water uptake by roots (S term in equation 1) on water uptake by plants per unit soil volume per unit time is determined.
In this model, S, based on the relationship between Feddes et, al (1978) is defined as follows:

$$S(h) = \alpha(h) S_P$$

Where:
$\alpha(h)$: Function of water stress
S_P : Potential of water absorption

Solution Method:
HYDRUS-1D model for simulate water movement in soil, Solves Richards equation using linear finite elements pattern. Since the one-dimensional, linear model of finite elements and finite differences are similar, the equation (1) with a non-explicit finite difference model has been following discrete:

$$\frac{\theta_i^{j+1,k+1} - \theta_i^j}{\Delta t} = \frac{1}{\Delta x}\left(K_{i+1/2}^{j+1,k} \frac{h_{i+1}^{j+1,k+1}}{\Delta x_i} - K_{i-1/2}^{j+1,k} \frac{h_i^{j+1,k} - h_{i-1}^{j+1,k+1}}{\Delta x_{i-1}}\right) + \frac{K_{i+1/2}^{j+1,k} - K_{i-1/2}^{j+1,k}}{\Delta x} - S_i^j$$

(5)
Where:

$$\Delta t = t^{j+1} - t^j \qquad (6)$$

$$\Delta x = \frac{x_{i+1} - x_{i-1}}{2}\ ,\ \Delta x_i = x_{i+1} - x_i\ ,\ \Delta x_{i-1} = x_i - x_{i-1} \qquad (7)$$

$$K_{i+1/2}^{j+1,k} = \frac{K_{i+1}^{j+1,k} + K_i^{j+1,k}}{2}\ ,\ K_{i-1/2}^{j+1,k} = \frac{K_i^{j+1,k} + K_{i-1}^{j+1,k}}{2} \qquad (8)$$

Where:
$i-1$ ، i ، $i+1$, are referred to The location of network points, k and $k+1$, to iteration, j and $j+1$, as different steps.
The mass conservation by (Celia et al., 1990), to become part of the first relation to matrix suction is used:

$$\frac{\theta_i^{j+1,k+1} - \theta_i^j}{\Delta t} = C_i^{j+1,k} \frac{h_i^{j+1,k+1} - h_i^{j+1,k}}{\Delta t} + \frac{\theta_i^{j+1,k} - \theta_i^j}{\Delta t} \qquad (9)$$

Where:
C_i, refers to Soil water capacity.
(Celia et al., 1990) method has shown that the mass balance has been successful in minimizing the error.
With replacing equation (1) in equation (2) after placing the order simple, the following equation is obtained:

$$\left[P_W\right]^{j+1,k}(h)^{j+1,k+1} = (F_W) \qquad (10)$$

So in terms of solving the above equation over the field, a diagonal system of equations can be obtained that is solved standard method such as Gauss elimination.
Procedure generally consists of three parts, pre-processing software, and the process is calculated. Data entry is done in a pre-processing step. Richards's equation is solved using the finite element method in Section II and finally, the model output data is obtained after processing.
This data includes simulation time, number of replicates at each time step, the cumulative number of iterations, the flow changes in the upstream boundary, the total cumulative inflow in the upstream, the cumulative water uptake by roots, the total cumulative output flow in the downstream, Matrix suction in the upstream, downstream, and by the roots [4].
Consequently, the purpose of this study is to use HYDRUS-1D model to simulate water movement in soil, soil hydraulic parameters to evaluate changes in depth during the irrigation period.

MATERIAL AND METHOD

Soils studied, homogeneous, single-layer texture is loam. Soil depth is 100 cm and the initial moisture content is measured 14% by volume. Sprinkling intensity is about 0.016 centimetres per minute and irrigation time is 13.5 hours.
A property of this model is mass balance estimation in time steps.

In this research, calculating the total balance in the soil profile is considered. Start time calculation usually starts from zero, but not always.
In this study, the number zero (start of irrigation) has been considered. Also, the irrigation time is 13.5 hours and the optional unit is minutes. As a result, 8 minutes, as calculations are terminated.
For more accurate simulations, we considered 9 outputs until the model once every 90 minutes; determine the amount of suction, flow and moisture content. The number of iterations is considered 20 that represent the maximum iteration for each time step (Δt).
Model with a variable Δt is starting simulation. Thus, given an initial value Δt for the model calculations can start. If the model, evaluate appropriate conditions, multiply this value in more than a multiplication factor and increase it and in poor condition, this value multiplied by a coefficient less than this value and its value decreases.
Thus, if the amount of calculated time steps (Δt) is small, the model can consider the value of a coefficient equal 1.3 and increases (Δt) and if the value of (Δt) is large, is capable by taking of values equal to 0.7, reduce the time step (Δt). Consequently, the loam soil texture and the possibility of predicting soil parameters using the neural network in considered model, parameters of residual moisture, moisture saturation, and saturated hydraulic conductivity and values of empirical equation are determined.
These values are shown in table (1). Boundary condition at the upstream is the constant flow and in Downstream has been considered as a free drainage. The input flow rate is -0.013 centimetres per minute that considered as upstream boundary conditions for the model.

RESULTS AND DISCUSSIONS

Soil values were estimated by the model is shown in the table 1. After simulation, the output of the program, the simulation time (0 to 810 min) is displayed. The number of iterations is specified in the time step that is usually between 4 to 6 reps.
Results related to

θ_r $(\frac{cm^3}{cm^3})$	θ_s $(\frac{cm^3}{cm^3})$	K_s $(\frac{cm}{d})$	α $(\frac{1}{cm})$	n	l
0.0609	**0.3991**	**12.04**	**0.0111**	**1.4737**	**0.5**

The numbers of repeated and cumulative values over time are shown in figures 1 and 2. Total number of iterations of the simulation is repeated in 1723. The model result, changes in the upstream boundary, the cumulative amount of input in the upstream boundary, the cumulative flow that has adsorbed its roots that in this research its value is Zero. Cumulative sum of the output of the downstream boundary of its value is -0.42×10^{-4} (cm) that is almost equal to zero. Because the upstream boundary is in direct contact with the water and is almost saturated, after 810 minutes the amount of suction is insignificant and approaching zero. Matrix suction on the downstream boundary is equal to -1921 (cm) and is constant throughout the simulation period following figures 3 to 6. Suction changes, moisture, hydraulic conductivity and flow depth at different times during the simulation are shown in figures 7 to 10. In given figures, considering irrigation time that is equal to 810 minutes and 9 selected simulations period, Results are shown once every 90 minutes. Soil moisture retention curve and hydraulic conductivity associated with soil suction are shown in figures 11 and 12.

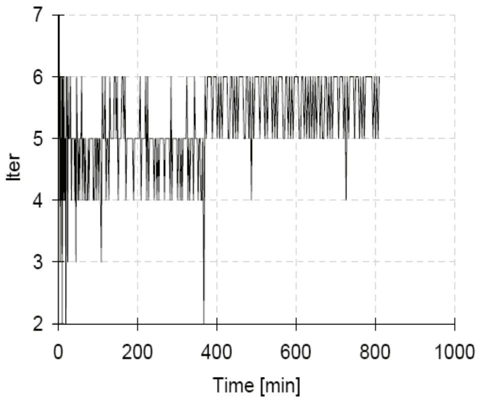

Fig. 1. The number of iterations in each time

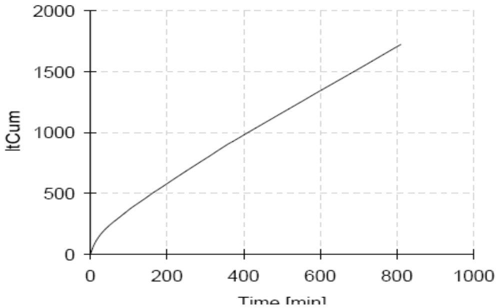

Fig. 2. Cumulative amount of iterations in the simulation

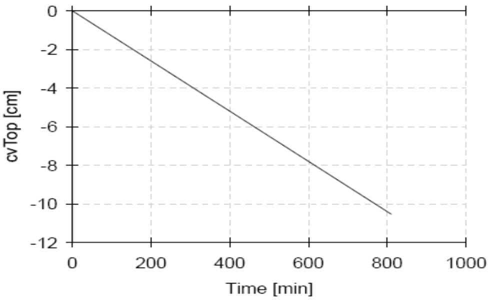

Fig. 3. Cumulative amount of incoming water from upstream

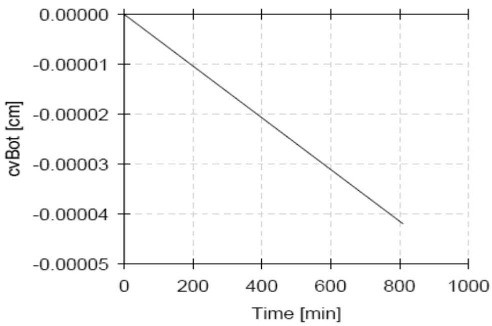

Fig. 4. Cumulative output of the downstream water

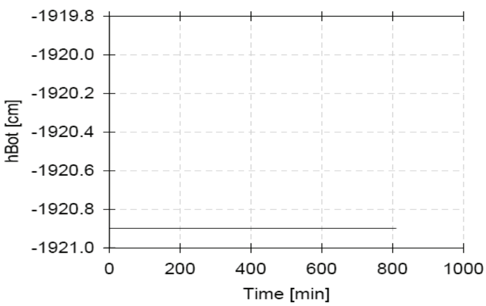

Fig. 5. The amount of suction on the downstream boundary

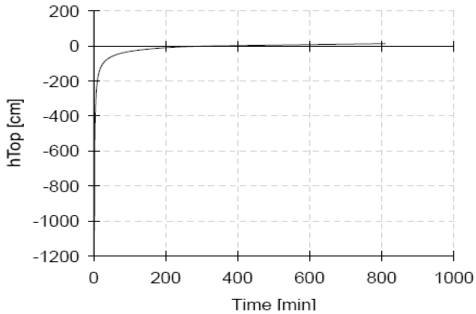

Fig. 6. The amount of suction on the upstream boundary

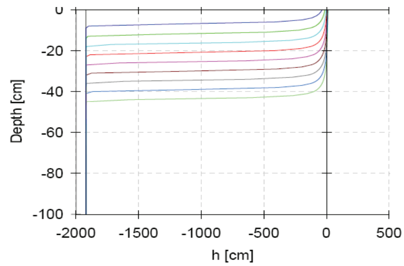

Fig. 7. Suction changes with soil depth at different times

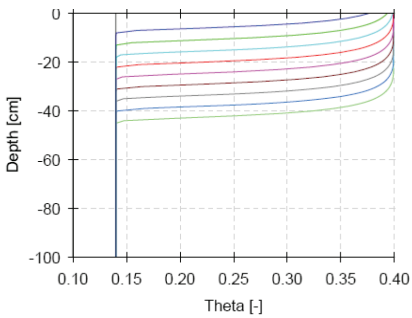

Fig. 8. Soil moisture changes with depth at different times

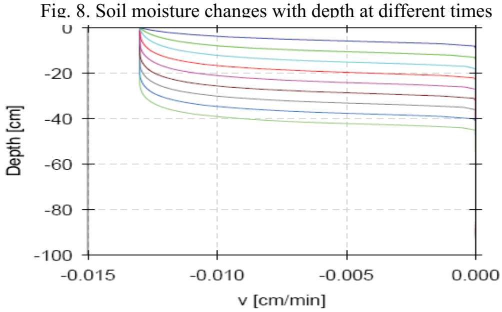

Fig. 9. Soil hydraulic conductivity changes with depth at different times

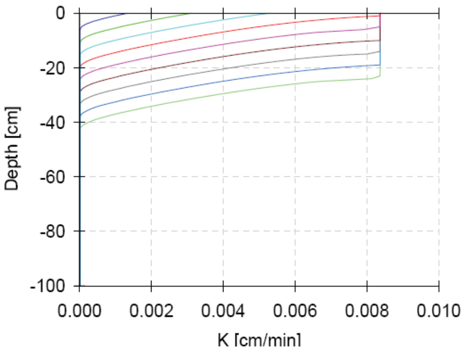

Fig. 10. Flow changes with soil depth at different times

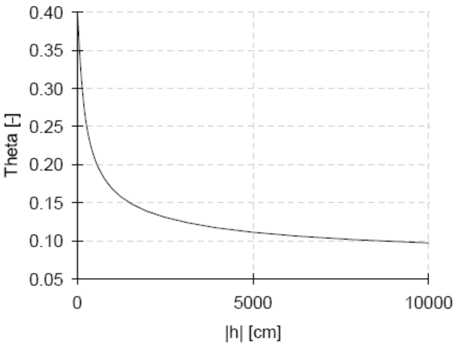

Fig. 11. The relationship between suction and moisture content, moisture retention curve

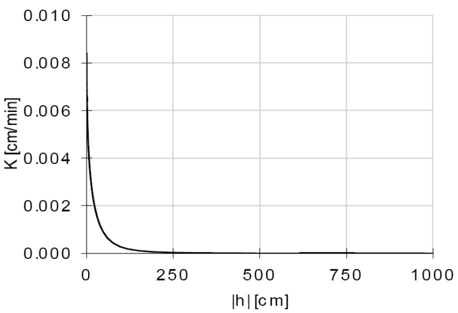

Fig. 12. The relationship between suction and hydraulic conductivity

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DESCRIPTION OF HYDROLYTIC LIGNIN IN TERMS OF ITS USE AS FERTILIZER AND AMENDMENT

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Abstract

The paper describes the chemical and physical composition, as well as, the properties of the waste-hydrolytic lignin from biochemical plants, which possesses fertilizing potential and whose object of activity is to produce fodder yeast. The properties of the latter, to be used as fertilizer and amendment for the restoration of the fertility of low productivity soils, are argued.

Key words: *waste, hydrolytic lignin, biochemical plants, chemical composition, physical composition.*

INTRODUCTION

Hydrolytic lignin is not usually used for psychological, economic, legal, as well as technological reasons. Being accumulated as waste year by year, it affects the normal functioning of the soil, of the atmosphere, and of water resources. However hydrolytic lignin contains biophile elements necessary for the plants. By virtue of maintaining a reasonable balance of soil elements, it is imperative to recuperate and to reintegrate it into the agricultural circuit through transforming and using it as fertilizer and amendment. By augmenting the hydrolytic lignin, three stringent current social-economic issues will be simultaneously solved: restoration of agricultural soil fertility, increase of plant productivity, and protection of the environment from pollution with organic wastes.
The aim of the paper is to present an analysis of chemical and physical properties of the hydrolytic lignin in terms of its being used as fertilizer and amendment.

MATERIAL AND METHOD

Samples of hydrolytic lignin, collected from dumps of biochemical plants from the cities Balti and Tighina, Republic of Moldova, during the period 1980-2005, served as material for analysis. The applied research methods include those of synthesis, generalization and data processing. Statistical data processing was performed according to the statistical methods using MS Excel programmer.

RESULTS AND DISCUSSIONS

The activity of the biochemical plants consists in producing fodder yeast. The sugars (carbohydrates) from various wastes of plant origin: wood shavings, saw dust, corn cobs, husks of seeds, etc., serve as nutritional source for the yeast. Carbohydrate hydrolysis is performed by treatment with sulphuric acid of 0.5 to 1.0% on raw material at a temperature of 140-190°C and the pressure of 0.4 to 1.2 Mpa [1, 2].
In these conditions, about 10-20% of the original raw material is dissolved and placed in the hydrolysis tower. The substances which were not dissolved (actual lignin and some polysaccharides) are downloaded from the tower as waste under the name of hydrolytic lignin.
The hydrolytic lignin is a dark brown solid material. Being downloaded from the hydrolysis tower, it retains, to a great extent, its form and raw material particle size, because the latter is hydrolyzed in a small proportion of up to 20% of the initial raw

material introduced into the tower [3, 4]. According to its chemical composition, the hydrolytic lignin consists of a complex of substances, whose mass is composed of natural lignin and poly-saccharine (84-91% of the dry mass of hydrolytic lignin). There are also present, various organic acids, sulphuric acid, minerals. Simultaneously, it contains a significant amount of functional groups: carboxyl (5-6%), hydroxyl (6-8%), methoxyl (10-11%), acid (9-14%) and phenol (3%) [5]. The presence of these functional groups renders an active role to the hydrolytic lignin in the chemical reactions.

Hydrolytic lignin possesses a strongly acid reaction (Table 1). The hydrolytic acidity is also extremely high, with a maximum of 1017 me H/100 g of dry mass. The average humidity (X) is of 63.7% with a very small standard deviation (S) (5.28%). The dry mass of hydrolytic lignin consists of up to 87.8% of organic matter. According to statistics, this value is very stable; the coefficient of variation (V) does not exceed 6%.

Therefore, the C:N proportion is very high (89-138); it is ten times higher than the optimum, when the activity of micro organisms does not affect the plant needs in nitrogen. Mineral nitrogen is presented in small amounts (0.4 to 4.0 mg/100 g). The quantities, which characterize the hydrolysable nitrogen - nitrogen potentially available for plants, are higher. The amount of easily and difficultly hydrolysable nitrogen is equal to an average of 100 mg/100 g of dry mass.

The ash varies within 2.9 to 18.6 %. The predominant mineral elements are: silicon (6.09%), sulphur (1.26%), calcium (0.96%). Total phosphorus constitutes an average of 0.20% with a standard deviation of 0.04%. The potassium content is not high either (0.60%), which is also characteristic of traditional organic fertilizers [6].

Out of the list of main microelements, hydrolytic lignin practically misses only cobalt. Molybdenum (0.1 to 0.7 mg/kg) and boron (1-4mg/kg) are found in small quantities. Concentrations higher than 18-90mg/kg are characteristic of manganese, copper and zinc.

Table 1. Chemical composition of hydrolytic lignin related to dry mass (n=15)

Indices and the measure unit	x	min	max	S	v
pH (H_2O)	3.5	1,9	5,9	1,22	35
Hydrolytic acidity, meH/100 g soil	796	510	1017	167.1	21
Humidity, %	63.7	59.1	76,3	5.25	8
Organic matter, %	87.8	81.4	97.1	5.24	6
Natural lignin, %	42.1	29.4	52.8	3.79	9
total C, %	47.6	41.3	51.4	3.49	7
Huminic acid C, %	4.5	3.2	6.8	1.39	31
fulvic acid C, %	5.1	3.5	7.9	1.74	34
Huminic acid C : fulvic acid C	0.9	0.5	1.5	0.25	28
total N, %	0.42	0,3	0.58	0.09	21
total C : total N	116	89	138	16.5	14
N-NO_3, mg/100 g soil	0.4	0.1	0.7	0.27	67
N-NH_4, mg/100 g soil	4.0	2.0	8.0	2.21	55
Easily hydrolysable N, mg/100 g soil	58.0	39.6	78.6	5.22	9
Difficultly hydrolysable N, mg/100 g soil	40.0	37.6	42.6	2.40	6
P_2O_5 total, %	0.2	0.15	0.25	0.04	18
Accessible P_2O_5, mg/100 g soil	10.2	2.3	19.8	7.09	69
K_2O total, %	0.6	0.04	2.11	0.67	111
Accessible K_2O, mg/100 g soil	26.9	16.4	34.6	7.20	27
total SiO_2, %	6.1	3.0	11.5	3.06	50
total Al_2O_3, %	0.12	0.06	0.19	0.04	34
total Fe_2O_3, %	0.37	0.2	0.62	0.31	71
total CaO, %	0.96	0.84	1.12	0.09	9
MgO total, %	0.15	0.11	0.19	0.02	16
total SO_3, %	1.26	0.7	2.01	0.47	37
total Na_2O, %	0.02	0.01	0.04	0.01	45
total Mn, mg/kg	86	11	183	66.4	77
total Cu, mg/kg	90	32	152	49.3	55
total Zn, mg/kg	18	3	65	18.4	102
total B, mg/kg	2	1	4	1.05	53
total Mo, mg/kg	0,3	0.1	0.7	0.23	56
total Cd, mg/kg	0	-	-	-	-
total Pb, mg/kg	2	1	3	0.82	41
total Ni, mg/kg	8	2	12	3.37	42
total Co, mg/kg	0	-	-	-	-

Approximately 50% of organic matter is natural lignin. From the range of organic fertilizers and of other fertilizing materials, hydrolytic lignin is the richest in organic matter (peat close) and also the poorest in total nitrogen (0.30 to 0.58%).

The fact that these elements are in comparatively large quantities can be considered positive, as they are assimilated by plants more intensely and are often observed in the soil in minimal amounts. Metal shaving a direct toxic effect are present in very low amounts (lead, 1-3 mg/kg) or are altogether absent (cadmium). Calcium predominates among aqueous extract ions and forms 8.3 ml, magnesium, and sulphur 3.2 ml, 11.9 ml/100 g of dry lignin correspondingly (Table 2).

Table 2. Chemical composition of aqueous extract of hydrolytic lignin, me/100 g dry mass (n=15)

Indices	x	min	max	S	v
Dry residue, %	4.59	1.45	9.78	3.04	66
Mineral residue, %	0.92	0.64	1.34	0.24	26
Carbon, %	0.9	0.5	1.50	0.32	37
Ca^{2+}	8.3	5.3	12.2	2.85	34
Mg^{2+}	3.2	0.7	5.2	1.65	51
Na^{+}	0.6	0.2	0.9	0.23	40
K^{+}	1.3	0.4	2.2	0.63	48
NH_4^{+}	0.4	0.2	0.7	0.16	38
HCO_3^{-}	1.6	0.1	3.8	1.33	82
SO_4^{2-}	11.9	7.1	17.4	3.33	27
Cl^{-}	0.06	0.04	0.10	0.02	35
H_2PO_4	0.2	0.03	0.3	0.09	45
NO_3	0.08	0.06	0.1	0.01	18

Based on these indices, it can be inferred that, among the water soluble minerals, calcium sulphate predominates in lignin - the substance that gives it an ameliorative character. And as it results from the difference of total residue value and of the mineral one, 80% of water soluble substances are organic constituents. Therefore, an essential part of the lignin mass consists of water - soluble substances, i.e. it is active from the chemical and mineralogical points of view.

The physical properties of hydrolytic lignin are very interesting under the agronomic aspect. The contents of a lignin fraction smaller than 0.001 mm does not exceed 11.4% (Table 3).The fractions bigger than 0.001-0.05 mm (the sand and the dust) constitute together 90 % of the lignin mass. From the granule-metric point of view, the hydrolytic lignin is characterized as a mineral possessing a coarse texture, falling within the average clay-sand subclass [7].

The micro structural composition analysis showed that 64-74 % of the fractions smaller than 0.01 mm were of the sand size. Consequently, while the analysis of size fractions from 0.01 to 0.005 mm, 0.005 to 0.001mm and less showed that they averaged 10.4%, 12.9% and 9.9%, the micro structural analysis of these fractions averaged 4.2%, 3.3% and 6.4%.

So, they considerably decreased, increasing the share of fractions from 0.25 to 0.05 mm from 28.6% (granule-metric analysis) to 49.5%. Under natural conditions, the hydrolytic lignin is not artificially dispersed with chemicals, as it is done in the case of particle size analysis; it is a sandy material in terms of micro structural composition.

Table 3. Physical properties of dry mass hydrolytic lignin (n=15)

Indices	x	min	max	S	v
Granulometric fractions					
1.00-0.25 mm	16.6	14.3	18.2	1.48	9
0.25-0.05 mm	28.6	25.3	31.9	2.28	8
0.05-0.01 mm	21.6	18.6	24.1	1.86	9
0,01-0.005 mm	10.4	8.5	12.4	1.38	13
0.005-0.001 mm	12.9	10.5	15.1	1.60	12
<0.001 mm	9.9	7.3	11.4	1.31	13
<0.01 mm	33.2	29.7	36.3	2.23	7
Microstructures fractions					
1.00-0.25 mm	15.6	13.8	17.1	1.14	7
0.25-0.05 mm	49.5	46.8	52.4	1.90	4
0.05-0.01 mm	21.0	18.1	23.8	2.06	10
0.01-0.005 mm	4.2	3.5	5.1	0.57	13
0.005-0.001 mm	3.3	2.8	4.0	0.44	13
<0.001 mm	6.4	5.1	6.5	0.86	13
<0.01 mm	13.8	12.1	15.4	1.08	8
Hydroscopic coefficient, %	5.97	5.53	6.53	0.42	7
Density, g/cm^3	1.37	1.27	1.45	0.06	5
Apparent density, g/cm^3	0.23	0.15	0.27	0.04	13
Total porosity, %	83	81	88	2.06	3

Such composition may have favorable consequences for agricultural practices. Being incorporated into the soil, the hydrolytic lignin will keep the soil in a loose state, more permeable to water and air.

The potential favorable consequences of hydrolytic lignin for agriculture are also confirmed by other physical properties. The density of lignin is very low (1.27-1.45 g/cm^3). The lignin apparent density (0.15-0.27 g/cm^3) is also characterized by very low parameters. While the low density is explained by the fact that 90 % of the lignin composition is formed of organic matter, the apparent density is caused by the high porosity of the hydrolytic lignin (81-88%).

The apparent density is two-three times lower than that of manure. The same volume of lignin will weigh two-three times less than the same volume of manure.

The low density, the high porosity, and as a result, the high water absorption capacity (210-450%) offer to lignin the perspective not only as an agricultural fertilizer, but also as a sub-layer in greenhouses and in other protected spaces. The material possessing such characteristics can serve as a good reservoir both for the water and air, as well as for nutritive elements.

CONCLUSIONS

1. Hydrolytic lignin possesses a powerful acid reaction (pH=3.5) and hydrolytic acidity (796 meH/100 g of dry mass). The average humidity constitutes 73.7%. It is rich in organic substances (87.8%) and poor in total nitrogen (0.42%), which determines the especially high value of the proportion C:N (116).
2. Among the mineral water soluble substances, calcium sulphate predominates in hydrolytic lignin; the substance renders to lignin an ameliorative character. Around 80% of water soluble substances are formed of organic constituents, which are active from the chemical and mineralogical points of view.
3. From the physical point of view, hydrolytic lignin is characterized as a sandy material. Being incorporated into the soil, it will maintain it in a loose state that will be more permeable to water and air.
4. The hydrolytic lignin possesses a density of 1.27-1.45 g/cm^3 and a reduced apparent density of 0.15-0.27 g/cm^3. Its porosity is of 83% and has high water absorption capacity of 210-450%. These parameters offer to the hydrolytic lignin the perspective of not only a fertilizer for agriculture, but also for being used as a sub-layer in greenhouses and in other protected spaces; it can serve as a good reservoir not only for water and air, but also for nutritive elements.

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PEDOGEOMORFOLOGICAL DATA FROM TITU-DAMBOVITA AREA

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Abstract

As an integrated part of the Titu-Potlogi divagation plain, the territory to which we refer to (created by rivers) slightly descends down from the north to the south in narrow or wide steps (with absolute altitudes between 155 and 220 m), continuing to the Picior de Munte Plain (a subdivision of Târgovişte Plain) to which it is closely attached.In these conditions the soil cover is made out of a multitude of soils that belong to cambisoils, luvisoils, protisoils, cernisoils and hidrisoils. Most of them have a weak acid reaction, a low content of humus and moderate supplying with nutrients. The main restrictions for agricultural production are caused by the lack of drainage, soil texture and the great variety of soils.

Key words: *soils, Titu-Sarata Plain, nutrients, drainage.*

INTRODUCTION

Systematic soil surveys in the Titu-Dâmboviţa were held (1978) in order to sustain the project to remove excess moisture from an area of about 3500 ha of the northern Municipality [2].

MATERIAL AND METHOD

The research comprised two parts: the land, which consisted of mapping and spatial reambulating studied 1:10.000 and 1:25.000 scale, with a collection of numerous soil and groundwater samples, with observations on relief, micro-, parent material, etc. Opened a significant number of soil profiles (150) to depths of 1-2 m, which were collected several samples. He then prepared a summary of samples and analyzes proposals (grain size, humus, reaction pH, exchangeable base saturation level, the physical and hydro, etc.).

Laboratory results were processed and interpreted as indicators of ICPA methodology [5].

Also soil map was completed and all correlative maps (relief, parent material, groundwater) and interpretative (pedoameliorativă clustering) of land. Morphological, physical, hydro and chemical properties of representative profiles are on the forms.

RESULTS AND DISCUSSIONS

The territory to which we refer is located in the Titu-Sărata Plain and corresponds, in relation to geomorphological space, with an important part of Titu-Potlogi divagation Plain, and slightly to the South, to the Picior de Munte Plain (Fig. 1) [1, 3].

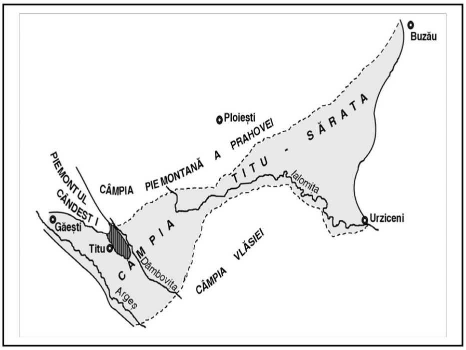

Fig. 1. The geographical position of the Titu-Sărata

The hydrogeological studies and the outcrops in the area show a less complex geological structure: silty clays or loess-like clays of fluvial origin, sand, sand and gravel mixtures with gravel at the base (Fig. 2).

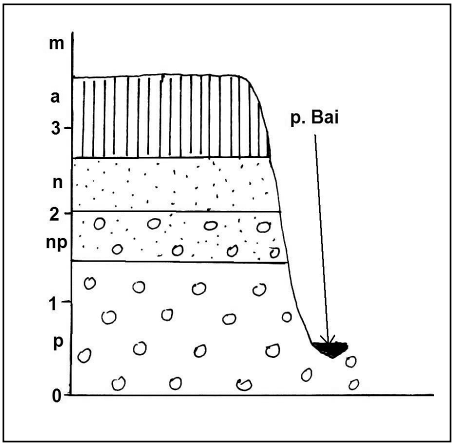

Fig. 2. Geology of the territory at Boteni and Serdaru
a- silty clays or loess-like loamy clays
n- sands
np- sands and gravels
p- gravels

The landscape is developed in slightly descending levels of 1.35-2.10 m absolute altitudes, wider or narrower, which constitute a divagation plain, looking like high meadows or fields looking slightly raised (Fig. 3) [2].

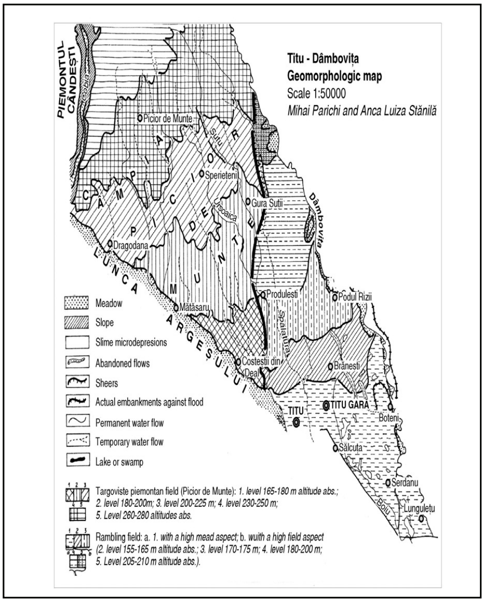

Fig. 3. Geomorphological map
of the Titu-Dâmboviţa area

The degree of fragmentation and the relief energy have extremely small values. Several shallow (0.3-1 m) creeks (Ursoaia, Şuţa, Spălătura etc.) are the only waters crossing the highest parts, as well as Baiul brook, with its numerous meanders visible on high meadows. There are, also, the old riverbeds, oxbows and even small depressions that can be easily observed especially in the actual floodplain (at 135-150 m abs. alt.).

Data available for the investigated territory situates it in the moderate sub-thermal, sub-humid agro climatic area, i.e. the 2nd sub zone, characterized by relatively high heat resources (9.0-10.50ºC) and water resources that often exceed 750 mm annually. The evapotranspiration slightly exceeds the minimum average rainfall (60-80 mm).

The Dâmboviţa River and Baiul brook are the main draining elements of the area. Until recently, Dâmboviţa went out of his bed at least once every 2-5 years by several points, starting from downstream the Rizi bridge, till Serdanu. The above-mentioned streams flood the northern and western margins of the territory; their springs are situated in the Picior de Munte Plain.

Groundwater occurs at depths of 3-5 and 5-10 m, near Dâmboviţa course, and at the limits of the upper relief. However, the dominant depths are at ranging from 1 to 3 m (Fig. 4).

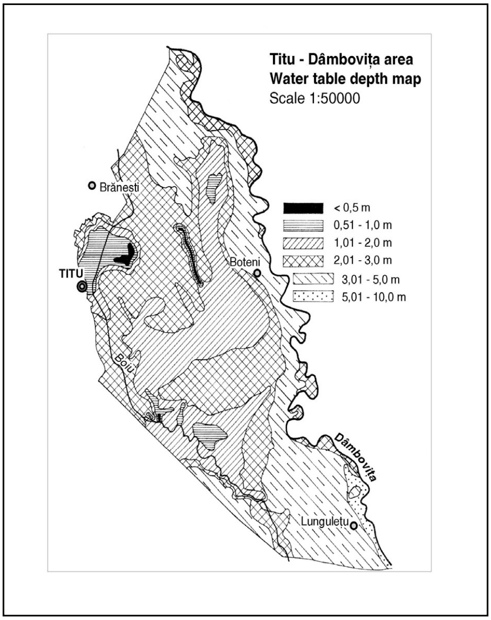

Fig. 4. Map of groundwater depth
in Titu-Dâmboviţa area

Under the specific of a divagation plain pedogenesis, there has formed a relatively wide range of soils belonging to Protisols, Cernisols, Cambisols, Luvisols, Hidrisols and Anthrisols (Fig. 5) [2, 4].

Protisols are represented by eutric and entic aluviosols. Usually, aluviosols characterize youngest relief forms, often subjected to alluviation by Dâmboviţa. Most of them have a mollic character, are under the influence of groundwater and even appear as gleyed.

These soils present a moderately developed profile. Most of them have a medium clayey texture, and their granulometry is dominated by fine sand (Table 1, Fig. 4). They have a neutral pH reaction (7.0-7.2), low humus content (2.1-2.2%) and a medium total capacity of exchange (20-22 me/100 g of soil). Their nutrient supply is poor.

Only phreatic cambic chernozems or gleyed subtypes represent ***Cernisols***. They appear locally, on higher parts of the floodplains, between Titu and Serdaru, being formed over loess-like sediments and flat, well-drained surfaces. They have a well-developed profile. Fine sand is also predominant in their composition (40-46%), followed by the clay fraction (under 34%). They have a slightly acid to neutral reaction (6.4-7.2), small to medium humus content (3.0-3.25%) and mid-supply with nutrients (N, 0.15-0.16% P, 16-20 ppm and K between 137 and175 ppm) (Table 1, 2) [5].

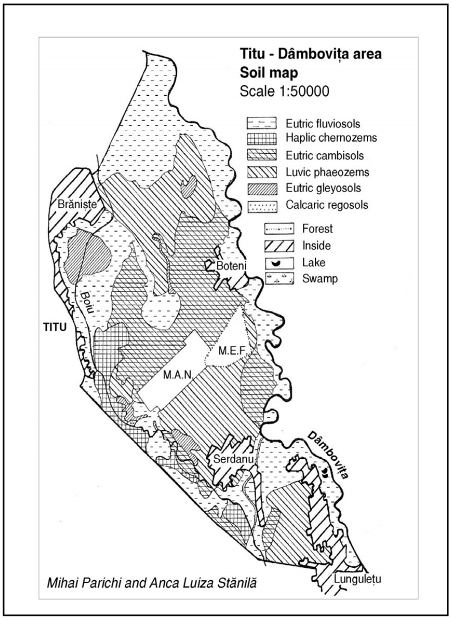

Fig. 5. Soil map of Titu-Dâmboviţa area

Table 1. Major physical characteristics of soils in Titu-Dâmboviţa area

Horizon	Depth	Granulometry			
		<0.002 mm	0.002-0.02 mm	0.02-0.2 mm	0.2-2.0 mm
Mollic Aluviosol					
Ap	0-16	25.8	24.8	42.5	6.9
Am	16-27	23.2	25.6	44.2	7.0
AC	27-42	22.6	28.1	39.8	9.5
C	65-85	25.7	19.3	46.5	8.5
Typical Cambic Chernozem					
Ap	0-18	28.7	25.7	41.6	4.0
Am	18-39	30.4	26.9	40.5	2.2
AB	40-50	33.2	31.3	34.5	1.0
Bv_1	50-70	34.0	25.4	39.7	0.9
Bv_2	80-100	32.1	29.9	37.1	0.9
Gleiyc Eutric Cambosol					
Ap	0-20	30.1	24.5	44.5	0.9
Am	24-38	27.7	31.1	40.4	0.9
AB	38-50	24.8	27.2	47.0	1.0
Bv_1	50-70	27.4	20.4	52.0	0.2
Bv_2	75-95	23.9	21.1	54.3	0.7
CG	115-135	39.0	29.2	31.1	0.7

Table 2. Major chemical characteristics of soils in Titu-Dâmboviţa area

Horizon	Depth	pH	Humus %	T me/100 g sol	Nt %	P mobil ppm	K mobil ppm
Mollic Aluviosol							
Ap	0-16	7.0	2.1	21.6	0.12	13.6	49.7
Am	16-27	7.1	2.0	20.6	0.10	45.5	88.8
AC	27-42	7.9	1.4	20.6	0.08	-	-
C	65-85	8.1	-	18.5	-	-	-
Typical Cambic Chernozem							
Ap	0-18	6.4	3.22	-	0.16	20.2	175.0
Am	18-39	6.9	2.08	-	0.13	16.3	137.1
AB	40-50	7.2	1.48	-	0.08	-	-
Bv_1	50-70	-	-	-	-	-	-
Bv_2	80-100	7.4	-	-	-	-	-
Gleiyc Eutric Cambosol							
Ap	0-20	6.1	2.3	-	0.14	4.9	111.7
Am	24-38	6.7	2.1	-	0.11	5.10	95.7
AB	38-50	6.9	1.5	-	10.3	-	-
Bv_1	50-70	7.1	-	-	-	-	-
Bv_2	75-95	7.5	-	-	-		-
CG	115-135	-	-	-	-	-	-

Cambisols are spread over a compact central area and are represented by gleyic eutric cambosols. They have formed on aluvio-proluvial materials slightly turned into loess and present a well-developed profile.

Analytical data for these soils show moderate clay content (27-30% in the upper horizon and not more than 39% to the base), but relatively high content of fine sand (40-52%).

They have a slightly acid to neutral pH reaction and the degree of saturation locates them in the category of eubazic soils. As for the humus content, it is below 2.3%. The supply of nutrients in these soils is poor (Fig. 6, 7) [5].

Luvisols are also present in the territory, by *mollic-vertic preluvosols*, over compact areas between Branişte and Lunguleţu.

They are characterized by a slight texture differentiation and a relatively high content of coarse sand. Their reaction is slightly acid to neutral (6.3-7.0), the humus content is low (2.4-3.2%), mainly concentrated within the upper horizon and a good supply of nutrients.

Hidrisols are represented only by *gleiosols*. These soils have a local appearance; their presence is due to some micro-depression areas and the existence of old, abandoned riverbeds near Boteni, Sălcuţa and Săveşti villages.

They have appeared on fluvial deposits, conditioned by a rich water regime. The hydrostatic level of groundwater is often hovering below 1 m depth.

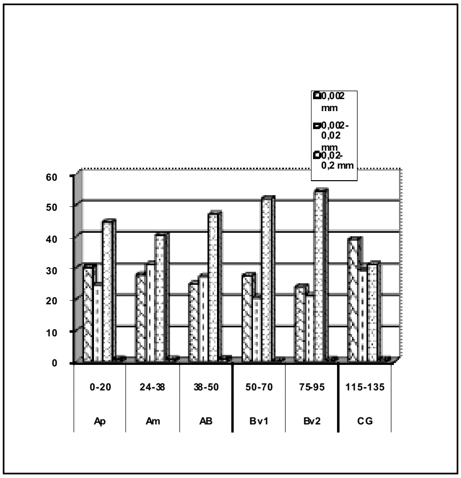

Fig. 6. Size composition of gleyed eutricambosol

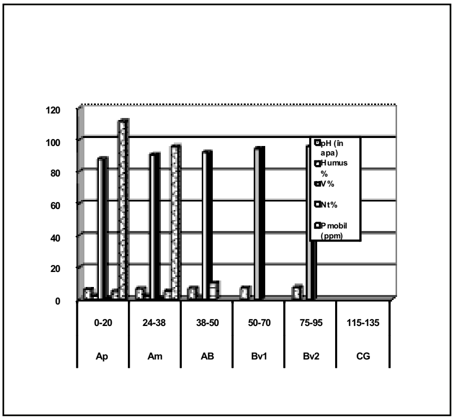

Fig. 7. Chemical proprieties of gleyed eutricambosol

The profile of these soils denotes a slight variation of clay content that recalls, of course, some stratification of parent material.

They appear as loose (-42.6.... -10%) and have high permeability at the surface and medium along the profile (3.1-96 mm/h).

In all cases, they have medium humus contents (4.3-4.8%), a neutral to slightly alkaline reaction (7.5-8.0) and a good supply of nitrogen nutrient (0.38%), but less adequate in phosphorus (3.6 ppm) and potassium (68.2 ppm) (Table 3, 4, Fig. 8, 9) [5].

Table 3. Physical characteristics
of major soils of the Titu- Dambovişa

Horizon	Depth	Granulometry			
		<0.002 mm	0.002-0.02 mm	0.02-0.2 mm	0.2-2.0 mm
Mollic-vertic preluvosol					
Ap	0-18	41.8	27.0	23.4	7.8
Amy	18-37	45.0	25.5	22.5	7.0
ABy	37-50	43.4	23.8	23.5	9.3
Bty	60-80	49.3	25.6	18.1	7.0
Bt	120-140	49.5	28.5	15.8	6.2
Eutric-molic gleiosol					
Ao	0-8	32.0	24.1	40.7	3.2
AG	10-23	33.3	25.1	37.3	4.3
Gor	23-40	27.3	26.3	42.4	4.0
Gro	40-70	33.7	25.8	36.4	4.1
Gr	80-100	46.6	31.5	20.2	1.7

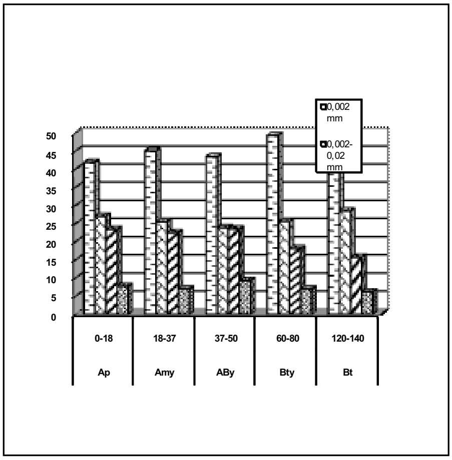

Fig. 8. Size composition of mollic vertic preluvosol

Table 4. Chemical characteristics of major soils
of the Titu- Dambovişa

Horizon	Depth	pH	Humus %	T me/100 g sol	Nt %	P mobil ppm	K mobil ppm
Mollic-vertic preluvosol							
Ap	0-18	6.7	3.2	94.2	0.18	20.8	188.4
Amy	18-37	6.3	2.4	92.3	0.13	1.8	116.3
ABy	37-50	6.6	1.5	93.2	0.12	-	-
Bty	60-80	7.0	-	96.6	-	-	-
Bt	120-140	7.7	-	-	-	-	-
Eutric-molic gleiosol							
Ao	0-8	7.5	4.8	-	0.38	3.6	68.2
AG	10-23	7.6	4.3	-	0.24	10.4	95.7
Gor	23-40	7.7	2.4	-	0.16	4.1	64.8
Gro	40-70	7.8	1.5	-	-	-	-
Gr	80-100	7.6	-	-	-	-	-

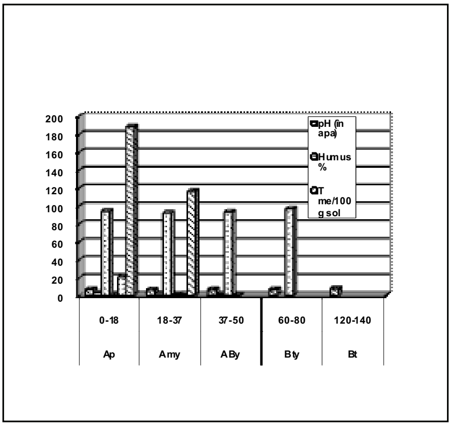

Fig. 9. Chemical proprieties of mollic vertic preluvosol

Anthrisols cover an insignificant area and are represented only by calcic erodosols.
They appear only on a former riverbed slope of Dîmbovişa, in the Serdanu. They have an incipient *Ap-C* profile, weak loamy texture and are rarely used for pasture.

CONCLUSIONS

Most of the investigated area is cultivated with cereals, but poor production results. Soils, relief and the drainage are the limiting factors.
The soil refers at texture (predominantly loamy and clayey and concerns the high degree of compaction and small permeability).
The relief imposes by slight alluvial irregularities and abandoned riverbeds and poor drainage occurs over more than two thirds of the territory. Floods add to all of these, even if they occur relatively rarely.

Under these conditions, most of the territory belongs to classes II (2207 ha) and III (673 ha) of land suitability to plowing.

To meet these shortcomings, a series of requirements for agro-pedo-ameliorative measures must be imposed for the impoundment of Dâmboviţa between Lunguleţu and Nucet localities: regulation of streambed, lavage, the improvement of soil aero-hydric regime and enforcement of agricultural work during the optimum time. A possible development for irrigation must be accompanied by an appropriate drainage system.

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AN OVERVIEW ON THE MAIN PROPERTIES OF A GLEYIC PHAEOZEM LOCATED IN MITOC, BOTOŞANI COUNTY, ROMANIA

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Abstract

The present scientific paper focuses on morphological description and characterization of one of the most representative soil types in Romania, in terms of natural fertility – the phaeozem. In order to emphasize its main physical and chemical features, a soil profile was digged on a plane arable surface located in Mitoc locality, Botosani county – a region situated in Romania's north-eastern part. The field characterization of soil, as well as the laboratory analysis, were made in order to evaluate its current agricultural potential, especially because the land occupied by phaeozems that corresponds to the investigated area has been used as pasture in the past, but it's intended to be intensively cultivated in present. The indicators that were analysed refer to both physical and chemical soil features, such as: particle size distribution (soil texture), carbonates content, soil reaction, organic matter content, C/N ratio, macronutrients content (total nitrogen, mobile phosphorus, mobile potassium), as well as a few of the micronutrients (such as zinc, copper, iron and manganese). All the soil samples collected from the field were analysed at National Research and Development Institute for Soil Science, Agro-Chemistry and Environment (ICPA Bucharest), in early 2012. The interpretation of data was made in accordance to the Methodology of Soil Studies Elaboration. The results indicated that the phaeozem investigated in Mitoc is a loamy soil, with moderate soil reaction, medium humus content, medium nitrogen, but very low phosphorus content on the entire soil profile; also, due to the particularity of the relief in the area, it is highly influenced by the ground water level, an aspect which led to frame it as a gleyic phaeozem subtype.

Key words: *phaeozem, Mitoc - Botosani, physical and chemical indicators, agricultural potential.*

INTRODUCTION

Phaeozems are among the world's most fertile soils, occupying approximately 1.5% of the continental land area on Earth, highly spread in American prairies in the north, as well as in south-eastern part of Europe, American pampas in south and Asian steppes [7]. In Romania, phaeozems are located mostly along the chernozems area, significant surfaces could be especially found in sub-Carpathian regions and Moldavian Tableland [6]. Due to their natural fertility, all surfaces occupied by phaeozems present major agricultural interest. In this context, the present work-paper focuses on the investigation of a phaeozem soil, located in Romania's north-eastern part, (respectively in Botosani county), in order to bring up to date the pedological data and to prepare the 300 ha land surface occupied by this specific soil for intensive using as arable land and a large range of crops. The investigated perimeter is part of Moldavian Plain, Dărăbani geomorphologic district [1]. The whole area, situated in close proximity to Prut river (less than 5 km distance), has an average altitude of 100-125 m. A particularity of the researched area is represented by the presence of small springs, an aspect which significantly influences soil type morphological features. At the date of field investigation, in 2011, the land occupied by phaeozems was used as pasture.

MATERIAL AND METHOD

In order to point out the main indicators that are related to agricultural potential of the phaeozem corresponding to the investigated perimeter, a profile was prepared and morphologically described in the early summer of year 2011, when the field was still unused for annual crops cultivation. The delimitation of the soil layers, the field observations, as well as the collection of soil samples for laboratory were made in accordance to the current pedologic methodology [8]. Based on the influence exerted by environmental elements and the determination of soil characteristics, the soil was identified as a Gleyic Phaeozem – FZgc (PHgl according to WRB-SR, 1998), with a profound, considerable thickness of topsoil horizon, Am (fig. 1). An important characteristic in definition of this specific soil type was represented by the absence of carbonates on the entire soil profile [4, 6] - as the samples treated with HCl solution and the soil analysis demonstrated later on. After the identification and short description in the field, soil samples have been taken for detailed laboratory analysis at ICPA Bucharest, Department of Agro-Chemistry and Plant Nutrition. The following indicators were determined: *particle size distribution* – using the standard procedure, based on sedimentation, pipette sampling and chemical treatment; *soil reaction* – by potentiometric method, in water suspension (1: 2.5); *humus content* (%) by Walkley-Black method, modified by Gogoaşă; *total nitrogen* – by Kjeldahl method; *mobile phosphorus and potassium content* by Egner-Riehm-Domingo method; in addition to this, a few of some *soil micronutrients* (such as Zn, Cu, Fe, Mn) were considered. The interpretation of laboratory data was made according to the limits prefigured by the previous cited methodology [8].

RESULTS AND DISCUSSIONS

Aspects regarding the morphology of the profile. As it could be observed in figure 1, the soil profile highlights the most important characteristics of phaeozems, respectively: *profound and dark Am horizon* (2.5B1/2 value according to Munsell color chart); *transition horizon with chroma < 3.5*; *the absence of carbonates*, as well as the *sporadic presence of biogenic formations.* However, in ABv and Bv horizons, slight mineral films were observed, continuing with increased accumulation of manganese and iron formations, along the profile depth.

Location: west of Mitoc village
Parental material: loess deposits [9]
Relief: generally flat
Average height: 100-150 m
Land using: pasture
Ground water depth: 1-1.5 m
Texture determined in the field: loamy

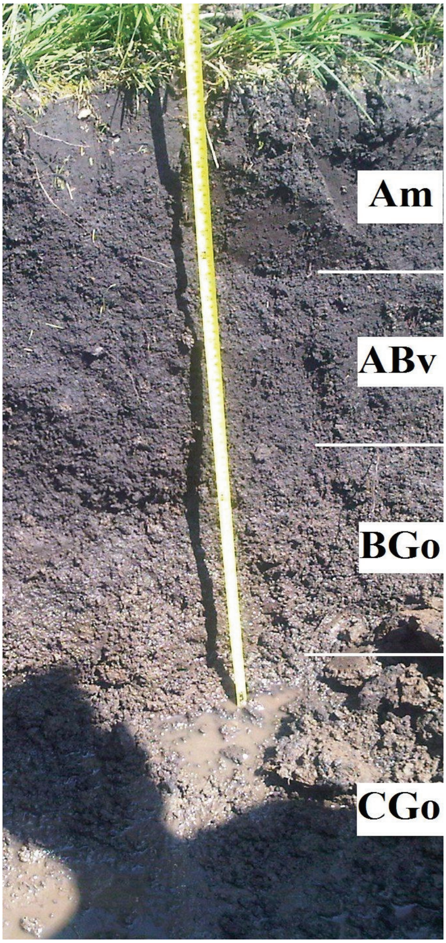

Fig. 1. Gleyic phaeozem profile - Mitoc, BotoŞani

Within profile, the soil material is slightly moist, a feature which increases and becomes dominant in Bv layer. The profile is also characterized by the presence of gleyization process (which appears evident before 95 cm depth) and determined the delimitation of the Go horizon; as a result of that, before C horizon, the soil material presents the specific orange and reddish-brown gleyization spots, due to the presence of iron. The gleyization intensity is moderate. Stagnant ground water appears in C horizon (before 120 cm depth), an aspect which, along with the other mentioned characteristics, led to the definition of soil at the subtype level: Gleyic Phaeozem - PHgl (WRB-SR, 1998) (Photo 1).

Photo 1. Stagnant ground water on soil profile, which determines the appearance of gleyization process

Photo 2. The general configuration of the relief in the researched perimeter (capture of a cultivated plot)

According to the results provided by the analysis tests of collected samples (table 1), the phaeozem from Mitoc has a loamy (medium) texture; also, the laboratory data confirmed the absence of carbonates all across the profile, an important element in definition of this specific soil type [4]. In order to emphasize the agricultural potential of Mitoc gleyic phaeozem, the most representative chemical indicators have been determined and rated, such as: soil reaction (pH), humus content (H%), total nitrogen (Ntot), phosphorus and potassium (mg/kg^{-1}); also, the C/N ratio which, together with the humus content, reflects the potential fertility of one soil: the higher fertility potential when C/N ratio is lower [3]. Thus, the Mitoc gleyic phaeozem presents a neutral reaction in the topsoil and the second horizon, which becomes slighty alkaline, once the depth increases (Table 2). The humus content, correlated with soil loamy texture is rated as edium (4.8-4.32%) for the two surface horizons and, of course, decreases significantly with depth. The C/N values going from 13.4 - 12.8 are rated as medium. Regarding the major macronutrients content (N, P, K), determined values are as follows: 0.059-0.243% in case of *nitrogen*, the first indispensable nutrient for plants, reflecting a moderate supply in the first 50 cm of soil; 13.7-1.5 mg/kg^{-1}, in case of the second major macronutrient - a value which shows a very low to extremely low *phosphorus* content for Mitoc gleyic phaeozem; regarding the *potassium*, analytical data provide no surprise, respectively a good and a very good supply, in accordance with general chemical characteristics of this specific soil (Table 2). Because of the importance of some micronutrients for plants nutrition (as long as their value does not exceed the allowable limit), figure 2 presents the determined values for the considered inorganic compounds (zinc, copper, iron and manganese), in relation with each horizon of the profile. The values are rated according to the limits provided by the speciality literature [2]. The following considerations can be enunciated: zinc is rated as medium in the first 50 cm and low in the 55-120 cm interval; copper content is rated as high in all four horizons considered (> 1.5 mg/kg reference limit); iron content is over the normal limit (> 0.3 mg/kg), an aspect which can be correlated with the influence exerted by the high level of ground water and appearance of gleyization process; as for the manganese content, it is rated as moderate, overall (5-20 mg/kg).

Table 1. Physical characteristics and carbonates content of Mitoc gleyic phaeozem (2012)

Soil horizon	Depth (cm)	Granulometric fractions (% of soil mineral part)				Carbonates (%)	Soil texture
		Coarse sand (2-0,2 mm)	Fine sand (0.2-0.02 mm)	Loam (0.02-0.002 mm)	Clay (< 0.002 mm)		
Am	0 – 30	0.5	42.1	28.6	28.8	0.0	LL
ABv	30 – 55	0.4	41.2	27.9	30.5	0.0	LL
Bv	55 – 90	0.4	30.1	36	33.5	0.0	TP
C	90 -120	0.5	39.9	27.3	32.3	0.0	LL

Tabel 2. Representative chemical indicators of the analyzed phaeozem in Mitoc (2012)

Soil horizon	Depth (cm)	Soil reaction (pH)	Humus content (H%)	Total nitrogen (Nt)	C/N ratio	P_{AL} (mg/kg^{-1})	K_{AL} (mg/kg^{-1})
Am	0 - 30	7.11	4.80	0.243	13.4	13.7	201
ABv	30 - 55	7.12	4.32	0.239	12.2	3.7	190
Bv	55 - 90	7.58	1.92	0.101	12.8	1.5	208
C	90-120	7.85	0.48	0.059	5.49	1.1	187

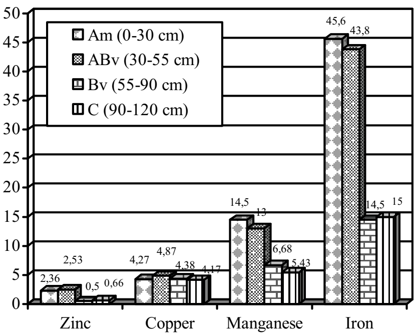

Fig. 2. Micronutrients content (mg/kg) for the investigated soil (2012)

CONCLUSIONS

The data regarding the investigated gleyic phaeozem located in Mitoc, Botosani county confirm its natural high potential for arable crops (medium texture, thick Am horizon, moderate humus content). Regarding the high level of ground water, as it was encountered in the field at the date of investigation, it can be evaluated as unfavourable only in the rainy years, when it can cause water excess and affect the soil normal airy and hydro regime. However, in latest dry years and in an area with no irrigation, it should not be considered as a restrictive factor, but on the contrary. A special attention should be given to nutrients supply: thus, although the micronutrients and potassium content are satisfactory, the phosphorus content rated as very low, as well as the medium nitrogen content, may impose the necessity of fertilization.

Still, the application of fertilizers, once the soil supply is already known, must be correlated with each plant requirements, anticipated yield and previous crop, in accordance to the proper agronomic technology. In addition to that, it is to say that the 300 ha land located in Mitoc and occupied by gleyic phaeozem can offer very good conditions for a large assortment of agricultural crops.

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THE EFFECT OF PROLONGED RELEASE MINERAL FERTILIZERS COATED WITH CO-POLYESTER FILMS FROM PET WASTE RECYCLING ON MAIZE PLANTS

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Abstract

The paper presents researches carried out in order to test complex mineral fertilizers coated with biodegradable co-polyester films using as raw material the polyethylene terephthalate (PET) waste, such as plastic bottles for food. Achieving of biodegradable coatings, based on polyethylene terephthalate, requires modifying the chemical structure of aromatic polyester (PET) with dicarboxylic acids (aromatic and / or aliphatic), and / or other polyols, to create a biodegradable capsule for prolonged release mineral fertilizers. In order to highlight capacity of complex mineral fertilizers coated with co-polyester films, to releasing nutrients in the soil in an extended time period, unlike common complex mineral fertilizers, a green house experiment was organized. Soil material used was collected from two contrasting soil types in terms of physico-chemical characteristics, namely Luvic Phaeozems, and Calcaric Fluvisols. The experimental variants were set up in vegetation pots of about 20 kg soils / pot capacity, in which fertilizer materials were introduced, namely co-polyester films coated complex mineral fertilizers ($N_{15}P_{15}K_{15}$) and regular granular complex mineral fertilizers. The crop was very early PR39D81 hybrid corn with excellent resistance to drought (hybrids belonging to the group FAO 200). For all measured phenological parameters: plant height, plant weight, root weight, cobs weight, grain weight and grain number, were recorded very significant increases in the values of the fertilized variants as compared to unfertilized, controls, variants of both soil types. The best results were obtained on Luvic Phaeozems soil where average size of maize plants at flowering stage was 29 cm higher in the variant fertilized with co polyester film coating complex mineral fertilizers, and 6cm higher in the variant fertilized with usual formula mineral fertilizers. Data obtained in this experiment showed that the effects generated by the use of complex mineral fertilizers coated with co polyester films in the proposed formula has been beneficial for the development of maize plants in a measure at least as high as in the classical variant of fertilization.

Keywords: *co-polyester films, mineral fertilizers, phenological parameters, polyethylene terephthalate, slow-release, soil.*

INTRODUCTION

To avoid problems caused by dissolving of fertilizers in soil moisture at a speed higher than its absorption in the plant, many types of slow-release active substance fertilizers were designed. One method to obtain such products involves creation of "core / shell" type micro-capsule, where *shell* consists in a polymeric film with low water permeability and the *core* is the active substances. If the polymer used for encapsulation is biodegradable, fertilizers are released slowly as a result of polymeric film biodegradation [9].

The physicochemical flexibility of branched polyesters achieved through simple modify-cation of the polymer systems, making them very usefully for the development of a variety of drug delivery vehicles in biomedical industry. The polymers' modular design is advantageous for the encapsulation of a wide range of drug compounds [6].

Aromatic polyesters such as polyethylene terephthalate, so-called PET shows excellent properties, which caused him to be marketed worldwide, often as packaging for liquids. However, until now, these polymers are considered resistant to microbial attack, so there is biodegradable, which is a huge disadvantage [1, 7, 8]. Starting from a desire to meet both biodegradability and superior properties of plastic materials, tests were performed on biodegradability co polyester monomers containing both aliphatic and aromatic [15]. Biodegradability of a plastic is implying the possibilities of living organisms to use it as a food source, by transforming its chemical structure within a reasonable period of time. The organisms which having this metabolic ability are microorganisms. Primary (or partial) biodegradability is altering the chemical structure resulting in loss of specific properties of polymers while the final (or total) biodegradability is total mineralization and assimilation of the resulting material by microorganisms [3, 4, 5]. The material is fully degraded by microorganisms to produce carbon dioxide or methane, water, mineral salts and biomass [12, 2]. The time period involved is usually several weeks to several months.

To obtain biodegradable coating materials, from polyethylene terephthalate, was performed modifying of the chemical structure of aromatic polyester (PET) by including of dicarboxylic acids and / or other polyols, thus resulting a co polyester structure. This co-polyester presents molecular weight high enough to ensure formation of a flexible and resistant to moisture continuous coating film proper for producing encapsulated fertilizers; able to provide controlled release of fertilizers, mainly by biodegradation, and which can being decayed to a convenient and measurable period of time under the influence of environmental factors.

Soil parameters such as humidity, temperature, pH, salinity, presence or absence of oxygen and nutrient supply level exerts a powerful effect on microbial degradation of polymers, so these conditions must be taken into account when testing biodegradability of polymers [11, 13, 14, 10].

MATERIAL AND METHOD

In order to highlight capacity of complex mineral fertilizers coated with co-polyester films, to releasing nutrients in the soil in an extended time period, unlike common complex mineral fertilizers, a green house experiment was organized, using soil material collected from two contrasting soil types in terms of physical-chemical characteristics, especially argyle content, namely Luvic Phaeozems, and Calcaric Fluvisols.

Experiment carried out in greenhouse, in vegetation pots with capacity of 20 kg of soil material / pot, with 5 repetitions for each variant, with those two different types of fertilizers: regular complex mineral fertilizers ($N_{15}P_{15}K_{15}$), and complex mineral fertilizers ($N_{15}P_{15}K_{15}$) coated with co-polyesters films, according to following experimental scheme:

Treatment code	Soil type	Treatment
V1	Luvic Phaeozems	Control - unfertilized
V2		Regular complex mineral fertilizers ($N_{15}P_{15}K_{15}$)
V3		Complex mineral fertilizers ($N_{15}P_{15}K_{15}$) coated with co-polyesters films
V4	Calcaric Fluvisols	Control - unfertilized
V5		Regular complex mineral fertilizers ($N_{15}P_{15}K_{15}$)
V6		Complex mineral fertilizers ($N_{15}P_{15}K_{15}$) coated with co-polyesters films

The crop was very early PR39D81 hybrid corn with excellent resistance to drought (hybrids belonging to the group FAO 200).

At the final of the plants vegetation period (at harvest), all phenological parameters were been measured: plants height. Plants weight, cobs weight, grains number/cobs, grains weight and roots weight. Data were statistically processed using standard analysis of variance (ANOVA), and differences between experimental variants were considered according to Tukey test (5%) values.

RESULT AND DISCUSSIONS

The plants height recorded significant differences between experimental variants, thus in both soil and fertilization types maize plants were been higher than control variants (Table 1, Fig. 1).

Whatever the type of fertilization, plant height of corn grown on Luvic Phaeozems was higher and statistically assured, than those grown on Calcaric Fluvisols. This result is normal because of natural properties of the first soil, well-known as more favorable for plants growing than those of the other soil type.

Table 1. Significance of biometrics data measured at maize plants in different fertilizing variants

Soil type	Fertilization	Plants height (cm)		Plants weight (g)		Cobs weight (g)		Grains number/cob		Grains weight (g)		Roots weight (g)	
		values	*significance*	*values*	*significance*	*values*	*significance*	*values*	*significance*	*values*	*significance*	*values*	*significance*
Luvic Phaeozems	**Control - unfertilized**	190	Ct	87.64	Ct	51.74	Ct	128	Ct	33.36	Ct	14.26	Ct
	Regular complex mineral fertilizers ($N_{15}P_{15}K_{15}$)	227	***	86.5		101.5	***	375	***	78.43	***	22.55	
	Complex mineral fertilizers ($N_{15}P_{15}K_{15}$) coated with co-polyesters films	216	**	84.47		95.2	***	328	***	74.75	***	12.96	
Calcaric Fluvisols	**Control - unfertilized**	163	Ct	91.91	Ct	55.86	Ct	123	Ct	37.36	Ct	21.34	Ct
	Regular complex mineral fertilizers ($N_{15}P_{15}K_{15}$)	202	***	77.86		83.68	**	279	***	62.18	**	18.41	
	Complex mineral fertilizers ($N_{15}P_{15}K_{15}$) coated with co-polyesters films	212	***	75.94		81.73	**	276	***	58.71	**	25.52	
	DL 5%	***14.1***		***17.769***		***15.676***		***70.4***		***14.187***		***9.852***	
	DL 1%	***19.3***		***24.35***		***21.481***		***96.5***		***19.441***		***13.5***	
	DL 0,1%	***26.3***		***33.171***		***29.263***		***131.4***		***26.484***		***18.391***	

The plants height
On Luvic Phaeozems, the best results concerning the maize **plant height** were been obtained under fertilization with regular complex mineral fertilizer, while on Calcaric Fluvisols the higher plants have grown under fertilization with complex mineral fertilizers coated with co-polyesters films.

The plants weight
Despite the fact that corn plants were shorter in fertilized variants, their weight was higher than that of plants grown in fertilized variants, in both types of soil or fertilization (Table 1, Fig. 2). Differences were more visible in the Calcaric Fluvisols case, while in Luvic Phaeozems values were been very closely.

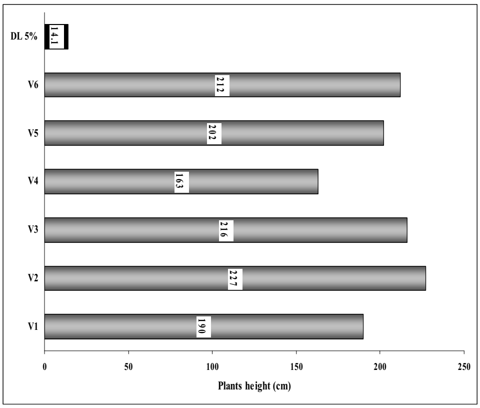

Fig. 1. Effect of fertilizer type on maize plants height

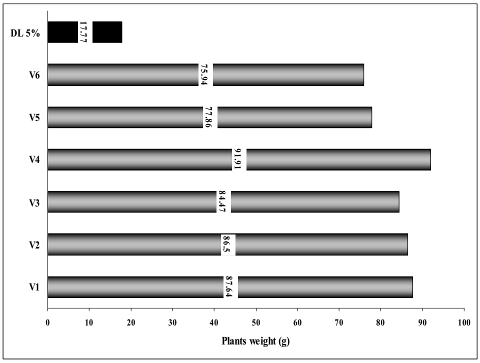

Fig. 2. Effect of fertilizer type on maize plants weight

The corn cubs weight

Very suggestive are the differences between experimental variants, in terms of **weight of corn cobs** (table 1, fig. 3). Thus both type of mineral fertilizers applied have leaded to very significant increases in weight of corn cubs, also for plants cultivated on Calcaric Fluvisols and Luvic Phaeozems. The best result was recorded in Calcaric Fluvisols variant fertilized with regular complex mineral fertilizer.

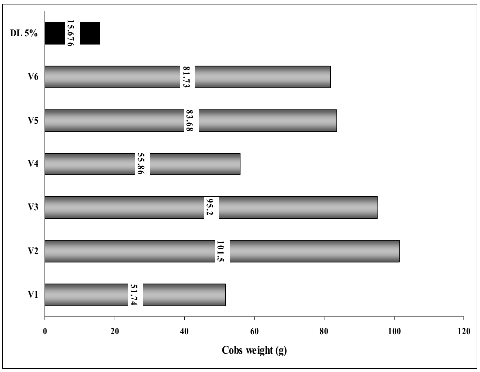

Fig. 3. Effect of fertilizer type on corn cobs weight

However, the two types of fertilizers, regular or coated with co polyester films have not resulted in significant differences between them, cobs weight values being relatively similar, for plants cultivated on the same soil type.

The grain number / corn cub

Results of measurement of other biometric parameter, **the grain number / corn cub**, are very similar with those described already for corn cubs weight (Table 1, Fig. 4).

The great value for entire experiment was recorded in variant cultivated on Calcaric Fluvisols and fertilized with regular mineral fertilizer. For the same soil type, value of the grain number / corn cub was noticeably reduced, but without statistic significance.

Very significant are remaining the differences between fertilized variants for both soil types and also for both types of mineral fertilizers, regular or coated with co polyester films, and the control variants, without fertilization.

Were been recorded very close values of grain number / corn cub in both control variants.

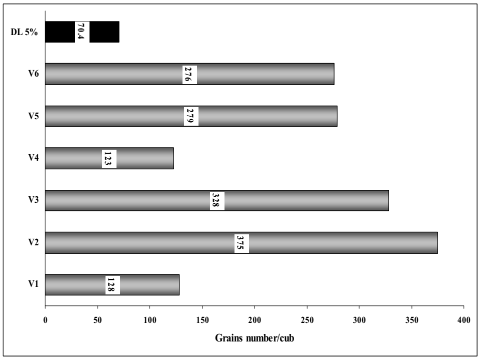

Fig. 4. Effect of fertilizer type on grains number/cubs

The grain weight

Obviously, the measurement of this biometric parameter furnished results that leaded the same pattern as data reported for the corn cubs' weight (Table 1, Fig. 5).

There are significant differences between the variants generated by soil type, the "harvest" recorded on Luvic Phaeozems being higher than that from Calcaric Fluvisols.

But, the most important differences were been obtained between experimental variant with and without fertilization.

The higher parameter value was obtained in variant cultivated on Calcaric Fluvisols and fertilized with regular mineral fertilizer.

The roots weight

Although the values obtained are not statistically different, the measurements showed differences between experimental variants (Table 1, Fig. 6).

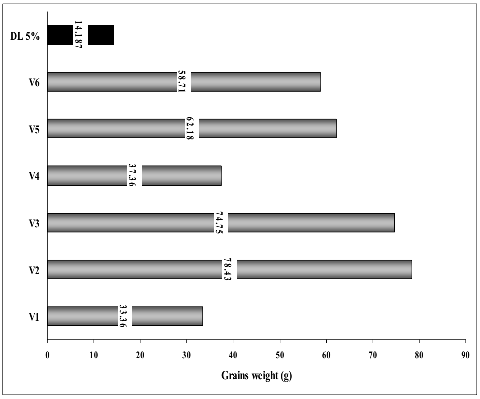

Fig. 5. Effect of fertilizer type on grains weight

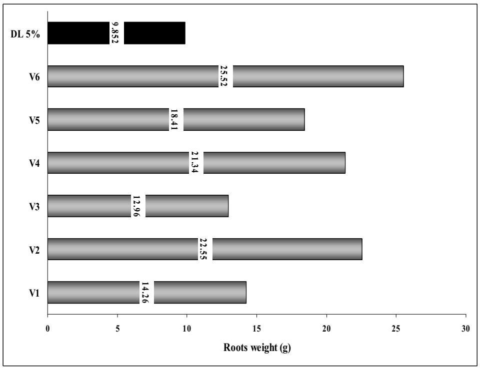

Fig. 6. Effect of fertilizer type on maize roots weight

In case of Luvic Phaeozems, the best development of maize roots have been recorded in the variant fertilized with regular complex mineral fertilizers, while in Calcaric Fluvisols the maize roots have been grown much better in experimental variant fertilized with complex mineral fertilizers coated with co polyester films. This result may be due to the improvement of soil structure through the application of complex mineral fertilizers coated with co polyester films, so that, in case of such a clayed soil, to promote a better development of roots of cultivated plants.

Data presented in Table 2 clearly showing the beneficial effects of applying the complex mineral fertilizers with NPK, both in regular formula, and coated with co polyester films version.

For all biometric parameters analyzed: plant height, weight of each plant, roots weight, cubs weight, grain weight and grain number, very significant increases in the values of the fertilized variants as compared to unfertilized (controls) variants of both soil types, were recorded

The best results were obtained in variants organized on Luvic Phaeozems soil, where the average size of maize plants at the flowering stage, in the variant fertilized with complex mineral fertilizers coated with co polyester films was 29 cm higher than control, and 6 cm higher than in variant fertilized with complex mineral fertilizers in regular formula.

It can be stated that the data obtained in this experiment have shown that the effects resulting from the use of complex mineral fertilizers coated with co polyester films in formula proposed in this research has been beneficial for development of the plants in a measure at least as good as the conventional fertilization.

Table 2. Significance of fertilization type on biometric parameters of maize plants in different fertilizing variants

Fertilization	**Plants height (cm)**		**Plants weight (g)**		**Cobs weight (g)**		**Grains number/cob**		**Grains weight (g)**		**Roots weight (g)**	
	values	***signify-cance***	***values***	***signifi-cance***	***values***	***signifi-cance***	***values***	***signifi-cance***	***values***	***signifi-cance***	***values***	***signifi-cance***
Control - unfertilized	177	Ct	89.77	Ct	53.8	Ct	125	Ct	35.36	Ct	17.8	Ct
Regular complex mineral fertilizers ($N_{15}P_{15}K_{15}$)	215	***	82.18		92.59	***	327	***	70.31	***	20.48	
Complex mineral fertilizers ($N_{15}P_{15}K_{15}$) coated with co-polyesters films	214	***	80.2		88.47	***	302	***	66.73	***	19.24	
DL 5%	***9.9***		***12.565***		***11.085***		***49.8***		***10.032***		***6.966***	
DL 1%	***13.6***		***17.218***		***15.189***		***96.5***		***13.747***		***9.546***	
DL 0,1%	***18.6***		***23.455***		***20.692***		***131.4***		***18.727***		***13.005***	

CONCLUSIONS

Experimental data clearly showing the beneficial effects of applying the complex mineral fertilizers with NPK, both in regular formula, and coated with co polyester films version.

For all biometric parameters analyzed: plant height, weight of each plant, roots weight, cubs weight, grain weight and grain number, very significant increases in the values of the fertilized variants as compared to unfertilized (controls) variants of both soil types, were recorded.

The effects resulting from the use of complex mineral fertilizers coated with co polyester films in formula proposed in this research has been beneficial for development of the plants in a measure at least as good as the conventional fertilization

Use of complex mineral fertilizers coated with co polyester films in formula proposed in this research did not induced toxicity aspects for maize plants.

Our research highlighted that the use of PET waste for production of co polyester films with applicability in production of complex mineral fertilizers, in prolonged release formulation, is a real and extremely useful possibility for recycling of this enormous waste accumulated in the environment.

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THE BEHAVIOUR OF SOME SUNFLOWER (*Helianthus annuus*) HYBRIDS FROM ABROAD UNDER WATER AND HEAT STRESS AT ARDS SIMNIC

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Abstract

The heat and water stress always bring about a diminishing of yields, the magnitude of it being influenced by the duration and the intensity of the stress phenomenon. Sunflower is a drought tolerant species yet long term water shortage can inflict damages in the growing and development of the sunflower plant. The present paper deals with 5 sunflower hybrids of German origin in the soil and clime conditions of ARDS (Agricultural Research and Development Station) Simnic (Dolj) in the „extremelly" dry year 2007 and during 2008 year which was considered dry. There were recorded reductions of the vegetation phases, of productivity elements as well as of seed yield. The best yield was given by Enduro hybrid and this hybrid is recommended for extension and further studies in this area and simmillar areas.

Key words: *head diameter, plant height, seed yield, sunflower, water and heat stress.*

INTRODUCTION

Sunflower is an important crop for Romania, ranking third in area after corn and wheat [3]. The main factor of progress of this culture is the introduction and expansion of production of sunflower hybrids with high production potential and high resistance to biotic and abiotic stress factors. Of abiotic stress factors, drought is an important goal of improving the species, especially in Oltenia area.
Although, in general, sunflower is a species well adapted to drought, due to efficient root system, the effects of climatic stress disturbance is manifested by morpho-anatomical, physiological and biochemical changes that ultimately lead to lower agricultural production [6].
In recent years the supply of sunflower hybrids became diverse, reaching 148 hybrids [1].
Therefore, sunflower growers must know these hybrids, both in terms of morphological and physiological traits and characteristics in terms of production, to choose hybrid or hybrids that best fit the actual conditions culture [4, 5].
This paper aims to analyze the behavior of five sunflower hybrids in central Oltenia area based testing for multi-cultures, compared with the recommendation of the best-adapted crop hybrids.

MATERIAL AND METHOD

Biological material was represented by five experimented sunflower hybrids of German origin (Mateol RO, Heliasol RO, Enduro, Salut RM, Heliador). Experimentation was done on a red preluvosoil, the ARDS Şimnic in crop years 2006 -2007 and 2007-2008. Studies were made on both seed yield and main elements of productivity of hybrids. Experimental variants were located by the method plots randomized blocks with four repetitions pattern. Each experimental plot had an area of 29.4 m2.
The experimental results were statistically processed by analysis of variance - Anova, F test and differences limit [7].
Analysis of connections between the characters was done by simple correlation method [2].
To better characterize the climatic conditions of experimental years 2007-2008, there are

presented, in comparison (Table 1) the monthly rainfalls and average temperatures and multiannual average, hence the extreme drought and the dry period relevant to the sunflower crop in the experimental years.

Table 1. The climatic conditions of experimental years 2007-2008 at ARDS Simnic

Year agricol	The months of the year					
	The cold period 1X - 31III	IV	V	VI	VII	VIII
Rainfalls (mm)						
Multi-annual average	203.4	54.0	63.7	74.4	88.3	66.3
2006/ 2007	-63.9	-54.0	+55.3	-27.4	-81.3	+49.7
2007/ 2008	+179.7	-2.0	-35.7	-30.4	+22.9	-66.3
Temperatures 0 C						
Multi-annual average		11.8	17.8	21.2	23.8	23.2
2006/ 2007		+0.9	+0.9	-0.4	+5.4	-0.1
2007/ 2008		+0.6	-0.7	+5.9	-0.3	+1.1

RESULTS AND DISCUSSIONS

The analysis of variance for seed yield and productivity elements of sunflower hybrids in 2007-2008 (Table 2) revealed distinct significant interaction effects of the years with the hybrids in respect of seed yield, plant height and the 1000 seed weight (TSW), and significant effects for the head diameter.

They show that hybrids react differently from one year to another.

Analyzing the experimental results for each year separately shows that the values obtained were similar for both seed yield and the elements of productivity.

In 2008 seed yield ranged from 1.29 t/ha to 1.79 t/ha (Fig. 1). The highest yield was obtained by hybrid Enduro (1.79 t/ha - a very significant positive difference from the control), followed by hybrid Mateol RO (1.63 t/ha - with a distinctly significant positive difference from the control).

Table 2. Anova and F test for seed yield and elements of productivity

Source of variance	Degrees of freedom	Sum of squares	Mean square	F- value
Seed yield				
Years	1	0.01		
Hybrids	4	1.20	0.3	
H x Y	4	14.81	3.70	16.04** (3.01-4.77)
Error	16	0.30	0.0187	
Plant height				
Years	1	563.36		
Hybrids	4	729.03	182.25	
H x Y	4	118.91	29.72	5.25** (3.01-4.77)
Error	16	555.26	34.70	
Head diameter				
Years	1	456.3		
Hybrids	4	807.2	201.8	
H x Y	4	387.2	96.8	23.9** (3.01-4.77)
Error	16	134.8	8.42	
TSW				
Years	1	22.56		
Hybrids	4	52.56	13.14	
H x Y	4	78.08	19.52	4.56* (3.01-4.77)
Error	16	46.16	2.88	

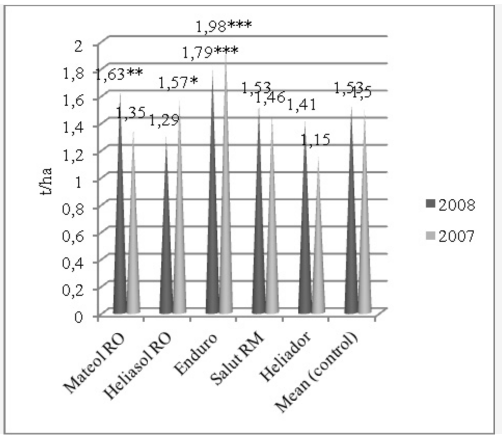

Fig. 1. Seed yield at hybrids studied - ARDS Simnic, 2007-2008

In 2007 seed yield ranged from 1.15 t/ha and 1.98 t/ha, the largest seed yield recorded by hybrid Enduro (1.98 t/ha).

Helisol RO hybrid had a good production (1.57 t/ha), significantly superior to control (mean).

The plant height in 2008 (Fig. 2) ranged between 106 cm and 126 cm.

Salut RM hybrid significantly exceeded only control (126 cm), the remaining hybrids recorded close to control and they were insignificant.

In 2007 the plant height varied between 100 cm and 110 cm emphasizing Salut RM hybrid (118 cm) which significantly exceeded the control.

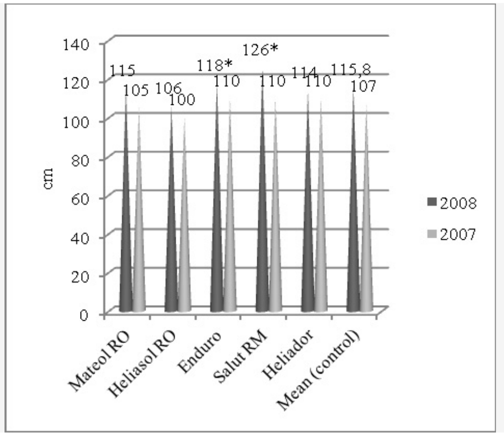

Fig. 2. Plant height at hybrids studied - ARDS Simnic, 2007-2008

The head diameter (Fig. 3) hybrids studied in 2008 ranged from 13 cm to 19 cm.

Enduro hybrid recorded the largest head diameter (19 cm - significantly positive compared to the control).

In 2007, hybrid Mateol RO recorded the largest head diameter (20 cm - significantly positive compared to the control).

1000 seed weight (TSW) in 2008 (Fig. 4) ranged between 34 g and 60 g, the highest value obtained TSW Mateol RO a hybrid (60 g), the only hybrid significantly exceeded distinct control.

In 2007, Enduro was the only hybrid which recorded a significantly higher TSW compared to the control (44 g).

As a mean, those two years of experimentation (Table 3) obtained a seed yield of 1.52 t/ha. We noted that Enduro hybrid with a production of 1.89 t/ha, was very significantly superior to control.

The lowest seed yield was obtained by Heliador (1.28 t/ha) and the remaining hybrids have achieved insignificant production.

The highest plant height (Table 3) was recorded at hybrid Salut RM (122 cm), the largest head diameter was obtained by hybrid Enduro (18.5 cm), and the largest TSW was obtained by hybrid Mateol RO (51 g).

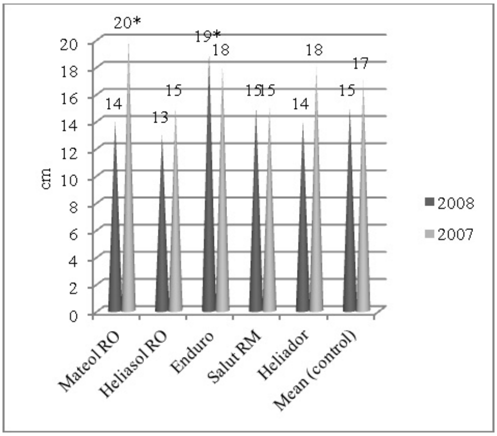

Fig. 3. Head diameter at hybrids studied - ARDS Simnic, 2007-2008

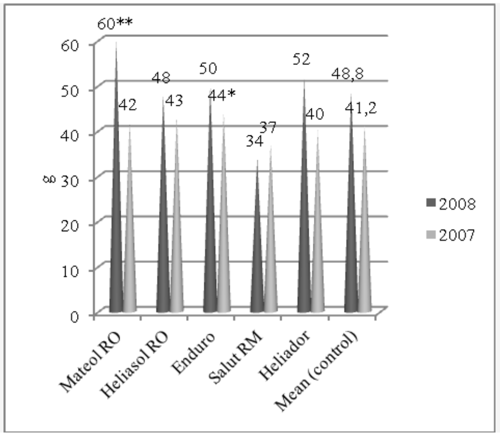

Fig. 4. 1000 seed weight at hybrids studied - ARDS Simnic, 2007-2008

In the study there were observed correlations between characters (Table 4) yet they were insignificant.

Table 3. Mean values for seed yield and productivity elements - ARDS Şimnic (2007-2008)

Hybrid	Seed yield (t/ha)	Plant height (cm)	Head diameter (cm)	TSW (g)
Mateol RO	1.49	108	17	51**
Heliasol RO	1.43	103^{0}	14^{0}	45.5
Enduro	1.89***	114	18.5*	47
Salut Rm	1.50	122**	15	35.5^{000}
Heliador	1.28^{00}	110	16	46
Mean (control)	1.52	111.4	16.1	45
LSD 5%	0.165 t/ha	7.21 cm	1.97 cm	3.54 g
LSD 1%	0.227 t/ha	9.93 cm	2.72 cm	4.88 g
LSD 0.1%	0.317 t/ha	13.84 cm	3.79 cm	6.80 g

Correlations between seed yield and elements of productivity were positive but very small, contrary to data obtained by other authors showing that adverse climatic conditions of culture can change these correlations.
The only negative correlation, there was close to significant between plant height and TSW.

Table 4. Correlations between seed yield and productivity elements in hybrids studied - ARDS Şimnic (2007-2008)

	Seed yield (t/ha)	Plant height (cm)	Head diameter (cm)	TSW (g)
Seed yield (t/ha)	-	0.302	0.694	0.089
Plant height (cm)		-	0.186	-0.743
Head diameter (cm)			-	0.486
TSW (g)				-

CONCLUSIONS

- The climate of the years 2007-2008 were unfavorable for sunflower crop.
- Enduro hybrid obtained the highest seed yields in both years of experimentation, recommending extension of the culture for the study area and other areas with similar climatic conditions.
- The least adapted to the experimental conditions was the hybrid Heliador which gave negative differences in comparison with control, both in 2007 and in 2008.
- In these conditions, plant height, head diameter and TSW were positively correlated with seed yield, but the values were insignificant.

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STUDY REGARDING USEFUL FAUNA ON CORN PLANTS

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Abstract

A large number of insects are living in the maize agroecosystem, being a species community and each species has a particular place in the food chains. If a lot of studies were done, in Romania about biology, ecology and control of corn insect pest, there are few knowledge about useful fauna or "non target organisms" [non target organism = an organism which is affected by an interaction (for example, a pesticide application) for which it was not the intended recipient]. Beneficial organisms include various insects and mites that feed on or parasitize corn pest species. During 2010-2011 there where counted arthropod fauna from corn plants, taking into consideration "transgenic" corn hybrids and conventional Romanian hybrids. Foliar non-target arthropod abundance was assessed using visual counting. Variants were in 4 replications, each corn plot had 4 rows and plot's area was 20.3 m2. Arthropods collected during animal visual counting on corn plants, for identification, were preserved in 700 alcohols and determined in the laboratory. Taking into consideration that not all specimens have been determined at species level, part of them were determined till the level of the genus, family, order or class. Possible impact of pesticide and GMOs crops on the trophic chains in agrocoenoses is of concern to farmers, to policy makers and to organizations and societies interested in environment conservation. The evaluation of hazards connected with the creation and release of GMOs should consider, among other things, their environmental impact. In terms of main species of arthropods captured, that are living on corn plants, the most abundant groups of insects belong to species of order Heteroptera, Coleoptera-Coccinellidae, Neuroptera and to spiders from arachnids. Between cultivars taken into consideration there are no significant differences from point of view of species structure or number of specimens on corn plants.

Key words: *transgenic corn hybrids, foliar non-target arthropod.*

INTRODUCTION

As a basic concept, biological diversity or biodiversity refers to the variety of life forms: the different plants, animals and micro organisms, the genes they contain, and the ecosystems they form [6]. The concept emphasizes the interrelated nature of the living world and its processes and is usually considered at main level, species diversity, Species diversity has two parts. Richness refers to the number of species found in a community and evenness refers to the relative abundance of each species [3]. The simplest measure of diversity is to count number of species in an area (species richness), but the major problem in species richness measurement is that species richness does not take into account species abundance and is highly influenced by sample size [6]. Ecosystem relationships resemble a web of connections from one living thing to many other living and non-living things. Due to the complex nature of ecosystem relationships, the removal or disturbance of one part of the ecosystem could affect the functioning of many other components of the ecosystem. Our knowledge of these relationships is incomplete, and the results of disturbance are thus to some extent unpredictable [7]. In this respect we approach our research, referring to corn agroecosystem in connection with corn cultivars. There are not enough data about the presence of different insect species in corn fields in most European countries. The distribution and abundance of different species depends on various factors (microclimate, fertilizing, organic matter content, previous crop, previous insecticide use, presence of weeds, etc.). If a lot of studies were done, in Romania about biology, ecology and control of corn insect pest, there are few knowledge about useful fauna or "nontarget organisms" [1, 2, 4]. Corn agricultural agroecosystems is considered unstable ecosystems, with specific interdependencies between different food chains that natural factors play a role. Imbalance of the number of different populations, the man some considered harmful, others useful, usually called "natural enemies of pests", requires a change in pest control strategy, which aims to maximize the natural factors of control and routing measures intervention by clean methods, men\support biodiversity [5].

MATERIAL AND METHOD

Foliar non-target arthropod abundance was assessed using visual counting. Variants were in 4 replications, each corn plot had 4 rows and plot's area was 20.3 m2. The observations were done on Tuesday in 2009-2010, as visual count (4 x 10 maize plants per each cultivars) was used to register all specimen fauna (once, in May and September or twice in June, July and August on Tuesday in 2009 and on Wednesday in 2010), especially natural enemies on plants. Arthropods collected during animal visual counting on corn plants, for identification, were preserved in 700 alcohols and determined in the laboratory. Taking into consideration that not all specimens have been determined at species level, part of them were determined till the level of the genus, family, order or class. The preliminary studies were done in 2009-2010 searching corn plants for all fauna existing on 27 corn cultivars (6 conventional corn hybrids and 21 hybrids containing transformation events (glyphosate-tolerant, corn rootworm protected, resistant to Lepidopteran and with two of transformation events).

RESULTS AND DISCUSSIONS

Useful arthropods observed by predilection, either in 2009 or 2010 were spiders, *Coccinellids* (larvae and adults), *Heteroptera* (*Nabis* spp., *Anthocoris* spp., *Orius* spp.) and *Chrysopidae* (larvae and adults) (Table 1 and 2).

The most abundant fauna, observed in our research belong to group of homopterous (27.3/2009, 27.5/2010), spiders are relatively frequent (7.1/2009, 5.6/2010), other groups are relatively common (17.3/2009, 15.3/2010). From our point of interest, useful fauna belonging to groups *Coleoptera* (*Coccinellidae*), *Neuropteran*, *Diptera* (*Syrphids*) and *Heteroptera* is well represented in corn agrocoenoses, (12.8/2009, 14.9/2010; 5.1/2009, 5.7/2010; 8.8/2009, 10.0/2010 respectively 6.0/2009, 7.5/2010). There are, of course the representatives of spiders searching for food on corn plants, together with those which made their net on corn plants or between plants are most common together with few strong or large species as *Tibicina haematodes* Scop. (*Homopterous*), *Tettigonia viridissima* L., *Tettigonia caudata* Charp. (*Orthoptera*).

Table 1. Fauna of arthropods identified in corn agrocoenoses in 2009

Groups of fauna registered	No. exemplars	Percentage
Arachnids	259	7.1
Orthoptera (grasshoppers and locusts)	130	3.6
Coleoptera (*Coccinellidae*)	466	12.8
Homopterous (*Cicadelids*)	993	27.3
Heteroptera	219	6.0
Hymenoptera (*Formicidae*)	437	12.0
Neuropteran	187	5.1
Diptera (*Syrphids*)	321	8.8
Other groups	630	17.3
TOTAL	**3642**	**100.0**

Table 2. Fauna of arthropods identified in corn agrocoenoses in 2010

Groups of fauna registered	No. exemplars	Percentage
Arachnids	232	5.6
Orthoptera (grasshoppers and locusts)	109	2.6
Coleoptera	619	14.9
Homopterous (*Cicadelids*)	1141	27.5
Heteroptera	310	7.5
Hymenoptera (*Formicidae*)	447	10.8
Neuropteran	237	5.7
Diptera (*Syrphids*)	414	10.0
Other groups	633	15.3
TOTAL	**4142**	**100.0**

Taking into account the whole arthropod fauna there is a large variation either between on different fauna components or during the period of observation time, but what is more important there are no significant differences between total observed arthropod fauna on plant either on conventional corn hybrids or corn hybrids containing transformation events in 2009 (8.113 exemplars/plant respectively 8.071) and 2010 (9.171 exemplars/plant respectively 9.243) (Table 3 and 4).

Corn fields contain a lot of specimens, especially insects, which could give to us the image of complexity of corn ecosystem and this kind of studies, are very useful for better understanding of corn ecosystem and the role of each species in the ecosystem, is the firs step in finding key species for a specific agroecosystem.

Taking into consideration only three most important groups of insects found on corn plants during of observed period (Coccinellids-60.14%, Heteroptera-24.56% and Neuropteran-15.30%), even they are no most common species, but are easier to identify till the species level. The most common species of Coccinellids is *Propylea quattuordecimpunctata* (49.13%), followed by *Psyllobora vigintiduopunctata* (36.92%), *Coccinella septempunctata* (8.43%) and *Adalia bipunctata* (5.52%). Even they are no to visible, Heteroptera species are relatively frequently, main species being *Nabis pseudoferus* (33.81%), *Nabis feroides* (27.40%), *Orius* spp. (18.15%), *Nabis rugosus* (11.03%), *Nabis ferus* (7.43%) and *Anthocoris* spp. (4,98%). At the end we have to underline that in Neuropteran populations the most spread is *Chrysoperla carnea* (68.57%), *Osmylus fulvicephalus* (25.71%) and *Drepanepteryx phalaenoides* (5.71%) (Table 5).

Table 3. Fauna of arthropods structure (exemplars/plant) identified in corn agrocoenoses in 2009

		Exemplars/plant								
		18-V	**08-VI**	**29-VI**	**13-VII**	**27-VII**	**10-VIII**	**24-VIII**	**07-IX**	**TOTAL**
Conventional corn hybrids	*Arachnids*	0.017	0.021	0.033	0.146	0.175	0.133	0.075	0.117	**0.717**
	Orthoptera (grasshoppers and locusts)	0.000	0.004	0.021	0.100	0.117	0.063	0.017	0.008	**0.329**
	Coleoptera	0.046	0.108	0.204	0.163	0.321	0.233	0.167	0.038	**1.279**
	Homopterous (*Cicadelids*)	0.150	0.213	0.250	0.608	0.513	0.242	0.154	0.075	**2.204**
	Heteroptera	0.038	0.067	0.113	0.096	0.083	0.029	0.021	0.029	**0.475**
	Hymenoptera (*Formicidae*)	0.046	0.038	0.154	0.221	0.283	0.063	0.054	0.004	**0.863**
	Neuropteran	0.000	0.025	0.104	0.063	0.092	0.033	0.038	0.004	**0.358**
	Diptera (*Syrphids*)	0.008	0.067	0.179	0.138	0.083	0.079	0.175	0.029	**0.758**
	Other groups	0.046	0.138	0.171	0.188	0.208	0.225	0.108	0.046	**1.129**
	TOTAL	**0.350**	**0.679**	**1.229**	**1.721**	**1.875**	**1.100**	**0.808**	**0.350**	***8.113***
Hybrids containing transformation events	Arachnids	0.014	0.033	0.043	0.052	0.100	0.076	0.071	0.024	**0.414**
	Orthoptera (grasshoppers and locusts)	0.014	0.019	0.029	0.033	0.052	0.043	0.024	0.029	**0.243**
	Coleoptera	0.043	0.057	0.133	0.138	0.119	0.124	0.100	0.043	**0.757**
	Homopterous (*Cicadelids*)	0.200	0.152	0.148	0.743	0.529	0.243	0.124	0.071	**2.210**
	Heteroptera	0.033	0.043	0.076	0.124	0.090	0.052	0.048	0.033	**0.500**
	Hymenoptera	0.052	0.057	0.210	0.262	0.286	0.200	0.024	0.005	**1.095**
	Neuropteran	0.005	0.052	0.086	0.100	0.133	0.048	0.048	0.010	**0.481**
	Diptera (*Syrphids*)	0.010	0.052	0.152	0.129	0.114	0.052	0.090	0.062	**0.662**
	Other groups	0.152	0.214	0.186	0.233	0.324	0.262	0.190	0.148	**1.710**
	TOTAL	**0.524**	**0.681**	**1.062**	**1.814**	**1.748**	**1.100**	**0.719**	**0.424**	***8.071***

Table 4. Fauna of arthropods identified in corn agrocoenoses in 2010

		Exemplars/plant								
		18-V	**08-VI**	**29-VI**	**13-VII**	**27-VII**	**10-VIII**	**24-VIII**	**07-IX**	**TOTAL**
Conventional corn hybrids	*Arachnids*	0.004	0.008	0.029	0.088	0.133	0.104	0.092	0.046	**0.504**
	Orthoptera (grasshoppers and locusts)	0.004	0.013	0.017	0.038	0.046	0.033	0.029	0.025	**0.204**
	Coleoptera	0.154	0.050	0.229	0.242	0.408	0.279	0.179	0.046	**1.588**
	Homopterous (Cicadelids)	0.146	0.229	0.267	0.838	0.442	0.271	0.179	0.092	**2.463**
	Heteroptera	0.050	0.079	0.133	0.158	0.129	0.050	0.033	0.063	**0.696**
	Hymenoptera (Formicidae)	0.075	0.075	0.179	0.275	0.350	0.050	0.042	0.008	**1.054**
	Neuropteran	0.004	0.017	0.063	0.046	0.125	0.050	0.058	0.008	**0.371**
	Diptera (Syrphids)	0.004	0.083	0.221	0.171	0.092	0.108	0.221	0.058	**0.958**
	Other groups	0.046	0.133	0.179	0.229	0.279	0.258	0.133	0.075	**1.333**
	TOTAL	**0.488**	**0.688**	**1.317**	**2.083**	**2.004**	**1.204**	**0.967**	**0.421**	***9.171***
Hybrids containing transformation events	*Arachnids*	0.019	0.019	0.038	0.086	0.133	0.100	0.090	0.043	**0.529**
	Orthoptera (grasshoppers and locusts)	0.014	0.019	0.024	0.038	0.071	0.052	0.038	0.029	**0.286**
	Coleoptera	0.067	0.081	0.210	0.181	0.243	0.167	0.119	0.067	**1.133**
	Homopterous (*Cicadelids*)	0.195	0.224	0.233	0.948	0.471	0.271	0.176	0.100	**2.619**
	Heteroptera	0.043	0.052	0.133	0.148	0.124	0.081	0.052	0.048	**0.681**
	Hymenoptera	0.071	0.071	0.152	0.233	0.314	0.043	0.029	0.010	**0.924**
	Neuropteran	0.014	0.081	0.105	0.152	0.195	0.081	0.062	0.014	**0.705**
	Diptera (*Syrphids*)	0.014	0.076	0.210	0.143	0.148	0.081	0.119	0.086	**0.876**
	Other groups	0.095	0.195	0.148	0.248	0.281	0.229	0.176	0.119	**1.490**
	TOTAL	**0.533**	**0.819**	**1.252**	**2.176**	**1.981**	**1.105**	**0.862**	**0.514**	***9.243***

Table 5. Fauna of Coccinellids, Heteroptera and Neuropteran insects identified in corn agrocoenoses during 2009-2010

Group	Species	2009	2010	TOTAL	Percentage
COLEOPTERA	*Propylea quattuordecimpunctata*	162	176	338	49,13
	Coccinella septempunctata	26	32	58	8,43
	Adalia bipunctata	18	20	38	5,52
	Psyllobora vigintiduopunctata	101	153	254	36,92
	Total Coccinellids	307	381	688	***60,14***
HETEROPTERA	*Orius spp.*	15	36	51	18,15
	Anthocoris spp.	5	9	14	4,98
	Nabis pseudoferus	42	53	95	33,81
	Nabis feroides	36	41	77	27,40
	Nabis ferus	6	7	13	7,43
	Nabis rugosus	10	21	31	11,03
	Total Heteroptera	114	167	281	***24,56***
NEUROPTERAN	*Chrysoperla carnea*	62	58	120	68,57
	Osmylus fulvicephalus	19	26	45	25,71
	Drepanepteryx phalaenoides	5	5	10	5,71
	Total Neuropteran	86	89	175	***15,30***
	No. of total specimens identified	**507**	**637**	***1144***	-

CONCLUSIONS

The most abundant fauna, observed in our research belong to group of homopterous, spiders are relatively frequent, other groups are relatively common.

Taking into account the whole arthropod fauna there is a large variation either between on different fauna components or during the period of observation time, but what is more important there are no significant differences between total observed arthropod fauna on plant either on conventional corn hybrids or corn hybrids containing transformation events in 2009 and 2010.

From point of interest, useful fauna belonging to groups Coleoptera (Coccinellidae), Neuropteran, Diptera (Syrphids) and Heteroptera is well represented in corn agrocoenoses during of observed period (Coccinellids represents 60.14%, Heteroptera 24.56% and Neuropteran-15.30%).

The most common species of Coccinellids is *Propylea quattuordecimpunctata*, followed by *Psyllobora vigintiduopunctata*, *Coccinella septempunctata* and *Adalia bipunctata* (5.52%), Heteroptera species are relatively frequently, main species being *Nabis pseudoferus*, *Nabis feroides*, *Orius* spp., *Nabis rugosus*, *Nabis ferus* and *Anthocoris* spp., in Neuropteran insect populations the most spread is *Chrysoperla carnea*, *Osmylus fulvicephalus* and *Drepanepteryx phalaenoides*.

Corn fields contain a lot of specimens, especially insects, which could give to us the image of complexity of corn ecosystem and this kind of studies, are very useful for better understanding of corn ecosystem and the role of each species in the ecosystem, is the firs step in finding key species for a specific agroecosystem.

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RESEARCH ON BEHAVIOR OF THE TRITICALE GENOTYPES IN THE SANDY SOILS CONDITIONS

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Abstract

Extension of arid accents visible deserts, determine the orientation in exploitation of sandy soils to new plant species, that by results obtained to diminish the negative effects of climate change. Due to low natural fertility and climatic conditions characterized by excessive heat and insufficient rainfall, the sandy soils can be characterized as an agricultural area with handicap, farmers provide with a limited range of crops to ensure land use in terms of profitability. In this context, triticale was studied in sandy soil conditions from Dabuleni, a cereal created by hybridization between Triticum and Secale genus, plants that use more than poor soils, drought and heat. The results obtained during 2009-2011 at 12 triticale genotypes, experienced in a competition test fields, highlight productions between 3771-4604 kg/ha. There were observed by high production and good resistance to frost, disease and pest the following varieties: Negoiu, Matroz, Plai, Stil.

Key words: *triticale, genotypes, resistance, production.*

INTRODUCTION

In Romania the phenomenon of drought is a specific feature, due to settlement of our country in a temperate excessive climate, with large deviations from normal values of climatic, agro-climatic, hydrological and pedological parameters. Emphasizing this phenomenon in the last period and the specific microclimate that is created especially in the South of Oltenia, it was requiring extensive studies in Research - Development Center for Field Crops on Sandy Soils Dabuleni, which led to the promotion of plant species with a good potential to exploit the ecopedological condition by southern Oltenia, sandy soils that lie on approximately 209,400 ha. Triticale is a cereal adaptable to drought conditions with high production potential and multiple uses [5]. Due to recombination of favourable characteristics from the two parental species (wheat and rye), triticale has a number of biological and economic traits [3, 4] as:

- resistance to low temperatures, which favours the extension of vegetation until late autumn and resume growth earlier in spring;
- rich biomass plants and fast-growing;
- high-lysine content;
- nutritional value of triticale grain is superior to both the wheat and barley and those of rye.

In recent decades, due to genetic progress achieved in improving varieties, there were created more competitive than current genotypes of cereals especially for hilly area with poor soil fertility and low pH [2, 3] In 1971, it was initiated to N.A.R.D.I. Fundulea the breeding program for triticale species, created by humans and in the year 1984 it was recorded here the first variety of this species, TF2, which inaugurated the introduction of the culture in Romania, triticale species with higher production and adaptability potential, superior to other cereals [1]. Research conducted in Mexico shows that at both triticale and wheat drought is affecting most production if it occurs in the skin phase [4].

MATERIAL AND METHOD

Extension of arid accents visible deserts, determine the orientation in exploitation sandy soils to new plant species that by results obtained to diminish the negative effects of climate change. In this context it was studied in sandy soil conditions from Dabuleni culture of triticale, a cereal created by hybridization between *Triticum* and *Secale* genus, which by plant biology make better use of poor soils, drought and heat. The research was conducted on 12 triticale genotypes, studied during 2009-2011 in a competition test fields. Experience has been placed under irrigation conditions, on a sandy soil with low natural fertility, characterized as follows: 0.66 to 0.78% humus, from 0.032 to 0.044% Nt, mobile P 28-34 ppm, available K 16-38 ppm, pH 5.4 to 6.7 (H_2O). There were made determinations on plant physiological resistance to environmental conditions (frost, pathogens, and drought) and productivity features. The results were interpreted statistically by analysis of variance method and using mathematical functions.

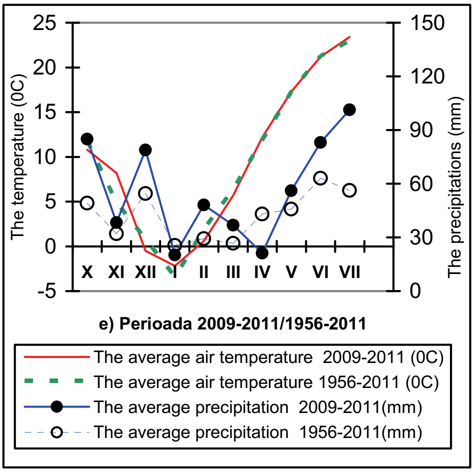

Fig. 1. Air temperature and precipitation recorded at weather station of CCDCPN Dabuleni

RESULTS AND DISCUSSIONS

Evolution of average air temperature recorded in the meteorological station of Research - Development Center for Field Crops on Sandy Soils Dabuleni trend of increased drought stresses in this area (Fig. 1). Compared to multiannual average, when during the triticale species vegetation period (October-July) were recorded in the air an average temperature of 9.59°C, in the studied period (2009-2011) the average air temperature has increased of 1.11°C. During the vegetation period triticale found in the sandy soils favourable conditions for growth and development. An increase amount of precipitation in the period under study (568.5 mm) was registered compared the multiannual average (426.1 mm). Area of sandy soils characteristic distribution of these precipitations is uneven, so that in certain periods (autumn, emergence, earring, and grain filling) is necessary to apply irrigation. Atmospheric drought and high temperatures during grain filling ears and creates a physiological imbalance in the water cycle in the plant (the transpiration exceeds absorption), which makes the grain to stop development, and to reduce weight.

Photo 1. Triticale on sandy soils

Results on the variability of plant physiological traits of triticale highlight good adaptability of the triticale species under sandy soil conditions (Table 1).

On average the 12 triticale genotypes have registered 1.9 tillers/plant in autumn, good resistance to winter (grade-1, 2), a good physiological resistance to major pathogens (*Erysiphe graminis*, *Puccinia graminis*, *Tilletia tritici*, *Ustilago nuda*), which cause damage grain straw (grades 1-2).

Table 1. Variability of physiological characters triticale tested on sandy soils (2009-2011)

Genotypes	Number of tillers / plant	Resistnce to winter (grades 1-9)	Resistance to pathogens (grades 1-9)			
			Erysiphe sp.	*Puccinia*	*Tiletia*	*Ustilago*
Plai	1.7	1.3	1	1	1.00	2.00
Titan	1.8	1.1	1.3	1	1.00	2.00
Stil	1.9	1.3	1	1	1.00	2.00
Gorun	2.2	1	1.3	1.3	1.00	2.00
Haiduc	1.9	1.3	1	1	1.00	2.00
Cascador	2.1	1	2.1	1	1.00	2.00
Migrator	2	1.1	1.3	1	1.00	2.00
Matroz	2.1	1.3	1.3	1	1.00	2.00
Negoiu	2.1	1.3	1.3	1	1.00	2.00
Nera	1.7	1.3	1.6	1.3	1.00	2.00
Nedeea	1.7	1.1	1.8	1	1.00	2.00
TF 2	2.2	1.3	1.3	1	1.00	2.00
Average	1.9	1.2	1.4	1.03	1.00	2.00

In the conditions of sandy soils, the vegetation period of triticale genotypes is between 225 to 228.5 days with an average of 227.1 days (Fig. 2). The Matroz triticale variety showed the shortest amount of vegetation and Nedeea variety of the largest growing season.

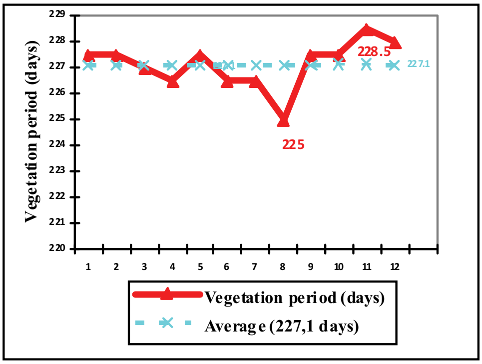

Fig. 2. Vegetation period of triticale genotypes tested on sandy soils (2009-2011)

Microclimate created on sandy soils in southern Oltenia offers favourable conditions for growth and development of the triticale culture. Determinations of biometrics on plant size, number of spikes/m^2 at harvest, spike length and number of grains/spike emphasizes a dependent variability by analyzed varieties (Table 2). Under the aspect of plant size, deviations of the 12 genotypes were recorded between -6.3 cm and 13 cm, from the average (93 cm). The elements of productivity highlight the variety Matroz who recorded at harvest spikes/m^2 527.3, 11.8 cm spike length and 40.7 grain in the spike.

Table 2. Variability of biometric measurements triticale tested on sandy soils (2009-2011)

Genotypes	Plant size cm	No. spikes / m^2	Spike length (cm)	No. grains / spike
Plai	102.6	502.3	10.6	37.3
Titan	106	535.6	10.3	37.3
Stil	95	509.6	11	41.3
Gorun	86.3	533	10.5	36.7
Haiduc	94	494.3	10.6	38.6
Cascador	89.6	527.3	10.1	35.3
Migrator	92	534.3	11.5	38
Matroz	87.6	527.3	11.8	40.7
Negoiu	86.3	506	10	38
Nera	87.3	524	10	38
Nedeea	93.3	513	9.8	32.6
TF 2	96	504	10.3	36.6
Average	93	517.5	10.5	37.5

Triticale plant has a maximum sensitivity to drought in the earring phase and grain filling. As the amount of bound water is higher so that genotype is more resistant to adverse weather conditions (high temperatures, drought, soil and air humidity low). Plants grow and develop normally if there is a stable equilibrium between water absorbed and eliminated from the organism. If this balance goes awry most metabolic processes are not proceeding normally.

In unfavourable environmental conditions when plant life activity is reduced than the amount of free water decreases and the bound water increases, which causes a higher resistance of plants. In the leaves of triticale amount of free water was influenced by both the variety and climatic factors. Free water content was between 57.36% in genotype Gorun and 59.02% in Titan genotype. Free water is retained low in the ribs and therefore travels easily, both inside the cell, and from one cell to another, providing state of the cell turgor.

It is the environment in which biochemical processes take place directly participating in their conduct. Under pressure thermo-fluid concentration increases cellular juice, as a reaction to adapt the plant to these conditions by increasing the cellular osmotic forces, forces that diminish water loss through sweat. Triticale studied cellular juice concentration values recorded between 13.45 to 14.55%, which has good adaptability at good genotypes: Negoiu, Matroz, Stil and Plai (Table 3).

Table 3. Variability of physiological indices of triticale genotypes studied on sandy soils (2009-2011)

Genotypes	Free water (%)	Bound water (%)	Dry substance (%)	Concentration of the vacuole juice (%)
Plai	58.9	4.72	36.38	14.3
Titan	59.02	4.46	36.52	13.45
Stil	56.49	4.60	38.91	14.3
Gorun	57.36	4.51	38.13	14.15
Haiduc	57.52	4.54	37.94	14.25
Cascador	57.65	4.58	37.77	14.25
Migrator	57.98	4.16	37.86	14.15
Matroz	57.47	4.45	38.08	14.45
Negoiu	57.24	4.76	38.00	14.55
Nera	57.99	4.55	37.46	14.05
Nedeea	57.8	4.08	38.12	13.95
TF 2	58.48	4.34	37.18	14.1
Average	57.83	4.48	37.69	14.16

Thousand grain weight (TGW), indicating that significantly influence the production obtained in the studied genotypes, varies in limits from 34.5 to 41.7 g and hectolitre weight (HW) varied between 60 and 67 kg (Fig. 3).

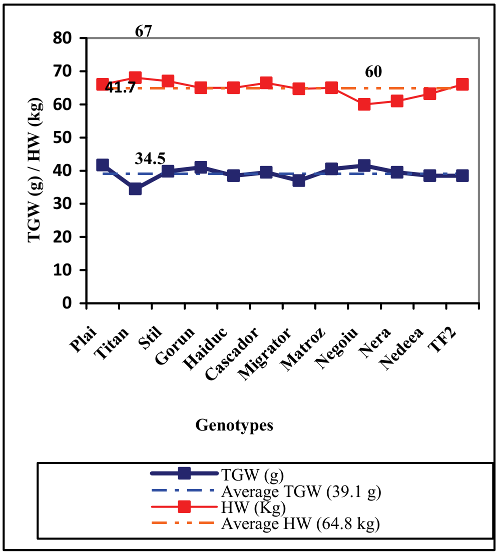

Fig. 3. TGW and HW variability of triticale genotypes tested on sandy soils (2009-2011)

Production results obtained in the 12 triticale genotypes were within 3371-4604 kg/ha, with an average deviation between – 396.5 kg/ha and 436.5 kg/ha. The highest production (4310-4604 kg/ha) were remarked by Negoiu, Matroz, Plai and Stil genotypes (Fig. 4).

Analyzing the relationship between grain production and cellular juice concentration recorded in the earring phase a finding of distinct significant positive correlation. As the concentration cellular juice increases, triticale genotypes better respond to stress in the sandy soil, through the productions obtained (Fig. 5).

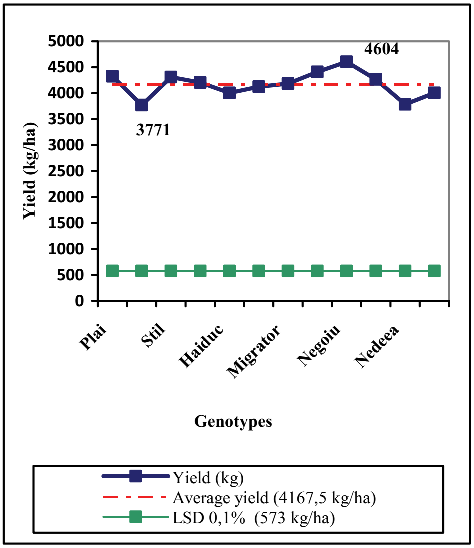

Fig. 4. Production variability obtained in some triticale genotypes

Photo 2. Negoiu triticale variety

Photo 3. Stil triticale variety

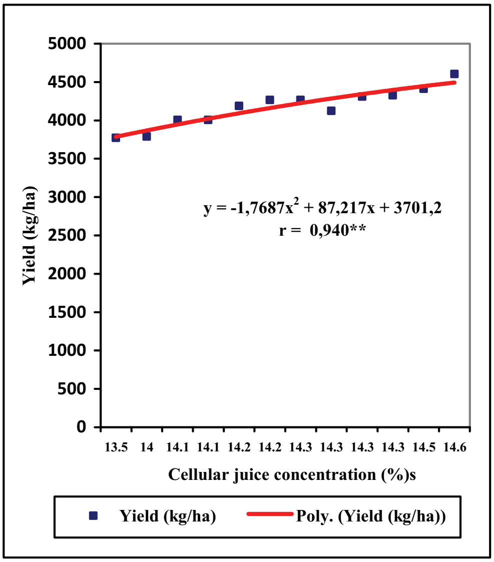

Fig. 5. The correlation between production and concentration of the cellular juice triticale

CONCLUSIONS

Microclimate created on sandy soils in southern Oltenia offers favourable conditions for growth and development of triticale culture.

The 12 triticale varieties showed a good physiological resistance (grades 1-2) to the main pathogens (*Erysiphe* sp., *Puccinia* sp., *Tilletia* sp., *Ustilago nuda*).

Thousand grain weight (TGW) at triticale genotypes grown on sandy soil varied in limits from 34.5 to 41.7 g and hectoliter weight (HW) varied between 60 and 67 kg.

Triticale genotypes: Negoiu, Matroz, Plai and Stil have obtained the biggest production (4310-4604 kg/ha) and the best physiological indices (4.45 to 4.76% - bound water and 14.3-14.55% - cellular juice concentration);

There is a distinct significant positive correlation between production and vacuolar juice concentration (r = 0.940 **).

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OPTIMIZATION OF THE PRODUCTION OF BEANS COWPEA UNDER THE IMPACT OF TECHNOLOGICAL FACTORS

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Abstract

In the guidelines for increasing protein content in food population and animal at national and international level, the basic concern is the exploitation of soils in arid and semiarid climates by adapted crops ecopedological specific conditions that contribute to reduced negative climate change and sustainable agriculture. In this research at Research - Development Center for Field Crops on Sandy Soils Dabuleni during 2004-2011 aimed to reduce the negative effect of drought in the area psamosoils by the potential biological cowpea a specific plant arid climate. The results obtained show that the cultivation of cowpea *Ofelia and providing sown an area of plant nutrition 20 germinable seeds/m^2 can successfully capitalize on sandy soils of low natural heritage. Rational fertilization by $N_{60}P_{60}K_{60}$ and applying fractionated nitrogen (1/3 sowing + 2/3 vegetation) resulted in the best production results (2752 kg/ha), due to optimization of plant physiological processes. In this experiment there was a maximum of the photosynthesis process, the CO_2 28.34 micromoles/m^2/second and minimum consumption of water through perspiration, the 2.26 millimoles H_2O/m^2/second.*

Keywords: *sandy soil, cowpea, nutrition, physiology.*

INTRODUCTION

Capitalization with good results psamosoils from Oltenia Southern by the cultivation cowpea (*Vigna unguiculata* L. Walp) can not be provided without conducting thorough studies favorable climatic conditions generated by the plant are found in this area.

Research by the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria by O. Boukar and al. [3] highlights the importance cowpea cultivation in drought affected areas, primarily for human consumption due to the significant content of grains protein, carbohydrates and some minerals that are beneficial to consumer health.

Role cowpea cultivated in a sustainable agricultural system, through its use in animal nutrition and contributes to maintaining the soil fertility through manure use was highlighted in 2010 by the research of H.A.

Ajeigbe and B.B. Singh at the International Institute of Tropical Agriculture (IITA), Kano, Nigeria [1]. Being a plant with low requirements to the natural fertility of soil, cowpea are grown usually on the poorest sands, with a hummus content below 0.5%, developing through plant biology mass vegetative rich, that incorporated into soil as green manure, contribute to improved physical and chemical properties of sand, with white lupine, pea and soybean [4]. Results obtained by Marinica Gh. during 1986-1993 show that cowpea have a water consumption of 4156 m^3/ha, compared consumed soy 7153 m^3/ha [6]. Efficient valorification of sandy soils by studying plant-soil-climate relationship in the context of conservation and environmental protection is consistent with national strategy to reduce the effects of drought and combating land degradation and desertification, prepared by MARD (Ministry of Agriculture and Rural Development) Romania. In this context, choosing the range of plant genotype and study the application of nutrients is a necessity to obtain high yields, secure and stable.

MATERIAL AND METHOD

Experimentation was conducted during 2004-2011 at the Research - Development Center for Field Crops on Sandy Soils Dabuleni, under irrigation on a sandy soil with low nitrogen content (0.03 to 0.1%), well stocked phosphorus (75-105 ppm), low to medium supplied in potassium (55-95 ppm), with a low organic carbon (0.11- 0.46%) and a weak acid to neutral pH (5.3 and 6.81).

Research aimed at studying the following factors: genotype, space nutrition, fertilization.

Research has been conducted in phases (genotypes were studied during 2004-2011, space nutrition in 2004-2006, fertility was studied in two phases from 2004 to 2006 and 2011).

To meet the objective of optimizing the production results obtained, there were correlated productivity and physiology of the plant with technological factors studied and existing climatic conditions.

Physiology tests were made with apparatus LCpro + Portable Photosynthesis System. The results were interpreted statistically by using analysis of variance and mathematical functions [2]

RESULTS AND DISCUSSIONS

Analysis of climatic factors playing a role in plant growth and development, such as temperature and precipitations (Fig. 1), revealed patchy the character of their distribution and intensity, both taken during the study and multiannual average.

The data obtained from the meteorological station Research - Development Center for Field Crops on Sandy Soils Dabuleni found an increase in average air temperature of 1.34°C during 2004-2011, compared to multiannual period 1956-2011.

Although the amount of precipitation recorded during the same period is higher than the multiannual average, however their uneven distribution associated with high temperatures in air emphasizes the character of drought and obliges us to find technological solutions to the cowpea, for use in optimal conditions.

First choice of biological material is one of the measures that do not incur a cost. Of the three cowpea genotypes studied to obtain the highest yield (2587 kg/ha) the variety Ofelia, who saw a difference in production of 326 kg/ha, significantly distinct compared with Aura variety (Table 1). Space nutritional size influences the growth and development processes of cowpea plant, with implications for the level of production obtained (Fig. 2).

Sowing compared to 10 germinable seeds/m^2 when there were 1814 kg/ha grain yield increases in the 151-483 kg/ha by increasing plant density. Compared to the variant that were sown 10 germinable seeds/m^2 have been very significant differences of production of 483 kg/ha by sowing of 25 germinable seeds/m^2. Exceeding this density decreases grain production to cowpea.

Mathematical analysis of the functional link between the number of germinable seeds and grain production obtained from cowpea show a degree of determination of production under the influence of this factor of 98%.

Calculation the economic optimum shows that by seeding of 20.6 germinable seeds/m^2 to optimize grain production in cowpea.

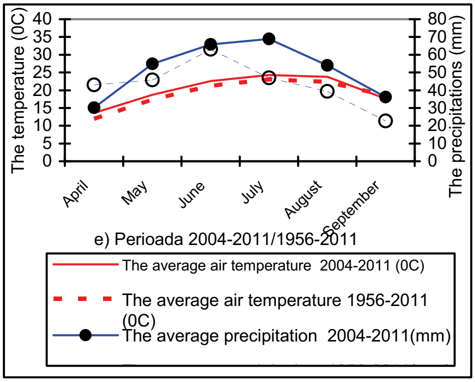

Fig. 1. Air temperature and precipitation recorded at weather station has CCDCPN Dabuleni

Table 1. Significance yields obtained in some genotypes of cowpea (2004-2011)

Genotype	Yield		Difference	Significance
	kg/ha	%	kg/ha	
Aura	2363	100	Control	Control
Ofelia	2689	105	326	**
D2-b/93	2439	99	76	-

LSD 5% = 146 kg/ha
LSD 1% = 247 kg/ha
LSD 0.1% = 479 kg/ha

Photo 1. Ofelia cowpea variety

Cowpea is a leguminous plant which he synthesizes the symbiotic way around 80.6% of nitrogen in the nutrition [4], still needs this macroelement to start installing vegetation to soil microbial activity.

Phosphorus and potassium also have a favorable influence on the formation of productivity elements on cowpea and plant resistance to stress factors on sandy soils.

The results in this (Fig. 3), shows the importance of the three macronutrients in maximizing production.

The results obtained in 2004-2006 showed a maximum of 2116 kg/ha of cowpea culture by fertilization with 30 kg nitrogen + 40 kg P_2O_5 + 40 kg K_2O / ha, resulting from fertilization a very significant difference in production, 771 kg/ha (0.1% LSD = 586 kg/ha).

Based on these results in 2011 it was initiated research that focused on higher doses of nitrogen, phosphorus and potassium and nitrogen application times in cowpea, in order to optimize production results. On sandy soils poor in organic matter, nitrogen fertilizer use is limited to losses that occur through leaching [5].

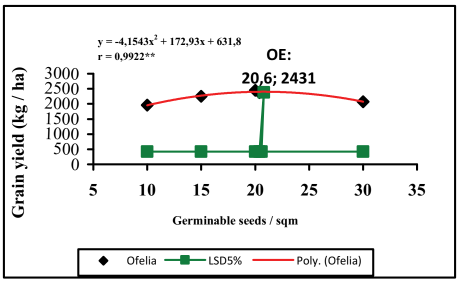

Fig. 2. Correlation between cowpea grain yield and the space of plant nutrition

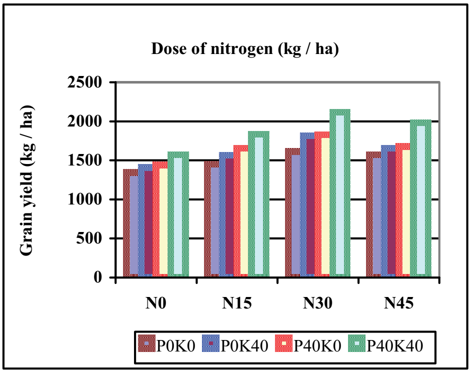

Fig. 3. Evolution cowpea grain yield depending on the dose of NPK, 2004-2006

Fractionated dose of nitrogen application reduces the losses. Measurements of plant physiology show that with increase in photosynthetic active radiation were recorded increases of CO_2 assimilation in the leaf (Table 2). There is also a differentiation of plant photosynthesis, depending on the dose of fertilization and application of nitrogen fertilizers. The cowpea crop fertilization with fractioned application of nitrogen $N_{60}P_{60}K_{60}$ and (1/3 sowing + 2/3 vegetation), photosynthesis process showed a maximum at 12 hour (28.34 µmol CO_2 $m^{-2}s^{-1}$) the surface temperature leaf was 35.6°C. to build the amounts of CO_2 plant cowpea lost 2.26 mmol H_2O $m^{-2}s^{-1}$. Greater heat stress by increasing the temperature of the leaf surface reduces the intensity of the photosynthesis process, such that at 15 hour it recorded a decline from 12 hour the same variant of fertilization, photosynthesis recorded 18.49 µmol CO_2 $m^{-2}s^{-1}$ at 15 hour, and consumption of water by sweating 5.78 mmol H_2O $m^{-2}s^{-1}$.

High nitrogen doses administered under thermal stress inhibits photosynthesis process in plants and also increases water loss through perspiration. Analyzing the correlation between fertilization and production of cowpea increases the production with favorable allocation of nutritional resources ($N_{60}P_{60}K_{60}$). It highlights a significant correlation between production and fertilization (Fig. 4).

Table 2. Influence of fertilization on the plant physiology cowpea

Experimental variant			*Cowpea plant physiology, at 12 hour		
No. var.	NPK	Time of application of nitrogen	Photosynthetic active radiation (μmol $m^{-2}s^{-1}$)	Photosynthesis (μmol CO_2 $m^{-2}s^{-1}$)	Perspiration (mmol H_2O $m^{-2}s^{-1}$)
1	$N_0P_0K_0$		1645	14.37	3.04
2	$N_0P_{60}K_0$		1753	15.34	3.65
3	$N_0P_0K_{60}$		2022	17.73	3.26
4	$N_0P_{60}K_{60}$		1875	20.29	3.56
5	$N_{30}P_{60}K_{60}$	*sowing*	1931	21.43	3.59
6		*1/3 sowing + 2/3 vegetation*	1805	20.00	2.34
7		*vegetation*	1916	23.15	3.98
8	$N_{60}P_{60}K_{60}$	*sowing*	1462	25.25	3.99
9		*1/3 sowing + 2/3 vegetation*	1712	28.34	2.26
10		*vegetation*	1606	27.23	3.39
11	$N_{90}P_{60}K_{60}$	*sowing*	1194	25.53	4.91
12		*1/3 sowing + 2/3 vegetation*	1790	26.01	3.66
13		*vegetation*	1410	26.51	3.49

*Leaf surface temperature: 34.1°C-36.2°C
*Atmospheric pressure: 1014-1016 atm.

Photo. 2. Aura cowpea variety

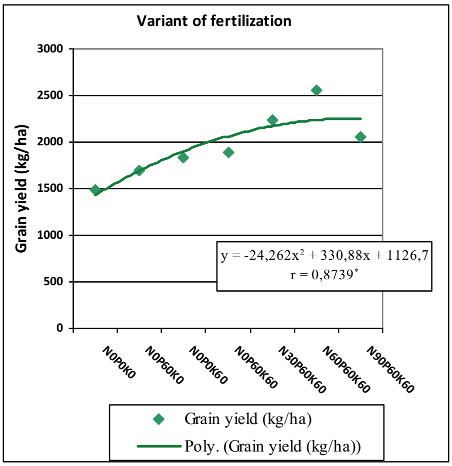

Fig. 4. The correlation between NPK fertilization and grain yield from cowpea grown on sandy soils, 2011

Results obtained from cowpea under the influence of fertilization highlights the application of higher doses of nitrogen causes the plant's vegetative growth to the detriment fructification, rich vegetation of the plant preventing sunlight penetration to the bottom of vexil flower, essential condition in the fecundation of flowers and maturation uniform clusters.

Fertilization application to determine cowpea significant to very significantly production increases from unfertilized control. The maximum production was achieved when the three macronutrients were applied in doses of N_{60} $P_{60}K_{60}$ (Table 3).

Table 3. Influence of NPK fertilization on production results in cowpea, 2011

Experimental variant		Yield		Difference	
NPK	Time of application of nitrogen	kg/ha	%	Kg/ha	Significance
$N_0P_0K_0$	-	1491	100	Mt.	Mt.
$N_0P_{60}K_0$		1690	116	229	-
$N_0P_0K_{60}$		1833	125	372	*
$N_0P_{60}K_{60}$		1894	130	433	*
$N_{30}P_{60}K_{60}$	*sowing*	2173	149	712	***
	1/3 sowing + 2/3 vegetation	2392	164	931	***
	vegetation	2143	147	682	***
$N_{60}P_{60}K_{60}$	*sowing*	2517	172	1056	***
	1/3 sowing + 2/3 vegetation	2752	188	1291	***
	vegetation	2390	164	929	***
$N_{90}P_{60}K_{60}$	*sowing*	2171	149	710	***
	1/3 sowing + 2/3 vegetation	2072	142	611	***
	vegetation	1932	132	471	**

LSD 5% - 323 kg/ha
LSD 1% - 434 kg/ha
LSD 0,1% - 572 kg/h

The application of N_{60} fractionated dose (1/3 sowing + 2/3 vegetation), an agrofond of $P_{60}K_{60}$ we obtained the best results in cowpea production (2752 kg/ha).

There is a distinct significant correlation between the 13 variants of fertilization and the production obtained from cowpea (Fig. 5).

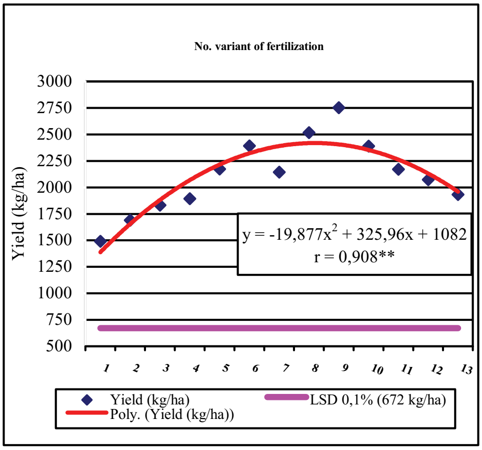

Fig. 5. The correlation between different formulas NPK fertilization and grain yield from cowpea grown on sandy soils, 2011

CONCLUSIONS

Variety of cowpea Ofelia has registered a production of 2587 kg/ha exceeds of cowpea Aura variety with a production difference of 326 kg/ha, significantly distinct. Size of area of nutrition influence the growth and development processes of plant, with implications for the level of production obtained.

Economically optimal production by 2431 kg/ha was achieved by 20.6 germinable seeds /m^2.

The cowpea crop fertilization with fractionated application of nitrogen $N_{60}P_{60}K_{60}$ and (1/3 sowing + 2/3 vegetation), photosynthesis process showed a maximum at 12 hour by 28.34 µmol $m^{-2}s^{-1}$ with a loss of transpiration of water by 2.26 mmol H_2O $m^{-2}s^{-1}$.

Application of fractional doses of N_{60} (1/3 sowing + 2/3 vegetation) a leading $P_{60}K_{60}$ agrofond, maximize grain production to cowpea (2752 kg/ha).

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RESEARCHES CONCERNING VEGETATION TREATMENT OF THE MAIZE CROP FOR CONTROLLING OF THE MAIZE LEAF WEEVIL (*TANYMECUS DILATICOLLIS* GYLL)

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Abstract

Maize leaf weevil (Tanymecus dilaticollis Gyll) is the main pest of this crop in south and south-east of the Romania. Every year, over 1 million hectares with maize are attacked by this pest, crop can be totally damaged if wasn't effected seed or vegetation treatments. In experimental field of Plant Protection Laboratory in frame of National Agricultural Research and Development Institute Fundulea it has studied new generation insecticides, used like correction vegetation treatment for maize leaf weevil control (Calypso 480 SC 0,09 l/ha, Decis Mega 50 EW 0,15 l/ha, Karate Zeon 5 CS 0,15 l/ha, Karate 2,5 WG 0,3 kg/ha). The insecticides assigned a satisfactory protection of the maize plants against this pest, saved plants percent were over 94 % at all treated variants while at untreated plants saved average plants percent, in period 2009-2011, were 79,02 %. Plants height at 50 days after sowing were higher than 159 cm at all treated variants while at control variant were 137,63 cm.

Key words: *control, maize, pest, treatment.*

INTRODUCTION

Maize is one of the most important crops in Romania [12]. According the data of Ministry of Agriculture and Rural Development, in 2010 it has cultivated 2.1 million hectares and in 2011 it has cultivated more then 2.6 million hectares of maize [13]. Because of heavy drought, especially from last autumn, many surfaces with oilseed rape were replaced with maize in spring of the year 2012, as result surface occupied with this crop will be higher than year 2011. Maize leaf weevil is the main pest in south and south east of the country [3, 4, 5]. The attack occurs when maize plants are in first phase of vegetation, from emergence until five leaf stage [6, 8, 9]. In some cases, young plants are destroyed before arrive at soil surface [1]. Even it is considered to be polyphagous, *Tanymecus dilaticollis* exhibits preference for maize, a crop which provides optimal development for the larvae and is the most preferred food by adults [1, 2, 10]. Due to this fact, the traditional practice in small farms of cropping maize after maize for several consecutive years contributes to the reproduction of this insect and thus to an increase in its population [2]. Year by year, at least one million hectares cultivated with maize are affected by *Tanymecus dilaticollis* [6, 7]. According Torus E. et all. (2011) the maize yields losses were on average 23% only because of the pests attack [12]. For avoiding yield losses because of this pest, the best control method is seed treatment [2, 6, 7, 9]. The most used products for seed treatment in Romania are on base of imidacloprid, clotianidin and thiametoxan [7]. These new insecticides replace treatments with products on base of carbofuran (Furadan, Carbofuran, Diafuran, etc). Even these products were effective against maize leaf weevil and generalized in agricultural production more than 30 years, they are high toxic for human and animals [6, 7]. In some cases, when is not effectuated seed treatment or this is effectuated wrong is necessary vegetation treatment [4, 11]. Otherwise maize leaf weevil attack level can be high; in some cases plants can be destroyed and areas with this crop must be sowing again. In this paper author collective has tested, in field conditions, some insecticides for controlling in vegetation, maize leaf weevil (*Tanymecus dilaticollis* Gyll), at NARDI Fundulea, in different climatic conditions of the period 2009-2011. The products are on base of tiacloprid (Calypso 480 SC), deltametrin (Decis Mega 50 EW), or different formulation of the lambda-cihalotrin (Karate Zeon 5 CS and Karate 2.5 WG).

MATERIAL AND METHOD

The experiments were carried at NARDI Fundulea, in spring period of the years 2009, 2010 and 2011. Every year the maize was sowing at third decade of the April. For favoring the attack of *Tanymecus dilaticollis*, the experimental plots were sowing after maize monoculture (at least three consecutive years with maize, before). The experiments were arranged according randomized block design, with plots length of 10 m and plot width of 4.2 m, equivalent of the 6 rows of maize. The distance between rows is 70 cm. The maize seeds were sowed manually with planter, at 35 cm distance between seeds on row, this is equivalent with a density of 40816 plants/ha. This low density have purpose to concentrate maize leaf weevil on the emerged maize plants to evaluate effectiveness of the insecticides used at vegetation treatment. To avoid migration of *Tanymecus dilaticollis* adults from one plot to another, the experimental plots were laterally isolated with a 2 m wide strip sown with pea, a plant repellent to this insect [1, 2, 8, 9, 10]. The vegetation treatment will be effectuated when maize plants are in BBCH stage 12-13 (two-three leaf stage). Attack intensity will be evaluated when maize plants are in BBCH stage 14 (four leaf stage). From each plot will be assessed 20 plants, from four rows. The plants from marginal rows of the plot weren't assessed. Five plants per each row will be marked with stakes. On the four rows assessed, marked plants will be in "stairs" system. Attacked plants will be rated by a scale from 1 to 9, as follows:

- Note 1: plant not attacked;
- Note 2: plant with 2-3 simple bites on the leaf edge;
- Note 3: plants with bites or clips on leaf edge;
- Note 4: plants with leafs chafed in proportion of 25 %;
- Note 5: plants with leafs chafed in proportion of 50 %;
- Note 6: plants with leafs chafed in proportion of 75 %;
- Note 7: plants with leafs chafed almost at the level of the stem;
- Note 8: plants with leafs complete chafed and beginning of the stem destroyed;
- Note 9: plants destroyed, with stem chafed until, close to soil level.

After 30 days from plant emergence it has evaluated saved plants percent by counting the all emerged plants from a plot and comparing with sowing seeds number/plot. After 50 days from plant emergence, on the same 20 plants that we assessed before attack intensity, it has measuring plants height. The data were statistical analyzed through variance analyze method by using of the Microsoft Excel 2003 and ARM 8 programs.

RESULTS AND DISCUSSIONS

Meteorological conditions, especially from last two decades of the April and first decade of the May is important for maize leaf weevil (*Tanymecus dilaticollis* Gyll). Drought and high temperatures in period when maize plants are in first phases stage (until BBCH 14) favorite attack of this pest. Data from table 1 show that in 2009, temperatures from April and May were higher them multiyear average, especially from the last two decades of the May.

Table 1. Influence of the temperature on the attack of the maize leaf weevil (*Tanymecus dilaticollis* Gyll) at NARDI Fundulea, period 2009-2011 (data recorded at NARDI Fundulea meteo station)

Year	Attack inten-sity	Saved plants (%)	Temperature (°C)						Ave-rage Temp.	Multiyear average Temp.	De-viation (°C)
			April			May					
			I	II	III	I	II	III			
2009	6.05	75.91	12.0	11.6	10.9	14.2	19.2	19.3	14.55	14.00	-0.55
2010	4.83	85.25	11.2	11.2	13.4	15.9	16.4	19.7	14.63	14.00	-0.63
2011	5.79	79.50	9.7	9.0	12.2	11.8	17.1	19.8	13.27	14.00	+0.73

Table 2. Influence of the rainfall on the attack of the maize leaf weevil (*Tanymecus dilaticollis* Gyll) at NARDI Fundulea, period 2009-2011 (data recorded at NARDI Fundulea meteo station)

Year	Attack inten-sity	Saved plants (%)	Precipitations (mm)						Total Prep. (mm)	Multiyear average (mm)	De-viation (mm)
			April			May					
			I	II	III	I	II	III			
2009	6.05	75.91	0.9	13.7	7.5	9.8	4.7	21.3	57.9	144.5	+86.6
2010	4.83	85.25	22.6	14.8	4.4	2.6	13.3	15.3	73.0	144.5	+71.5
2011	5.79	79.50	3.2	23.6	2.1	48.4	23.0	5.6	105.9	144.5	+38.6

In 2010 temperatures were higher than multiyear average, especially from last decade of the April. Contrary in 2011 the temperatures from the April and first decade of the May were lower than multiyear average and the temperatures from last two decades of the May were higher than multiyear average (Fig. 1).

The attack at untreated plants in this three year was different. Data from table 2 show that precipitation level were lower than multiyear average in all of three years taken in study (2009-2011). From this year, in 2009 were recorded the lowest level of precipitations. For example in last decade of the April were 7.5 mm of precipitations, in first decade of the May were 9.8 mm of precipitations and in second decade of the May were only 4.7 mm of the rain. As result, combined with high temperatures, especially from May (table 1) in 2009 the attack intensity at untreated plants were of 6.05 and saved plant percent were of 75.91%.

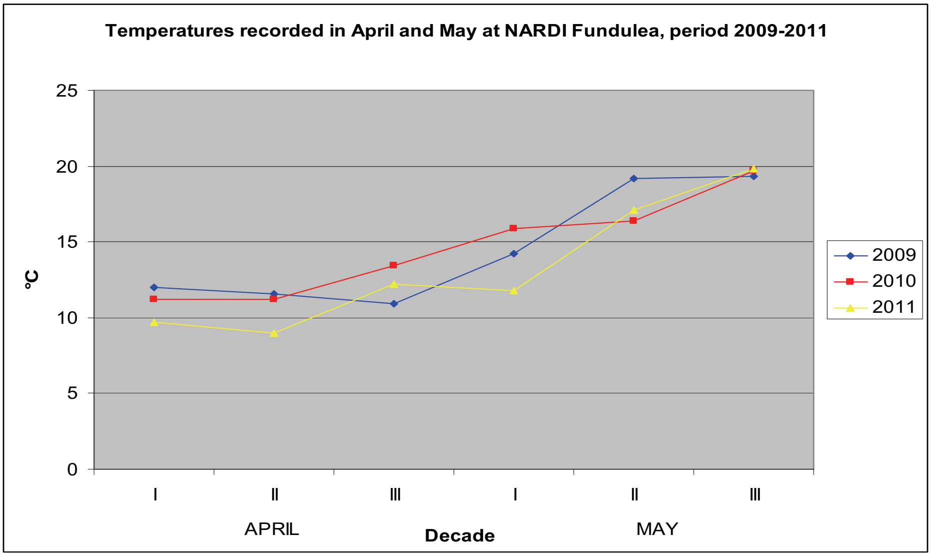

Fig. 1. Temperatures recorded in April and May at NARDI Fundulea, period 2009-2011

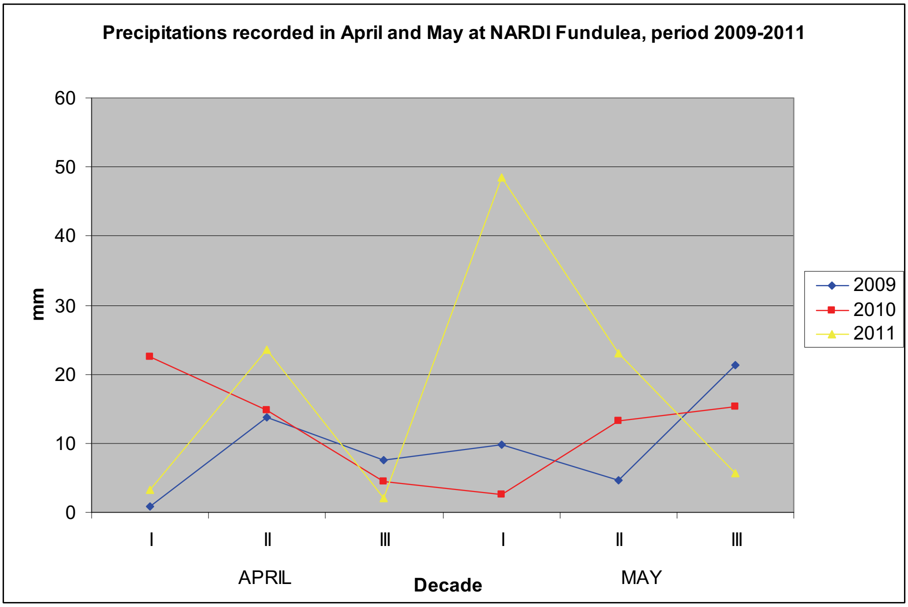

Fig. 2. Temperatures recorded in April and May at NARDI Fundulea, period 2009-2011

In 2010, even temperatures recorded in last decade of the April, when maize were sowed, and all decades of the May, attack level of maize leaf weevil on untreated plants have lowest level from all of three years taken in study (Tables 1, 2). In 2011 attack level on untreated plants was of 5.79 and save plant percent was of 79.50%. Temperatures from last decade of the April were high then 12.0 Celsius degree and precipitation level was low, only 2.1 mm (Fig. 2). As result, the attack of the *Tanymecus dilaticollis* at young emerged plants was higher.

In these different climatic conditions, from one year to another, at NARDI Fundulea it has tested some insecticides, for controlling *Tanymecus dilaticollis* Gyll. These insecticides were applied like vegetation treatments, when maize was in 2-3 leaf stage (BBCH 12-13). The tested insecticides are on base of tiacloprid (Calypso 480 SC), deltametrin (Decis Mega 50 EW), or different formulation of the lambda-cihalotrin (Karate Zeon 5 CS and Karate 2.5 WG). Data from table 3 show that in 2009 all products have effective control of the maize leaf weevil. The lowest value of the attack intensity was at variant treated with Karate Zeon 5 CS. Variant treated with Decis Mega 50 EW have an attack intensity of 4.01 and variant treated with Calypso 480 SC have highest value of the attack intensity from all of the treated variants (I=4.20). At untreated variant average attack intensity on scale from 1 to 9 were of 6.05, that means the most of the maize plants were with leafs chafed in proportion of 75%, while plants from treated variants were with leaf chafed in proportion of 25%. Plant height parameter have low variance at all treated variant, while at untreated variant, average plants height at 50 days after emergence was of 122.69 cm. Saved plants percent was 75.91% at untreated variants while at treated variants was over 95 %, except variant treated with Calypso 480 SC (92.50%). All products provided a satisfactory protection of the maize plants, in climatic conditions of the spring period, year 2009.

Table 3. The effectiveness of some products used for vegetation treatment at maize crop against *Tanymecus dilaticollis* Gyll, at NARDI Fundulea, year 2009

Nr. crt.	**Variant**	**Rate (l/ha, kg/ha)**	**Attack intensity (1-9)**	**Plants height (cm)**	**Saved plants percent (%)**
1	Control (untreated)	—	6.05	122.69	75.91
2	Calypso 480 SC	0.09	4.20***	136.68***	92.50***
3	Decis Mega 50 EW	0.15	4.01***	135.16***	95.00***
4	Karate Zeon 5 CS	0.15	3.98***	138.77***	96.00***
5	Karate 2,5 WG	0.30	4.05***	137.65***	95.75***
			DL5%=0.59	DL5%=5.09	DL5%=4.56
			DL1%=0.82	DL1%=7.14	DL1%=6.40
			DL0.1%=1.16	DL0.1%=10.08	DL0.1%=9.04

Table 4. The effectiveness of some products used for vegetation treatment at maize crop against *Tanymecus dilaticollis* Gyll, at NARDI Fundulea, year 2010

Nr. crt.	**Variant**	**Rate (l/ha, kg/ha)**	**Attack intensity (1-9)**	**Plants height (cm)**	**Saved plants percent (%)**
1	Control (untreated)	—	4.83	145.53	85.25
2	Calypso 480 SC	0.09	3.49**	159.43**	98.00***
3	Decis Mega 50 EW	0.15	3.64**	160.25**	98.75***
4	Karate Zeon 5 CS	0.15	3.65**	160.00**	99.00***
5	Karate 2,5 WG	0.30	3.45***	159.00**	99.25***
			DL5%=0.69	DL5%=7.98	DL5%=2.02
			DL1%=0.97	DL1%=11.20	DL1%=2.84
			DL0.1%=1.37	DL0.1%=15.82	DL0.1%=4.01

Analyzing the data from table 4 it has ascertained that attack level at untreated plants was of 4.83. All plants from treated variants have an attack intensity lower then 3.5. The differences between treated variants were low, and at variants treated in vegetation with Decis Mega EW and Karate Zeon 5 CS the attack level was almost similar. The lowest value of the attack intensity was at variant treated with Karate 2.5 WG (I=3.45). Only at this variant statistical difference comparative with control variant were distinct significant (table 4). Regard as average maize plants height, after 50 days from plants emergence, at control variant this value was of 145.33 cm. At all treated variant this value ranged from 159.00 and 160.25 cm, almost equal. Saved plants percent, an important parameter regard plant losses because of the maize leaf weevil attack was of 85.25 % at control (untreated) variant and between 98.00 and 99.25 % at treated variants. There are low differences between treated variants. All products provided a satisfactory protection of the maize plants, in climatic conditions of the spring period, year 2010.

In climatic conditions of the spring period, from year 2011, the attack intensity at untreated maize plants was of 5.79 on a scale from 1 to 9. That means the majority of the maize plants from untreated variant were with leafs chafed in proportion of 75 %. The attack level at treated variants was highest from all of the three years taken in study. At variant treated in vegetation with Karate Zeon 5 CS was the lowest value of the attack intensity, of 4.30 followed very close by variant treated, in vegetation, with Calypso 480 SC (I=4.40). At variant treated, in vegetation with Karate 2.5 WG the attack intensity was of 4.50 while at variant treated, in vegetation, with Decis Mega EW the attack intensity was of 4.55. There are not significant differences between control variant and treated variants this year and the differences between treated variant were very low. Average plant height at treated variants has values bigger than 153.16 cm and low differences between these variants. At untreated variant, average plant height at 50 days after plants emergence was of 144.69 cm (Table 5).

Table 5. The effectiveness of some products used for vegetation treatment at maize crop against *Tanymecus dilaticollis* Gyll, at NARDI Fundulea, year 2011

Nr. crt.	Variant	Rate (l/ha, kg/ha)	Attack intensity (1-9)	Plants height (cm)	Saved plants percent (%)
1	Control (untreated)	—	5.79	144.69	75.90
2	Calypso 480 SC	0.09	4.40**	155.18**	94.50***
3	Decis Mega 50 EW	0.15	4.55*	153.16*	96.50***
4	Karate Zeon 5 CS	0.15	4.38**	157.68**	96.50***
5	Karate 2,5 WG	0.30	4.50**	155.15**	96.75***
			DL5%=0.90	DL5%=7.04	DL5%=6.75
			DL1%=1.27	DL1%=9.88	DL1%=9.48
			DL0.1%=1.79	DL0.1%=13.95	DL0.1%=13.38

Table 6. The effectiveness of some products used for vegetation treatment at maize crop against *Tanymecus dilaticollis* Gyll, at NARDI Fundulea, average values of the years 2009-2011

Nr. crt.	Variant	Rate (l/ha, kg/ha)	Attack intensity (1-9)	Plants height (cm)	Saved plants percent (%)
1	Control (untreated)	—	5.55	137.63	79.02
2	Calypso 480 SC	0.09	4.03***	150.43***	95.00***
3	Decis Mega 50 EW	0.15	4.07***	149.52***	96.75***
4	Karate Zeon 5 CS	0.15	4.00***	152.15***	97.17***
5	Karate 2,5 WG	0.30	4.00***	150.60***	97.25***
			DL5%=0.48	DL5%=4.90	DL5%=2.65
			DL1%=0.68	DL1%=6.88	DL1%=3.71
			DL0.1%=0.96	DL0.1%=9.71	DL0.1%=5.24

Saved plants percent, was of 94.50 % at variant treated with Calypso 480 SC. This was lowest value from all treated variants. At the rest of treated variants, saved plants percent was almost similar, 96.50 % at variant treated with Decis Mega 50 EW and Karate Zeon 5 CS or 96.75 % at variant treated with Karate 2.5 WG. All products provided a satisfactory protection of the maize plants, in climatic conditions of the spring period, year 2011. Analyzing the average values of these parameters, from period 2009-2011, it has ascertained that all insecticides used in vegetation at maize crop against *Tanymecus dilaticollis* Gyll reduce attack intensity from average value of 5.55 at approximate 4.00 on an intensity scale from 1 to 9 (Table 6).

That means the majority of the maize plants from untreated variant were with leafs chafed in proportion between 50 and 75% and the majority of the maize plants from treated variants were with leafs chafed in proportion of 25%. In all of the three years there are not significant differences between insecticides used in this experiment, but significant differences between control variant and treated variants (Fig. 3). The situation is similar regarding average plant height parameter. On average, at untreated variant, plant height at 50 days after emergence was of 137.63 cm. At treated variants, this parameter ranged between 149.52 and 152.15 cm. The differences between untreated variant and treated variants were significant. Generally, at untreated variant, plant losses because of maize leaf weevil attack in first phase of the vegetation were more than 25% (Fig. 4). At treated variant saved plant percent was higher than 95%. At variants treated with Karate Zeon 5 CS and Karate 2.5 WG was the higher values of this parameter, but generally the differences between treated variants, in period 2009-2011 were low. In same time differences between control variant and treated variant was significant and statistical assigned.

Photo 1. Attack of the *Tanymecus dilaticollis* Gyll on maize young leaf (original)

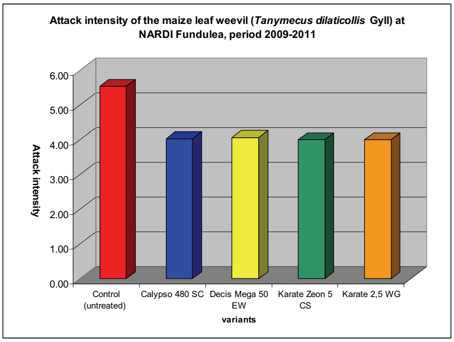

Fig. 3. Attack intensity of the maize leaf weevil (*Tanymecus dilaticollis* Gyll) at NARDI Fundulea, period 2009-2011

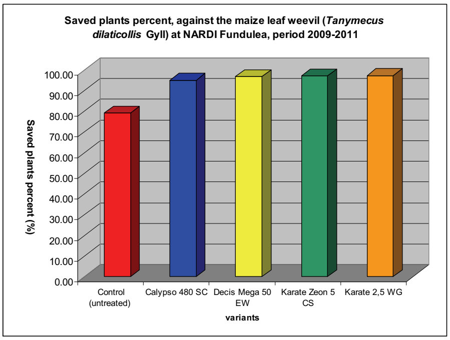

Fig. 4. Saved plants percent, against the maize leaf weevil (*Tanymecus dilaticollis* Gyll) at NARDI Fundulea, period 2009-2011

CONCLUSIONS

Although climatic conditions from one year to another are different, the maize leaf weevil (*Tanymecus dilaticollis* Gyll) is the main pest of maize crops in south and south east of the country.

The attack intensity at untreated plants is different from one year to another and depends of crop technology and climatic conditions.

All products from this experiment, used like vegetation treatment, provided a satisfactory protection of the maize plant, in climatic conditions of the spring, from years 2009-2011.

Using of the vegetation treatment at maize crop is recommended when it is not effectuated seed treatment or this is effectuated wrong.

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WATER MANAGEMENT – LARGER YIELD AND LOWER COSTS

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Abstract

Water is the limiting factor for plant production. From "black" soil, soil without plants, there is almost no evaporation. All plants are using water for growth and when the soil is covered by plants, no matter whether it is crops or weeds, it is consuming up to 5 litres of water per m^2 per day. When the soil is cultivated under dry conditions, an evaporation of 15 litres per m^2 of water can be expected. Weed control and soil tillage are key factors in water management. To avoid unnecessary evaporation, the weeds must be controlled from harvest, before harvest if possible, until a new crop is to be planted. And the weeds must be controlled in the early growth stages of the crops, to secure water, neutrinos and light for the crop. To minimise the evaporation, the soil tillage and the working depth by tillage must be reduced to a minimum. By new technologies no tillage and strip tillage are possible to reduce the evaporation, machine costs, and diesel and labour costs. To reduce the temperature of the soil, the speed of the wind and a better penetration of the precipitation, between 30-50 per cent of the straw and stubbles are recommended to be kept on the top of the soil. The water which is available for the crops depends on the precipitation, loss of water and crop rotation. Wheat grown after rapeseed, barley or wheat has about 120-150 more litres of water available per m^2 than wheat grown after maize or sun flower, if good water management is practiced.

Key words: *evaporation, precipitation, tillage, weed control.*

INTRODUCTION

Very often water is the limiting factor for plant production. By good water management more water can be available for the plant production. Water can be limited in more ways; the amount of precipitation can vary from year to year and from month to month, but nothing can be done. Only by irrigation more water can by supplied. The water capacity of the soil is essential for the availability of water for the plants in the growing season. The main challenges for water management is:

- To make the water able to penetrate the soil;
- To store the water in the soil;
- To avoid unnecessary evaporation.

Soil tillage and control of weeds are main factors in relation to water management. By each soil tillage water is evaporating; most under dry conditions in combination with severe cultivation. Under more humid conditions the evaporation is lower. For growth all plants needs water whether it is weeds or crops. To save water for production, weeds needs to be controlled as early as possible.

MATERIAL AND METHOD

Studies A literature study has been made. Results from field trials and from farm experiences have been submitted.

RESULTS AND DISCUSSIONS

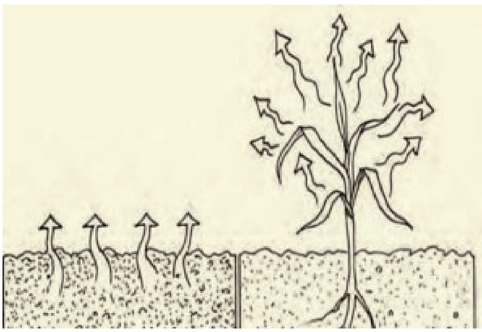

Fig. 1. Evaporation is low from "black" soil but up to 5 mm per day when the soil is coverage by plants. *2009 Sustainable Agriculture Research and Education*

Evaporation

From “black” soil without plant coverage, there is almost no evaporation, but when soil is covered by plants the evaporation is raising. The evaporation depends on the percentage of plant coverage and the weather conditions.

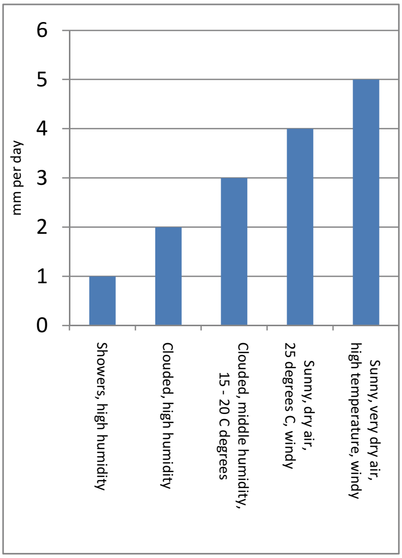

Fig. 2. Evaporation from a well established crop [1]. *Danish Agricultural Advisory Service*

The evaporation from the plants is largest under sunny, dry, windy and hot weather conditions. When the soil is covered by plants, crop or weeds, the evaporation is up to 5 l/m^2 or 5 mm per day. Under more cool or/and humid conditions the evaporation is lover.

Soil tillage

According to results from Agricultural Water Conservation Clearinghouse, USA, the evaporation by soil tillage is 15 mm or 15 l per m^2 per treatment.

To get a good penetration of the rain, to reduce the evaporation, to reduce the speed of the wind, to give shade and reduce the temperature of the soil, and to trap the snow during the winter Agricultural Water Conservation Clearinghouse recommend to keep 30-50 pct. of the straw and stubbles on top of the soil.

Weed control

Control of weeds is essential. Weeds in the fallow period, form harvest until a new crop is established, can each day use big amounts of water – water which is lost for the flowering crop. The loss of water depends on the amount of weeds and the period the weeds are allowed to grow.

Local conditions

The precipitation is different in different parts of the country - different in amount and different in timing. And the amount of precipitation varies from year to year. Statistics about weather conditions can be found from different sources. Below are shown figures from Meteo Romania and Meteorologisk Institutt Norge

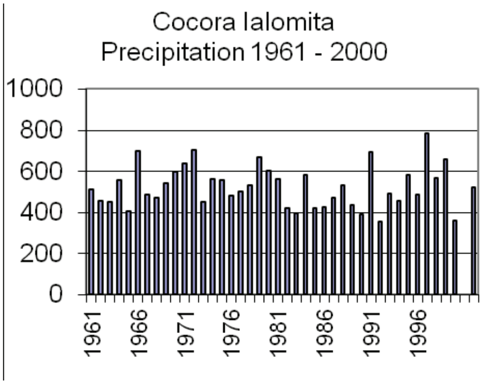

Fig. 3. Precipitation 1960-2000 at the location Cocora. Ialomita, *Meteo Romania*

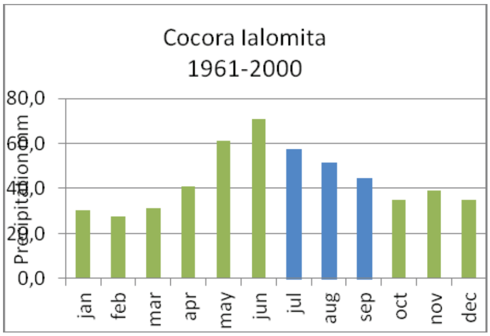

Fig. 4. Average monthly precipitation 1960-2000 at the location. Cocora Ialomita. *Meteo Romania*

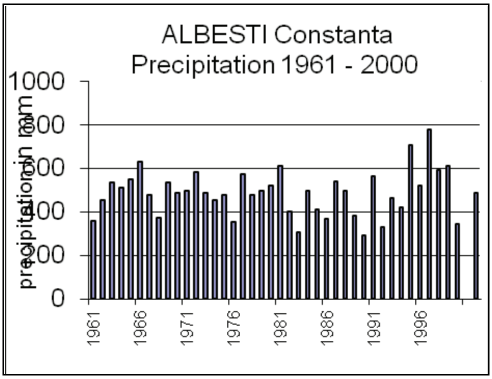

Fig. 5. Precipitation 1960-2000 at the location Albesti Consstanta, *Meteo Romania*

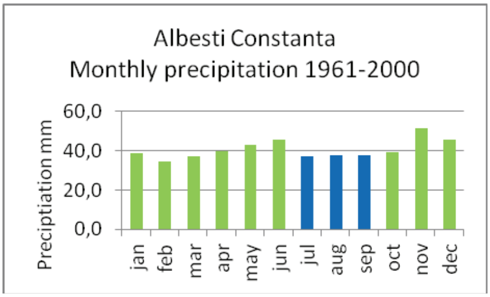

Fig. 6. Average monthly precipitation 1960-2000 at the location. Albesti Constanta. *Meteo Romania*

The months July, August, September are marked, because in these months the land is without production "fallowed", when cereals and oil seed rape are grown. In this period the precipitation must be stored in the soil and evaporation avoided.

Soil tillage

By soil tillage water is evaporating, and soil tillage is expensive, machine costs, diesel and labour.

Table 1. Soil tillage: Labour and machine requirements hours/ha (100 hp) [2]. *University of Nebraska-Lincoln*

Operation	Plow	Chisel	Disk	Ridge Plant	Strip-till	No-till
Shred stalks				0,43		
Moldboard plow	0,95					
Chisel plow		0,53				
Knife fertilize	0,33	0,33	0,33	0,33	0,50	0,33
Disk	0,40		0,40			
Disk or field cultivate	0,40	0,40	0,40			
Plant	0,53	0,53	0,53	0,63	0,53	0,53
Cultivate	0,45	0,45		0,90		
Spray			0,15		0,28	0,28
Total	**3,05**	**2,23**	**1,80**	**2,28**	**1,30**	**1,13**
Index	100	73	59	75	43	37

Table 2. Soil tillage: Diesel consumption litre/ha (100 hp) *University of Nebraska-Lincoln.*

Operation	Plow	Chisel	Disk	Ridge Plant	Strip-till	No-till
Shred stalks				5,2		
Moldboard plow	21,3					
Chisel plow		9,9				
Knife fertilize	5,7	5,7	5,7	5,7	9,5	5,7
Disk	7,0		7,0			
Disk or field cultivate	7,0	7,0	7,0			
Plant	4,9	4,9	4,9	6,4	4,9	4,9
Cultivate	4,1	4,1		8,1		
Spray			1,0		2,2	2,2
Total	**50,0**	**31,6**	**25,6**	**25,5**	**16,6**	**12,8**
Index	100	63	51	51	33	26

Establishment

To make the seeds germinate water is needed. The water can either come from precipitation or from capillary water. By soil tillage the capillary transport of water is broken in the depth of the tillage. If the tillage is deeper than the seeding depth, the seeds will not get in contact the capillary water.

Photo 1. Rapeseed established after two cultivations, Calarasi autumn 2011. *Photo Christian Haldrup*

The picture above and under is from the same field autumn 2011 in Calarasi area. The difference between the two parts is that there have been made two cultivations where the rapeseed are well established and three cultivations in the other part of the field. By the third tillage the water for germination has evaporated.

Grain/seed filling period

From flowering the production of grains and seeds are starting. In a good day under good conditions a good cereal crop is producing 200 kg per ha per day. The number of days of production is essential for the production. Water can and are often the factor for the number of production days.

Photo 2. Rapeseed established after three cultivations, Calarasi autumn 2011. *Photo Christian Haldrup*

CONCLUSIONS

Water is a limiting factor for plant production. By good water management more water can be available for the production of grains/seeds. Water must be available for germination and growth and as much water as possible must be "saved" for the crops in the grain/seed filling period.

Unnecessary loss of water must be avoided. The soil must be kept "black" free of plants, in the period between two crops. To save most water it is best to control weeds 10 days before harvest by using glyphosat. After harvest weeds and germinating barley/wheat must be controlled, either by glyphosat or by upper tillage, with a working depth of no more than 4-5 cm.

30-50 pct. of the straw and stubbles must be kept on top of the soil to reduce wind speed, reduce the soil temperature, stop the snow and keep it on the fields and make easier for the rain to penetrate into the soil.

Weeds in the crops must be well controlled and at the early staged. This can avoid unnecessary use of water, shade, use of nutrients and taking space.

To avoid unnecessary evaporation soil tillage and working depth must be reduced as much as possible.

No tillage and strip tillage are new technologies in Romania but common growing technologies in areas in US and Australia which are comparable to Romanian conditions. The technologies are developed to reduce the waste of water, optimise the yields and reduce the costs.

Larger yield and lower costs –
Water management

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OILSEED RAPE PRODUCTION UNDER THE AUTUMN WATER STRESS CONDITIONS IN ROMANIA

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Abstract

In this paper, the authors analyze the most important technological factors affecting OSR crop establishment in the droughty years, noticed during the last 8 years. In Romania, many farmers have considered oilseed rape to be a high-risk crop, for some good reasons: uneven emergence because of drought during the planting and crop establishment periods, hard winters, very low densities in the spring, repeated temperature oscillations during early spring. High temperatures during pod filling period limit the yield. Seed quality is essential for crop establishment, especially under drought conditions. Deep cultivation in order to allow the rapeseed roots to go deep after water. Straw-management is also important. Early cultivation is recommended, to determine germination of lost seeds from the previous crop and weeds. The soil has to be kept black with glyphosate. For usual planting (1-15 September), the best results in the droughty years were obtained where seedbed was ready for planting in late July/mid August. Only few tillage operations have to be performed during the planting period.

Key words: *oilseed rape, drought, yield.*

INTRODUCTION

Oilseed rape (OSR) was one of the most profitable crops in Romania during the last 9 years. Nevertheless, large variation in area harvested and yield has been recorded.

Table 1. Dynamics of oilseed rape during the last 5 years in Romania

Specifica-tion	Units	2008	2009	2010	2011	2012
Area harvested	Thousands hectares	365.0	419.9	537.3	382.5	85.1
Yield	Kg/ha	1844	1357	1755	1951	
Total yield	Thousands tones	673.0	569.6	943.0	746.6	

However, many farmers have considered oilseed rape to be a high-risk crop, for some good reasons [2, 3, 4]:

- Drought during the planting period.
- Uneven emergence because of drought during the crop establishment period;
- Hard winters (the temperatures sometimes decrease below –20^{o}C or –25^{o}C).
- Very low densities in the spring.
- Repeated temperature fluctuation during early spring (from +20^{o}C to –5^{o}C).
- Droughty period during spring and summer.
- High temperatures (more than 30 ^{o}C) during pod filling period limit the yield to less than 2 t/ha (national average).

For all those reasons and some others, in 1995, only 305 ha cultivated with oilseed rape have been harvested in Romania.
Due to the very good prices of the harvest during the last few years, farmers had profit if the yield exceeded 1-1.2 t/ha. In 2011, some farmers have obtained a net income above 700-800 Euros/ha (for the yields higher than 4 t/ha).
For these reasons, many technical arguments were found to indicate that oilseed rape is not quite a high-risk crop, such as:

- Between 1st and 6th of September, a rainfall (at least 10 l/m^2) will occur in normal year all over the country (30 years average) [2].
- Freezing is not a major problem, according to map of the freezing risk for oilseed rape in Romania [2]

In conclusion, we could say that drought during planting and crop establishment periods remains a high risk factor affecting oilseed rape.

MATERIAL AND METHOD

The information on which this analysis is based was gathered during some research projects: "Establishment of the rapeseed technology in order to increase yield and surface in the South and South – East of the Romania" (founded by World Bank and Ministry of Agriculture), CEEX Project (Contract BIOTECH nr. 2/06.10.2005): Complex valorisation of some renewable natural resources to obtain bio-fuels, glycerine and ecological solvents and Novel technologies to obtain bio-fuels from renewable sources specific to Romanian agriculture – TINOCIP, PN II, project no. 22138/2008.

RESULTS AND DISCUSSIONS

In the autumn of 2011, Romanian farmers took the chance and tried to plant oilseed rape, despite the climate threats (drought period in late August and September). For that reason, 350.000 ha were planted. The poor crop establishment and a hard winter have determined the decreasing of the cultivated surface by 75%, up to 85,100 hectares.

One of the causes for this extreme reduction of the OSR cultivated surfaces could be the fact that Romanian farmers are not used to have low plant densities in spring.

It is very easy to understand that, if we are thinking that 10 years ago, their aim was to harvest 100 plants per m^2. They do not trust technologies for low densities. Big farmers did not keep low profit crops (less than 2 t/ha). This was a reason why winter survival rate was so small in 2011/2012 [1]

In 2012, low plant densities produced higher yield than expected: 5-10 plants per m^2 produced 0.7-2 t/ha, 10-15 plants per m^2 yielded 2-3 t/ha. As a result, the farmers who experienced low densities this year and the amazing OSR plants recovery will less likely replace rapeseed crop.

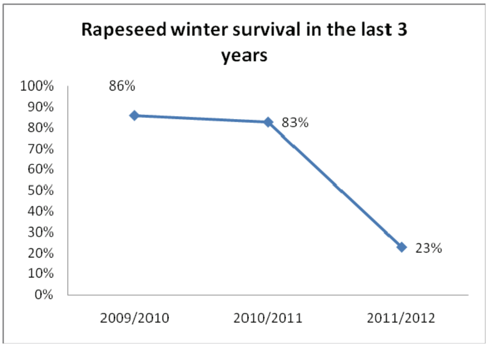

Fig. 1. OSR winter survival in the last 3 years

Some of the key points of the technologies used in droughty conditions by some of the most performing farmers are described below.

1. Good quality seeds. Seed quality is essential for crop establishment, especially under drought conditions. By using certificated seeds, the farmers could avoid fake seeds, with very low germination.

When only pure lines were planted in Romania (before 2003), many growers used to sow "farmer's seed", sometimes two years old. In this case, small vigour seeds determined poor establishment. After the introduction of the hybrids, the quality of the seeds used for planting significantly increased. When farmer' seeds were used, the yield was between 2.5-3.5 t/ha (for pure lines) and 0.8-2 t/ha (for hybrids).

2. Planting date - before or after rain? In the last few years, in the South of Romania, oilseed rape plants seem to develop better if the seeds are sown after rain, even if the optimal sowing period is outdated.

When the sowing is in the dry soil, the rain before emergence could determine crust formation. Some hybrids such as Exagone (Monsanto), with fast development/growth in the autumn, allow farmers to wait for a September rain before planting.

Optimum planting period in the South of Romania: 1-10 September.

During the last few years, the best results were obtained when the farmers have planted oilseed rape after a rainfall, even if they had to wait until 20th of September.

In the last few years, many experiments (in Romania and other Central European countries), were conducted to see if better results are obtained with early planting (8-15 August). In early planting bigger amount of inputs are used: two growth regulator applications and 2-3 insecticide treatments (because of longer vegetation period in the autumn).

A.I. Spinciu reported [7] that planting in 15 of August 2011, just after a 15 l/m^2 rainfall, was a better choice (3.2 t/ha) than sowing 8 days later (1.7 t/ha).

3. Plant protection. Under water stress conditions, herbicides applied before emergence have little effect. For that reason is better to avoid their application. A solution, hopefully soon available for Romanian farmers, will be the use of post emergence herbicide, such as Cleranda from BASF (metazachlor + imazamox) for hybrids from Clearfield system.

Barley volunteers seem to be more harmful for OSR plants than winter wheat volunteers, due to the allelopathic effect of barley seedlings.

Herbicide rotations determined some problems, especially in the droughty years. Sulfonylurea herbicides used for the previous crop are responsible for the uneven emergence.

When the farmers have learned that is better to plough after using sulfonylurea herbicides in a droughty year, another problem has arisen: deep soil tillage (plough and disks) increases water loss. These tillage practices affect crop emergence and establishment.

4. Nitrogen fertilization. In Romania, on many soils, nitrogen fertilization is needed in the autumn. In many cases, if nitrogen fertilizers are not applied, nitrogen deficiency could appear, because of straw incorporation.

5. Soil tillage. Romanian farmers have tried to improve soil tillage in order to save water. Direct drilling is now used on large surfaces.

Some of the better performing farmers are thinking to use strip till.

In conventional tillage, a passage with a roller after planting increases the plant emergence.

We present a case study about technologies under droughty conditions [6].

A. Farmer. He cultivated 385 ha with OSR. The main characteristics of the technology are:

1. No ploughing. Soil tillage consists in stubble disc cultivation in the harvest day and soil loosens (35 cm depth) 3 weeks after. Both cultivator and soil loosener aggregates contained a roller. He rent some machinery in order to till in time. The final operation for seedbed preparation was made by a complex seed drill.
2. Two glyphosate applications: one before winter wheat harvest and another one 3 weeks after a rainfall.
3. Seedbed was ready in mid August.
4. 40 kg N/ha were used for fertilization in the autumn + 40 kg P_2O_5/ha. In the spring, 80 kg N/ha were added.

Plant densities in spring was 41 plants per m^2 and the yield was 3.5 t/ha.

B. Part time farmer. 20 ha with OSR.

1. Ploughing one week after harvest. 5 t/ha straw were incorporated. He did not till the soil until late August. Seedbed preparation was made in early September.
2. No fertilization in the autumn. In spring, part time farmer applied 90 kg N/ha.

Plant densities in spring was 21 plants per m^2 and the yield was 0.7 t/ha.

6. Irrigation. The irrigation is the ultimate method to improve crop establishment during the droughty periods.

A.I. Spinciu [7] mentioned the remarks from the experience of the autumn of 2011, when a severe drought was noticed in the South of Romania (see table 2).

Table 2. Irrigation effect on plant density and yield

Specification	Plant density per m^2	Yield (t/ha)
Irrigated (300 mc/ha before planting on 27th of August)	63	4
Irrigated (300 mc/ha before emergence)	58	3.6
Non irrigated, planted after 15 l rain/m^2 on 15th of August	48	3.2
Non irrigated, planted "in dust" on 23rd of August	20	1.7
	12-15	Destroyed

CONCLUSIONS

- The best results in the droughty years were obtained where seedbed was ready for planting mid/late August.
- Only few tillage operations have to be performed during the planting period. In this situation, the plants have emerged and grew better.
- Early planting (early or mid August) seems to be a promising possibility for OSR in the droughty years.
- Planting after rainfall seems to be a better choice than sowing "in dust".

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STUDIES CONCERNING NECTAR SECRETION AT RAPESEED (*Brassica napus* L. ssp. *oleifera* D.C.)

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Abstract

Rapeseed (Brassica napus L. ssp. oleifera D.C.) is one of the main melliferous plants due to its nectar secretion and important number of flowers per plant, but especially due to its flowering in a critical period for honey bees, when important quantities of pollen and nectar are required. Although the nectar secretion of the rapeseed flowers is very important for the good development of the honey bees families in the spring and for obtaining some commercial honey yield by the beekeeper, and is playing an important role in the attractiveness of the honey bees as pollination agent for the rapeseed crops, there is still a lack of information concerning the nectar secretion by the rapeseed flowers. Under these circumstances, researches were carried out regarding the nectar secretion and honey production of different rapeseed crops located in different places from South Romania in the years 2009 and 2010. The nectar determination was completed by rapeseed plant characteristics such as plant high, average number of plants per square metre, average number of inflorescences per plant, average number of flowers per inflorescence, and average number of flowers per plant.

Key words: *nectar secretion, honey, rapeseed.*

INTRODUCTION

Honey bees and rapeseed plants have a special relationship: living one life is dependent on another. Rapeseed flowers give protein (pollen) and energy (nectar) food to honey bees, and in exchange honey bees assure the cross-pollination process. Many authors have hypothesized that a good nectar secretion of the rapeseed flowers is associated with a better pollination due to the increased number of bees that are visiting the flowers [1]. Even the self-fertility of the rapeseed flowers is possible within a certain percentage, the seed yields obtained in the crops without entomophilies pollination are significantly lower compared to those obtained in crops pollinated by honey bees [2].

The nectar secretion and the conditions under which nectar is produced by the rapeseed flowers are essential for farmers (for entomophilies pollination of the crop) but especially for beekeepers. For a beekeeper who wants to obtain honey production, it is essential to know which crops produce nectar and how much they are producing that.

Although rapeseed crop is important for beekeeping, there is a lack of studies regarding the secretion of nectar of the rapeseed flowers [2]. However, it is obviously that the important number of flowers per unit of area gives great melliferous value to the rapeseed crops; this is being emphasised by the flourishing in a critical period for honey bees, when the demands for protein and energy needs are high. Moreover, the melliferous importance of the rapeseed crops in Romania is emphasised by the increasing cultivated surfaces in the last years, the rapeseed being more and more of interest for the Romanian farmers.

The present study started from the idea that there is a strong need to know more about the melliferous characteristics of the rapeseed plant. This necessity is more emphasised when we talk about pastoral beekeeping to the rapeseed crops, situation when the beekeeper has to know as much as possible about the melliferous potential of the rapeseed crop.

A better understanding of the nectar secretion processes is necessary for a future improvement of the nectar secretion of the rapeseed plants through plant breeding and agricultural techniques which give an increased attractiveness of the rapeseed flowers for the honey bees, this being a necessary condition for a better pollination, respectively for a better yielding capacity of the crops.

MATERIAL AND METHOD

Studies concerning the nectar secretion were performed in different rapeseed crops located in South Romania, in the years 2009 and 2010. In 2009, the studies were performed in seven rapeseed crops, out of which three rapeseed crops in Giurgiu County (Bălănoaia, Valea Bujorului, and Naipu), three rapeseed crops in Călăraşi County (Lehliu, Şoldanu, and Dichiseni), and one rapeseed crop in Teleorman County (Nicolae Bălcescu). In 2010, the studies were performed in two rapeseed crops, out of which one rapeseed crop in Călăraşi County (Ulmeni) and one rapeseed crop in Ilfov County (Baloteşti).

In all studied rapeseed crops there were performed the following determinations:

- Determination of the nectar secretion (quantity of nectar per rapeseed flower and its concentration in sugar;
- Calculation of the potential honey production (quantity of honey per hectare);
- Determination of the honey production (quantity of honey per hive).

Determination of the nectar secretion. The quantity of secreted nectar per flower was determined by the capillaries method. Extracting nectar from flowers was performed using glass capillary micropipettes, which were composed of three distinct parts, respectively: a capillary tube of 50 mm length which was ending with a capillary head having an inner diameter of 0.1 mm; two spherical bubbles forming an angle of 90^{o} and having an inner diameter of 4 mm; a suction head of 10 mm length having an inner diameter of 2 mm (Photo 1). On the suction head, there was placed a rubber tube of 50 cm length which was ending with a glass tube (Photo 2)

Photo 1. Glass capillary micropipette

Photo 2. Glass capillary micropipette with rubber tube and glass tube

Before using the glass capillary micropipettes, these were marked and weighted using an analytical balance, and were kept in closed boxes. For using the glass capillary micropipettes, the rubber tube was fixed on the suction head, the capillary head was placed into the rapeseed flower, and the glass tube ending the rubber tube was placed into the mouth and the nectar was aspired. The nectar was passing through the capillary tube and arrived into the first spherical bubble where it was collected.

The nectar was extracted from 10 rapeseed flowers which were mull isolated for 24 hours. After the nectar was extracted from the 10 analysed rapeseed flowers, the rubber tube was taken out from the suction head and the glass capillary micropipette was weighted using the analytical balance. The difference in weight between the glass capillary micropipette with nectar and its initial mass represents the nectar extracted from the rapeseed flowers. The quantity of nectar was expressed as mg nectar per flower.

The sugar concentration in nectar was determined by using a refract meter (portable refract meter OPTICA, 0-80 Brix). In this respect, the rubber tube was fixed again on the suction head of the glass capillary micropipettes with nectar, the glass tube ending the rubber tube was placed into the mouth and the nectar was blowing away on the refract meter blade. The two blades of the refract meter were then closed and the nectar concentration in sugar was read on the refract meter scale (Photo 3).

Photo 3. Determination of the nectar concentration in sugar with refract meter

In 2009, for each rapeseed crop there were performed 20 nectar determinations, each determination consisting in 10 analysed rapeseed flowers. This meant that 200 rapeseed flowers were analysed for each rapeseed crop. The nectar determinations were repeated after one week.

In 2010, for each rapeseed crop there were performed 20 nectar determinations per day during 13 days, and each determination consisted of 10 analysed rapeseed flowers. This meant that a total number of 2,600 rapeseed flowers for each rapeseed crops were analysed.

In both years of determinations, the nectar was extracted between 8 a.m. and 12 a.m. when the rapeseed crop was in the full flowering stage (between 28 of April and 12 of May). Before the nectar determination, the rapeseed inflorescences were mull isolated 24 hours to avoid loses of nectar caused by insects. The quantity of nectar obtained in this manner was conventionally considered to be the quantity secreted within 24 hours.

Calculation of the potential honey production. The quantity of nectar and its sugar concentration are used for calculating the potential honey production per unit of surface. But, it is also necessary to determine the number of rapeseed flowers per plant and the number of plants per hectare. In this respect, parallel to nectar analysis, 20 plants of each rapeseed crop were analysed for determining the number of flowers per plant, as well as the average number of inflorescences per plant and the average number of flowers per inflorescence. Also, the number of plants per hectare was determined of each rapeseed crop studied to calculate the number of flowers per hectare.

The sugar production per flower was calculated from the quantity of nectar (in mg per flower) and its sugar concentration, this representing the quantity of sugar (in mg) per flower produced in 24 hours. By multiplying the quantity of sugar per flower with the average number of flowers per hectare, it was obtained the quantity of sugar produced per hectare by the rapeseed crop in 24 hours.

It was determined that a rapeseed flower was flowering for three days and knowing that the honey contains 80% sugar and 20% water, it was then calculated the potential honey production.

Determination of the honey production. In each analysed rapeseed crop there were bee hives and one hive with an average development of the bee family was put on a control balance. Each day during the flowering stage it was registered the hive weight in order to establish the quantity of honey produced by the bee family.

RESULTS AND DISCUSSIONS

Results obtained in 2009. In the analysed rapeseed crops from South Romania in 2009, the nectar secretion varied between 0.69 and 2.45 mg per flower, with an average value of 1.13 mg per flower. However, more often the nectar secretion varied between 0.7 and 1.2 mg per flower. The nectar concentration in sugar was in average 62.1%, with a variation between 38.2 and 72.8%. However, more often the nectar concentration in sugar varied between 66 and 73%. As it was expected, there was registered a negative correlation between nectar secretion and nectar concentration in sugar, respectively when the nectar secretion was high the nectar concentration in sugar was small and vice-versa (Fig. 1).

The honey production was determined by the nectar secretion and its concentration in sugar and by the biological characteristics of the rapeseed plants, which at their turn are determining the number of rapeseed flowers per surface unit and even the nectar secretion of the rapeseed flowers.

The plant high, one of the characteristics that can potentially affect the number of flowers per plant was in average of 128 cm in the analysed rapeseed crops, with variations between 89 and 148 cm (Table 1). But, the correlation of the average number of flowers per plant with plant high in the analysed rapeseed crops from South Romania in 2009 was not so good, which meant that the number of flowers per plant was less influenced by the plant high (Fig. 2).

The plant population is known to be one of the crop characteristics with a significant effect on the productive capacity of the crop, as well as on the number of flowers per plant and per surface unit (square metre). The plant population varied between 19 and 66.5 plants per square metre (Table 1). There was a significant negative correlation of the average number of flowers per plant with the average number of plants per square metre in the analysed rapeseed crops from South Romania in 2009. That meant the higher plant population the lesser number of flowers per plant is (Fig. 3). But, there is a positive correlation of the average number of flowers per square metre with the average number of plants per square metre up to 50-55 plants per square metre. After this threshold the average number of flowers per square metre starts to decrease (Fig. 4).

The average number of inflorescences per plant was of 4.7, with variations from 2.9 up to 7.9 (Table 1). There was a significant negative correlation of the average number of inflorescences per plant with the average number of plants per square metre in the analysed rapeseed crops from South Romania in 2009 (Fig. 5).

The average number of flowers per inflorescence was of 58.4, with variations between 54.1 up to 67.3 (Table 1). It is interesting to notice that there was a positive correlation of the average number of flowers per inflorescence with the average number of inflorescences per plant (Fig. 6). This means that when there are more inflorescences per plant, the number of flowers per inflorescence is higher. That can be explained by the fact that more inflorescences per plants means good growth and development conditions for the rapeseed plants which can develop more flowers per inflorescence.

The average number of flowers per plant was of 277, with variations between 157 and 532 (Table 1).

Up to 300-400 flowers per plant, the nectar secretion as mg per flower is increasing, but after this threshold the nectar secretion is decreasing (Fig. 7).

The potential honey production (the calculated honey production) varied between 195.9 and 331.7 kg per hectare, with an average value for the analysed rapeseed crops of 242.2 kg per hectare (Fig. 8).

The honey production per hive (control hive) varied from 6.3 up to 23 kg, with an average value of 17.2 kg (Fig. 8).

Table 1. Rapeseed plant characteristics in the analysed crops from South Romania in 2009

Place of analysed rapeseed crop	Plant high (cm)	Average number of plant per m^2	Average number of inflorescence per plant	Average number of flowers per inflorescence	Average number of flowers per plant
Bălănoia	121	53.5	3.6	58.3	210
Lehliu	139	29.5	5.9	56.0	330
Şoldanu	148	19.0	7.9	67.3	532
Nicolae Bălcescu	136	65.0	2.9	54.1	157
Naipu	142	45.0	4.3	56.5	243
Valea Bujorului	123	53.0	3.8	57.9	220
Coslogeni	89	52.0	4.3	55.5	239
Radomireşti	128	66.5	4.6	61.9	285
Average	*128*	*47.9*	*4,7*	*58.4*	*277*

Results obtained in 2010. In the analysed rapeseed crops from South Romania in 2010 the nectar secretion was determined every day during ten days. Each day the nectar secretion and the nectar concentration in sugar had different values, according to the climatic conditions and the progressing of the flowering process. This variation from day to day was registered in both rapeseed crops analysed in South Romania in 2010. As in 2009, there was registered a negative correlation between nectar secretion and nectar concentration in sugar, which meant that when the nectar secretion was high the nectar concentration in sugar was small and vice-versa (Fig. 9 and 10).

In the analysed rapeseed crops from South Romania in 2010 and during the ten days of analyses, the nectar secretion was in average 1.88 mg per flower, while the nectar concentration in sugar was in average 49.2%.

In the analysed crops in 2010, the average number of flowers per plant was of 265 and the potential honey production (the calculated honey production for the rapeseed crops) was in average of 324.8 kg per hectare.

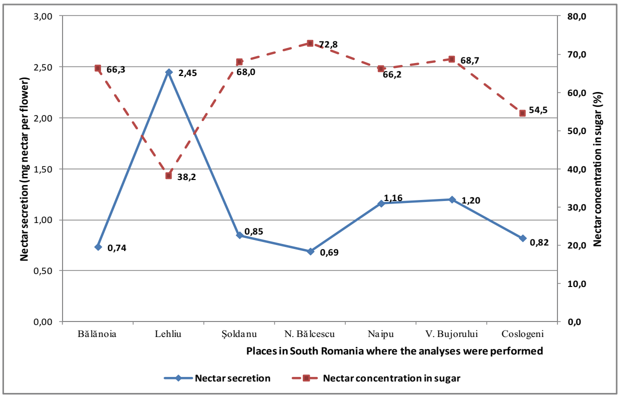

Fig. 1. Nectar secretion and its concentration in sugar in the analysed rapeseed crops from South Romania in 2009

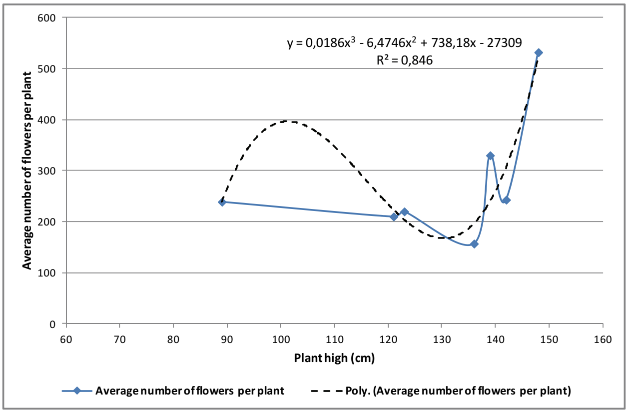

Fig. 2. Correlation of the average number of flowers per plant with the plant high in the analysed rapeseed crops from South Romania in 2009

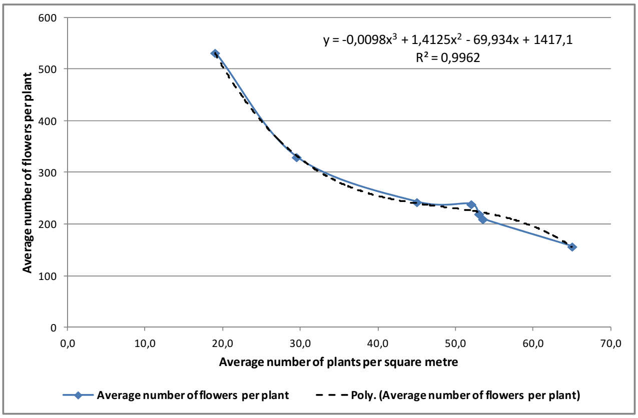

Fig. 3. Correlation of the average number of flowers per plant with the average number of plants per square metre in the analysed rapeseed crops from South Romania in 2009

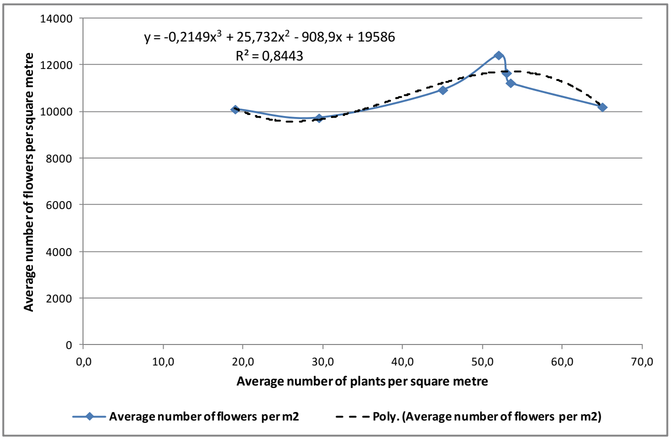

Fig. 4. Correlation of the average number of flowers per square metre with the average number of plants per square metre in the analysed rapeseed crops from South Romania in 2009

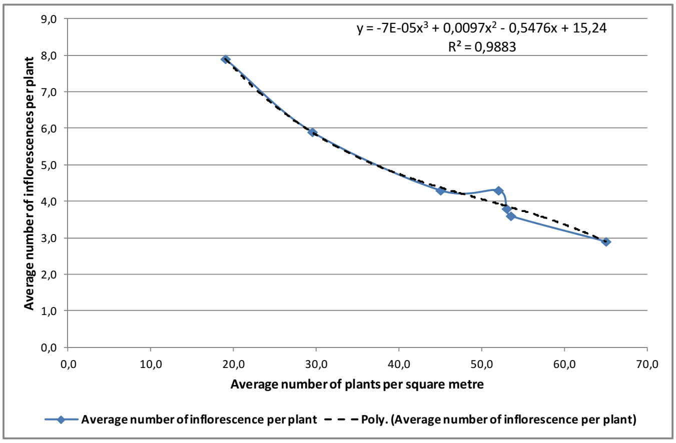

Fig. 5. Correlation of the average number of inflorescences per plant with the average number of plants per square metre in the analysed rapeseed crops from South Romania in 2009

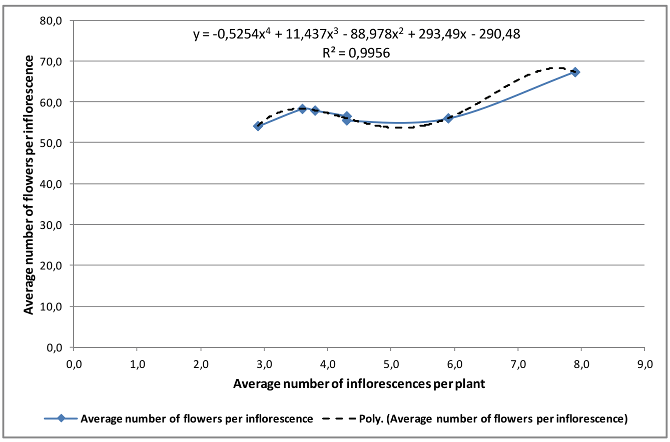

Fig. 6. Correlation of the average number of flowers per inflorescence with average number of inflorescences per plant in the analysed rapeseed crops from South Romania in 2009

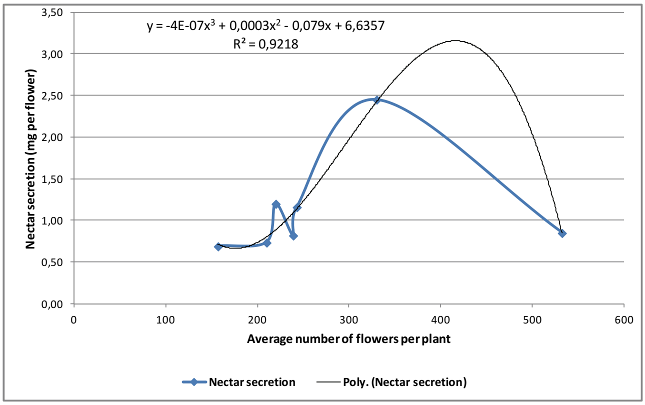

Fig. 7. Correlation of the nectar secretion with average number of flowers per plant in the analysed rapeseed crops from South Romania in 2009

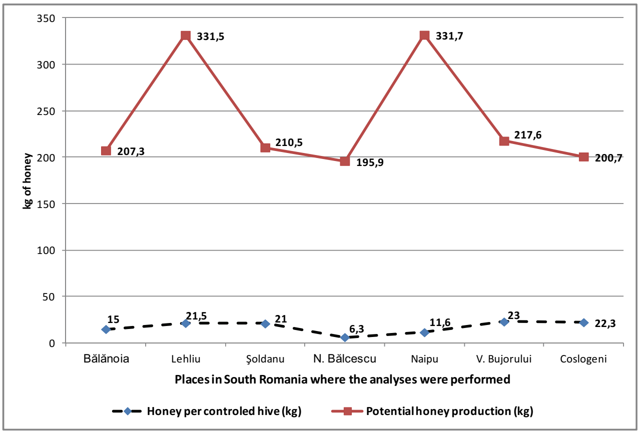

Fig. 8. The potential honey production and the honey production per hive in the analysed rapeseed crops from South Romania in 2009

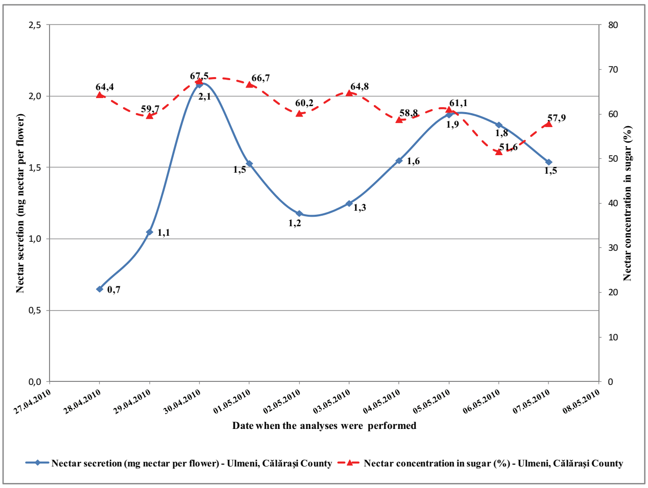

Fig. 9. The nectar secretion and the its concentration in sugar in the rapeseed crop from Ulmeni, Călăraşi County from South Romania in 2010

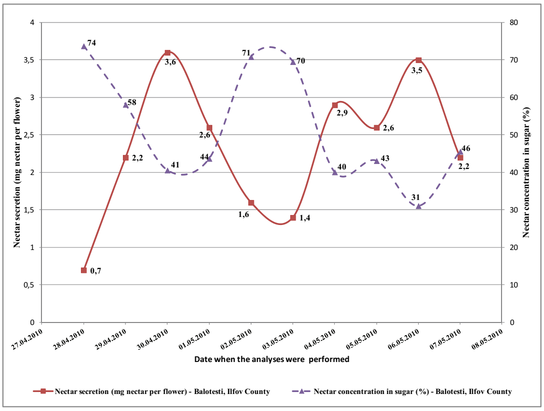

Fig. 10. The nectar secretion and its concentration in sugar in the rapeseed crop from Baloteşti, Ilfov County from South Romania in 2010

CONCLUSIONS

In the analysed rapeseed crops from South Romania in 2009, the nectar secretion was in average 1.13 mg per flower, with an average concentration in sugar of 62.1%. In 2010, the nectar secretion was in average 1.88 mg per flower, with an average concentration in sugar of 49.2%. In the analysed rapeseed crops from South Romania in 2009, there were identified the following correlations:

- the average number of flowers per plant was not so good correlated with plant high;
- the average number of flowers per plant was negatively correlated with the average number of plants per square metre;
- the average number of flowers per square metre was positively correlated with the average number of plants per square metre up to 50-55 plants per square metre; after this threshold the average number of flowers per square metre starts to decrease;
- the average number of inflorescences per plant was negatively correlated with the average number of plants per square metre;
- the average number of flowers per inflorescence was positively correlated with the average number of inflorescences per plant;
- the nectar secretion was increasing up to 300-400 flowers per plant, but after this threshold the nectar secretion was decreasing;
- the nectar secretion was negatively correlated with the sugar concentration in nectar.

The potential honey production (the calculated honey production) in the analysed rapeseed crops from South Romania in 2009 was in average 242.2 kg per hectare, while in 2010 was in average 324.8 kg per hectare.

The honey production per hive (control hive) in the analysed rapeseed crops from South Romania in 2009 was in average 17.2 kg.

The data registered in the analysed rapeseed crops from South Romania in 2010 showed that the nectar secretion and the sugar concentration in nectar are varying in time from one day to another, according to the climatic conditions and the progressing of the flowering process.

ACKNOWLEDGEMENTS

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STUDIES CONCERNING WATER UPTAKE DURING GERMINATION PROCESS AT CEREALS

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Abstract

Seed germination is a complex physiological process through which the embryo is passing from the latent to active life. The germination process starts with water uptake by imbibition of seeds, the water been necessary for enzyme system activation in view to breakdown the complex substances stored within the seed, as well as for translocation and use by the embryo of the substances resulted from the enzyme activity. After this first germination stage, the germination process continues with embryo growth, and finishes with the radicle emergency from the seed, during these stages the water continuing to be uptake by the seed after a specific curve. The main aim of the present study is to determine the water uptake by different cereal seeds (wheat, durum wheat, triticale, barley, and maize) during the germination process, this been expressed through the seed water content and water absorbed by seeds reported to their dry matter content in different germination stages. Also the study is aiming to find out the time needed for the germination process, as well as how the process of water uptake is going on from the begging up to the end of the germination process.

Key words: *germination, water uptake, seeds, cereals.*

INTRODUCTION

Seeds have a reproductive role, meaning the assurance of survival of the plant species. Seed germination is a complex physiological process through which the embryo is passing from the latent to active life and starts a new life cycle. Thus, it can be assumed that the germination process makes the seeds to accomplish their reproductive role.

Seed germination incorporates those events that commence with the uptake of water [1, 3] through the imbibition process. Imbibition is the uptake of water determined by the very low water potential of the dry seeds. Imbibition process is a physical phenomenon which is not connected with any living process but which has essential consequences for all the physiological processes within the seed.

Water uptake by imbibition process is followed by embryo growth. Radicle protrusion through all seed covering layers is considered as the completion of germination process [2]. Thus, the germination process finishes with the radicle emergency from the seed.

During all the germination stages, the water continues to be uptake by the seeds after a specific curve, with different intensity and in different quantities.

Water is a basic requirement for germination process. This is essential for enzyme system activation in view to breakdown the complex substances stored within the seed, as well as for translocation and use by the embryo of the substances resulted from the enzyme activity.

A good understanding of germination process and its basic requirements (especially water) with practical applications in agriculture remains an essential issue for a modern crop production.

The present study is aiming at determining the water uptake by different cereal seeds (wheat, durum wheat, triticale, barley, and maize) during the germination process, this been expressed through the seed water content and water absorbed by seeds reported to their dry matter content in different germination stages. Also, this is aimed at establishing the time needed for the germination process, as well as at establishing the performing of the process of water uptake from the begging up to the end of the germination process on a constant temperature of 20°C.

MATERIAL AND METHOD

Studies concerning water uptake during germination process at cereals were carried out at the following species: wheat (*Triticum aestivum* L.), durum wheat (*Triticum durum* Desf.), triticale (*Triticosecale* Wittm.), barley (*Hordeum vulgare* L.), and maize (*Zea mays* L.).

The water content of the seeds from all the five cereal species were determined by the help of a moisture analyser. Three samples of twenty-five intact seeds (caryopses) from each species were counted paying attention the seeds not to be affected anyhow (broken seed, seed with coat layer affected, seeds affected by pathogens et al.). Each sample was weighted with an analytic balance and put on a germination seedbed of moist filter paper.

The filter paper was used as envelope with two layers of papers below the seeds and two layers above the seeds (method BP = Between Papers, according to the standard SR 1634:1999, equivalent with the ISTA standard Seeds for Sowing. Determination of Germination). The paper envelops were of 14 cm of length and 7 cm of width (98 cm^2) for all the analysed species except maize which has much bigger seeds and for which the paper envelops were double as surface, respectively 14 x 14 cm (196 cm^2). Seeds were placed on the germination seedbed in such a manner not to touch each other.

Each moist germination seedbed with the twenty-five seeds was introduced in a plastic bag and then it was put in an incubator at a constant temperature of 20°C.

Each hour the seeds were weighted at an analytic balance up to the moment when the seeds were germinated in a proportion of 50% out of the twenty-five seeds. A single seed were considered germinated when the radicle protruded through the seed coat was of 2 mm.

The obtained data were statistically processed by analyses of variance (Anova-single factor).

RESULTS AND DISCUSSIONS

The average weight of one dry seed at the analysed cereal species was the following: 39.3 mg for wheat, 41.9 mg for durum wheat, 47.2 mg for triticale, 53.8 mg for barley (Fig. 1), and 338 mg for maize (Fig. 2).

The end of germination process, respectively the moment when the seeds were germinated (the radicle protruded through the seed coat of 2 mm) under conditions of moisture and constant temperature of 20°C, were reached at 14 hours for barley, 20 hours for wheat and durum wheat, 22 hours for triticale, and 54 hours for maize (Fig. 1 and 2).

It has to be emphasised the very short germination period registered at barley, with six days shorter than those of wheat and durum wheat. For reaching the end of the germination process, triticale needed two days more than the wheat and durum wheat. Maize is a thermophile plant with high requirements for temperature starting from the germination. That is why, for reaching the end of the germination process, the maize needed 54 hours, which means 2.7 times more than the period required by wheat and durum wheat. Wheat and durum wheat reached the end of the germination process in 20 days both of them, even there are some differences between the seeds of these two species concerning their weight and chemical composition.

Compared to the average weight of one dry seed, the average seed weight at the end of the germination process was 1.45 times bigger at wheat, durum wheat and maize, 1.4 times bigger at barley, and 1.7 times bigger at triticale. It can be assumed that the increased average seed weight at the end of the germination process is due mainly to the water absorbed by the seeds. It is interesting to notice that from all the analysed cereal species, barley has absorbed the smallest amount of water and triticale has absorbed the highest amount of water, while wheat, durum wheat and maize have absorbed quite similar quantities of water.

The average weight of all seeds at the analysed cereal species has the most important increasing in the first hour after the seeds were put under germination conditions, respectively moisture and temperature of 20°C. Thus, after the first hour, the seed weight has increased because of the imbibition process with 2.4 mg for wheat seeds, 3.6 mg for durum wheat seeds, 3.7 mg for triticale seeds, 8.0 mg for barley seeds and 14.9 mg for maize seeds (Fig. 3).

Compared to the average increasing rate (mg per hour) of the seed weight during the whole germination process, the average increasing seed weight after the first hour of the germination process was 2.7 times bigger for wheat seeds, 3.6 times bigger for durum wheat seeds, 2.5 times bigger for triticale seeds, 5 times bigger for barley seeds and 5.3 times bigger for maize seeds.

Compared to the other analysed cereal species, maize seeds absorb the largest quantity of water through the imbibition process in the first hour of the germination process, this been due to the fact that the maize has the largest seeds. Among other cereal species except maize, barley seeds absorb the largest quantity of water, while the wheat seeds absorb the smallest quantity of water through the imbibition process in the first hour of the germination process.

After the first hour of the germination process, the seed water content of the analysed cereal species was in average of 17.3%. The highest value was registered at barley with 22.1% (distinct significant difference compared to average for the analysed cereal species), while the smallest value was registered at maize with 14.1% (negative significant difference compared to average for the analysed cereal species). The wheat, durum wheat and triticale have registered comparable values, respectively 16.1% for wheat, 17.6% for durum wheat and 16.8% for triticale (Fig. 4). It has to be emphasised the rapid imbibition capacity of barley seeds. In the case of maize, although the average increasing seed weight after the first hour of the germination process was the biggest among the analysed cereal species, the quantity of water absorbed by seeds was not so important reported to the whole seed weight. This led to the smallest value of the seed water content at maize after the first hour of the germination process.

After two hours of germination, for all the analysed cereal species the seed water content increased in average with another 3% compared to the value registered after one hour. The average seed water content of the analysed cereal species was of 20.4% (Fig. 4). After two hours of germination process, as in the case after one hour, maize registered the smallest increase in the seed water content, respectively from 14.1 to 15.7%. Also, barley registered the highest value (24.6%), while wheat, durum wheat and triticale registered comparable values, respectively 20.0% for wheat, 21.0% for durum wheat, and 20.7% for triticale.

At the end of the germination process, the seed water content was in average for all the analysed cereal species of about 40% (39.9%). In this moment, triticale has registered the highest value, with 47% (very significant difference compared to average for the analysed cereal species), while barley has registered the smallest value, with 36.8% (negative distinct significant difference compared to average for the analysed cereal species). This time, the wheat, durum wheat and maize have comparable values, respectively 38.6% for wheat and durum wheat, and 38.3% for maize (Fig. 4). It has to be emphasised the triticale seeds capacity to absorb important quantities of water in the second period of the germination process.

Water uptake by seeds reported to their dry matter content at all analysed cereal species after the first hour of germination was in average about 21% (21.1%). The highest value was registered at barley seeds with 28.4% (distinct significant difference compared to average for the analysed cereal species), while the smallest value was registered at maize seeds with 16.4% (negative significant difference compared to average for the analysed cereal species). The values registered by the other analysed cereal seeds were the following: 19.1% for wheat, 21.4% for durum wheat, and 20.4% for triticale (Fig. 5). The proportions between species are similar to those registered at seed water content.

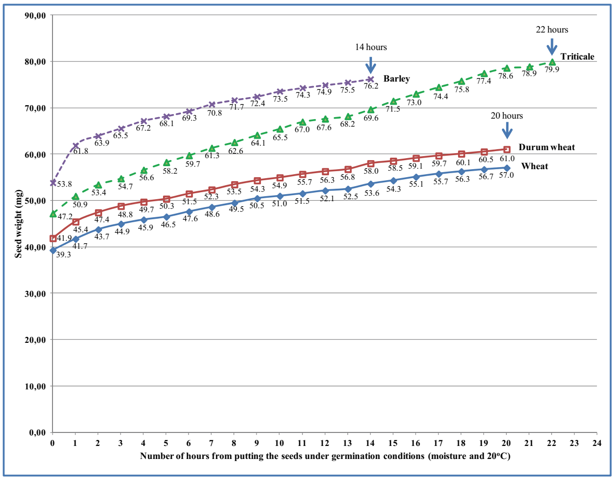

Fig. 1. Seed weight during the germination process at the analysed cereals

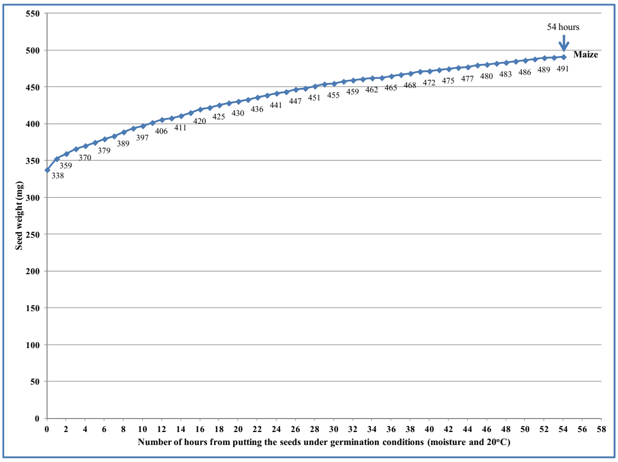

Fig. 2. Seed weight during the germination process at maize

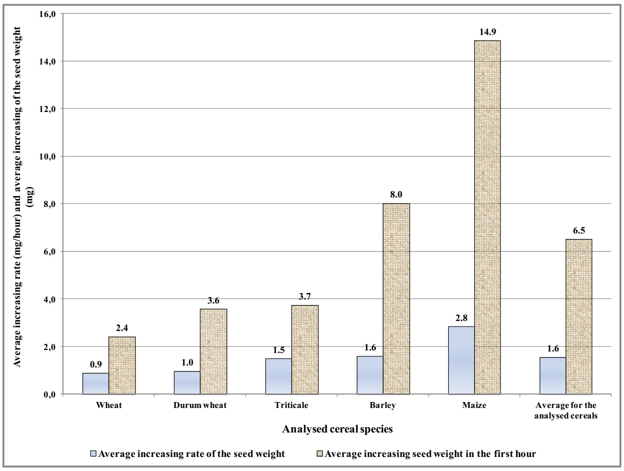

Fig. 3. Average increasing rate of the seed weight during the whole germination process and average increasing seed weight after the first hour of the germination process at the analysed cereals

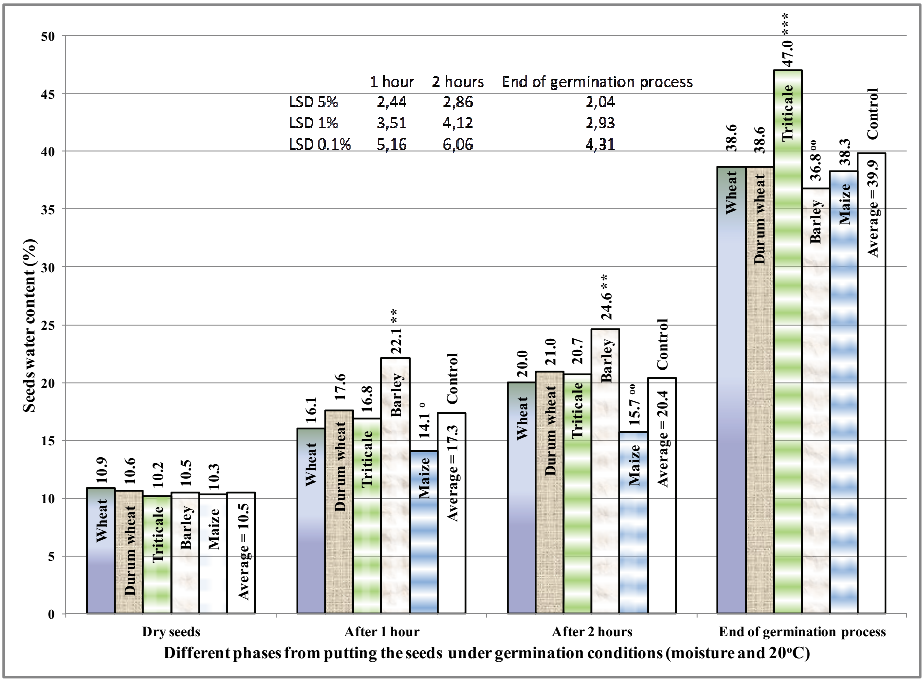

Fig. 4. Water content of seeds at the analysed cereals in different phases of the germination process

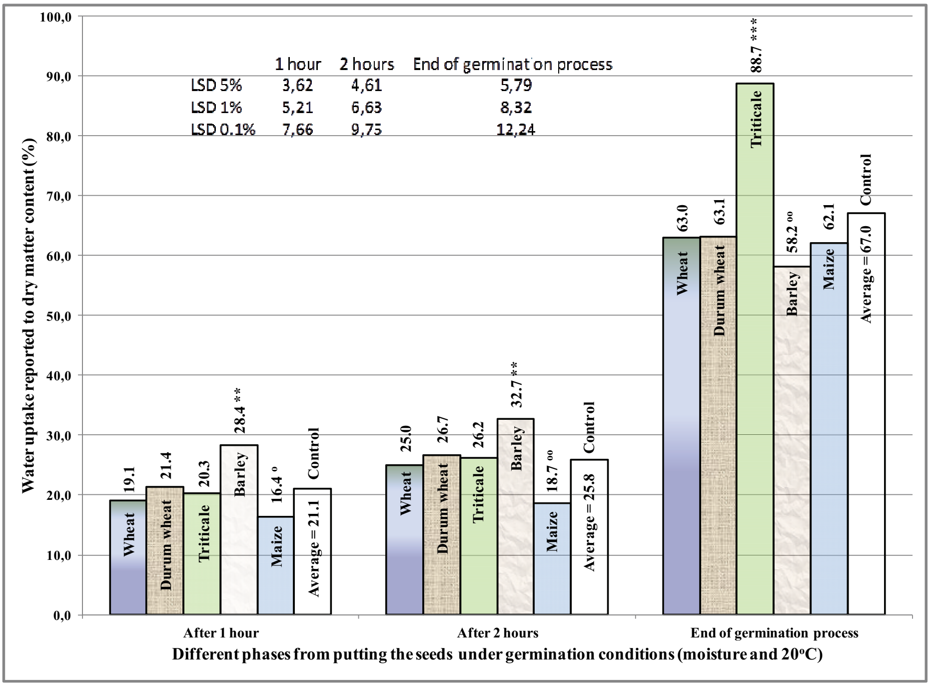

Fig. 5. Water uptake by seeds reported to their dry matter content at the analysed cereals in different phases of the germination process

After two hours of germination, the water uptake by seeds reported to their dry matter content at all the analysed cereals was in average about 26% (25.8%). As in the case of after the first hour of germination, the highest value was registered at barley with 32.7%, while the smallest value was registered at maize with 18.7%. The values registered by the other analysed cereal seeds were the following: 25% for wheat, 26.7% for durum wheat, and 26.2% for triticale (Fig. 5).

At the end of the germination process, the water uptake of seeds reported to their dry matter content at all the analysed cereals was in average 67%. The highest value was registered at triticale with 88.7% (very significant difference compared to average for the analysed cereal species), while the smallest value was registered at barley with 58.2% (negative distinct significant difference compared to average for the analysed cereal species). The wheat, durum wheat and maize seeds have registered comparable values, respectively 63% for wheat, 63.1% for durum wheat, and 62.1% for maize (Fig. 5).

CONCLUSIONS

At a constant temperature of 20^{o}C, the germination process takes 14 hours for barley, 20 hours for wheat and durum wheat, 22 hours for triticale, and 54 hours for maize.

After the first hour of the germination process, the seed water content of the analysed cereal species was in average about 17%, while the water uptake by seeds reported to their dry matter content was in average about 21%.

At the end of the germination process, the seed water content at the analysed cereal species was in average about 40%, while the water uptake by seeds reported to their dry matter content was in average about 67%.

The seed water content registered the following values:

- for wheat, 16.1% after one hour and 38.6% at the end of germination;
- for durum wheat, 17.6% after one hour and 38.6% at the end of germination;
- for triticale, 16.8% after one hour and 47% at the end of germination;
- for barley, 22.1% after one hour and 36.8% at the end of germination;
- for maize, 14.1% after one hour and 38.3% at the end of germination.

The water uptake by seeds reported to their dry matter content registered the following values:

- for wheat, 19.1% after one hour and 63% at the end of germination;
- for durum wheat, 21.4% after one hour and 63.1% at the end of germination;
- for triticale, 20.3% after one hour and 88.7% at the end of germination;
- for barley, 28.4% after one hour and 58.2% at the end of germination;
- for maize, 16.4% after one hour and 62.1% at the end of germination.

Wheat, durum wheat and triticale have a comparable behaviour concerning the water uptake in the first hour of germination.

Wheat, durum wheat and maize have a comparable behaviour concerning the water uptake at the end of the germination process.

Barley seeds absorb very rapidly water in the first hour of germination, but at the end of germination process, they have the smallest water content and the smallest water uptake by seeds reported to their dry matter content among all analysed cereals.

Triticale has the highest values for water seed content and water uptake by seeds reported to their dry matter content at the end of germination process.

Maize has the smallest values for water seed content and water uptake by seeds reported to their dry matter content after the first hour of germination.

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RESEARCH ABOUT MANGANESE REGIME FROM AGRICULTURAL ECO-SYSTEMS IMPROVED BY THE SEWAGE SLUDGE

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Abstract

*Mn is another element in the category of heavy metals, which in small quantities is useful in feeding the plant, while the excess could induce specific phytotoxic phenomena. For the purpose of observing trends of Mn content of plants were used progressive sludge doses: between 0 and 50 t,ha^{-1}, with doses of chemical fertilizer: 0, ½ and 1/1 of crops specific needs. In general, mobile Mn ranged between 400 and 650 mg, which are relatively high concentrations. Under these conditions the plants have absorbed field Mn^{2+} ions in specific quantities. The correlations obtained between the contents of Mn and complex doses shows obvious increase in leaves of maize (r=0.832***) and soybean (r=0,530*), inconclusive in wheat (both years), and decreased concentrations of Mn in the three species grains. Such researches might reveal some aspects in relation to nutrition with micronutrients such as Mn, of each plant part.*

Key words: *luvicsoil, maize, Mn, processed sludge, soybean, wheat.*

INTRODUCTION

In its current state, the luvicsoil contains Mn in appreciable quantities, having its origin in the decomposition of ferromagnetic rocks. After iron (Fe) and aluminium (Al), manganese (Mn) represents the most abundant chemical constituent in rocks making up the earth shell [7]. Soil contains transformed Mn under different forms associated with the mineral and organic part.

The most common are Mn oxides and hydroxides. They can originate from the parental material or alteration process. Both Mn crystalline and amorphous state exist under more forms, including ferromanganese balls or concretions. Their forming has at their base the alternation of oxidation and reduction processes (Photo 1). Dominant forms of Mn in the ferromagnetic concretions composition (balls) are represented by $Mn_2O_3.nH_2O$ [3].

In order to become accessible for plants, Mn oxides and hybrids need to be reduced to Mn^{2+} ions. Between Mn^{2+} from soil solution, Mn^{2+} changeable and superior oxides of Mn there is a dynamic balance controlled by the complexity of the reduction conditions (redox potential).

Photo 1. The Mn concretions from luvicsoil (original)

Accessibility of Mn^{2+} depends of several factors, among which the most important are: pH, microbiological activity, organic matter (OM) and soil's humidity regime. The last researches proved that the availability of

Mn^{2+} occurs in soils with pH contained between 5 and 6. Mn^{2+} is thus present mainly in acid soils, while on neutral soils manganese is under a trivalent form (Mn^{3+}) as Mn_2O_3, and in alkaline ones (pH over 8) under tetravalent form (Mn^{4+}) in an inert oxide, MnO_2 [11].

Luvicsoil having as characteristic the acid environment [10] favors the reduction processes following which manganese is in bivalent form - Mn^{2+}, available for plants absorption [2]. The specific microbial activity here is reduced, leading to a true conservation of accessible Mn^{2+} forms. OM influences the mobility of Mn^{2+} both by lower affinity compared with other heavy metals, being thus permanently available and by the specific decomposition degree. Due to unfavorable drainage the reduced forms of Mn are predominant by stimulation of bacteria which decompose OM using Mn oxides as O_2 source.

It is such noted that luvicsoil specific to Piteşti Research Center contains Mn accessible to plants in relatively higher concentrations. A safe source of OM for local agriculture is represented by the digested sludge [5] from Pitesti Wastewater Treatment Plant. Being qualitatively comparable with manure [1, 9] sludge such processed represents a new source both for macro-nutrients for agricultural plants: nitrogen, phosphorus, potassium, calcium etc., but also for micro-nutrients among which manganese is in concentrations close to the ones of the soil.

MATERIAL AND METHOD

In the period 2004-2007 a complex experiment was initiated. During this experiment plants were cultivated by the structure: 1- maize, 2- winter wheat, 3- soybeans and 4- winter wheat. In normal cultivation technologies these plants were fertilized with different doses of organic-mineral. Thus, these doses were applied to sewage sludge: 0 $t.ha^{-1}$, 5 $t.ha^{-1}$, 10 $t.ha^{-1}$, 25 $t.ha^{-1}$ and 50 $t.ha^{-1}$. The sewage sludge suffered an anaerobic digesting followed by dewatering within Pitesti Wastewater Treatment Plant (Photo 2).

Chemical fertilizers were differentiated on three levels: unfertilized, needs to ½ of normal and total doses (1/1). Plants have received such $N_{50}P_{50}$/maize, $N_{60}P_{40}$/wheat, $N_{30}P_{30}$/soybeans and $N_{40}P_{40}$/wheat for doses ½ and $N_{120}P_{80}$/maize, $N_{120}P_{80}$/wheat, $N_{60}P_{60}$/soybeans and $N_{80}P_{80}$/wheat for the 1/1 doses.

Photo 2. The processed sewage sludge used

Sludge doses were applied in the same quantities in the first two years- from maize and wheat in year two, following that soybeans and wheat in the past year to receive their residual effect. The experiment with the lot divided had the A factor- sludge doses and the B factor- chemical fertilizers doses. Each variant had a surface of 100 m^2 each and was rehearsed (replicated) for three times.

Leaves samples were taken during flowering period: at maize the leaves located at cob level (Photo 3), at winter wheat the last 3 leaves including the standard leaf (Photo 4) and the soybeans the leaves in the central area of the plant but also with bean- pods in formation process.

Photo 3. The maize leaves samples taking moment

Photo 4. The wheat leaves samples taking moment

Soil samples were collected with the agrochemical sampling device of arable horizon 0-20 cm, between flowering to maturity period. Chemical analysis were performed according to the latest European standards and methodologies: Mn/soil, leaves and grains- SR ISO 11047-99, Mn- mobile forms of ground- SR ISO 14870-99, both over sludge an-aerobically digested and over soil and plants. The data were statistically processed by analysis of the variant and with the help of correlations and regressions.

RESULTS AND DISCUSSIONS

Mn contents of cross-cultural environment. Following the determinations made soil Mn content of heavy metal demonstrate both the overall shapes and forms as total and mobile manganese in the soil. Total manganese in the soil ranged from average to good values considered (Table 1). Thus, in the four years ranged from 661-795 mg.kg^{-1} d.w. Mn the minimum and 861-1050 mg.kg^{-1} d.w. the maximum values.

Table 1. Mn contents from soil (mg.kg^{-1} d.w.) total forms

Heavy metal	Maize	Wheat, 2	Soybean	Wheat, 4	Toxic limit
Mn, limits	769 – 899	661 – 861	758 – 981	795 – 1050	➢ 2000
Mn, average	829	766	849	910	

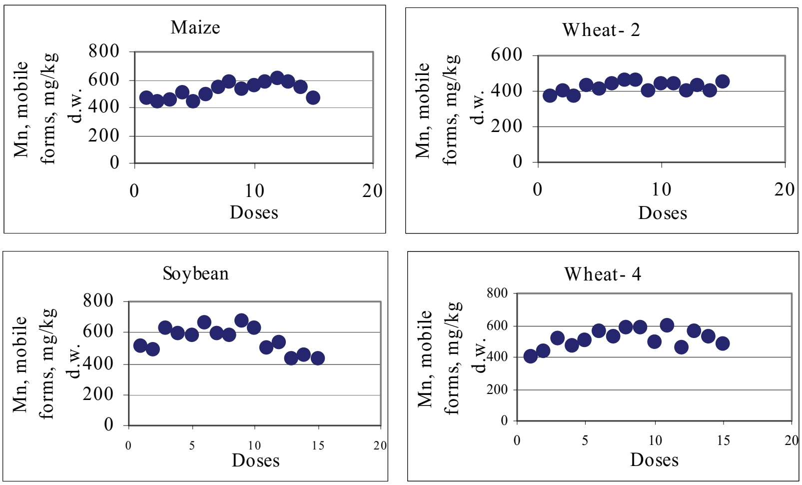

Fig. 1. The evolution of mobile Mn concentrations depending on the doses of sludge & chemical fertilizers applied

Due to domestic sludge introduced into the soil, mobile Mn known quite positive and relative developments (Fig. 1). Depending on the dose used, mobile Mn ranged from 400 to 650 mg.kg^{-1} d.w. in four years. Since the limits of Mn is between the normal, this state contributes to ensuring good conditions for plant nutrition [12, 13]

Experiments on the influence of Mn content in leaves and grains. Given the soil conditions of culture, in which both the total and mobile forms of Mn were at high enough levels, it was expected than Mn^{2+} uptake by plants have the same extent.

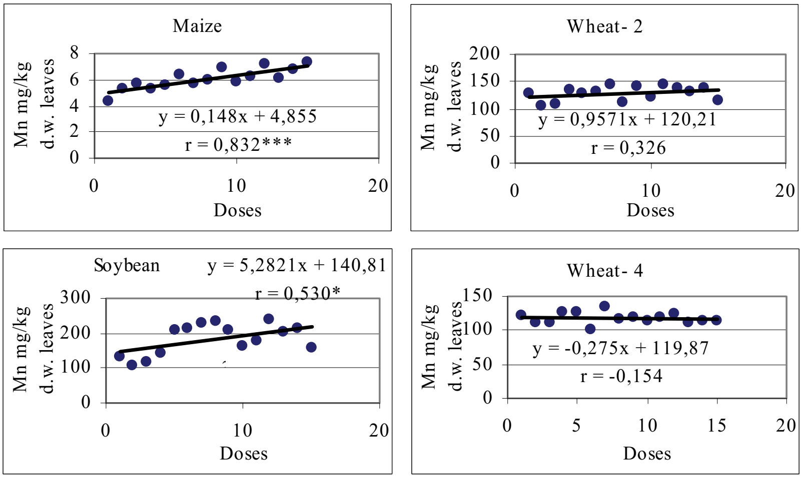

Fig. 2. Mn concentrations evolution from leaves of plant, flowering period

High levels of Mn^{2+} in the soil can result in phytotoxicity (Photo 5) phenomena [4, 8].

Photo 5. The Mn excess on maize leaves

In the extreme, of great importamce is the analysis of plant, in several moments of plant life. Both Mn and other chemical elements, minerals etc, are selectively absorbed by each plant species [1]. Mn content of plant leaves showed different aspects (Fig. 2). Maize contained in its leaves between 4-7 $mg.kg^{-1}$ d.w. Mn. Experimental factors very obviously increased leaf Mn content (r = 0.832***). In the same way (r= 0.530*), Mn in leaves of soybean growth experienced obvious limit values between 120 and 210 mg (Photo 6). In wheat leaves Mn concentrations have been less upward, even capped. Absolute levels ranged between 100 and 150 mg in the two years.

Photo 6. The wheat leaves samples taking moment

The correlations obtained between doses of fertilizers complex with Mn concentrations of grains shows characteristic differences, different from those in leaves, due to negative trends (Fig. 3). Thus, decreasing state were obtained from maize in the first year with the index of correlation I = 0.589, the soybean third year, I = 0.100 and wheat last year, I= 0.531. Wheat in the second year has seen increases in grain Mn, I = 0.513. Negative trends of Mn correlations show that the mature plants had no need of this micronutrient.

<u>Agrochemical indices that limit transfer of Mn in the agricultural medium.</u> Recently succeeded in limiting the development of indices (344/708/2004 Ord.) concentrations of

Mn [6] of agricultural land, when applying sludge waste (Table 2).
The first index, the maximum tolerable intake of Mn from domestic sewage: MTI_{Mn} concentrations will be below 1084 $mg.kg^{-1}$ d.w. Mn. The second indicator, annual allowable sludge waste time: AN was at 4 $t.ha^{-1}$. For a 4-5 year cycle of crop rotation, can be applied between 15-20 $t.ha^{-1}$ sludge waste.

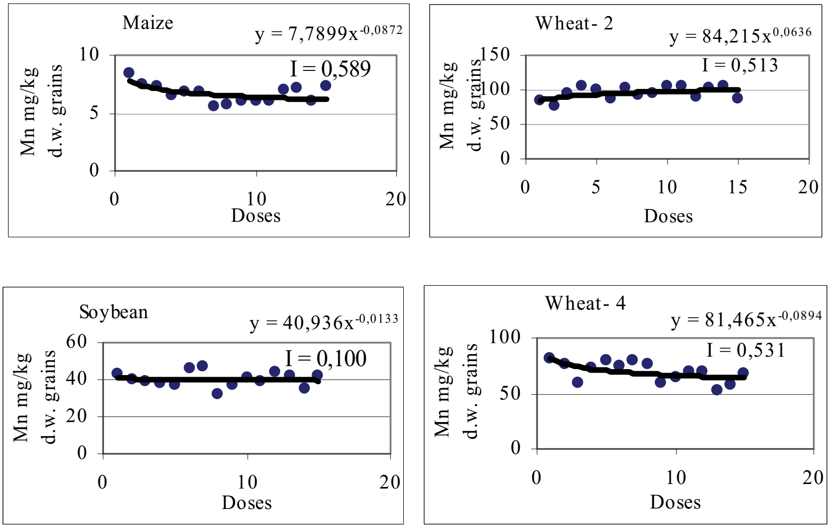

Fig. 3. Mn concentrations evolution from grains, maturity period

Table 2. Indices of mobile Mn- $mg.kg^{-1}$ d.w. (after Borlan, 1994)

Indices		Calculation
Mn	Maxim tolerable intake	$MTI_{Mn} \le 3400.CEC*/35 = \le 1084$
	Annual allowable norm	$AN_{Mn} = 3400.CEC/35.Mn = 4\ t.ha^{-1}.y^{-1}$

*CEC, cationic exchange capacity (11,16 me/100 s.u. soil)

CONCLUSIONS

By using processed sludge (anaerobic digestion and dehydrated) has been a relative improvement of the soil eco-environment. Average levels of the four experimental years showed a significant increase in mobile forms of Mn, between 400 and 650 $mg.kg^{-1}$ d.w., with a tendency to decrease. High concentrations of mobile Mn here is not any danger to plants, because its absorption takes place each active and specific crops.
Sludge and chemical fertilizers have significantly changed the Mn content of leaves. Soybean contained the most Mn: 140-210 mg, with r = 0.530*. Wheat Mn content of 120 mg, with the increase (year 2) and fall (year 4), and maize increased between 5 and 7 mg, with r = 0.832***.
Correlations obtained with the production of useful product (grain) show that Mn in growing plants used after they have deposited in the grain, in an inverse relationship. Mn mature stage was not necessary and that the contents: 6-7 mg in maize, 80-100 mg in wheat and 40 mg in soybean, were exported by grains.

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STUDY ABOUT BIODIVERSITY OF MATRICARIA INODORA LIGULAE FLOWERS TYPE

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Abstract

The presence of scentless chamomile - Matricaria inodora (Matin-Bayer code) in cultivated fields, can result of agricultural practices and adapt it to the potential of that environment. On the podzolic soils of the South part, the weed is perfectly adapted like an invasive species. In dense crops such as: forage grasses, winter barley, winter wheat and fallow land on, weeds vegetate well, proving the potential for competition known and in highlighting the influence of morphology, possible as a result of growing (or not) of these agricultural lands. Biodiversity studies have been performed on numerous capitula and marginal - type flowers namely ligulae, which were analyzed the number and length of their petals. The data obtained showed that the number of flowers had type ligulae maximum frequency depending on the culture: 45/Lolium, 80/barley, 43/wheat and 90/uncultivated land (fallow). Modal value revealed 21 ligulae flowers. The length of the flowers to group around 1.0 cm, to a maximum of 80/Lolium, 60/barley, wheat and fallow land. Both determinations expressed specific asymmetric histograms. Flowers of the type ligulae revealed that the shape of botanical long-petal represented between 4.0 %/wheat and 11.5%/Lolium, from of all scentless chamomile analyzed.

Key words: *biodiversity, crops, ligulae type flowers, long-petal form.*

INTRODUCTION

Weeds, among which scentless chamomile-*Matricaria inodora* L., belong together in a dynamic agricultural system [1]. Develop and use measures were strong influencing factors in the management of all species of weeds. In today's conditions, the management calls for proper application of control measures by which to reduce as much competition with crops [3]. Thus, there is no need to eradicate all weeds, or their destruction before the disappearance, but to reduce their vigour to the point that ensure perpetuation of the species. Of all the existing weeds, *Matricaria* resisted and still resist to the farmer intervention by adjusting most apparent in dense crops such as: herbs and winter cereals [5]. The study of biology and morphology in particular can give some information for the application of management and the evolution of characters in response to the adaptation that occurs over time [6]. Some studies refer to the plant characteristics, including biodiversity highlight [4, 7]. Maintain and possibly increase plant biodiversity, including all weeds, are obvious and necessary character of the sustainability of agricultural land. Biodiversity of scentless chamomile is best by ecotypes study [2] results in the history of agricultural cultivation of land and its adaptation to the geographical ecology. Eco-typical characters of weeds can be found and studied from the root to the top of the plant. In the present study were chosen ligulae flowers from the edge of capitula and were determined two of them: the number of petals, with medium length. Data demonstrate specific deviation from the mean values of determinations, with some specific features of agriculture from podzolic soils, Argeş area.

MATERIAL AND METHOD

In order to determine the number and type of flowers ligulae length, dense populations of scentless chamomile were chosen [8], which are in a phase of mass flowering, from Argeş county agricultural area (Photo 1).

Photo 1. Matricaria inodora flowering plant from winter wheat

Choosing ecotypes. Each selected population had a high degree of infestation: high density of without control measure surface. Were investigated by four sole of eco-systems: Ryegrass (*Lolium multiflorum*), winter barley, winter wheat and sole fallow.

Sampling. Infested area was covered with chamomile in zig-zag on a diagonal length of sole, without trying to choose a particular plant, special weed plant. Parking was one every 2 steps, which was measured by capitula: the number of ligulae flowers and their average length. Each plant selected for measurement was intended to be well educated and many flowers. Mainly surrendered to the top of the inflorescence. The procedures were repeated 50 times for each field examines. A total of 200 capitula were measured for each crop/ field.

Capitula analyses. Selected heads were analyzed and recorded the number of petals found, together with their average length. The data obtained were elaborated histograms for the four agricultural ecosystems: *Lolium multiflorum*, winter barley, winter wheat and fallow sols. In order observation of correlations between the two characters: the length and number of ligulae petals of chamomile, these correlations were developed. A table summarizes the variability of different flowers of *Matricaria* habitats highlights the two characters mean, variance, standard deviation and coefficient of variation. Length variability in the data analysis ligulae flowers was observed that some refer to as botanical proportions long-petal.

RESULTS AND DISCUSSIONS

Analysis of the species flower *Matricaria* ligulae type showed specific variations, regardless of the eco-system analysis (Photo 2).

Photo 2. The weed capitula general aspect

Variability type number ligulae flowers. Of all measurements performed: 200 for each type of ecosystem, it was observed that the number of flowers petals ligulae type (Photo 3) were registered between 12-27 pieces.

Photo 3. Low number of flowers petals ligulae type

How varied the number of petals and their frequency in the 4 types of ecosystems, revealed very different cases (Fig. 1). Thus, the eco-system of the species *Lolium multiflorum*, the histogram shows a maximum of 45 of 21 flowers capitula ligulae type. Distribution to the other frequencies (the module), has been progressively fewer petals and sharply higher numbers of petals.

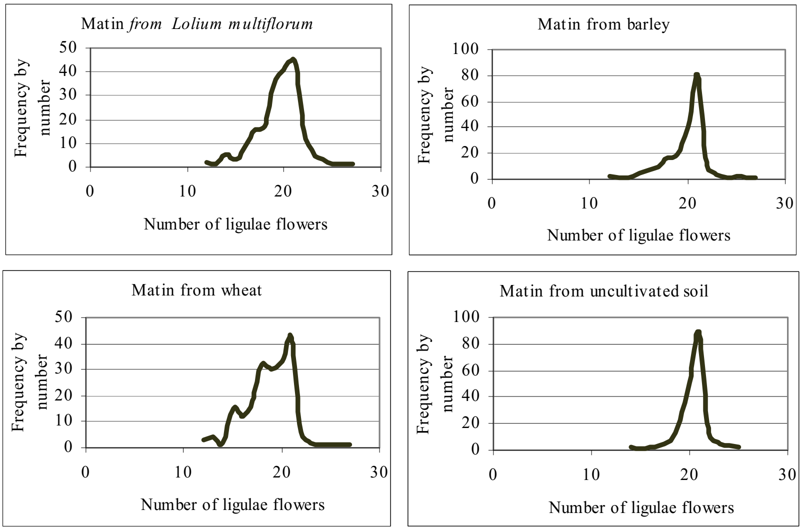

Fig. 1. Variability of *Matricaria inodora* ligulae flowers number from agroecosystems

Scentless chamomile in winter barley had a maximum frequency of 81 capitula with 21 flowers/capitula. Other values of the petals have been formed between 12 and 21 succesevely ascending and descending flowers at large numbers. The maximum winter wheat (modal value) was 42 capitula with 21 petals. In the section with fewer petals/capitula, number of pieces have followed an increase in scale, while heads with petals have fallen more sharply (Photo 4).


Photo 4. The weed encroachment level from wheat

Eco-fallow system (agricultural fallow) shows modal value of about 90 pieces, all at 21 ligulae/ capitula. Heads with fewer parts, and with more pieces were relatively few, and the chart looks like a bell (the Gauss bell), approximately symmetrical. Research highlights the variability in the number of petals around the most represented: 21 petals/ capitula.

<u>Length variability ligulae type flowers.</u> Compared with the number of petals of bad chamomile ligulae dimensions expressed by the length of petals known variations (Photo 5) of totally different (Fig. 2).


Photo 5. *Matricaria inodora* capitula with semi-long ligulae type flowers

Bad chamomile from annual ryegrass had the highest frequency, 79 petals, 1.0 cm long. Heads with petals shorter than 1.0 cm have evolved faster in comparison to the longest. In winter barley crop module shows a maximum of 60 capitula by 1.0 cm in length. Heads with shorter petals had a secondary maximum of

0.8 cm length, after which the size decreased a little. Petals to 1.0 cm longer than the frequency gradually decreased. Winter wheat had a module of the frequency of 65 capitula, whose length was 1.0 cm. Petals shorter area followed the same distribution as barley, while the petals longer have decreased numbers faster. Chamomile petals with the sole cultivated looks capitula module 60, to 1.0 cm long.

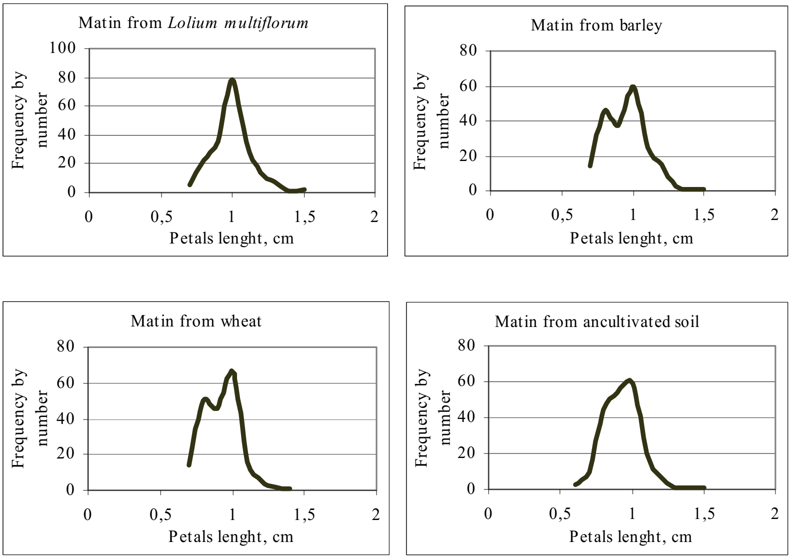

Fig. 2. Variability of *Matricaria inodora* flower petals lenght from agroecosystems

Petals with lengths of 0.8 cm and 0.9 cm approached the numerical modal frequency. Research highlights the variability of length petals to best demonstrated value: 1.0 c,m.

Correlations between length and number of petals, ligulae type. To further characterize the biodiversity of the chamomile flowers ligulae type, it is also possible to correlate the two characters: the number and length of these flowers. When considering the correlations of barley and wheat crops, will find different situations (Fig. 3). Bad chamomile positioning barley shows a regression line to about 19 ligulae flowers type, depending on the length of petals, falls at a constant rate of -0.2744 flower petals each length graduation. Wheat weed regression positioned right about 19-20 ligulae flowers, petals grow to that length with a constant rate of +0,6576 flower petals each length graduation.

Other aspects of biodiversity ligulae type of flowers. For a better characterization of the investigations, they have an important statistical index of variability. Data refer to the average of two determinations, variance, standard deviation (error) and coefficient of variation (Table 1). Values have sensitive oscillations.

Measured by length of lingual type flowers, could separate data from botanical species: long-petal. If considered as belonging to 1.0 cm length over this form, then the proportion of habitats obtained ranged from 4.0% (wheat) and 11.5% (*Lolium multiflorum*) (Table 2).

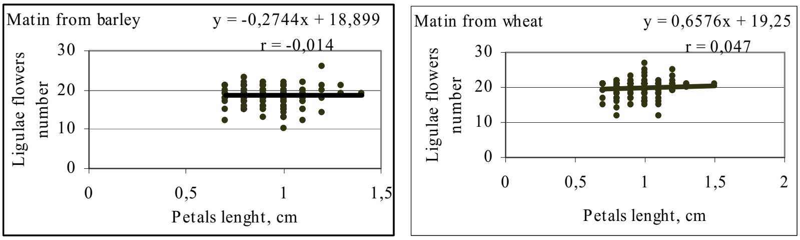

Fig. 3. Correlations between *Matricaria inodora* petals lenght and ligulae flowers number from barley and wheat eco-systems

Table 1 . Synthetic indices of Matricaria inodora's ligulae flowers variability from agroecosystems

Indices	*Lolium*	Barley	Wheat	Ancultivated
Ligulae lenght, cm				
Media, ā	1.00	0.95	0.924	0.931
Variance, s^2	0.0189	0.0216	0.0164	0.0186
Standard deviation, s	0.1375	0.1470	0.1281	0.1365
Coef. of variation, s%	13.77	15.47	13.90	14.70
Ligulae flowers number				
Media, ā	19.44	19.88	18.66	20.45
Variance, s^2	5.336	4.230	5.554	2.218
Standard deviation, s	2.310	2.057	2.357	1.489
Coef. of variation, s%	11.86	10.30	12.60	7.30

Table 2. Proportion of *Matricaria inodora* long-petal form from agroecosystems

Eco-system	Matricaria inodora, long- petal form, %
Lolium multiflorum	11.5
Winter barley	9.5
Winter wheat	4.0
Ancultivated	5.0

CONCLUSIONS

Number of petals and their length ligulae type showed variability depending on eco-systems researchers: values ranged around 21 ligulae flowers/capitula, with their average length of 1.0 cm (Photo 5).

Photo 5. The *Matricaria inodora* weed with medium ligulae type characteristics

The correlations obtained between the two characters show different situations: the negative trend of the culture of barley and the positive for wheat.

The proportion of habitats form long-petals investigated ranged between 4.0% (wheat) and 11,5% (from *Lolium multiflorum*).

Research of this type could become important in the study of variability of weeds in crops development, including the species *Matricaria inodora*.

Ecotypes researchers have demonstrated a specificity expressed zonal farming systems practiced in the South podzolic soil.

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OILSEED RAPE CROP IN ROMANIA UNDER CLIMATIC CONDITIONS OVER THE LAST 5 YEARS: CULTIVATED AREAS AND YIELDS

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Abstract

During last years the oilseed rape has expanded on crop due to its high oleic content and to the increasing of numerous technical applications based on rapeseed oil such as: use of rapeseed oil as an alternative to fossil fuels, use of rapeseed oil for pharmaceutical industry, use of rapeseed oil in chemical industry for obtaining industrial solvents etc. The extension of rape crop was promoted by the European Union's restriction to cultivate genetic modified soybean and also by the penetration of varieties, particularly the new hybrids that allow rape cultivation within varied areas in terms of climatic conditions. In Romania, over the last 20 years the cultivated area of oilseed rape has increased from 14 800 ha in 1990 to 381.000 ha in 2011, the rape crop becoming one of the most important field crops in the country.

Key words: *areas, biofuel, oilseed rape, yield.*

INTRODUCTION

In recent decades, the oil crops sector has been one of the most vibrant in world agriculture. Over the past 20 years the sector grew at 4.3 percent per annum compared with an average of 2.3 percent per annum for all agriculture [3].
The major driving force has been the growth of food consumption in developing countries, mostly in the form of vegetable oil but also direct consumption of soybeans, groundnuts, etc., as well as in the form of derived products other than oil [3].
Another major driving force has been the non-food industrial use of vegetable oils, with China and the EU being major contributors to this growth [3].
In terms of actual oil produced and used, the world currently uses some 40 percent of supply for non-food applications. Two decades ago the share was less than half of this. The main industrial products involved include paints, detergents, lubricants, oleo chemicals in general and, increasingly, biodiesel. These are commodities for which world demand can be expected to grow much faster than the demand for food [3].
In terms of food, oilseed rape has a content between 61 and 72% in two of the valuable substances: fat (42-48%) and protein (19-24%) which had led over the last years to an increased attention for this crop, attention carefully materialized also in Romania by expanding cultivated area.
In Romania an essential role for the extension of rape crop area had and still has the non-food use of rapeseed oil in obtaining biodiesel.
The increasing demand of biofuels due to the enforcement of EU Directive 2003/30/CE which state that by the year 2020, biofuels should have a percentage of 20% from total conventional fuels used in road transport sector, makes this ascending driving force of oilseed rape crop cultivated area to continue in the near future.
Besides subsidies for energy crops, in farmer's option for rape crop it can be mentioned the following arguments which illustrates importance of oilseed crop:
- the early harvest makes rape to be an excellent plant for winter cereals;
- meeting almost all requirements for diesel engines, the rapeseed oil is used for biodiesel production [1];
- abundant in proteins, minerals and carbohydrates rapeseed cakes have a good fodder value being an excellent feed for swine and cattle;
- by its incorporation in the soil in a certain growth stage the oilseed rape help to limit

the drains mainly of nitrogen and other nutrients, a reason for rape to be an important source of green manure [1];
- use of canola straws in building materials.

MATERIAL AND METHOD

The present analysis was conducted during 2012 using as sources the specialized literature from Romania and abroad. Also were consulted the results of reports achieved by competent national institution.

The main indicators used for this analysis are represented by cultivated area, yield and production. Data used for the present analysis are official data extracted from the available statistical yearbooks of National Institute for Statistics and also statistics released by the Ministry of Agriculture and Rural Development. Data have been processed using the common statistical method such as fixed basis index as presented in the bellow formula, where Xn is the variable value in the year n and X_1 is the variable value in the year 1 considered comparison basis.

$FBI = (Xn / X_1) \times 100$

RESULTS AND DISCUSSIONS

The extension of rape crop was promoted by the European Union's restriction to cultivate genetic modified soybean and also by the penetration of varieties, particularly the new hybrids that allow rape cultivation within varied areas in terms of climatic conditions.

Together with Romania's European Union adhesion in 2007, our country has aligned to EU legislation prohibiting the OMG soy crop which forced the farmers to abandon the cultivation of this crop and to turn their attention to other crops.

By comparing cultivated areas of canola and soybean from the years of EU pre adhesion and adhesion, it can be concluded that most of Romanian farmers had decided to replace soybean crop with rapeseed crop. Therefore in 2007 year the cultivated area with oilseed rape was 364.9 thousands ha, being approximately three times higher than in 2006, while cultivated areas with soybean degreased from 177.5 thousand ha in 2006 to 133.2 thousand ha in 2007 (Table 1).

Table 1. Rapeseed and soybean cultivated areas in 2006 and 2007

Area cultivated with :	UM	2006	2007	2007/ 2006 %
Soybean	Thousand ha	177.5	133.2	75.05
Rapeseed	Thousand ha	102.5	364.9	355.89

Source: 2006 – FAO 2012
2007 - N.I.S. Data -2011 Statistical Romanian Yearbook

In Romania, according to the official estimations, the surfaces which can be cultivated with oilseeds crops during one agriculture year and respecting crops rotations and using performing technologies are evaluated to 1.6 million ha, out of which 950 thousand ha with sunflower, 500 thousand ha with oilseed rape and 150 thousand ha with soybean [4].

During analyzed period 2007 – 2011 the oilseeds crops cultivated area had increased from 1340.4 thousand ha in 2007 to 1455 thousand ha in 2011.

Taking as reference 2007 year, in 2010 rapeseed crop had a spectacular increase being placed on second position within oilseeds structure with 537.3 thousand ha, meanwhile in 2011 rapeseed crop has maintained its second position even the increase exceeded only 1.4 times 2007 increase (Table 2).

Table 2. Structure of oilseeds crops cultivated area, 2007-2011

	Area -thousand ha-					
	2007	2008	2009	2010	2011*	2011/2007 %
Oilseed crops, out of which:	1340.4	1246	1253.8	1410	1455	108.55
Sunflower	835.9	813.9	766.1	790.8	988	118.20
Rapeseed	364.9	365	419.9	537.3	381.6	104.58
Soybean	133.2	49.9	48.8	63.9	74	55.56

Source: 2007 - 2010 - N.I.S. Data -2011 Statistical Romanian Yearbook
2008 - N.I.S. Data -2008 Statistical Romanian Yearbook
** N.I.S. Data- press release no.70/30.03.2012*

In 2011 the rapeseed cultivated area was 381.6 thousand ha which means a share of 26.23% from the Romania's oilseeds crops cultivated area by comparing with 2007 year when it has a share of 27.22% (Table 3).

Table 3. Share of rapeseed crop of Romania's oilseed crops cultivated area (%)

	2007	**2008**	**2009**	**2010**	**2011***
Oilseed crops (thousand ha)	1340.4	1246	1253.8	1410	1455
Rapeseed (%)	27.22	29.29	33.49	38.11	26.23

For Romania the most favorable areas for rapeseed crop cultivation includes Câmpia de Vest (Western Plain), Câmpia Dunării (Danube Plain), Dobrogea and the south of Moldavia [2]. The most important rapeseed crop cultivated areas in Romania are mainly in the south-east and southern region, areas where the rapeseed importance among oilseeds crops it is shown by the year to year increase of cultivated areas. In these regions the counties with the most important oilseed rape cultivated areas are Călaraşi, Ialomiţa, Teleorman in South region and Constanta, Brăila, Tulcea, Galaţi in South East region (Table 4).

Table 4. Distribution of oilseed rape cultivated areas by Development Regions (thousand ha)

	2007	2008	2009	2010	2010/2007 %
Romania	364.9	365	419.9	527.2	144
Macro region 1	9.2	8.1	10.8	8.5	92
North-West	7.2	6.6	8.1	5.0	70
Centre	2	1.6	2.7	3.4	172
Macro region 2	157.4	191.8	210.7	237.4	151
North-Est	30.2	36.6	49.8	25.9	86
South-East	127.2	155.2	160.8	211.5	166
Macro region 3	163.3	122.7	150.8	201.4	123
South - Muntenia	159	119.2	147.9	195.6	123
Bucuresti - Ilfov	4.3	3.4	3	5.8	134
Macro region 4	35	42.4	47.6	79.9	228
South-West Oltenia	27.3	32.9	35.6	62.9	231
West	7.7	9.5	12	17.0	221

Source: EUROSTAT - v2.9.10-20120426-852PROD_EUROBASE
No statistical data for 2011

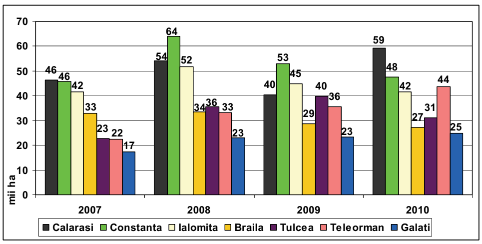

Fig. 1. The evolution of rapeseed cultivated areas during 2007-2010 in the main 7 counties in Romania

By analyzing the rapeseed crop cultivated areas in the above mentioned counties, we can observe that the most important growing surface is in Teleorman county, where the rapeseed cultivated area increased in 2010 by 94% compared with 2007 when rapeseed surface occupied 22,424 ha. We can also observe that on the top of largest rapeseed cultivated areas counties, the first position oscillates between Călăraşi and Constanţa counties.

During 2007-2011 period the oilseed rape production has registered a continuous increasing trend, on the one hand due to the increasing of cultivated areas and on the other hand due to the yield increasing per ha. By comparing with 2007 year when total oilseed rape production was 361.5 thousand tons, in 2011 year this production increased 2 times reaching 744.8 thousand tons. (Table 5)

Table 5. Dynamics of total and average production for rapeseed crop during 2007 - 2011

	2007	2008	2009	2010	2011*	2011/ 2007 %
Average production (kg/ha)	991	1,844	1,357	1,755	1,951	197
Total production (thousand tons)	361.5	673	569.6	943	744.8	206.03

Source: 2007 - 2011 – MARD data (http://www.madr.ro)
** N.I.S. data- press release no.70/30.03.2012*

Regarding the yield per ha, in 2011 it can be observed an increase by 97% compared with 2007 when the yield was 991 kg. By comparing 2011 year with 2010, although the yield increased by 11% the oilseed rape production has decreased by 22.4% due to the reduction of cultivated area.

CONCLUSIONS

During last years the oilseed rape has expanded on crop due to its high oleic content and to the increasing of numerous technical applications based on rapeseed oil such as: use of rapeseed oil as an alternative to fossil fuels, use of rapeseed oil for pharmaceutical industry, use of rapeseed oil in chemical industry for obtaining industrial solvents etc.

In Romania, during 2007 – 2011 period, with a share of 26.23%, the rapeseed crop had reached the second position in the oilseed crops structure, which highlights the growing importance of this crop among oilseeds crops. The largest rapeseed cultivated areas are in following counties: Călăraşi, Constanţa, Ialomiţa, Tulcea, Brăila, Teleorman and Galaţi.
During 2007 – 2011 period the oilseed rape production has registered a continuous increasing trend, on the one hand due to the increasing of rapeseed cultivated areas and on the other hand due to the yield increasing.

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EFFICIENCY OF UTILIZATION OF A DROUGHT INDEX IN EVALUATION OF ADAPTABILITY TO DROUGHT OF CORN HYBRIDS (*Zea mays* L.*)* IN EARLY TESTING STAGES

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Abstract

Evaluation of drought tolerance is a complex and relatively difficult process. Two main approaches were considered by scientist for drought tolerance estimation: (i) testing in water managed locations and (ii) testing in large corn testing network, in targeted environments and managed irrigation – full and limited. A large volume of field data and other related traits could be generated in this type of approach , but usually for drought evaluation purpose two data breakouts were examined: full irrigated (non-stressed) and limited irrigated (water stressed). Selection of the hybrids is done for dual performance, for reaching a balance between a reasonable performance in drought conditions and a good response to favourable water regime. Usually a regression chart between performance in limited irrigation and full irrigation (non-stressed) is used to select hybrids. A new selection drought index (DRIND) is proposed. Application of DRIND on experimental data obtained in 2011 in East European Pioneer corn yield test network showed good efficiency in selecting the most adapted (drought tolerant) corn hybrids.

Key words: *corn, drought tolerance, drought index, hybrids, Zea mays* L.

INTRODUCTION

Large areas cultivated with corn in Eastern Europe are frequently affected by drought. Long period of drought generally enhanced by heat during flowering and grain setting and filling are extremely harmful to corn, causing significant yield losses that can sometimes end with total failure of the crop. Consequently, improving drought tolerance of the modern corn hybrids has become in the last decade one of the essential breeding objective of any breeding program from Eastern Europe and even world-wide. Drought tolerance quantification in corn is a difficult and complex process that requires precise phenotyping in locations where water stress is precisely managed and has been based on the comparison between yields obtained in water stress environment and low or non-water stressed locations. This approach generated in a relative large number of indices for drought selection based on a mathematical relation between stress- and optimum conditions [4, 9]. Fischer and Maurer proposed in 1978 an index S of drought stress susceptibility [3]. Lin and Binns, in 1988, using grain yield in different environments proposed a formula for quantifying the drought tolerance taking as reference terms the best performing genotype in each location [5]. In his study, Moghaddam and Hadi-Zadeh [6] found Stress Tolerant Index (STI) was more useful in order to select favorable corn cultivars under stressful and stress-free conditions [2, 4, 8].

Khalili et al., (2004) showed that based on Geometric Mean Productivity (GMP) and STI indices, corn hybrids with high yield in both stress and non-stress environments can be selected. Water shortage during flowering also postpones tasseling and silking, increases Anthesis Silking Interval (ASI) and causes partial or no pollination and pollen reception. Additionally, the emerged silks may dry soon as the result of water shortage and high temperatures, which consequently will affect the reception of pollens, their subsequent germination, elongation and penetration into the stigma and inside the ovules. Fertilization may not occur well and this can reduce the seed number on the cobs [4]. Bolanos *et al*. (1993) found that the ASI increased to 4.6 days in stress treatment in flowering stage and to 8.3 days in severe stress treatment before and after florescence compared to 2.2 days in control. The occurrence of stress during seed filling period reduced final seed weight [1]. Richards (1996) believed that the yield-based selection of genotypes in both stress and non-stress environments can lead to the selection of high yield genotypes under stress conditions since, the response of selection under non-stress conditions is maximal and hereditability of the yield under these conditions is high [7]. The purpose of the present study is to propose a new drought tolerance (adaptability) index (DRIND) for a better, more rapid and precise estimation and selection of the drought tolerance.

MATERIAL AND METHOD

Pioneer corn hybrids representing two early testing stages (first year of testing – R1 and second year of testing – R2) and two maturities group, FAO480 and FAO550, were tested in 2011 in different locations from Eastern Europe, including Romania. For ensuring achievement of the two water stress levels, different irrigation regimes were applied, using small sprinklers equipments. Thus, full irrigation locations were accounted for low water stress level while limited irrigated and non-irrigated locations for high water stress level (table 1).

Table 1. Number of Pioneer R1 and R2 corn hybrids, representing 2011 testing, grouped into two maturities, number and irrigation regime of the testing locations

Stage	R1		R2	
Maturity group	FAO 480	FAO 550	FAO 480	FAO 550
No. of hybrids tested	103	90	99	101
Total no.of locations	12	11	18	16
- Full irrigated - LS	5	5	8	8
- Limited irrigated - HS	3	3	5	4
- Non-irrigated - HS	4	3	5	4

Same sources of seeds were used for planting all locations by centralizing the process of filling seed bags. High input technology was applied to trials in all locations. Trials were mechanically over planted and manually thinned to the desired plant populations at 6 leaves stage. Experimental plot consisted of 2 rows long of 6 m, distance between rows was 75 cm; entries were randomized or nested into experiment. Yield and other important agronomic traits were collected. Results were processed and were used during a normal advancement process; a large volume of field data and other related traits were generated, but usually for drought evaluation purpose two data breakouts were examined in : yield in full irrigated (non-stressed) and in limited irrigated (water stressed). Selection of the hybrids was done for dual performance, for reaching a balance between a reasonable performance in drought conditions and a good response to favourable water regime. Usually a regression chart between performance in limited irrigation and full irrigation (non-stressed) is issued to select hybrids. In this study, in addition to this regression chart, a new drought tolerance (adaptability) index (DRIND) is proposed for a better, more rapid and precise estimation of the drought tolerance.

The adaptation index (DRIND) is calculated by using a **graphical screening interface,** that in addition to an usual Excel regression chart, displays the prediction and confidence upper and lower limits (for a preselect level of significance); each data point is identified with a tag picked up from the column situated at the left of the “X” column in input sheet. The mean yields for irrigated and rainfed conditions are presented as dashed magenta lines.

Tagging of data points allows a quick visual identification of the hybrids with good performance both under irrigated and rainfed conditions.

DRIND is calculated as a sum of the distance along the regression line between its intersection with Y axis and its intersection with the perpendicular from the data point (representing the average behavior of a hybrid over the two water stress levels) and the distance from the data point to regression line (a correction accounting for the behaviour of a hybrid under water stress conditions). The sign of the distance from data point to regression line (correction factor) is positive if the point is above regression line or negative if it is bellow it.

Some exemplifications of DRIND were computed by using the results of testing of several populations of hybrids presented in table 1; efficiency of DRIND in discriminating more tolerant and adaptable hybrids was estimated by comparing the results of normal advancement (selection on the basis of examination in parallel of the grain yield obtained in the two breakouts of the environments, low and high water stress locations) with selection on the basis of values of DRIND, ordered descending, obtained by using the computing graphical interface proposed.

RESULTS AND DISCUSSIONS

Regression line between average yield over HS locations and over LS locations, as produced by the **graphical screening interface** showing the positions of the tested hybrid on the graph and special tags for outlining the promoted hybrids by the normal advancement process (A in green) and the checks (C in red) are presented for maturity group FAO480 in figures 1 and 2 for R1 hybrids and R2 hybrids, respectively. A rapid visual selection of the most adaptable hybrid with better drought tolerance is possible; most of the advanced hybrids are placed in upper right quarter of the graph for both testing stages, R1 and R2.

Similar situation could be noticed also for maturity group FAO550, shown in figures 3 and 4; a great part of the normally advanced hybrids (parallel selection of most performing hybrids in the two water stress levels) are placed in the graph area (upper right quarter) which is the most favourable for drought tolerance selection.

In tables 2-5, DRIND values, ordered descending are presented for both maturity groups and both testing stages.

High values of a simple statistics such as <u>% of normally advanced hybrids which are placed in the first top third of the DRIND ordered descending</u> in tables 2-5, presented in table 6, suggest that selecting for improved drought tolerance and consequently for better adaptability of the hybrids by using DRIND could have a good efficiency.

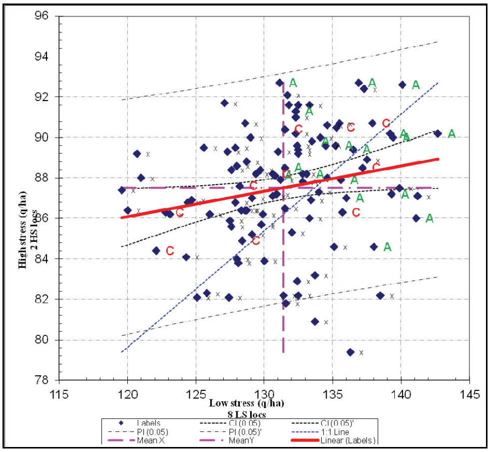

Fig. 1. Regression line between average yield in high water stress locations (HS) and average yield in low water stress locations (LS), R1 hybrids, maturity group FAO 480

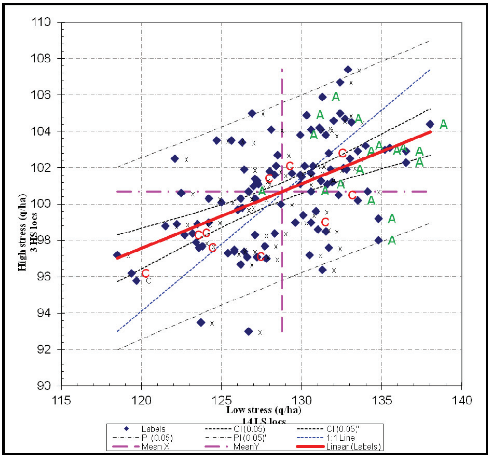

Fig. 2. Regression line between average yield in high water stress locations (HS) and average yield in low water stress locations (LS), R2 hybrids, maturity group FAO 480

Since the selection criteria took into consideration other agronomics and disease traits part of hybrids placed in top third of DRIND ordered descending, and potentially selectable for adaptability (better drought tolerance) were dropped; the most frequent reason for this are: innapropiate tall plant stature and high ear insertion, low ear profile, root and stalk lodging as weel as low parent test potentiality of the hybrids components.

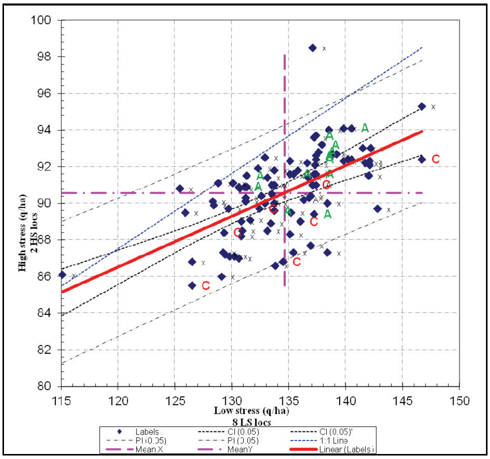

Fig. 3. Regression line between average yield in high water stress locations (HS) and average yield in low water stress locations (LS), R1 hybrids, maturity group FAO 550

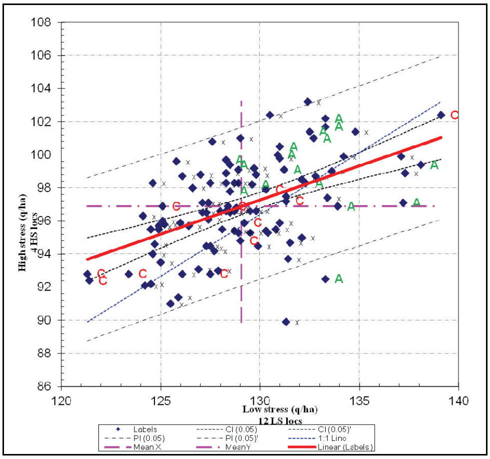

Fig. 4. Regression line between average yield in high water stress locations (HS) and average yield in low water stress locations (LS), R2 hybrids, maturity group FAO 550

The essential advantages of using DRIND are that selection using two breakouts in parallel, which could be some burden and confusing, is avoided; is more precise than visual selection on the graph being an exactly computed index which can be ordered descending and make the selection process easier and more objective.

Table 2. Computation of drought tolerance index (DRIND) for R1 hybrids tested in 2011, maturity group FAO 480

Advancement decision *	Yield - q/ha - in LS	Yield - q/ha - in HS	DRIND Sorted descending
A	140.1	92.6	145.7
A	142.7	90.2	145.2
x	137.3	92.4	143.0
A	136.9	92.7	143.0
A	139.2	90.2	142.2
A	139.4	90	142.1
C	137.9	90.7	141.6
x	141.2	87.1	140.5
x	139.9	87.5	139.8
x	135.5	90.7	139.5
x	137.5	88.9	139.3
A	141.1	86	139.2
C	135.3	90.5	139.1
A	136.5	89.4	139.0
A	139.3	87.2	138.9
A	134.6	90.6	138.7
x	133.3	91.6	138.6
C	137.2	88.5	138.6
A	135.2	89.6	138.1
A	131.1	92.7	138.0
x	132.5	91.6	137.9
x	131.7	92.1	137.8
x	134.1	90	137.5
A	134.5	89.6	137.4
A	132.3	91.3	137.4
x	131.8	91.6	137.3
x	132.3	91	137.1
A	133.5	89.8	136.8
A	135.6	87.9	136.5
x	132.3	90.2	136.2
A	136	87	135.8
x	134.6	88	135.7
C	131.5	90.4	135.7
x	132.4	89.6	135.6
x	132.5	89.4	135.5
x	132.5	89.2	135.3
A	138	84.6	134.9
C	135.7	86.3	134.8
A	133.1	88.2	134.7
x	134	87.3	134.4
x	132.8	88.2	134.4
x	131	89.3	134.1
A	132.8	87.8	134.0
A	131.5	88.5	133.6
x	128.6	90.7	133.6

*) *A – Advanced hybrid using the normal advancement process*
C – Check hybrid
X – dropped hybrid

Table 2. Computation of drought tolerance index (DRIND) for R1 hybrids tested in 2011, maturity group FAO 480 - **continued**

Advancement decision	Yield - q/ha - in LS	Yield - q/ha - in HS	DRIND Sorted descending
x	133.4	86.9	133.5
x	127.1	91.7	133.4
x	129	90	133.1
x	131.2	87.9	132.7
x	138.5	82.2	132.7
A	130.8	88.1	132.6
C	130.6	88.2	132.5
x	133.3	86	132.4
x	135.1	84.6	132.4
x	129.7	88.4	131.9
x	130.9	87.2	131.6
x	127.9	89.5	131.6
x	128.7	88.8	131.5
x	129.4	88.2	131.5
x	131.5	86.5	131.4
x	130.6	87.1	131.3
x	127.3	89.3	130.9
x	128	88.6	130.7
x	132	85.3	130.5
x	127.6	88.4	130.1
x	129.1	87	129.9
C	128.2	87.6	129.7
x	129.9	86.2	129.7
x	125.6	89.5	129.6
x	133.7	83.2	129.6
x	129.8	85.7	129.0
x	129.8	85.7	129.0
x	128.7	86.4	128.8
x	128.6	86.4	128.8
x	127.9	86.8	128.6
x	128.3	86.4	128.5
x	132.4	82.9	128.1
x	129.1	85.2	127.8
x	136.3	79.4	127.6
x	132.5	82.2	127.5
x	127.5	85.9	127.2
x	130	83.9	127.2
x	133.7	80.9	127.0
x	127.6	85.6	127.0
C	128.4	84.9	126.9
x	131.4	82.2	126.5
x	126	86.2	126.3
x	131.6	81.8	126.2
x	124.7	86.9	125.9
x	124.4	86.8	125.6
x	128	84	125.6
x	128.1	83.8	125.4
x	120.7	89.2	125.0

Table 2. Computation of drought tolerance index (DRIND) for R1 hybrids tested in 2011, maturity group FAO 480 - **continued**

Advancement decision	Yield - q/ha - in LS	Yield - q/ha - in HS	DRIND Sorted descending
x	121	88	123.9
x	123.1	86.2	123.8
C	122.8	86.3	123.6
x	127.4	82.1	122.9
x	124.3	84.1	122.5
x	119.6	87.4	122.1
x	125.8	82.3	121.7
x	120	86.4	121.3
x	125.1	82.1	120.9
C	122.1	84.4	120.9

Table 3. Computation of drought tolerance index (DRIND) for R2 hybrids tested in 2011, maturity group FAO 480

Advancement decision	Yield - q/ha - in LS	Yield - q/ha - in HS	DRIND Sorted descending
x	132.9	107.4	147.8
A	138	104.4	147.0
x	132.4	106.7	146.6
A	131.3	105.9	144.9
x	132.4	105	144.4
A	136.5	102.9	144.2
A	132.7	104.7	144.2
x	133.1	104.5	144.2
A	135.5	103.1	143.9
x	132	104.6	143.6
A	135.2	103	143.5
A	136.5	102.3	143.4
A	134	103.2	143.1
A	130.3	104.9	143.0
x	131.1	104.2	142.6
x	131.2	104.1	142.5
A	133.5	102.9	142.4
x	131.5	103.8	142.3
x	130.6	104.1	142.2
x	133	102.5	141.6
A	129.9	103.8	141.4
C	131.7	102.8	141.2
x	126.9	105	141.1
x	132.6	102	140.7
A	132.8	101.9	140.7
x	128.1	104.1	140.6
x	131.8	101.9	140.1
x	134.1	100.7	139.9
x	130.7	102.1	139.7
A	130.2	102.1	139.4
x	131.9	101.2	139.2
x	128.5	102.7	139.1
x	130.6	101.7	139.1

Table 3. Computation of drought tolerance index (DRIND) for R2 hybrids tested in 2011, maturity group FAO 480 – **continued**

Advancement decision	Yield - q/ha - in LS	Yield - q/ha - in HS	DRIND Sorted descending
A	131.2	101.3	138.9
A	133.5	100.2	138.9
A	131.6	101.1	138.9
x	126.3	103.4	138.7
C	132.3	100.5	138.6
x	129.9	101.6	138.5
x	130	101.5	138.5
A	134.8	99.2	138.4
x	129.4	101.7	138.4
x	125.6	103.5	138.4
C	128.4	102.1	138.3
x	129.9	101.1	137.9
A	130.6	100.7	137.8
x	124.7	103.5	137.8
x	128	101.8	137.6
x	128.3	101.6	137.6
A	134.8	98	136.9
x	126.4	101.9	136.8
x	130.9	99.6	136.6
C	127.1	101.4	136.6
x	127.2	101.3	136.5
x	127.3	101.1	136.3
x	127	101	136.0
x	130.1	99.4	135.9
x	128.7	100	135.8
C	130.6	99	135.6
x	131.5	98.5	135.6
A	126.7	100.7	135.4
x	131	98.6	135.4
x	127.1	100.3	135.2
x	129.6	99	135.0
x	122.1	102.5	135.0
x	126.2	100.3	134.6
x	131.7	97.6	134.5
x	126.3	99.8	134.1
x	126	99.7	133.7
x	125	100.1	133.7
x	128.3	98.4	133.5
x	124.2	100.3	133.4
x	130.5	97.2	133.3
x	122.5	100.6	132.8
x	131.3	96.4	132.7
x	127.1	98.3	132.6
x	127.7	97.7	132.2
x	124.2	99	131.8
x	127.8	97	131.4
C	123.5	98.9	131.2
x	127.2	97.1	131.2

Table 3. Computation of drought tolerance index (DRIND) for R2 hybrids tested in 2011, maturity group FAO 480 – **continued**

Advancement decision	Yield - q/ha - in LS	Yield - q/ha - in HS	DRIND Sorted descending
x	126.4	97.4	131.1
x	125.8	97.5	130.8
C	126.6	97.1	130.8
x	125.8	97.4	130.7
x	122.2	98.9	130.4
C	123.2	98.4	130.4
x	125.4	97.3	130.3
x	126.2	96.7	130.0
C	122.7	98.3	130.0
x	123.4	97.9	129.9
x	121.5	98.8	129.9
x	123.8	97.7	129.9
C	123.6	97.6	129.6
x	118.5	97.2	126.0
x	126.7	93	125.6
C	119.4	96.2	125.3
C	119.7	95.8	124.9
x	123.7	93.5	124.4

Table 4. Computation of drought tolerance index (DRIND) for R1 hybrids tested in 2011, maturity group FAO 550

Advancement decision	Yield - q/ha - in LS	Yield - q/ha - in HS	DRIND Sorted descending
x	146.7	95.3	153.9
x	137.1	98.5	151.2
C	146.7	92.4	150.4
A	140.5	94.1	148.2
x	142.2	93	148.0
x	139.8	94.1	147.7
x	141.5	93	147.5
x	142.1	92.3	147.0
x	142.1	92.1	146.8
x	141.7	92.2	146.6
x	138.5	94	146.6
x	140.5	92.4	146.1
x	142	91.5	146.0
x	140.2	92.4	145.8
x	139.2	92.7	145.5
A	137.4	93.7	145.5
x	139.8	92.3	145.4
x	138.8	92.7	145.2
x	137.2	93.6	145.2
A	137.9	93.2	145.2
A	137.6	92.8	144.5
x	142.8	89.7	144.3
A	137.4	92.6	144.1
A	137.4	92.4	143.9

Table 4. Computation of drought tolerance index (DRIND) for R1 hybrids tested in 2011, maturity group FAO 550 – **continued**

Advancement decision	Yield - q/ha - in LS	Yield - q/ha - in HS	DRIND Sorted descending
x	137.3	92.1	143.5
x	136.6	92.2	143.1
A	137.4	91.6	142.9
A	137.2	91.6	142.8
x	136.7	91.4	142.2
x	135.1	92.3	142.2
A	137.4	91	142.2
x	135.8	91.8	142.0
C	137.1	91	142.0
x	138.4	90	141.6
A	135.4	91.6	141.5
x	135.1	91.6	141.3
x	136.9	90.4	141.1
x	136.8	90.3	140.9
x	132.9	92.5	140.9
x	133.7	91.8	140.6
A	136.3	90.2	140.4
A	137.2	89.4	140.1
x	132.3	91.9	139.7
x	133.1	91.4	139.7
x	133.7	91	139.6
x	133.5	91	139.5
C	133.5	90.5	138.8
x	135.2	89.5	138.8
C	136	89	138.7
A	131.3	91.5	138.5
x	133.7	90	138.4
x	138.4	87.3	138.3
x	132.6	90.4	138.1
A	133.7	89.6	137.9
A	132.9	90	137.8
x	131.3	90.9	137.8
x	136.9	87.7	137.8
A	131.1	90.9	137.7
x	130.6	90.9	137.3
x	130.7	90.8	137.3
x	135.1	88.3	137.3
x	130.1	91.1	137.2
C	132.4	89.7	137.1
x	131.2	90.3	137.0
x	133.4	88.9	136.8
x	131.2	90.1	136.8
x	128.8	91.1	136.3
x	135.4	87.3	136.2
x	133.1	88.5	136.1
x	131.6	89.1	135.8
x	129.7	89.7	135.2
x	130.8	89	135.1

Table 4. Computation of drought tolerance index (DRIND) for R1 hybrids tested in 2011, maturity group FAO 550 – **continued**

Advancement decision	Yield - q/ha - in LS	Yield - q/ha - in HS	DRIND Sorted descending
C	134.5	86.8	135.0
x	128.3	90.1	134.7
x	130.9	88.5	134.6
x	128.4	89.9	134.6
x	133.8	86.6	134.3
x	130.8	88.2	134.1
x	125.4	90.8	133.6
C	129.3	88.4	133.3
x	130.6	87	132.5
x	130.2	87.1	132.4
x	125.9	89.5	132.3
x	129.8	87.1	132.1
x	129.4	87.2	131.9
x	129.2	87.3	131.9
x	129.1	86	130.2
x	126.5	86.8	129.4
C	126.5	85.5	127.8
x	115.1	86.1	120.6

Table 5. Computation of drought tolerance index (DRIND) for R2 hybrids tested in 2011, maturity group FAO 550

Advancement decision	Yield - q/ha - in LS	Yield - q/ha - in HS	DRIND Sorted descending
C	139.1	102.4	152.3
x	132.4	103.2	149.7
A	133.3	102.2	148.9
x	134.8	101.4	148.6
A	133.3	101.7	148.2
x	137.1	99.9	147.9
A	138.1	99.4	147.8
x	130.5	102.4	147.6
A	132.5	101.4	147.4
A	132.7	101	147.0
x	137.3	98.9	146.7
x	134.2	99.9	146.3
A	131	100.5	145.4
x	129	101	145.0
x	133.6	99	144.8
A	130.9	100	144.7
x	131	99.8	144.5
A	137.2	97.1	144.3
x	132.8	98.7	144.0
x	127.6	100.8	143.9
A	131.2	99.1	143.7
A	132.1	98.5	143.4
A	132.3	98.3	143.2
x	129.7	99.2	143.0

Table 5. Computation of drought tolerance index (DRIND) for R2 hybrids tested in 2011, maturity group FAO 550 – **continued**

Advancement decision	Yield - q/ha - in LS	Yield - q/ha - in HS	DRIND Sorted descending
A	128.3	99.7	142.9
x	133.4	97.4	142.6
A	128.5	99.4	142.6
x	129.8	98.8	142.5
x	128.9	99.1	142.4
A	133.9	96.9	142.3
x	128.3	98.9	141.8
x	131.3	97.5	141.6
A	129.6	98.2	141.6
C	130.3	97.9	141.6
x	125.8	99.6	141.4
x	128.9	98.3	141.4
x	128.7	98.3	141.3
C	131.3	97.2	141.2
x	128.3	98.3	141.1
x	127	98.8	141.0
x	127.5	98.3	140.6
A	128.5	97.8	140.5
x	126.1	98.7	140.4
x	126.6	98	139.7
x	126.6	98	139.7
x	129.8	96.6	139.6
x	129.5	96.6	139.5
x	131	95.9	139.4
x	128.8	96.8	139.4
C	128.4	96.9	139.3
x	128.7	96.6	139.1
x	124.6	98.3	139.0
x	127.4	97.1	139.0
x	127.1	97.1	138.8
C	128.3	96.6	138.8
x	128.5	96.5	138.8
x	132.1	95	138.8
x	130.8	95.5	138.8
x	128	96.6	138.7
C	129.2	95.9	138.4
x	130.3	95.4	138.4
x	130.4	95.3	138.3
A	127.3	96.5	138.2
x	131.5	94.7	138.1
x	127.1	96.5	138.1
x	129.5	95.3	137.8
x	127.4	96.1	137.7
C	125.1	96.9	137.5
x	128.7	95.4	137.5
A	128.9	95.3	137.5
x	128.1	95.5	137.3
x	129.9	94.5	137.0

Table 5 Computation of drought tolerance index (DRIND) for R2 hybrids tested in 2011, maturity group FAO 550 – **continued**

Advancement decision	Yield - q/ha - in LS	Yield - q/ha - in HS	DRIND Sorted descending
C	129	94.8	136.9
x	131.4	93.7	136.7
x	126	95.9	136.7
x	126.4	95.7	136.6
x	125.1	96	136.3
A	133.3	92.5	136.2
x	124.1	96.3	136.2
x	125.2	95.8	136.1
x	124.9	95.7	135.8
x	127.5	94.5	135.7
x	124.9	95.5	135.6
x	127.3	94.5	135.5
x	127.7	94.2	135.4
C	124.5	95.5	135.3
x	124.7	94.6	134.3
x	127.9	93	133.9
x	126.9	93.1	133.5
C	127.5	92.8	133.4
x	124.6	94	133.4
x	125	93.5	133.0
x	126.1	92.8	132.7
x	131.3	89.9	131.7
C	123.4	92.8	131.2
x	124.5	92.2	131.0
x	125.9	91.4	130.7
x	124.2	92.1	130.7
C	121.3	92.8	130.1
x	125.5	91	130.0
C	121.4	92.4	129.6

Table 6. Efficiency of DRIND in selecting more drought tolerant hybrids as compared with normally advancement process

FAO maturity group	Testing stage	% of normally advanced hybrids which are placed in the first top third of the values of DRIND ordered descending in tables 2-5
480	R1	76.2
480	R2	65.0
550	R1	50.0
550	R2	78.9

CONCLUSIONS

Percents of normally advanced hybrids which are placed in the first top third of the DRIND ordered descending were relatively high suggesting that selection for improved drought tolerance (for better adaptability) of the hybrids by using DRIND could be at least as efficient as the normal advancement process based of parallel selection in two outbreaks or/and visual selection on the graph representing the linear regression between the two outbreaks.

Additionally DRIND has several essential advantages; selection using two breakouts in parallel, being some burden and confusing, is avoided; it is more precise than visual selection on the graph being an exactly computed index which can be ordered descending and making the selection process easier and more objective.

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AMELIORATION EFFECT OF ALFALFA CULTURE IN THE MINI-TILL AGRICULTURE SYSTEM

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Abstract

Multiannual research contributed at identifying three types of biotechnology based on the principles of ecological agriculture: a) based on the direct impact of crops in the soil organization of structural-functional indices. b) based on influence of agro-ameliorative cultures on the operating regimes of soils (resource-reproductive). c) based on crop cultivation as energy (energy- reproductive). Research has shown that differentiated beans crop cultivation to remedy the degraded soils can display enlarged physical factors of fertility. Optimizations of those guarantee the improvement of hydrothermal, air-hydric and oxidation-reduction regimes with future optimization of nutrition and bio-production regimes.

Key words: *biotechnology, ecological agriculture, crop rotation, alfalfa, mini-till.*

INTRODUCTION

Currently along with the traditional applied technology in agriculture more frequently it is called to use alternative technologies focused on minimizing agro-ecological diversification tillage and practicing crop rotation and organic fertilization based on soil organic matter incorporation. The three types of bio-remediation and restoration of degraded lands: a) based on the direct impact of crops in the soil organization of structural-functional indices. b) based on influence of agro-ameliorative cultures on the operating regimes of soils (resource-reproductive). c) based on crop cultivation as energy resources (energy-resource-productive). In what follows, we refer to evolution and dynamics of the operating parameters of chernozems models in such as technology [1].

MATERIAL AND METHOD

Conceptual foundations of regional models, such as technologies have been used since 1992 in the Scientific Research Laboratory "Pedogenetic Processes" under the leadership of Dr. Gh. Jigau and it have to be mentioned the investigated results were generalized in several publications. Future researches have helped the improvement over time and develop conceptual models of four conservative agricultural technologies and to adapt their principles to the concrete conditions and composition of landscape [1, 2, 3].

RESULTS AND DISCUSSIONS

Evolution of organizational structural-functional indices in the crops technologies have the direct impact on cultivated plants and respectively indices of structural-functional organization of the soil. The concept of such as technology is based on the crop rotation cultivation of alfalfa or other perennial capable grasses, via their root systems, to ensure the organization stability structural-functional indices in the soil. The data in Table 1 shows that under such a crop rotation is establishing a steady reproduction of physical factors of fertility, in particular, structure, bulk density and pore space.

From the table we find that despite the enormous variability of climate conditions during the years 2006 - 2012 the dynamics physical characteristics remains within the optimal range.

Table 1. Dynamic indices of structural organization of the arable layer in the typical chernozem moderate humiferous in terms of remediation technologies (SRL Agrosfera BM. Mean values 2006- 2012)

Period	Depth cm	Apparent density g/cm³	Humidity % g/g	Porosity %	The range of useful water %
Field 1. Sunflower					
25.03	0 – 10	1.03	25.44	60.15	18.49
	10 – 20	1.13	26. 38	57.60	17.97
	20 – 30	1.19	28.70	55.85	17.80
30.06	0 – 10	1.11	17.46	58.11	18.20
	10 – 20	1.17	19.75	56.69	18.04
	20 – 30	1.19	20.78	56.23	17.96
28.09	0 – 10	1.14	18.71	58.42	18.20
	10 – 20	1.19	18.63	58. 32	17.96
	20 – 30	1.24	22.47	55.58	17.80
Field 2. Autumn wheat					
25.03	0 – 10	1.06	26.18	61.43	18.40
	10 – 20	1.18	28.00	56. 32	17.96
	20 – 30	1.21	29.06	54. 33	17.51
30.06	0 – 10	1.13	19. 38	58.94	18.25
	10 – 20	1.26	19.96	53.12	17.24
	20 – 30	1.28	19.64	51.69	17.80
28.09	0 – 10	1.12	23.28	59.52	18. 33
	10 – 20	1.16	26.22	58.49	18.25
	20 – 30	1.26	29.71	52.43	17.01
Field 3. Corn					
25.03	0 – 10	1.10	26.01	58.87	18. 30
	10 – 20	1.14	28.02	57.98	18.04
	20 – 30	1.22	29.73	55.27	17.60
30.06	0 – 10	1.09	18.78	60.08	18.43
	10 – 20	1.16	23.58	57.60	17.97
	20 – 30	1.27	23.66	52.80	17.92
28.09	0 – 10	1.26	16.96	52. 34	17.01
	10 – 20	1.32	20.22	50.19	16. 31
	20 – 30	1.33	22.75	49.81	16.19
Field4. Sugar Beet					
25.03	0 – 10	1.13	25.26	58.41	18.20
	10 – 20	1.18	26.99	55.74	17.75
	20 – 30	1.21	27.73	55. 39	17.78
30.06	0 – 10	1.26	23.81	52. 34	17.01
	10 – 20	1.27	24.47	52.80	16.92
	20 – 30	1.34	25.57	50.91	16. 31
28.09	0 – 10	1.17	20.81	55.91	17.80
	10 – 20	1.24	22. 30	54.73	17.51
	20 – 30	1.37	26. 33	50. 30	16.61
Field 5. Alfalfa					
25.03	0 – 10	1.13	26.52	58.11	18.20
	10 – 20	1.19	26.99	55.74	17.75
	20 – 30	1.19	27.73	55.90	17.78
30.06	0 – 10	1.26	23.18	52. 34	17.01
	10 – 20	1.27	24.47	52.80	16.92
	20 – 30	1. 35	25.57	50.19	16. 31

28.09	0 – 10	1.19	20.81	55.58	17.80
	10 – 20	1.21	21. 30	54.73	17.51
	20 – 30	1. 37	26. 33	49. 30	16.61

Conforming to the data obtained the benefits of this system is:

- to secure energy for system reproduction of organic matter in the soil;
- encouraging natural processes of formation and reproduction of soil structure;
- optimization of agro and hydro properties by creating a favorable work performance seedbed preparation, sowing, plant growth and development;
- reducing the call for fertilizers and irrigation.

Evolution of organization of structural-functional indices within resource-productive technologies

The concept of such as technology involves the cultivation of crops in order to decrease the negative impact of intrinsic factors and time optimization of surroundings while pedogenesis and promote reproductive processes and tipogenetical elementary processes.

In order to evaluate a biotechnology model of the first type for monitoring the progress of structural organization indices in the typical chernozem the time depending on the length of alfaalfa cultivation.

The data from the Table 2 show that alfaalfa root system through fasciculation in time lead to the improvement of indices of structural organization of soil.

Table 2. Alfalfa function in the reproduction of the soil physical properties

Depth of sampling, cm	**Apparent density, g/cm3**	**Total porosity %**	**The aggregate composition.%**			
			Rough %	**Grainy %**	**Cloggy %**	**Powdery %**
Alfalfa 1 year						
0 – 10	1.12	56.0	5	60	25	10
15 – 20	1. 38	45.0	15	55	25	5
20 – 25	1.22	52.0	10	70	20	-
25 – 30	1. 33	47.0	15	55	30	-
40 – 50	1. 36	47.0	15	50	35	-
50 – 60	1.40	45.0	20	40	40	-
70 – 80	1.42	45.0	20	30	50	-
Alfalfa 2 years						
0 – 10	1.08	57.0	-	70	20	10
15 – 20	1. 33	47.0	10	60	30	-
20 – 25	1.21	52.0	5	70	25	-
25 – 30	1.26	50.0	5	65	30	-
40 – 50	1. 30	49.0	15	60	25	-
50 – 60	1. 38	46.0	20	45	35	-
70 – 80	1.41	45.0	10	40	50	-
Alfalfa 3 years						
0 – 10	1.08	57.0	-	80	20	-
15 – 20	1.26	50.0	-	80	20	-
20 – 25	1.20	53.0	-	80	20	-
25 – 30	1.23	50.0	-	70	30	-
40 – 50	1.27	50.0	-	70	30	-
50 – 60	1. 36	47.0	5	45	50	
70 – 80	1.42	45.0	5	35	60	
Alfalfa 4 years						

0 – 10	1.09	57.0	5	65	30	-
15 – 20	1.26	50.0	5	65	30	-
20 – 25	1.22	52.0	5	75	20	-
25 – 30	1.23	50.0	5	75	20	-
40 – 50	1.29	49.0	10	60	30	-
50 – 60	1. 38	46.0	10	50	40	-
70 – 80	1.43	45.0	20	45	35	-

From the table we see that after the first year of cultivation of alfalfa, the soil horizon agrogen do not suffer hardly any changes, it is layered in several substrates with very variable indices of structural organization. After 2nd year of cultivation, this is more attenuated, and after year 3 becomes distinguishing features of chernozem natural profile. After year 5 of growing the settlement indices remain practically unchanged and even aggregate composition suffers negative changes evidenced by increasing the content of aggregates >10 mm and reducing the aggregate agronomic value.

The specified weight is determined by soil consolidation following over-drying of soil. It is therefore appropriate to be cultivated alfalfa improvement for three years. From the Table 3 we see that the effect of alfalfa is of long duration. The data table shows that even sunflower cultivation after three years does not lead to significant deterioration of structural-functional organization indices.

Table 3. Impact of alfalfa on crop rotations pedo-reproductive

Depth of Samples cm	Apparent Density g/cm3	Total Porosity %	Organizational Aggregate.%			
			Rough %	Grainy %	Cloggy %	Powdery %
Grain rotation Pr.1						
0 – 10	1.12	56.0	-	15	15	80
15 – 20	1.56	38.0	70	-	30	-
20 – 25	1.23	51.0	15	60	20	-
25 – 30	1.43	43.0	40	30	30	-
40 – 50	1.40	45.0	-	60	40	-
50 – 60	1. 37	46.0	-	45	55	-
70 – 80	1.27	50.0	-	60	40	-
Rotation of cereal - forage (alfalfa three years) Pr.2						
0 – 10	1.12	56.0	-	80	20	-
15 – 20	1.26	50.0	-	60	40	-
20 – 25	1.23	51.0	-	80	20	-
25 – 30	1.29	49.0	-	70	30	-
40 – 50	1. 39	46.0	15	60	25	-
50 – 60	1. 33	48.0	-	60	40	-
70 – 80	1.42	45.0		50	50	-
Sunflower after alfalfa 3 years Pr.3						
0 – 10	1.08	57.0	10	40	20	30
15 – 20	1.27	50.0	-	80	20	-
20 – 25	1.23	51.0	-	80	20	-
25 – 30	1. 30	49.0	-	70	30	-
40 – 50	1. 37	46.0	-	60	30	-
50 – 60	1. 35	48.0	-	50	50	-
70 – 80	1.40	46.0	-	40	60	-

The second model of reproductive biotechnology of elementary processes is based on cultivation of intermediate surface protects from the sun, thus ensuring stability and hydrothermal regimes air-hydric time.

In order to assess this effect was observed signs of structural-functional organization of land under cultivation of intermediate crops.

The third type of resource-reproductive technologies involves the cultivation of ameliorative cultures that improve the operating complex process by increasing soil organic matter content of fresh soil.

In order to evaluate this model were monitored structural-functional indices in the cultivation and agrochemical faceliei and yellow mustard as green fertilizer (Table 7, 8).

Table 4. The recovery of soil quality indicators under No-Till cultivation of alfalfa

Deph. cm	Grain				Alfalfa				Soy			
	ρ_b g/cm^3	W. %	Aggregate		ρ_b g/cm^3	W. %	Aggregate		ρ_b g/cm^3	W. %	Aggregate	
			Of Rough	Of Grain			Of Rough	Of Grain			Of Rough	Of Grain
0-10	1.27	13.3	-	20	1.09	8.0	40	60	1.23	8.9	40	60
30-40	1.48	15.7	10-20	20-30	1.27	17.4	20	80	1.41	14.4	40	60
50-60	1.59	14.0	20	<10	1.29	20.2	10	90	1.50	13.8	60	30

Table 5. The recovery of soil quality indicators under No-Till the intermediate culture mustard

Deph. cm	Without intermediate crop							With intermediate crop						
	ρ_b g/cm^3	W. %	Aggregate		H %	mg/100g		ρ_b g/cm^3	W. %	Aggregate		H %	mg/100g	
			Of Rough	Of Grain		P_2O_5	K_2O			Of Rough	Of Grain		P_2O_5	K_2O
0-20	1.27	10.41	30	60	3.5	1.3	30.0	1.23	16.2	20	70	3.5	1.30	29
20-35	1.49	14.5	45	55	-			1.41	17.8	10-20	75-80	-	-	
35-60	1.64	13.4	50	45	-			1.47	13.8	40	60	-	-	
75-90	1.52	13.3	40	40				1.46	14.0	30	60			

Tabel 6. The recovery effect of soil quality indicators under No-Till the intermediate culture of facelia

Deph. cm	Without intermediate crop							With intermediate crop						
	ρ_b g/cm^3	W. %	Aggregate		H %	mg/100g		ρ_b g/cm^3	W. %	Aggregate		H. %	mg/100g	
			Of Rough	Of Grain		P_2O_5	K_2O			Of Rough	Of Grain		P_2O_5	K_2O
0-10	1.14	5.8	20-25	65-70	3.5	1.1	36.8	1.28	9.39	<20	>80	3.5	1.3	40.1
20-30	1.64	12.0	10-20	-	-			1.48	14.0	10-20	80-90	-	-	
45-55	1.50	12.9	20-30	10-15	-			1.48	15.4	15-20	80	-	-	
65-75	1.60	12.8	30	10-15				1.53	15.4	20-25	60			

Tabel 7. Fito-ameliorative cultural influence on soil physical properties (in the years 2006 to 2011) (0- 50 cm)

Crop	**Apparent Density. g/cm^3**	**Density of solid phase. g/cm^3**	**Total Porosity. %**
Incorporation into the soil at the beginning of flowering			
Facelia	1.08	2.52	57.3
Yellow Mustard	1.17	2.59	54.8
Incorporation into the soil mass flowering phase			
Facelia	1.11	2.53	56.1
Yellow Mustard	1.20	2.62	54.5
Incorporation into the soil after flowering			
Facelia	1.14	2.55	55.3
Yellow Mustard	1.20	2.62	53.1

Table 8. The role of fertilizer in crop biotechnology fitoameliorative productive resources (Mean data 2006- 2011) (Layer 0- 50 cm)

Crop	Accumulation of biomass t/ha	The content of nutrients in the soil. kg/ha			pH
		N	P_2O_5	K_2O	
Incorporation into the soil at the beginning of flowering					
Facelia Yellow Mustard	25.94 28.83	103. 76 86.49	77.82 86.49	233.46 288.30	7.45 7.45
Incorporation into the soil mass flowering phase					
Facelia Yellow Mustard	27.89 31.18	111.56 93.54	83.67 93.54	251.01 311.80	7.40 7.40
Incorporation into the soil after flowering phase					
Facelia Yellow Mustard	27.30 29.98	109. 20 89.94	81.90 89.94	245.70 299.80	7.40 7.40

From the tables presented we find that the incorporation of fresh organic matter in soil helps to improve settlement indices. Also the effect caused by the intensification of activity in the soil biota with refinement of it. Structure, galleries of earworms and other worms etc. While the green table in the soil is incorporated significant amounts of nitrogen. Phosphorus and potassium, which allows us to produce high yields and quality without mineral fertilization practice. In addition, the transportation costs are excluded for fertilizers. thus reducing unit production cost.

CONCLUSIONS

Growing differentiated crop beans to remedy the soils from degraded fields can display enlarged physical factors of fertility. Optimization of those ensures the improvement of hydrothermal, air - hydric and subsequent oxidation-reduction systems with optimization of the regime of nutrition and function of bio-production.

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A COMPARATIVE FARM LEVEL CULTIVATION OF CONVENTIONAL AND BT COTTON

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Abstract

Pakistan is an agricultural country whereas cotton crop is the main cash crop. The crop has been problematic due to a multitude of pests incurring a large proportion of pesticide consumption in the country. Bt cotton although being cultivated in Pakistan for many years has been formally commercialized recently. The farmers' false perception about control of all insect pests as well as a boost in yield favoured the rapid adoption of this technology. There is a need to establish a comparative quantified economic advantage from this technology.The present study gives an overview of pesticide consumption, yield increase and monetary benefits in conventional and Bt cotton on per acre basis.

Key words: *Bt cotton, economic advantages, pest control.*

INTRODUCTION

Approximately 1300 species of chewing and sucking insects cause 10-40 percent yield loss of the cotton crop worldwide. An excessive use of pyrethroids and dry weather boost up the pest infestation.

Major sucking insects include aphids (*Aphis gossypii* L.) whitefly (*Bemisia tabaci* L.), jassid (*Amrasca biguttula biguttula* (Ishida.)), thrips (*Thrips tabaci* L.), and mites (*Tetranychus urticae* L.). Aphids cause honey dew production during sap sucking which stain the boll cotton lint thus reducing its quality cotton. Photosynthesis and plant growth is affected. Thrips, whitefly and jassid cause damage from June till October. The vegetative growth of the plant is affected which may result in shedding of the leaves, flower buds, bolls and immature boll opening. The fibre quality may also be compromised due to sever insect attack.

Lately, mealy bug (*Phenacoccus solani*) which has always been a minor pest has caused significant yield loss and the majority of existing cotton varieties is susceptible to it [1].

The complex of chewing insects causes the major yield loss and annually there has been a 20-30% loss of yield due to various bollworms. American bollworm (*Helicoverpa armigera* Hub.), spotted bollworm (*Earias insulana* Boisd*, Earias vittella* Fab.), army bollworm (*Spodoptera litura* Fab. & *Spodoptera exigua* Hub.) and pink bollworm (*Pectinophora gossypiella* Saunders) are the main insect pests of cotton in Pakistani fields. The bollworms' intensity period ranges from the end of July till mid October although the army bollworm is persistent in the field till harvest. The chewing insects' complex is the major cause of pesticide consumption. The lepidopteran larvae consume leaves, bolls and meristematic tissue. The control has been difficult due to egg laying and susceptibility period of the target insects being confined to early instars of development. Leaf curl, stunting, boll rot, bacterial blight, and root rot are main plant diseases of cotton in Pakistan. Cotton leaf curl is the major disease and causes upto 40% loss of yield [3]. Whitefly is the transmitter of this pathogenic virus. The leaves are curled, darkened and drop early thus the rate of photosynthesis along with a reduced crop growth, occurs.

It is estimated that in Pakistan, farmers spend US$300 million on pesticides annually, of which more than 80% is used on cotton, especially for the bollworms [5]. Total pesticides consumption in Pakistan during 2009-10 was 98,623 metric tons whereas in Punjab it has increased from 14,000 tons in 1990 to over 58,000 tons in 2010 (Fig. 1).

At the beginning of the decade 2000, many farms obtained Bt cotton seed from local agriculture market and private seed companies. The germplasm was mainly imported illegally from India,China and Australia [4]. Due to high cost of pesticides and the false notion about the Bt technology i.e. Bt cotton is effective against all types of pests-both chewing and sucking complex,the unapproved Bt cotton seed has been readily available in the market since 2002. The Bt cotton was formally commercialized in 2011. The following study was carried out to determine the comparative economic efficiency of Bt and conventional cotton crop under similar agronomic conditions on a local farm to determine cost effectiveness and on behalf of the Bt technology.

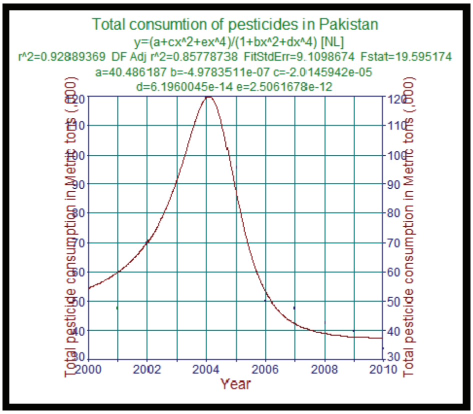

Fig. 1. Trend of Pesticide consumption in Pakistan
Source: DG Pest warning Punjab Agriculture Department [2]

MATERIAL AND METHOD

The comparative economic efficiency of Bt cotton was analyzed at Hassan Mahmood Qureishi farms (HQ), Multan (Pakistan).The farm is situated on Old Dunya Pur road, Multan and is a leading progressive farm in the area.The total farm area is 325 acres. Cotton is the major crop culture during Kharif (summer) season and covers 175 acres whereas the rest of the area is reserved for vegetables, fodder and minor crops. Irrigation is applied both from tubewell and canal sources. Bt cotton was gradually spread for cultivation and at the farm the area under Bt cotton has gradually increased over the years (Fig. 2).

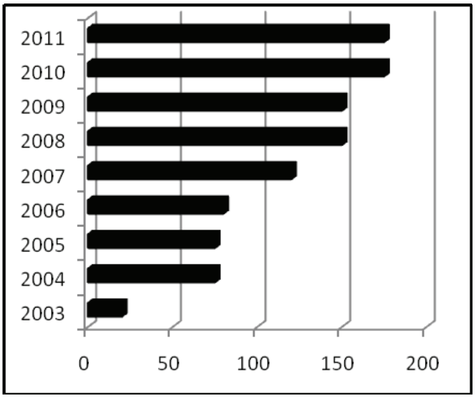

Fig. 2. The evolution of area reserved for Bt cotton cultivation at HQ farms

In the present study, Bt and conventional cotton was grown on adjacent one acre plots on ridges and similar agronomic practices were adopted from sowing till harvest. Bt cotton seed was purchased from a registered seed supplier company and the Bt plot was surrounded by a refuge conventional cotton on an area comprising 20% of the Bt plot size.

RESULTS AND DISCUSSIONS

It must be mentioned here that the Bt cotton is not designed for a default yield increase and there is no promise of productivity enhancement due to Bt seed only. But, the Bt plant has a season long resistance against main lepidopterans i.e. *Helicoverpa armigera* and *spodoptera litura*. The efficacy against *Pectinophora gossypiella* and *Earias insulana*, *Earias vitella* is not much promising, although significant control is there. The need to spray may arise depending upon the refuge size; level of pest infestation; vigour of parent genome; availability of nutrients especially nitrogen and the extent of expression of Bt toxin at the specific growth period.

The cost benefit table has been generated from the year round data for expenses on various operations on both plots to highlight key areas of differences for expenses and net profit/acre (Table 1, 2 & 3).

Table 1. Per acre cost of production (conventional cotton)

Yield 42 Mds per Acre, Crop Duration: 9 Months Monetary unit is Rs

Operation / Activity	**Operation / Inputs expense description**	**Quantity/Dose**	**Unit rate**	**Operation cost**	**Total cost**
Land Preparation	i) Cultivator	3	500	1500	2000
	ii) Drill / Planter	1	500	500	
Farm Yard Manure	Manuring	5 trolleys	500	2500	2500
Seed Sowing	i) Seed (Hybrid Variety)	8 kg	500	4000	4500
	ii) Seed Treatment (Confidar)	1 kg	500	500	
Fertilizer	i) NP	2 bags per acre	2450	4900	17050
	ii) SOP	1bages per acre	3600	3600	
	Urea	2 bags per acre	1700	3400	
	iii) CAN	3 bages per acre	1450	4350	
	iv) Transportation	8 bags	50	400	
	v) Labour Charges of Application	8 bags	50	400	
Weed Control	i) Weedicide (Dual Gold)	600 ml per acre	500	500	4000
	ii) Hoeing (Tarphali)	2	1500	3000	
	iii) Thinning	one thinning	500	500	
Irrigation	i) Water Rates (For 1Year)	5	1000	1000	7400
	ii) Additional Tube Well Irrigation	4	1200	4800	
	iii) Labour Charges for Irrigations	9	150	1350	
	iv) Water Channel Cleaning	1	250	250	
Insect - Pest Control	i) Pesticides	9 sprays	500	4500	5850
	ii) Labour Charges for Spray	9 sprays	150	1350	
Picking & Harvesting	i) Picking Labour Charges	42 maunds	200	8400	11340
	ii) Transportation	42 maunds	20	840	
	iii) Deduction for Inert Matter (1Kg for 1 Mds)	42 kg	2500/50kg	2100	
Land & Managerial Expenses	i) Land Rent (For 1 Year)	25000	25000	25000	25800
	ii) Manager Salary (For 100 acre @ 10000/- per month)	---------	800	800	
Total income	---------------	42 maund	2500	--------------	105000

Table 2. Per acre cost of production (BT Cotton)

Yield 50 Mds Per Acre   Crop Duration: 10 Months

Operation / Activity	Operation / Inputs expense description	Quantity/Dose	Unit rate	Operation cost	Total cost
Land Preparation	i) Cultivator	3	500	1500	2000
	ii) Drill / Planter	1	500	500	
Farm Yard Manure	Manuring	5 trolleys	500	2500	2500
Seed Sowing	i) Seed (Hybrid Variety)	8 kg	500	4000	4500
	ii) Seed Treatment (Confidar)	1 kg	500	500	
Fertilizer	i) NP	2 bags per acre	2450	4900	18750
	ii) SOP	1bages per acre	3600	3600	
	Urea	3 bags per acre	1700	5100	
	iii) CAN	3 bages per acre	1450	4350	
	iv) Transportation	8 bags	50	400	
	v) Labour Charges of Application	8 bags	50	400	
Weed Control	i) Weedicide (Dual Gold)	600 ml per acre	500	500	4000
	ii) Hoeing (Tarphali)	2	1500	3000	
	iii) Thinning	one thinning	500	500	
Irrigation	i) Water Rates (For 1Year)	5	1000	1000	11450
	ii) Additional Tube Well Irrigation	7	1200	8400	
	iii) Labour Charges for Irrigations	12	150	1800	
	iv) Water Channel Cleaning	1	250	250	
Insect - Pest Control	i) Pesticide	6 sprays	500	3000	3900
	ii) Labour Charges for Spray	6 sprays	150	900	
Picking & Harvesting	i) Picking Labour Charges	50 maunds	200	10000	14125
	ii) Transportation	50 maunds	20	1000	
	iii) Deduction for Inert Matter (1Kg for 1 Mds)	50 kg	2500	3125	
Land & Managerial Expenses	i) Land Rent (For 1 Year)	25000	25000	25000	25800
	ii) Manager Salary (For 100 acre @ 10000/- per month)	---------	800	800	
Total income	--------------	50 maund	2500	---------------	125000

Table 3. A comparative economic evaluation of the two crop systems

Economic difference for the two crop types	BT Cotton	Conventional Cotton	Difference for BT culture (+/-)
Total expenditure	87025	80440	+6585
Total expenditure /40 Kg	1741	1915	-174
Net Income	37975	24560	+13415
Net Income /40 Kg	760	585	+175

In comparison with conventional crop culture, Bt cotton required higher amount of nitrogenous fertilizer for its more flourishing growth and long crop season. More irrigations were subsequently applied to Bt crop. As Bt cotton gave promising control of chewing pest complex, fewer pesticide sprays were applied while the yield was 8 maunds/acre higher. Picking and harvesting charges increased consequently. The net income for each maund from Bt crop was significantly more than its comparator crop (Fig. 3).

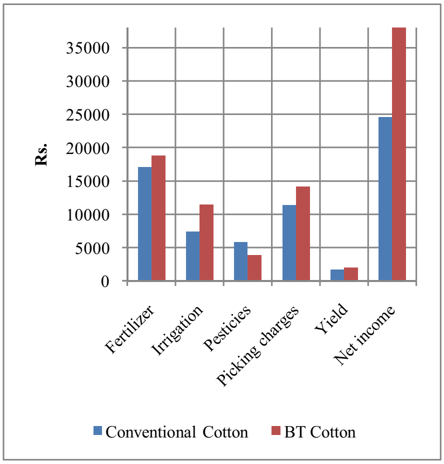

Fig. 3. Important agronomic factors contributing to higher economic return from the BT crop

The results prove an economic benefit for growing of Bt cotton Several studies have examined the extent of the impact of Bt cotton on yield and pesticide use in developing countries. Although results differ across countries and seasons, these studies are in agreement that Bt cotton helped farmers in controlling yield losses, reducing pesticide expenditures, and hence increasing their incomes. According to a study conducted by Qaim et al. in Argentina in 2003, it was revealed that Bt cotton can reduce the pesticide application rates up to half thus contributing to agronomics and sustainability of agriculture in a given country. There are a number of secondary benefits associated with the reduction in insecticide (non biological) use, which include enhanced populations of beneficial insect and wild life, reduced potential runoff of insecticides; and improved safety for farm workers by reducing potential exposure. Similarly in China, recently it has been reported that plantation of Bt crops is also beneficial in reducing pests of nearby non-Bt crops. Although the Bt crop is economically beneficial at the moment; however, the non-compliance of refuge crop may result in a surge in resistance in target insect pests and a return to bio-pesticides in the future.

CONCLUSIONS

The Bt cotton causes less financial burden on the farmers. However it may cause hidden environmental costs. The majority of the farmers planting Bt cotton are unaware of the refuge crop culture along with Bt crop. Moreover, the long duration of the Bt crop might delay the upcoming cultivation time of the following crop and a reduction in its yield.All this necessitates the selection of a proper sowing time for Bt culture allowing a sufficient delay for the next crop.

There is a need to incorporate a biotechnological solution in Bt cotton genome to prevent losses from sucking insects' complex. The farmers must be educated to plant refuge crop along with Bt crop culture to prevent a resistance build up in target insect pests.

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RESEARCH REGARDING WEED INFESTATION IN WHEAT CROP AT ECOLOGIC PROD FARM, MIHAIL KOGALNICEANU - CONSTANTA COUNTY

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Abstract

Weeds are unwanted plants that grow on agricultural land, pastures, parks, gardens, industrial land, airports, etc., producing various and enormous damage. The accurate knowledge of weed infestation is currently an important tehnological sequence in integrated weed control and helps to establish differentiated strategies for reducing these very damaging species to a level that does not affect wheat production. Too many weeds on 1 m² raise serious problems in terms of rotation, demanding necessary agricultural machinery, chemicals, etc. Winter cereals are infested by about 147 weed species. The accurate knowledge of the infested areas and the dominant species of different fields allow the farmer to plan in advance the necessary machinery, fuel and herbicides for weed contro lwith minimal environmental pollution. Weed mapping was initiated in 1973, aiming to establish the quantitative and qualitative level of weed infestation in farms. This paper refers exclusively on weed mapping in wheat between 2010 and 2012 at a farm belonging to S.C. ORGANIC PROD LTD, the Mihail Kogalniceanu area, Constanta county. The species found were: Brassica nigra, Cannabis ruderalis, Chenopodium album., Cirsium arvense, Convolvulus arvensis, Descurainia sophia, Fumaria officinalis, Galium aparine, Lamium amplexicaule, Polygonum convolvulus, Setaria sp., Sonchus arvensis and *Xanthium italicum. The results of this paper are the subject of doctoral theme.*

Key words: *infested areas, weeds, wheat.*

INTRODUCTION

Weeds are unwanted plants that grow on agricultural land, pastures, parks, gardens, industrial land, airports, etc., producing various and enormous damage [1, 2].
The accurate knowledge of all sole weeding structure is currently an important link in integrated weed control and helps to establish differentiated strategies to reduce these very damaging species to a level that does not harm wheat production [4].
Too many weeds on 1 m^2 raise serious problems in terms of rotation, demanding necessary agricultural machinery, chemicals, etc.
Winter cereals are infested by about 147 species of weeds [6]. The accurate knowledge of the infested areas and the dominant species of different fields allow the farmer to plan in advance the necessary machinery, fuel and herbicides for successful action with minimal environmental pollution. Weed mapping was initiated in 1973, aiming to establish thequantitative and qualitative level of the weed infestation in farms [3].
Knowing the weeds in wheat crop is an important link in the integrated control of these species [7].
The essential elements of the mapping process are: the mapping period, the number of determinations, the correct identification and registration of the species according to a consistent method.
This paper refers exclusively on weed mapping in wheat between 2010 and 2012, at a farm belonging to S.C. ORGANIC PROD LTD, the Mihail Kogalniceanu area, Constanta county.

MATERIAL AND METHOD

The data on weed infestation were obtained by the quantitative numerical method [5].

The weed species were numbered and identified from sample surfaces (0.25 square meters).
This method is fast and sufficiently accurate. For ease and accuracy, the collected weeds were grouped by species; the average height in centimetres was appreciated and noted in the tables (photo 1).
For each of the three years of research, measurements on the weed occurrence in the wheat sown fields were performed 1-2 days before the preferred time of herbicide application by using the methodology used in weed crop mapping in Romania.
Five determinations were made for each plot sown to wheat; subsequently, the average number of weeds encountered on one square meter, the participation of each weed species (%) and consistency (%) were calculated for each species.
Based on the observations performed during the three years of research in S.C. ORGANIC PROD LTD, the Mihail Kogalniceanu area, Constanta county, a general list of common weeds, dominant weeds and weed-issue groups was established.
Weeds are the dominant species, with the highest number of individuals/one square meter; their weeding participation is equal to or higher than 60%.

Photo 1. Height measurement *Polygonum convolvulus* species

RESULTS AND DISCUSSIONS

In 2012, 12 species of weeds were determined in plot A 462 in wheat crop; most of them were dicotyledonous (9 species), two perennial dicotyledonous and one of monocotyledonous annual species (Table 1).
Of these species, *Cannabis ruderalis* and *Polygonum convolvulus* were dominant, and *Setaria* sp. and *Galium aparine* were co-dominant species.
The average number of weeds per square meter was 463.2 plants.
Species with more than 60% constancy (k%) were present in most of the plot, thus determining the choice of herbicide. In this case, species with low constancy also occurred rarely in the plot.
The specification of the botanical class is an important practice since dicotyledonous perennial weeds are more resistant than dicotyledonous annual weeds in both chemical means and agro control.
It should be noted that the average species (a) and average number of weeds on a square meter plot in the survey (M) were sufficient to establish control measures for cereal grains; however, in order to have a complete picture of the situation and to estimate the assumptions, participation (p%) and consistency (k%) were required.
In 2011, 12 species were identified in the same plot, i.e. A462; it should be noted that the species *Setaria* was not present, but *Lamium amplexicaule* occurred instead (Table 2).
Cannabis ruderalis and *Polygonum convolvulus* occurred as dominant species.
The average number of weeds per square meter was 226 plants.
As seen in Table 3, in 2010, only three species were identified in A 515 plot where *Lamium amplexicaule* was dominant.
The average number of weeds per square meter was 671.2 plants.
The period 2010 and 2012 recorded a variation in the number and density of weed species, depending primarily on the plot, weather conditions, crop system, precrop and herbicides.

Table 1. Weed species in plot A 462, (26.IV.2012)-wheat after wheat; ploughing at 28 cm

Species	Phenophase Height	Measurements					Species (s) amount	Species average (a)	Participation (p%)	Constancy (k%)	Botanical class
		1	2	3	4	5					
Cannabis ruderalis	A7	184	36	268	208	120	816	163.2	35.23	100	Da
Galium aparine	A12	-	-	52	60	50	162	32.4	6.99	60	Da
Polygonum convolvulus	A8	124	136	306	84	100	750	150	32.38	100	Da
Convolvulus arvensis	A6	20	-	4	6	16	46	9.2	1.99	80	Dp
Chenopodium album	A3	-	12	12	24	16	64	12.8	2.76	80	Da
Brassica nigra	A6	12	28	24	12	16	92	18.4	3.97	100	Da
Descurainia sophia	A7	8	-	-	-	4	12	2.4	0.52	40	Da
Xanthium italicum	A4	8	-	4	-	-	12	2.4	0.52	40	Da
Setaria sp.	A1	48	12	44	80	40	224	44.8	9.67	100	Ma
Cirsium arvense	A6	-	20	32	-	20	72	14.4	3.11	60	Dp
Sonchus arvensis	A4	-	4	-	2	-	6	1.2	0.26	40	Da
Fumaria officinalis	C12	-	36	-	24	-	60	12	2.59	40	Da
		404	284	746	500	382	2316	**463.2**	99.99		

Table 2. Weed species the plot A 462, (6.IV.2011)-wheat after rape; ploughing at 30 cm

Species	Phenophase Height	Measurements					Species (s) amount	Species average (a)	Participation (p%)	Constancy (k%)	Botanical class
		1	2	3	4	5					
Cannabis ruderalis	A6	88	40	44	60	64	296	59.2	26.19	100	Da
Galium aparine	A11	4	12	4	8	4	32	6.4	2.83	100	Da
Polygonum convolvulus	A7	80	100	108	96	84	468	93.6	41.42	100	Da
Convolvulus arvensis	A5	4	4	8	8	8	32	6.4	2.83	100	Dp
Chenopodium album	A2	8	-	4	4	8	24	4.8	2.12	80	Da
Brassica nigra	A5	8	12	12	8	12	52	10.4	4.60	100	Da
Descurainia sophia	A7	4	4	4	-	4	16	3.2	1.42	80	Da
Xanthium italicum	A2	4	4	4	-	-	12	2.4	1.06	60	Da
Lamium amplexicaule	A6	24	12	28	36	36	136	27.2	12.04	100	Da
Cirsium arvense	A6	8	-	-	12	-	20	4.0	1.77	40	Dp
Sonchus arvensis	A3	4	-	-	2	-	6	1.2	0.53	40	Da
Fumaria officinalis	C11	16	-	8	12	-	36	7.2	3.19	60	Da
		252	188	224	246	220	1130	**226**	100		

Table 3. Weed species in plot A 515, (10.IV.2010)-wheat after rape; ploughing at 30 cm

Species	Phenophase Height	Measurements					Species (s) amount	Species average (a)	Participation (p%)	Constancy (k%)	Class botanical
		1	2	3	4	5					
Lamium amplexicaule	A7	400	316	352	408	452	1928	385.6	57.45	100	Da
Galium aparine	A12	272	212	280	232	184	1180	236	35.16	100	Da
Descurainia sophia	A8	48	68	32	56	44	248	49.6	7.39	100	Da
		720	596	664	696	680	3356	671.2	100		

To a large extent, weed infestation in wheat crop depended on the crop condition in the period from April to May.

Optimal uniform wheat density was an effective means of controlling the weed cover plantlet stage, resulting in their suffocation.

This was shown in certain locations where mapping was performed (the number of weeds was lower than in the areas that displayed good wheat density).

CONCLUSIONS

The weed species found were: *Brassica nigra, Cannabis ruderalis, Chenopodium album., Cirsium arvense, Convolvulus arvensis, Descurainia sophia, Fumaria officinalis, Galium aparine, Lamium amplexicaule, Polygonum convolvulus, Setaria sp., Sonchus arvensis* and *Xanthium italicum.*

The small number of species identified in most cases represented by dicotyledonous did not raise special herbicide problems.

Knowing the weeds in wheat crop is an important technological sequence in the integrated control of these species.

There was a change in the number and density of weed species according to the plot, weather and crop management.

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RESEARCH REGARDING WEED CONTROL IN WHEAT

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Abstract

Management control and weeding status play an important role in the tehnological sequence of wheat crop. Despite systematic and sustained fight against weeds, the latter continue to cause low production quality and quantity. Under conditions of modern agriculture, the studies on integrated weed management should be based on an elaborated program that combines herbicide use with culture-specific agrotechnical methods, closely connected with the type of weed infestation. Herbicide application is the best method of all the complex measures of integrated control. The intelligent use of herbicides involves an investment of scientific knowledge in different domains. Given the high percentage of chemical control methods within the integrated control system (biological control having no concrete support), proper application of herbicides should be given special attention. The need for further research on wheat weeding is real as chemical industry provides farmers with new herbicides; on the other hand, no herbicide has been created to destroy the entire weed range existing in a crop. This paper presents a series of measures (crop rotation, tillage, fertilizer and herbicide) aimed at increasing efficient weed control in wheat crop in a dynamic analysis covering the years 2010-2012. The results of this paper are the subject of doctoral theme.

Key words: *integrated control system, management, weeds.*

INTRODUCTION

Management control and weeding status play an important role in the tehnological sequence of wheat crop [6].

Despite systematic and sustained fight against weeds, the latter continue to cause low production quality and quantity [1].

Under conditions of modern agriculture, the studies of integrated weed management should be based on an elaborated program that combines herbicide use with culture-specific agrotechnical methods, closely connected with the type of weed infestation [4].

Herbicide application is the best method of all the complex measures of integrated control.

The intelligent use of herbicides involves investment of scientific knowledge in different domains [3].

This paper presents a series of measures (crop rotation, tillage, fertilizer and herbicide application), aimed at increasing efficient weed control in wheat crop in a dynamic analysis covering the years 2010-2012.

MATERIAL AND METHOD

Between the period 2010 and 2012, an experiment based on herbicide application was performed on chernozem-grown wheat at S.C. ORGANIC PROD LTD, the Mihail Kogălniceanu area, Constanţa county.

Six variants were studied: untreated control, Rival Star 75 GD (25 g/ha), Dicopur D (1 l/ha), Dicopur Top 464 SL (1 l/ha), Granstar Super 50 SG (40 g/ha) and Sekator Progress OD (150ml/ha).

Application was implemented for Dicopur D, Dicopur Top and Sekator Progress, elongation of the first internode (early phase of growing wheat J) [5], and for Rival Star 75 GD and Granstar Super 50 SG the phenophase of four internodes (middle phase of growing wheat J).

The area of the experimental plots was 25 square meters.

We worked in four repetitions, in Latin rectangle.

In terms of rainfalls during the growing season, 2010 was very favorable, 2011 favorable and 2012 less favorable, especially towards the end of vegetation, as reflected by the yields obtained. The agrophytotechnical measures applied to the soil by the time of harvesting were the same in all variants.

In 2012, wheat followed wheat in plot A 462. It was ploughed at 28 cm in depth. Fertilization consisted in the application of a complex $N_{20}P_{20}K_0$ – 200 kg/ha fall under the plough, and urea – 120 kg/ha and foliar fertilizer with Green last – 10 l/ha were administered in spring.

In 2011, wheat followed rape.

Ploughing was done at 30 cm in depth. Fertilization consisted in the application of a complex $N_{18}P_{46}K_0$ – 150 kg/ha fall under the plough, and ammonium nitrate – 120 kg/ha in spring.

In 2010, wheat followed rape in plot A 515. Ploughing was done at 30 cm in depth. Fertilization consisted in the application of a complex $N_{12}P_{56}K_0$ – 150 kg/ha fall under the plough, and ammonium nitrate – 200 kg/ha in spring. The variety was De la Brad.

RESULTS AND DISCUSSIONS

The weeding level, herbicide application before and immediately after harvest were measured in each of the three years of research.

In 2010, the most favourable in terms of rainfall and medium in terms of weeding, compared with the other two years of research, the highest increase production (2.6 q/ha) was recorded in the variant treated with Rival Star 75 GD (Table 1).

Significantly distinct differences in production were recorded in nearly all the variants investigated, except the variant treated with Dicopur D, which recorded the lowest, i.e. statistically significant yield (1.3 q/ha).

In 2011, favourable in terms of precipitation and lowest weeding, in decreasing order, the highest increase production (1.8 q/ha) was recorded in the variant treated with Granstar Super 50 SG (Table 2).

2011 also recorded the highest wheat production out of the three years studied.

The variant treated with Dicopur D provided a significant yield increase of 0.7 q/ha, while all other variants separately provided a distinct significant increase ranging between 2.3 q/ha and 2.6 q/ha.

In the last year studied, 2012 respectively, unfavourable in terms of rainfall and highest weeding level, that the highest increase production (2.2 q/ha) was recorded in the variant treated with Rival Star 75 GD (Table 3).

As in the previous years, an almost similar behaviour of herbicides was recorded.

Thus, the Dicopur D variant achieved a significant yield increase of 1.3 q/ha while in the other variants increases ranging between 1.7 q/ha and 2.2 q/ha were distinctly significant.

In 2012 the lowest wheat productions were recorded, compared with the other years of research.

Concerning the weed species identified at the end of vegetation in the variants treated with herbicides applied in 2012, we have identified the following species: *Cirsium arvense* and *Galium aparine* in the untreated variants and in those treated with Dicopur D; the last species was found in the variant treated with Dicopur Top and *Chenopodium album*, *Polygonum aviculare*, *Polygonum convolvulus* and *Setaria* sp. in the all experimental variants (Table 4).

Weeding decreased in all the experimental variants, with values between 11.1% and 50.0% at the end of vegetation in the experimental variants that were treated with herbicides, compared with the untreated variant.

Table 1. Wheat yield (variety De la Brad) using herbicides applied in 2010

Variants	Dose l (kg)/ha	Yield		Difference (q/ha)	Significance
		q/ha	%		
Untreated	-	45.6	100	-	Witness
Dicopur D	1	46.9	102.9	1.3	*
Dicopur Top 464 SL	1	47.9	105.0	2.3	**
Sekator Progress OD	0.150	48.0	105.3	2.4	**
Rival Star 75 GD	0.020	48.2	105.7	2.6	**
Granstar Super 50 SG	0.040	48.0	105.3	2.4	**
DL 5% = 1.3 q/ha		DL 1% = 2.3 q/ha		DL 0.1% = 2.8 q/ha	

Table 2. Wheat yield (variety De la Brad) using herbicides applied in 2011

Variants	Dose l (kg)/ha	Yield		Difference (q/ha)	Significance
		q/ha	%		
Untreated	-	50.2	100	-	Witness
Dicopur D	1	50.9	101.4	0.7	*
Dicopur Top 464 SL	1	51.6	102.8	1.4	**
Sekator Progress OD	0.150	51.8	103.2	1.6	**
Rival Star 75 GD	0.020	51.9	103.4	1.7	**
Granstar Super 50 SG	0.040	52.0	103.6	1.8	**
DL 5% = 0.7 q/ha		DL 1% = 1.4 q/ha		DL 0.1% = 2.1 q/ha	

Table 3. Wheat yield (variety De la Brad) using herbicides applied in 2012

Variants	Dose l (kg)/ha	Production		Difference (q/ha)	Significance
		q/ha	%		
Untreated	-	34.9	100	-	Witness
Dicopur D	1	36.2	103.7	1.3	*
Dicopur Top 464 SL	1	36.6	104.9	1.7	**
Sekator Progress OD	0.150	36.8	105.4	1.9	**
Rival Star 75 GD	0.020	37.1	106.0	2.2	**
Granstar Super 50 SG	0.040	37.0	106.0	2.1	**
DL 5% = 1.4 q/ha		DL 1% = 1.7 q/ha		DL 0.1% = 2.3 q/ha	

Table 4. Weed species identified at the end of vegetation after herbicides application (no./m^2 – 30.06.2012)

Weed species	Variant					
	Untreated	Dicopur D	Dicopur Top 464 SL	Sekator Progress OD	Rival Star 75 GD	Granstar Super 50 SG
Cirsium arvense	4	4	-	-	-	-
Chenopodium album	20	16	12	4	4	4
Galium aparine	8	8	4	-	-	-
Polygonum aviculare	4	4	-	-	-	-
Polygonum convolvulus	4	4	4	4	4	4
Setaria sp.	32	28	30	30	28	30
Total weeds	72	64	50	38	36	38
Difference (%)	-	11.1	30.5	47.2	50.0	47.2

Setaria sp. was dominant at the end of vegetation because herbicides included no annual monocotyledonous in their weed control range.
Other species were reported after rainfalls and herbicide application.

CONCLUSIONS

Wheat weed control by herbicide application as a sequence in a complex integrated control measures ensures yield increases between 0.7 q/ha and 2.6 q/ha statistically and varies depending on weather conditions.
Research showed that in two out of the three years of research, the variant treated with the herbicide Rival Star 75 GD definitely recorded the highest production.
Our results showed that the most effective treatments were obtained in the variants treated with the herbicides Rival Star 75 GD, Granstar Super 50 SG and Sekator Progress OD.
The variant treated with the herbicide Dicopur D recorded the lowest production.

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THE USES OF WILD SPECIES HELIANTHUS ARGOPHYLLUS FOR OBTAINING SUNFLOWER GERMPLASMS WITH IMPROVED RESISTANCE TO DROUGHT AND BROOMRAPE INFESTATION

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Abstract

In this paper we present the results from the study on new sunflower forms obtained through hybridization between cultivated sunflower (Helianthus annuus) and wild species Helianthus argophyllus. The aim was to improve drought and broomrape resistance of some Romanian sunflower inbreed lines. The investigation encompassed the period 2008-2011. Interspecific F1 plants were obtained by embryo rescue techniques, and than as a results of and back-crossing and selfpollination with cultivated sunflower, BC4F2 was obtained. The heritability in first generation was intermediate but the plants strongly resembled the wild species in their most morphological traits. For drought resistance we selecting the plant with pubescent leaves. The BC2, BC3 and BC4 were assayed in vegetation house for broomrape resistance with tests performed with artificial inoculation using broomrape seeds collected from two infested areas with broomrape (F and G races). Concerning drought and broomrape resistance the results indicated good resistance, suggesting successful of gene introgression. Resistant lines will be selfpollinated and retested in the next year and some of the obtained hybrid forms will be included in a sunflower breeding program as genetic sources for drought and broomrape resistance.

Key words: *wild sunflower, interspecific hybridization, embryo rescue, drought and broomrape resistance.*

INTRODUCTION

Sunflower is a plant of the American continent where *Helianthus annuus*, together with *Helianthus tuberosus*, has been used since antiquity. The first attempt at using interspecific hybridization in sunflower was made in Russia in 1916 [4]. After many years, due to climatic changes, the interest in interspecific hybridization is renewed, as a tool to achieved stress and diseases resistance, CMS sources, oil quality or modified biochemical composition.

The usefulness of many species of wild sunflower is limited by their poor crossability and high degree of F1 sterility in interspecific hybrids. These impediments can be overcome by using embryo rescue techniques, chromosome doubling of the F1 and the creation of amphiploids [5].

The wild *Helianthus argophyllus* species possess considerable variability for resistance to drought, diseases and parasitic plant which can be utilized for the improvement of cultivated sunflower [5].

This paper aims to present a part of the results of interspecific hybridization between cultivated sunflower (*Helianthus annuus*) and wild species (*Helianthus argophyllus*) and present their potential useful for breeding and selection.

MATERIAL AND METHOD

Six cultivated sunflower (Romanian sunflower inbreed lines created by NARDI Fundulea, 2n = 34) and wild species (*Helianthus agrophyllus*, 2n=34), were grown under field conditions and vegetation house at NARDI Fundulea during 2008-2011.

Methods included: interspecific hibridization, embryo rescue, selfpollination and back-crossing, field and biochemical evaluation.

For hibridization, starting from the beginning of anthesis, daily the female plants were hand emasculed and fresh pollen was applied to the inflorescences. Pollination was performed with a flannel applicator every two days. The wild species were used both as mother and father parent, in order to make a comparative study and finally to choose what results to be promoted (Table 1).

Table 1. Working scheme

2008	***Helianthus argophyllus***	**x**	***Helianthus annuus* (L 1029 B, L 991B, L 1093B, L 1095C, L 1085 C, L 1088 C**
		↓	Embryo rescue
	F1	x	*Helianthus annuus*
		↓	(Screening for pubescence)
	BC_1F_1	x	BC_1F_1 (Selfpollination)
		↓	
2009	BC_1F_2	x	*Helianthus annuus* (Screening for phomopsis)
		↓	
	BC_2F_2	x	*Helianthus annuus* (Screening for broomrape)
		↓	
2010	BC_3F_2	x	*Helianthus annuus* (Screening for broomrape)
		↓	
2011	BC_4F_2	x	*Helianthus annuus* (Screening for broomrape)
		↓	
	13 lines BC_5F_2 for breeding program		

A method for breaking the dormancy and retrieving seedlings from sunflower embryos 20 days post-pollination was used in case of interspeciphic hybrids with *H. argophyllus*. Embryos allowed to develop in planta for 20 days were excised, dehulled and incubated under lights (12 h photoperiod) in Petri dishes on filter paper moinstened with 10 ml of a solution containing 0.025 ppm GA3, 1 ppm IAA and 2.5 ppm KNO3.

The descendants were investigated for some characteristics important in sunflower breeding. Biometric studies and biochemical characterization of seeds were carried out in F2 generation. For drought resistance were selected the plants with pubescent leaves. The BC2 – BC4 plants were also investigated for broomrape resistance with tests performed under artificial inoculation using broomrape seeds from two Romanian infested areas.

RESULTS AND DISCUSSIONS

The BC1F1 hybrids presented a large variability concerning morphological traits, such as leaf length, leaf weight, height of plants, branches, pubescences and size of head and seeds, (Photo 1 and 2).

Photo 1. *H. Agrophyllus* x LC 1029 B, (BC_1F_2), heights superior to the parents

Photo 2. *H. argophyllus* x LC 1088C, BC1F2, pubescent leaves

Leaf lengths of sunflower inbred ranged from 174 to 258 mm and average of 70 mm for wild species (*H. argophyllus*). In hybrid plants, high value was obtained in combination *H. argophyllus* x LC 1095 C (262 mm). The leaf width presented genotypic variability and ranged from 150 mm (LC 1095 C) to 238 (LC 1093 B) mm for sunflower inbreeds, 37 mm for *H. argophyllus*, and from 150 mm (LC 1095 C x *H. argophyllus*) to 246 mm (LC 1093B x *H. maximiliani*) for hybrid plants (Table 2). This last exemple shows a high hybrid value. This trait is determined by four dominant genes action [9].

Leaf area, like the above characters was variable according to the genotype (Table 2). In fact recent studies have detected common QTL for leaf area at flowering (LAF-P-12-1, LAF-W-12-1) in linkage group 12. Genomic regions on the linkage groups 9 and 12 are specific for QTLs of leaf-related traits in sunflower [3].

Table 2. Variability of parental lines and descendants (BC_1) for morphological aspect of leaves

Biological material	Leaf lenght (mm)	Leaf width (mm)	Leaf area (mm^2)
LC 1029 B	203	206	290
LC 991 B	210	232	335
LC 1093 B	258	238	422
LC 1085 C	246	207	355
LC 1095 C	174	150	179
LC 1088 C	195	156	208
L 1029 B x *H. argophyllus*	168	159	183
L 991 B x *H. argophyllus*	228	226	239
L 1093 B x *H. argophyllus*	224	207	318
L 1095 C x *H. argophyllus*	155	135	143
H. argophyllus x L 1029 B	225	193	131
H. argophyllus x L 991 B	198	150	205
H. argophyllus x L 1093 B	200	150	205
H. argophyllus x L 1085 C	216	177	264
H. argophyllus x L 1095 C	262	187	111
H. argophyllus x L 1088 C	226	192	198
H. argophyllus	70	78	37

Height of plants is an agronomic trait involved in plant productivity. It is polygenically controlled and low stem is controlled by recesive dwarfing genes, but all modes of inheritance for plant height were present in the F1 generation. Heterosis was most frequent, followed in decreasing order by partial dominance, dominance and intermediacy [8].

Our results show that sometimes the height of hybrids was superior to parental lines (Fig. 1). This suggests that wild parent dominated in genetic control of that trait over the cultivated one.

The hybrid plants (BC1, F1) had an intermediate value of weight of 1000 seeds (Fig. 2). This trait is inherited by incomplete dominance [3].

Head diameter is an important yield component. Several workers have suggested significant positive correlation between head diameter and seed yield and thus concluded that increased head diameter could lead to higher seed yield. One the other hand diameter of head is strongly influenced by environmental conditions [7]. Head diameter study releaved a wide range of values of this character. The cultivated sunflower parental lines had a head diameter between 100-120 mm. In comparison with those parental lines some descendants presented high values of this trait (higher 140 mm), (Fig. 3). The size of diameter is a polygenic character with strong additive effect [9].

The oil content is presented in Fig. 4. The average oil content of F2 seeds was very close to that of the maternal parent, indicating almost complete dominance of the maternal parent. This result is in agreement with those obtained in rape [1, 2].

The screening for broomrape resistance was performed in vegetation house with F and G broomrape race (Table 3).

Table 3. The broomrape resistance of descendants (BC4, F2, 2011)

	Frequency [(no. of infested sunflower plants/total no. of plants) x 100]	Intensity (no. of *Orobanche* plants/no. of infested sunflower plants)	Attack degree [(F x I) / 100] (%)
Control	100	23.0	23.0
Arg x 4C (NR)	66.7	5.7	3.8
Arg x 4C (DR)	100	10.0	10.0
Arg x 4C (D,I)	100	4.0	4.0
Arg x 6C (N)	100	4.0	4.0
Arg x 6C (D)	66.7	1.7	1.1
Arg x 5C (N)	100	36.0	36.0
Arg x 5C (D)	100	3.5	3.5
1B x Argo.	100	6	6
2 B x Argo.	100	13.5	13.5
4C x Argo.	66	3.3	2.2
3B x Argo.	33	0.3	0.1
5 C x Argo.	100	24	24
6C x Argo.	100	9	9

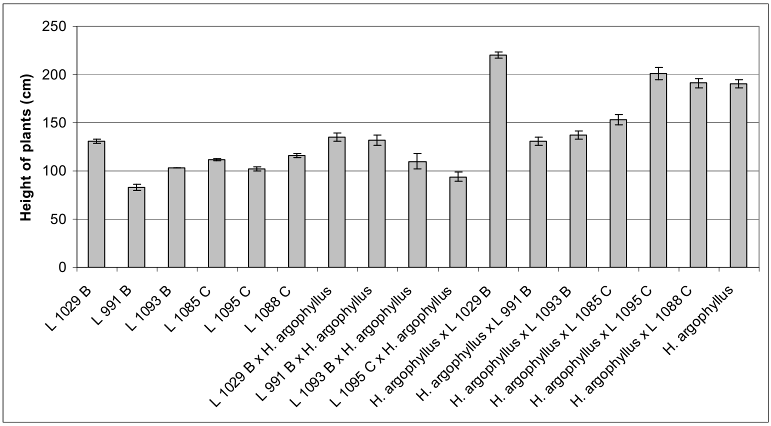

Fig. 1. Height of parental lines and descendants (BC1)

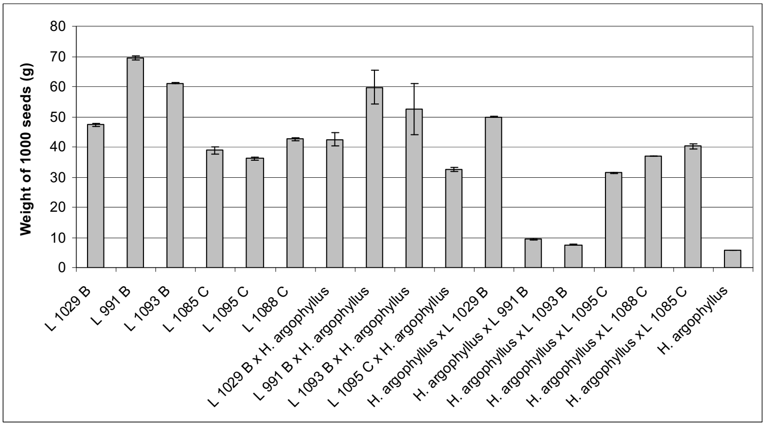

Fig. 2. Weight of 1000 seeds for parental line and obtained descendants (BC_1)

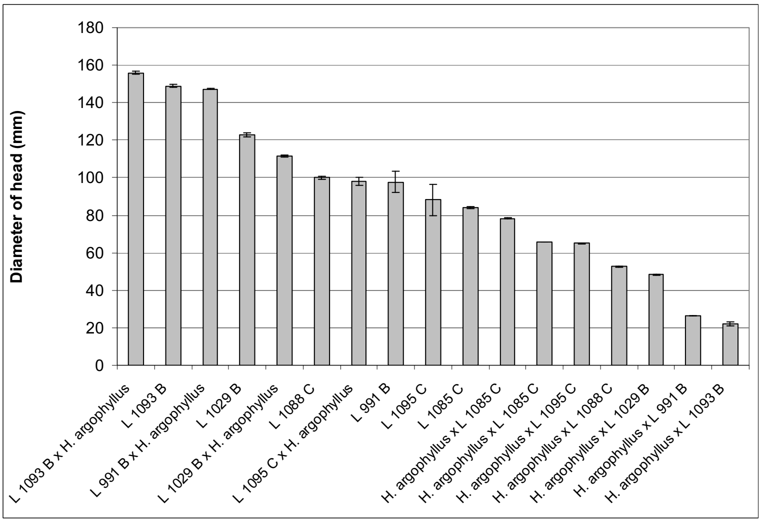

Fig. 3. Diameter of head for parental line and obtained descendants (BC_1)

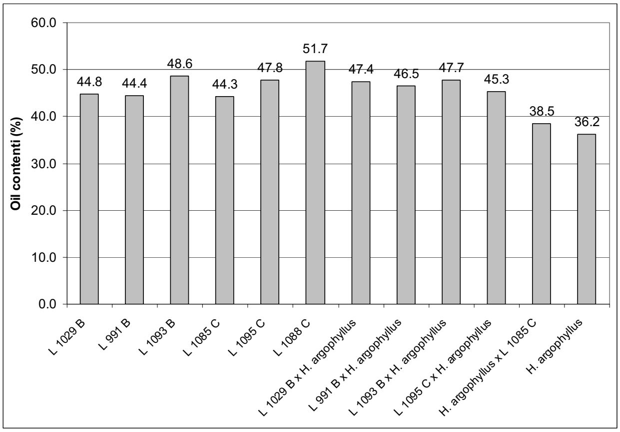

Fig. 4. The oil content in parental line and obtained descendants (BC_2, F_2)

The descendants which were presented the broomrape infestation smaller than control were self pollinated and those with high broomrape infestation (5C x Argo, Argo. X 5C (N) were pollinated with *Helianthus maximiliani*, other sunflower species known as resistant to broomrape infestation. Broomrape presents serious problems to sunflower production in Romania, as well. It is constantly expanding its distribution area, forming new more virulent races [6]. Although some authors indicate possibilities of chemical control of broomrape, though most studies show that genetic resistance is the most important method for controlling the parasite.

CONCLUSIONS

The wild specie *Helianthus argophyllus*, can be crossed as a female parent with *Helianthus annuus* and F1 hybrids were obtained by embryo rescue technique. When cultivated sunflower (*H. annuus*), which was crossed as a female parent with both wild species, the F1 hybrids obtained in this study were fertile and had a combination of morphological traits from both parents. The screening of descendants for pubescences and broomrape resistance was done and results indicated a good drought resistance and broomrape resistance for some of them. The descendants with good performances will be self pollinated in next generation because interspecific hybrids are important as donors for introgressing new favourable alleles into parental inbred lines.

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PRELIMINARY RESEARCH REGARDING *MONILINIA LAXA* (Aderhold & Ruhland) Honey ex Whetzel ATTACK IN PLUM TREE

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Abstract

The importance of fruit-tree growing is determined by the importance of fruit as food. However, in order to enjoy them, the fruit must be firstly protected against the various pathogen infections. The range of disease attack is highly variable each year, according to crop and area. From this point of view, this paper presents aspects regarding the Monilinia attack degree in plum tree. Monilia disease, brown rot of fruit or plum mummification, is a widespread disease of plum growing in all countries and may cause serious damage by destroying flowers and fruit. Fungus Monilinia laxa is a specific wound parasite that penetrates the tissues of the organs it attacks (fruit, branches, leaves) through various injuries caused by insects (Cydia funebrana) and hail, or open gates to other parasitic fungi (Stigmina carpophila). Research followed all the stages of the disease attack, as well as the occurrence of the first symptoms correlated with weather conditions, the evidence of the symptoms in plum tree, the data related to frequency (disease incidence), intensity (severity) and efficacy treatments with fungicides Dithane M-45 WP (80% mancozeb active ingredient), Topsin AL 70 WP (70% thiophanate methyl active ingredient), Merpan 80 WDG (80% captan active ingredient), Bravo 500 SC (500 g/l clorotalonil active ingredient), Alcupral 50 WP (50% cooper oxychloride active ingredient), Teldor 500 SC (500 g/l fenhexamid active ingredient) and Signum FG (26,7% boscalid + 6,7% piroclostrobin active ingredient) the pathogen Monilinia laxa, the varieties Anna Späth, d'Agen, Record, Stanley and Tuleu timpuriu. The study was developed during the proces of doctoral studies programme financed trough project POSDRU/107/1.5/S/76888.

Key words: *attack, disease, monilia, plum, fungicides.*

INTRODUCTION

The importance of fruit-tree growing is determined by the importance of fruit as food. However, in order to enjoy them, the fruit must be protected firstly against various pathogen infections [1].

The range of disease attack is highly variable each year, according to crop and area [4]. From this point of view, this paper presents aspects regarding the *Monilinia* attack degree in plum tree.

Monilia disease, brown rot of fruit or plum mummification is a widespread disease of plum growing in all countries and may cause serious damage by destroying flowers and fruit [2].

Fungus *Monilinia laxa* is a specific wound parasite that penetrates of the organs it attacks (fruit, branches, leaves) through various injuries caused by insects (*Cydia funebrana*) and hail, or open gates to the attack of other parasitic fungi (*Stigmina carpophila*) [5].

The results of this paper are the included in the topic of the personal of doctoral thesis.

MATERIAL AND METHOD

Visual observation is the fastest method to identify a disease based on signs and symptoms shown by infected plants. This method involves a high degree of subjectivity, depending largely on the diagnosing person's level of knowledge.

The scoring attack for *Monilinia laxa* has a particular importance for the plum tree in establishing the need for chemical treatments during the vegetation season.

The attack value is represented by frequency (F%), intensity (I%), attack degree (AD%) and loss (L%). Frequency is the percentage of fruit attacked out of 100 examined fruit. Attack intensity indicates the degree to which the fruit is attacked under examination. Intensity was noted directly in percentage. The attack degree referred to the severity of disease in the crop and was calculated using frequency and intensity.

Calculations included five fruit trees belonging to the same variety in each variant (with or without treatment). For accurate information, we noted the attack/tree in every third row of fruit trees. We observed the attack in the same tree on two levels by moving on the diagonal of the row, and we calculated the average.

Intensity was noted directly in percentage. The attack degree present severity of disease in the crop and was calculated using the frequency (disease incidence) and intensity (severity).

Damage or loss is the result of strong attack, resulting in crop losses valued by certain methods.

Transformation coefficient from degree attack to damage for *Monilinia laxa* was k=0.9.

We used a grading scale from 0-4: 0=absence of disease, 0%; 1=low attack, 1-25%; 2=low to medium attack, 26-50%; 3=medium to strong attack, 51-75% and 4=high attack, 76-100% [3].

The fungicides used were Dithane M-45 WP (80% mancozeb active ingredient), Topsin AL 70 WP (70% thiophanate methyl active ingredient), Merpan 80 WDG (80% captan active ingredient), Bravo 500 SC (500 g/l clorotalonil active ingredient), Alcupral 50 WP (50% cooper oxychloride active ingredient), Teldor 500 SC (500 g/l fenhexamid active ingredient) and Signum FG (26.7% boscalid + 6.7% piroclostrobin active ingredient) [6, 7].

The varieties used in this study were: Anna Späth, d'Agen, Record, Stanley and Tuleu timpuriu.

The experiments were established in a 10-year old years.

Research was conducted between 2010 and 2011.

Treatments were applied as follows: first, at the end of vegetation; second, white button phenophase treatment; the third, treatment when 10-15% of petals were shaken and the last treatment applied at the beginning of fruit ripeningt. Four treatments were applied in different variants (Table 1).

The results were statistically assured by using variance analysis.

RESULTS AND DISCUSSIONS

Successful management of *Monilinia laxa* involves a combination of health practices aimed to reduce the amount of initial inoculum and the judicious use of fungicides.

Table 1. Treatment options

No. treatment	Phenophase	Fungicides	Concentration (%)
1	end of vegetation	Alcupral 50 WP	0.4
2	white button	Dithane M-45 WP	0.2
		Merpan 80 WDG	0.15
		Bravo 500 SC	0.15
3	10-15% petals shaken	Bravo 500 SC	0.15
		Dithane M-45 WP	0.2
		Merpan 80 WDG	0.15
4	beginning of fruit ripeningt	Teldor 500 SC	0.08
		Topsin AL 70 WP	0.07
		Signum FG	0.05

Observations took place a week after the application of the last treatment for each plum tree variety.

Only the effect of chemical treatments in different combinations was highlighted as cultural hygiene measures imposed by technology were applied in all variants.

Climatically, 2010 was more favorable than 2011 for the attack of the pathogen *Monilinia laxa*.

It must be noted that the attack on the flowers, leaves and shoots in spring was insignificant in both years of research and all varieties under study.

Dangerous attack was reported in the fruit, as most of the fruit attacked fell while only few remained mummified in the tree crown.

Table 2 presents the variants as follows:

Variant 1 was without the application of fungicides.

Variant 2 of treatment consisted of application of fungicides: Dithane M-45 WP, Bravo 500 SC, Teldor 500 SC.

Variant 3 of treatment consisted of application of fungicides: Merpan 80 WDG, Dithane M-45 WP, Topsin AL 70 WP.

Variant 4 of treatment consisted of application of fungicides: Bravo 500 SC, Merpan 80 WDG, Signum FG.

Table 2. Response of plum varieties to the pathogen *Monilinia laxa*

Variety	**Variant**	**Medium attack**						**Loss** (%)		**Note**	
		Frequency (%)		Intensity (%)		Attack degree (%)					
		Year									
		2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Anna Späth	1	47	42	100	100	47	42	42.3	37.8	2	2
	2	7	4	100	100	7	4	6.3	3.6	1	1
	3	8	5	100	100	8	5	7.2	4.5	1	1
	4	3	1	100	100	3	1	2.7	0.9	1	1
d'Agen	1	48	39	100	100	48	39	43.2	35.1	2	2
	2	7	5	100	100	7	5	6.3	4.5	1	1
	3	8	6	100	100	8	6	7.2	5.4	1	1
	4	3	2	100	100	3	2	2.7	1.8	1	1
Record	1	36	28	100	100	36	28	32.4	25.2	2	2
	2	5	2	100	100	5	2	4.5	1.8	1	1
	3	5	3	100	100	5	3	4.5	2.7	1	1
	4	0	0	0	0	0	0	0	0	0	0
Stanley	1	71	55	100	100	71	55	63.9	49.5	3	3
	2	9	7	100	100	9	7	8.1	6.3	1	1
	3	10	6	100	100	10	6	9.0	5.4	1	1
	4	6	4	100	100	6	4	5.4	3.6	1	1
Tuleu timpuriu	1	45	35	100	100	45	35	40.5	31.5	2	2
	2	6	4	100	100	6	4	5.4	3.6	1	1
	3	7	4	100	100	7	4	6.3	3.6	1	1
	4	2	1	100	100	2	1	1.8	0.9	1	1
DL 5%						0.9	0.5				
DL 1%						1.3	0.7				
DL 0.1%						1.8	0.9				

The data presented in Table 2 show that the results on the behaviour of the plum tree varieties to the pathogen *Monilinia laxa* in both untreated variants (V1) and the variants treated with various fungicides (V2, V3 and V4) are statistically assured in a very significant manner.

It is noteworthy that there was no attack of *Monilinia laxa* in the variety Record during the two years of research in the variants treated with fungicides Bravo 500 SC (applied in phenophase white button), Merpan 80 WDG (applied in phenophase 10-15 petals shaken) and Signum FG (applied at the beginning of fruit ripeningt).

The varieties Anna Späth and d'Agen had a similar response to *Monilinia laxa* in 2010 in the variants treated with fungicides (3-8% attack degree). In 2011 the variety Anna Späth had a slightly lower attack degree (1-5%) than the variety d'Agen (2-6% attack degree).

The variety Stanley showed the highest attack degree of *Monilinia laxa* (55-71% attack degree) în the variant without treatment and 4-10% attack degree in the variants treated with fungicides).

The variety Tuleu timpuriu was very little attacked in the variants treated with fungicides (2-6% attack degree în 2010 and 1-4% attack degree în 2011).

In terms of scale scoring, all varieties showed a weak attack in the variants treated with fungicides, denoted by 1.

In the varieties Anna Späth, d'Agen, Record and Tuleu timpuriu, we found low to medium attack in the untreated variants.

The variety Stanley showed medium to strong attack in the untreated variants.

The increasing order of attack degree in the investigated plum varieties was thw following: Record (0-5% attack degree), Tuleu timpuriu

(1-7% attack degree), Anna Späth (1-8% attack degree), d'Agen (2-8% attack degree) and Stanley with an attack degree of 4-10% in all the variants treated with fungicides.

All the variants treated with fungicides were shown to be effective, compared with the untreated variant.

The effect of fungicide application was influenced by climatic conditions, as shall be demonstrated in a subsequent paper. The application of systemic fungicides in the ripe fruit phenophase played an important role in protecting the fruit when rainfall occurred until the harvest.

CONCLUSIONS

Monilia disease, brown rot of fruit or plum mummification, is a widespread disease of plum growing in all countries and may cause serious damage by destroying flowers and fruit.

The range of *Monilinia laxa* attack in plum tree is highly variable each year.

The variety Record showed the lowest attack degree of the pathogen *Monilinia laxa* both in the untreated variants and the variants treated with fungicides.

The highest attack degree of the pathogen *Monilinia laxa* was recorded in the variety Stanley (55-71% attack degree in the varieties with no treatment and 4-10% in the treated variants).

In all the variants treated with various fungicide combinations, the attack degree of the pathogen *Monilinia laxa* was much lower, compared with the untreated variants.

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CONSIDERATIONS ON ENERGETIC EFFECT TO CROP PRODUTION ON ERODED SOILS

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Abstract

At the current stage of the development of society, there is an increasing need for food, which favours the production in agriculture, the intensive use of agricultural techniques, increased norms of fertilizer, in order to avoid the deficit of nutritive elements and to decrease soil fertility. Soils with varying degrees of erosion are often employed in agricultural production; the share of highly eroded soils in the Republic of Moldova is of 114,000 ha (14.5%). Thus, with 1% increase of the agricultural production, the energy expenditure is increased by 2-3%. As a result, there appears the need to develop and implement energetic-economic, energetic-profitable and natural resource protection technologies in the agricultural production system. The solution of the identified difficulties consists in the initial awareness of the mutual relationship between the latter and the adaptation of the existing agricultural technologies to the contemporary ones, whose distinctive character consists in using information technologies in agriculture production. This involves quantitative assessment, management and optimization of energy flow in agro-ecosystems. As a result of scientific investigations carried out within the Institute of Pedology, Agrochemistry and Soil Protection "Nicolae Dimo", geo-information technologies were implemented in order to estimate the types of degradation and the energy analysis method in agriculture, so as to contribute to lower energy costs in agricultural production and to reduce the soil degradation process through erosion.

Key words: crop production, energetic effect, soil erosion.

INTRODUCTION

To develop a balanced ecological system on the performance agriculture, indispensable, the major value has analysis of agro ecological landscape capacity analysis and its potential biological structure. However, we must not forget that soil organic matter is one of the basic accumulators and natural resources of energy on Earth.

Based on the fact that environmental conditions have worsened, have been intensified degradation processes of fertility and soil quality, and appropriately reduced the productivity in agriculture. On the result, the energy and education status of their rational management are very current.

Results on the energy reserves of the organic matter of soil are found at many scientists [1, 3, 4], it is proved the global role of humus as a colossal geochemical accumulator, the main keeper the solar energy of the Tere's surface. The Total reserves of energy that link to the humus of the soil cover are equivalent or even to some extent prevail over its accumulating in the surface of the fitomass.

From the point of ecological and agronomical view at the same level of energy reserves of the humic substances is important and actual to estimate that part of the energy of soil organic matter that which can be mobilized on the processes of transformation and which participating in circulation of substance and energy, is used by living organisms for vital processes, appropriate, determine crop productivity, influence on soil processes and its fertility.

In the frame of developing modern technologies for precision farming and performance is required to estimates the natural potential and anthropogenic of soil resource, energy potential of soil organic matter as energy accumulator towards crop productivity of these soils.

An important condition for dealing with the ecological crisis is ecologisation of agriculture, managing the processes of reproduction of soil organic matter and its energetical potential.

MATERIAL AND METHOD

The researches were performed at experimental stations of soil science and soil erosion of Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo”, village Ursoaia, district Cahul, on slopes with an inclination of 4° - 6° and East and West exposition, with length of 400 m.
Based on ecological and economic situation were researched for cultivation of perennial grasses on highly eroded cernoziom. Mixture of perennial grasses was composed of *Bromus inermis Lezss* and *Onobrichis viciifolia Scop*.
Plant growth and development depends, as we know, the nutrient content in soil, and the rate of plant development, their ability to use soil nutrients for crop formation, depend on the requirements for fertilizer plant.
For these reasons, in the experience we used two groups of fertilizers: organic fertilizers, as manure (bovines) and chemical fertiliser (Ammophos, potassium sulphate and ammonium nitrate) the dose of 60 kg / ha of active substance for each primary element (NPK).
Determination of the energy potential of soil organic matter and energy content of the production of perennial irburi (dry grass) was determined using the method of calculating the structure and potential energy of organic matter of the soil from agricultural landscape [2].

RESULTS AND DISCUSSIONS

Assignment of land at high risk for erosion in the agricultural cycle requires careful attention to the development of crop rotation scheme and required to perform agricultural work in order to be mitigate maximal the degradation of soil quality and fertility.
At the begining of the experience to growing perennial grasses was found that the humus content was 2.1% decreasing during seven years after from weeding cultivation and cereal crops with 1.1%. All this took place, especially, result of washing the surface layer at the expense of rainfall.
Later growing perennial grasses increased the protection of soil till 80-90 %, contributed to reducing leakage from the solid surface and soil loss with 30 t/ha/an (Table 1).

Table 1. Amount and cost of washing soil by erosion to the cultivation of crops in strips and monoculture

Slope orientation, of sector	Tilling		Corn		Winter wheat		Pease		Perennial grasses		Culture system in strips	
	t/ha	lei/ha	t/ha	lei/ha	t/ha	lei/ha	t/ha	lei/ha	t/ha	lei/ha	t/ha	lei/ha
Vest I	33.6	2113	27.5	1732	6.7	422	13.1	826	1.0	64	12.8	791
Est II	25.8	2225	21.1	1822	5.1	443	10.0	858	0.8	67	12.1	1122
Vest III	51.7	4022	42.4	3298	10.3	804	17.8	1525	1.7	121	24.1	1793
Est IV	30.9	1887	24.6	1567	6.0	265	9.8	780	0.9	58	10.7	709

It is known that perennial grasses are well developed root system due to which they contribute to improved physical properties, physico-chemical and increasing organic matter content in soil profile.
In our experience the humus content in the unfertilized variant, increased from 2.1% till 2.5% during four years.
In variants where they applied fertilizers, organic matter content increased to 2.84-2.98 % (Table 2).
Soil organic matter has a wide range of tasks relating to the sustainable functioning of soil on the frame of natural ecosystems and agricultural.
Energy potential of their, determine the soil fertility and ecological status.
For characterize of the energy potential were selected following indicators: humus content (C), energy reserves of humic substances (Qh), energy potential of soil organic matter (Q), energy capacity of the soil (E) and energy content of the soil (Ec).
From Table 2 we can see that the cultivation of perennial grasses on highly eroded soil it positively affects the energy potential of soil. Both at the variants fertilized and unfertilized variant the energy potential is characterized, in 2000 year that it has the optimal values from 4633.7 GJ till 4787.6 GJ and it is an increase in the years of study that to the the year 2003 values to be from 5488.6 GJ till 6439.3 GJ. It

clear that variants where were applied organic fertilizers, even at one time to the begining of experience is characterized by higher values.

Table 2. Influence of perennial grasses and fertilizers on the structure of the energy potential of strongly eroded chernozem

Variant	Humus content, %	Energy potential of soil organic matter, **Q, GJ/ha**	Energy reserves of humic substances, **Qh, GJ/ha**	Energy capacity of the soil, **E, GJ/ha**	The energy content of the soil, **Ec, GJ/ha**
2000					
Witness	2.41	4633.7	4116.7	1372.2	1440.9
Manure 100 t/ha	2.43	4672.2	4150.9	1383.6	1452.8
Manure 200 t/ha	2.53	4864.5	4321.7	1440.6	1512.6
$N_{60}P_{60}$ annual	2.48	4768.4	4236.3	1412.1	1482.7
$N_{60}P_{60}K_{60}$ annual	2.49	4787.6	4253.4	1417.8	1488.7
2001					
Witness	2.49	5380.5	4253.4	1417.8	1630.5
Manure 100 t/ha	2.52	5445.4	4304.6	1434.9	1650.1
Manure 200 t/ha	2.58	5575.0	4407.1	1469.0	1689.4
$N_{60}P_{60}$ annual	2.52	5445.4	4304.6	1434.9	1650.1
$N_{60}P_{60}K_{60}$ annual	2.65	5726.3	4526.7	1508.9	1735.2
2002					
Witness	2.52	5445.4	4304.6	1434.9	1650.1
Manure 100 t/ha	2.56	5531.8	4373.0	1457.7	1676.3
Manure 200 t/ha	2.93	6331.3	5005.0	1668.3	1918.6
$N_{60}P_{60}$ annual	2.71	5855.9	4629.2	1543.1	1774.5
$N_{60}P_{60}K_{60}$ annual	2.78	6007.2	4748.8	1582.9	1820.4
2003					
Witness	2.54	5488.6	4338.8	1446.3	1663.2
Manure 100 t/ha	2.63	5683.0	4492.5	1497.5	1722.1
Manure 200 t/ha	2.98	6439.3	5090.4	1696.8	1951.3
$N_{60}P_{60}$ annual	2.78	6007.2	4748.8	1582.9	1820.4
$N_{60}P_{60}K_{60}$ annual	2.84	6136.8	4851.2	1617.1	1859.6

Energy reserve of the totality of humic substances comes as an indicator to confirm the role of perennial grasses and organic fertilizers to increase the energy value of soil. Just cultivation of perennial grasses led to increased energy reserve in the arable layer with 222.1 GJ after four years of development. The organic fertilizers and chemicals, both, increase the supply of energy values for humic substance in the middle with 120-200 GJ per year. Thus, for 2003 year they were for organic fertilizers 5090.4 GJ, and for those chemical 4851.2 GJ.

Graphical representation of the energy content of soil productivity and energy potential towards the perennial grasses can give us a clearer regarding lair results (Fig. 1, 2, 3, 4).

According to data obtained is noted that the energy potential of soil organic matter at the experimental field have a positive impact on productivity of perennial grasses.

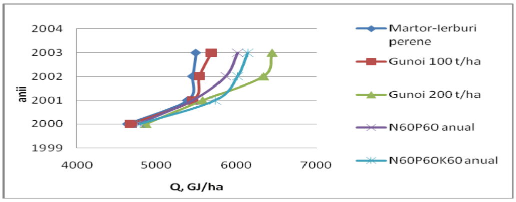

Fig. 1. Potential energy values of soil organic matter based fertilizers in the cultivation of perennial grasses

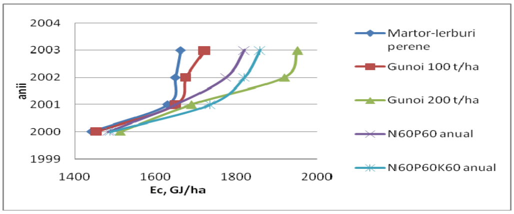

Fig. 2. Values of energy content of the soil according to fertilizers in the cultivation of perennial grasses

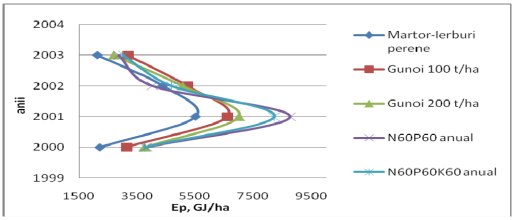

Fig. 3. Energy content in the production of perennial grasses (dry grass) according to fertilizer administered

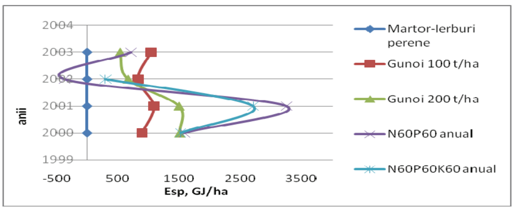

Fig.4. Energy content in addition to production of perennial grasses (dry grass) according to fertilizer administered

On variants where organic fertilizers were applied is obtained uniform yields for whole period of study. The most productively was be the 2001 year when, the harvest in energy units was 6606.6 GJ/ha, 7016.8 GJ/ha, and for variants with chemical fertilizers 8768.2 GJ/ha, 8226.4 GJ/ha. Addition harvest is also the highest this year, it being 1090.6 GJ/ha, 1500.8 GJ/ha and appropriate 3252.2 GJ/ha, 2710.4 GJ/ha.

CONCLUSIONS

Character and direction of orientation of flow of substances and energy in an ecosystem determines the formation of soil fertility, sustainability and the production of this.

Cultivation of perennial grasses on eroded soil ensures protection at 90%. The amount of washing soil is 0.9-1.7t/ha the cost of soil loss being 25-121 lei/ha;

To the perennial grasses cultivation the energy potential of soil organic matter increases with 100 GJ/ha/year;

Due to perennial grasses and fertilizers given, the energy capacity of the soil increases in average with 54 GJ/ha annual. The major effect of energy storage is observed for variants with organic fertilizers 200 t/ha and $N_{60}P_{60}K_{60}$;

Energy potential of soil organic matter ensure the addition to harvest perennial grasses (dry grass) calculated in energy units, equal to 1090.6 – 3252.2 GJ/ha/year.

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THE BEHAVIOR OF SOME NEW CORN HYBRIDS, CULTIVATED IN BRAILA COUNTY

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Abstract

This paper deals with the behaviour of 35 corn hybrids in 2010 crop, hybrids created by ISTA (Instituto Sementi e Technologie Agro-alimentari) Italy, hybrids which were cultivated for the first time in Braila county. Out of these hybrids, 22 belong to FAO 300-400 group, 11 hybrids belong to FAO 400-500 group and 2 hybrids belong to FAO 500 group. The results obtained were compared with the ones of the aboriginal hybrid, Olt, considered as control hybrid. The experiment was performed in Albina village, Braila county, on a typical chernozem soil with physical and chemical characteristics which are favourable to the growth and development of corn plants, area which is characterized by a semi-draughty steppe climate, the main limitative factor being the water. Each hybrid was sowed in two repetitions, the second one being placed randomisedly, the length of a repetition plot being 12 m, thus it results an area of 8.4 m^2 for each repetition and an area of 588 m^2 for the entire allotment. For the hybrids analyzed and the control hybrid, there are determined productivity elements (number of corn grains/cob, average weight of the corncobs, weight of the corn grains/cob), the yielding, hectolitre mass (MH), the mass of 1000 grains (MMB) and finally, the productions obtained, all these being expressed at 15% humidity. The production of the control hybrid was 0.86 kg/m^2, and this production was outrun by 6 hybrids: PR36B08 (0.87 kg/m^2), RM10-IVS-3 (0.92 kg/m^2), RM10-IVS-7 (0.90 kg/m^2), RM10-IVS-9 (0.90 kg/m^2), ISH 303 (0.89 kg/m^2), ISH 508 (0.91 kg/m^2). Based on the results presented, it can be concluded that out of the hybrids analyzed, best behaved the following hybrids from class FAO 300-400: RM10-IVS-3, RM10-IVS-9, PR36B08, RM10-IVS-7, ISH303, from class FAO 400-500, best behaved the following hybrids: RM10-IVS-21, RM10-IVS-22 and from class FAO 500, ISH 508 hybrid.

Keywords: *phenophase, corncob, yielding, production, productivity elements.*

INTRODUCTION

Corn occupies third place between plants cultivated in the world, in what concerns the area, following to wheat and rice and the second place in what concerns the productivity, following to wheat. The area cultivated with corn at world level in 2010 was 161.90 mil ha with an average production of 5215 kg/ha. In Europe, the area cultivated with corn also in 2010 was 14.11 mil ha, with an average production of 6064 kg/ha.

In the European Union, Romania occupies first place in what concerns the area cultivated with corn, holding almost 30% from total area of 8.6 million hectares.

In our country, the area cultivated with corn in 2010 was 2.09 mil ha, with an average production of 4317 kg/ha.

MATERIAL AND METHOD

The experience was placed within the range of Albina locality, Brăila county, on a typical chernozem type of soil, with physical and chemical characteristics which are favourable to the growth and development of corn plants, area which is characterized by a semi-draughty steppe climate, the main limitative factor being the water.

Selecting corn hybrids could be an important instrument in weeds management for corn farmers [1].

The preliminary plant was autumn wheat, plant considered as being a good precedential for corn crop. This rotation wheat-corn is quite frequent, taking into consideration that these crops are basic crops in crops' structure.

The rotations that involve also green crops are much more persistent as compared with the actual rotations on a short time [5].

The preparation of the seedbed was done by using the disk harrow, followed by working with the perpendicular combiner on the direction of seeding, during the day previous to the seeding day.

The seeding was performed in equidistant rows, at the distance of 70 cm between rows and 18 cm between grains on a row, resulting a density of 7.8 germinabile seeds/m², at the depth of 7 cm.

The seeding was done during the optimum period, on 15.04.2010. At the same time with the seeding, there were applied also complex dressings, with the ratio 18:46:0 in dosage of 120 kg/ha.

The optimum density of the plants for the maximum corn production per area unit is different from one corn hybrid to another, following to the interactions between the hybrid and different densities [2].

The springing occurred between 29–30 April, the average density at springing being 6.5-7 plants/m².

Each hybrid was sowed in two repetitions, the second repetition being placed randomisedly, the length of a repetition plot being 12 m, thus it results an area of 8.4 m^2 for each repetition and an area of 588 m^2 for the entire allotment.

The average density at harvest was 5 plants/m². The harvesting was done on 9^{th} September 2010.

The delays at harvesting should be avoided, especially when there are used hybrids with low resistance at dropping [3].

The production potential can be increased through extending the period of blooming and of physiological maturity, maintaining constant the vegetation period by complete interception of the radiations in the blooming period [4].

For the hybrids analysed and the control hybrid (Olt), there are determined productivity elements (number of corn grains/cob, corncobs, weight of the corn grains/cob), the yielding, hectolitre mass (MH), the mass of 1000 grains (MMB) and finally, the productions obtained, all these being expressed at 15% humidity.

RESULTS AND DISCUSSIONS

The behaviour of the hybrids analysed was appreciated based on the results obtained at the determinations performed on the productivity elements and quality indices. The hybrids analysed are part of different FAO groups, as it is presented in table 1.

Table 1. The hybrids analysed, with their classification in FAO groups

No.	Hybrid	FAO Class	No.	Hybrid	FAO Class
1	PR36B08	300-400	19	RM10-IVS-17	300-400
2	RM 10-IVS-1	300-400	20	RM10-IVS-18	300-400
3	RM10-IVS-2	300-400	21	RM10-IVS-19	300-400
4	RM10-IVS-3	300-400	22	ISH404	300-400
5	RM10-IVS-4	300-400	23	RM10-IVS-20	400-500
6	RM10-IVS-5	300-400	24	RM10-IVS-21	400-500
7	RM10-IVS-6	300-400	25	RM10-IVS-22	400-500
8	RM10-IVS-7	300-400	26	RM10-IVS-23	400-500
9	RM10-IVS-8	300-400	27	ISH403	400-500
10	RM10-IVS-9	300-400	28	RM10-IVS-24	400-500
11	RM10-IVS-10	300-400	29	RM10-IVS-25	400-500
12	ISH303	300-400	30	RM10-IVS-26	400-500
13	RM10-IVS-11	300-400	31	RM10-IVS-27	400-500
14	RM10-IVS-12	300-400	32	RM10-IVS-28	400-500
15	RM10-IVS-13	300-400	33	SHOP4	400-500
16	RM10-IVS-14	300-400	34	ISH507	500
17	RM10-IVS-15	300-400	35	ISH508	500
18	RM10-IVS-16	300-400	36	OLT - control	400-500

The results obtained regarding the number of grains and the number of grains per cob at the hybrids analysed are presented in Figure 1 and 2.

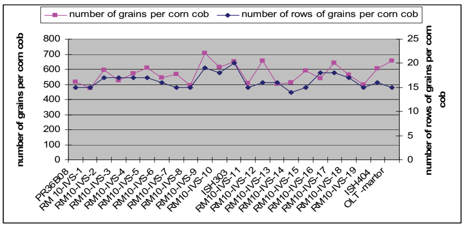

Fig. 1. The results on the number of grains and number of rows per cob hybrids from FAO 300-400 group analysed

The number of grains per cob was the smallest for *RM10-IVS-23* hybrid (392 grains), between 400-500 grains for 3 hybrids: *RM10-IVS-1, RM10-IVS-8, RM10-IVS-19*, between 500-600 grains for 18 hybrids: *RM10-IVS-13, RM10-IVS-11, RM10-IVS-14, PR36B08, RM10-IVS-3, RM10-IVS-16, RM10-IVS-6, RM10-IVS-21, RM10-IVS-18, RM10-IVS-26, RM10-IVS-7, RM10-IVS-4, RM10-IVS-24, RM10-IVS-27, RM10-IVS-15, ISH403, RM10-IVS-2, ISH507,* between 600-700 grains for 11 hybrids: *ISH404, RM10-IVS-5, RM10-IVS-10, RM10-IVS-28, RM10-IVS-17, RM10-IVS-25, RM10-IVS-20, SHOP4, ISH303, RM10-IVS-12, RM10-IVS-22* and over 700 grains per cob for 2 hybrids: *RM10-IVS-9* and *ISH508.*

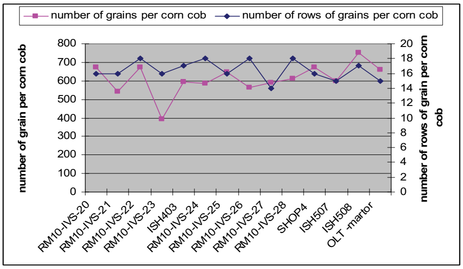

Fig. 2. The results on the number of grains per cob and number of rows in groups to analyze FAO 400-500 and 500 hybrids

As compared with the control sample, it is observed that it was outrun by 3 hybrids: RM10-IVS-25, RM10-IVS-20 from FAO 400-500 group and ISH508 from FAO 500 group.

Average number of grains rows per cob was 14 for 2 hybrids, 15 for 9 hybrids, 16 for 8 hybrids, 17 for 7 hybrids, 18 for 7 hybrids, 19 for one hybrid and 20 for one hybrid, it results that for most of hybrids, the number of grains rows per cob was between 15-18.

For the hybrids analysed, it was established the average weight of the cobs and the average weight of the grains per cob, the results being represented graphically in figures 3 and 4. The weight of the grains per cob varied within quite large limits, between 92.49 – 221.57 g. There were distinguished ISH508 (190.79 g) and SHOP4 (221.57 g) hybrids. For any of the hybrids, the grains' weight did not exceed Olt control hybrid grains' weight (230.52 g), PR36B08 168.79 g). Out of FAO 300-400 class, there were distinguished RM10-IVS-3 (170.34 g) and PR36B08 (168.79 g) hybrids.

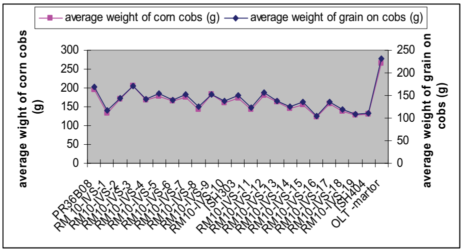

Fig. 3. The results of the average weight of cobs and grains hybrids from FAO 300-400 group analysed

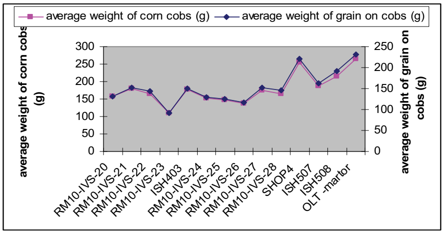

Fig. 4. The results of the average weight of cobs and grains hybrids from FAO 400-500 and 500 groups analysed

Out of FAO 400-500 class, it was distinguished SHOP4 (221.57 g) hybrid, and out of FAO 500 class, it was distinguished ISH508 (190.79 g) hybrid.

In the figures 5 and 6, there are represented the results obtained regarding the mass of 1000 grains (MMB) and grains production in t/ha at 15% humidity for the hybrids analyzed.

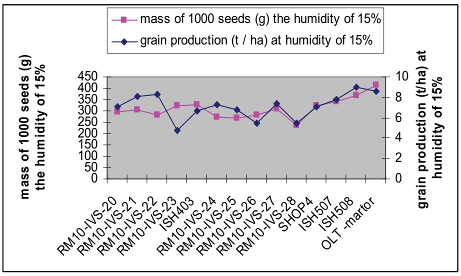

Fig. 5. Mass of 1000 seeds and productions obtained hybrids from FAO 300-400 group analysed

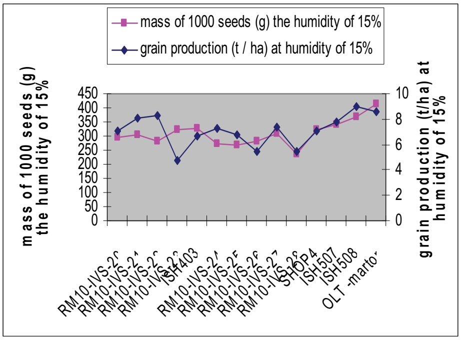

Fig. 6. Mass of 1000 seeds and productions obtained for the hybrids from FAO 400-500 and 500 groups analysed

The production of control hybrid was 8.56 t/ha, and this production was outrun by 6 hybrids: PR36B08 (a plus of 0.1 t/ha), RM10-IVS-3 (a plus of 0.63 t/ha), RM10-IVS-7 (a plus of 0.41 t/ha), RM10-IVS-9 (a plus of 0.48 t/ha), ISH 303 (a plus of 0.36 t/ha), ISH 508 (a plus of 0.47 t/ha).

The mass of 1000 grains (MMB) varied between 238.03-368.72 g; it should be mentioned that for any of the hybrids analysed, the MMB did not exceed the MMB achieved by the control hybrid (414.68 g). MMB had values bellow 300 g for the majority of the hybrids, as follows: RM10-IVS-28, RM10-IVS-16, ISH404, RM10-IVS-25, RM10-IVS-24, RM10-IVS-22, RM10-IVS-18, RM10-IVS-19, RM10-IVS-15, RM10-IVS-10, RM 10-IVS-1, RM10-IVS-2, RM10-IVS-3, RM10-IVS-4, RM10-IVS-5, ISH303, RM10-IVS-11, RM10-IVS-17, RM10-IVS-20, RM10-IVS-26 and values of over 300 g for the hybrids: PR36B08, RM10-IVS-6, RM10-IVS-7, RM10-IVS-8, RM10-IVS-9, RM10-IVS-12, RM10-IVS-13, RM10-IVS-21, RM10-IVS-14, RM10-IVS-23, ISH403, RM10-IVS-27, SHOP4, ISH507, ISH508.

In what concerns the production obtained, it varied within quite large limits, between 4.7-9.1 t/ha, productions bellow 5.0 t/ha were obtained for one single hybrid RM10-IVS-23; productions between 5.0-6.0 t/ha were obtained for 5 hybrids: RM10-IVS-8, RM10-IVS-16, RM10-IVS-19, RM10-IVS-26, RM10-IVS-28; productions between 6.0-7.0 t/ha were obtained for 5 hybrids: RM10-IVS-1, RM10-IVS-18, ISH404, ISH403, RM10-IVS-25, productions between 7.0-8.0 t/ha were obtained for 10 hybrids: RM10-IVS-5, RM10-IVS-10, RM10-IVS-11, RM10-IVS-14, RM10-IVS-20, RM10-IVS-24, RM10-IVS-27, SHOP4, ISH507, RM10-IVS-15, productions between 8.0-9.0 t/ha were obtained for 11 hybrids: PR36B08, RM10-IVS-2, RM10-IVS-4, RM10-IVS-6, ISH303, RM10-IVS-12, RM10-IVS-13, RM10-IVS-17, RM10-IVS-7, RM10-IVS-21, RM10-IVS-22 and productions over 9.0 t/ha were obtained for 3 hybrids: RM10-IVS-9, ISH508, RM10-IVS-3.

In figures 7 and 8, there are presented the results obtained regarding the ratio per cob and hectolitre mass for the hybrids analysed.

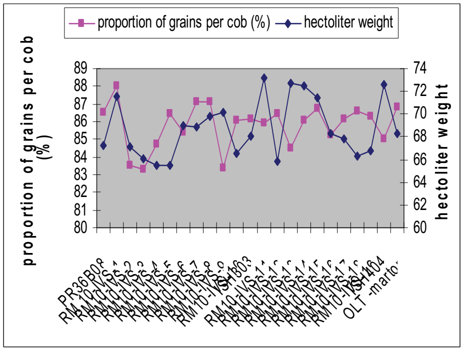

Fig. 7. The ratio of grains per cob and hectolitre mass for the hybrids from FAO 300-400 group analysed

The yield had values that varied between the limits 83.33-88.46%, a yield bellow 85% was obtained for 10 hybrids: RM10-IVS-3, RM10-IVS-9, RM10-IVS-2, RM10-IVS-20, RM10-IVS-23, RM10-IVS-21, RM10-IVS-24, RM10-IVS-13, RM10-IVS-4, ISH404, between 85.0-86.0% for 6 hybrids: RM10-IVS-16, ISH403, RM10-IVS-25, RM10-IVS-26, RM10-IVS-11, RM10-IVS-6, between 86.0-87.0% for 13 hybrids: PR36B08, RM10-IVS-5, RM10-IVS-10, ISH303, RM10-IVS-14, RM10-IVS-12, RM10-IVS-15, RM10-IVS-17, RM10-IVS-18, RM10-IVS-19, RM10-IVS-22, RM10-IVS-27, ISH507, between 87.0-88.0% for 4 hybrids: RM10-IVS-7, RM10-IVS-8, RM10-IVS-28, SHOP4, over 88% for 2 hybrids: RM10-IVS-1, ISH508.

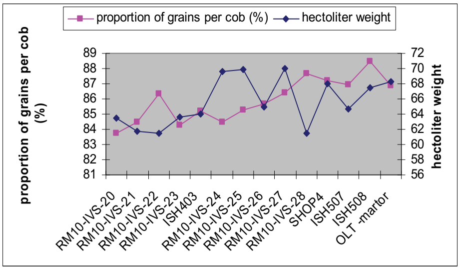

Fig. 8. The ratio of grains per cob and hectolitre weight group for the hybrids analyzed, FAO 400-500 and 500

Higher values of the yield as against the control hybrid (86.94%) were obtained for the hybrids: RM 10-IVS-1 (88.05%), RM10-IVS-7 (87.09%), RM10-IVS-8 (87.09%), RM10-IVS-28 (87.67%), SHOP4 (87.17%), ISH507 (86.96%), ISH508 (88.46%).

It was calculated Pearson correlation coefficient between yield and the diameter of the corn cob, the values obtained being -0.481 in case of the hybrids from FAO 300-400 group and -0.492 in case of the hybrids from FAO 400-500 and 500 groups; the values obtained show that for the tardy hybrids, the yield is more strongly negatively influenced by the diameter of the corn cob. The correlations between yield and corn cob's diameter are graphically represented in the figures 9 and 10.

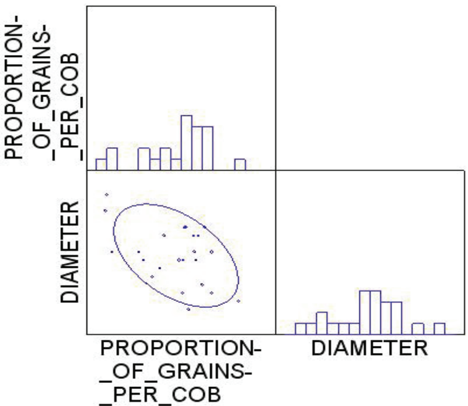

Fig. 9. The correlation between yield and corn cob's diameter for the hybrids from FAO 300-400 group

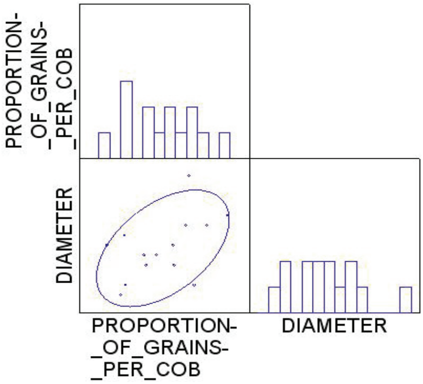

Fig. 10. The correlation between yield and corn cob's diameter for the hybrids from FAO 400-500 and 500 groups

It was calculated Pearson correlation coefficient between the mass of 1000 grains and the production obtained, the values obtained being 0.313 in case of hybrids from FAO 300-400 group and 0.527 for the hybrids from FAO 400-500 and 500 groups; the values obtained show that between those two variables there is a positive correlation, a correlation higher in case of more tardy hybrids.

The graphic representation of the correlation between those two variables is given in figures 11 and 12.

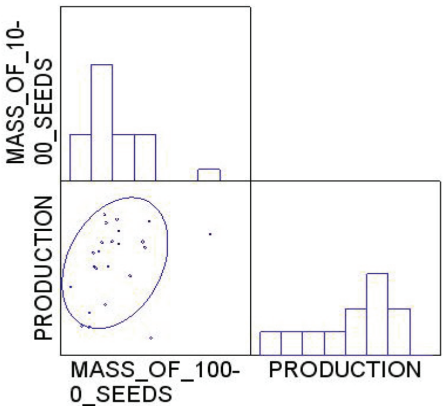

Fig. 11. The correlation between the mass of 1000 grains and the production for the hybrids from FAO 300-400 group

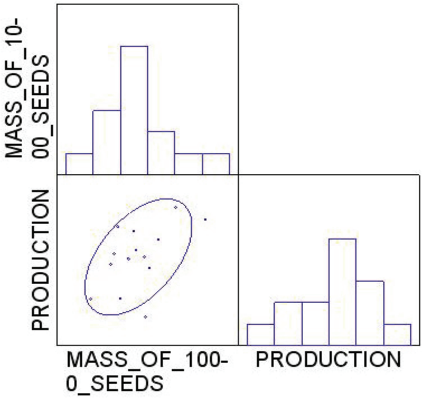

Fig. 12. The correlation between the mass of 1000 grains and the production for the hybrids from FAO 400-500 and 500 group

CONCLUSIONS

Based on the results presented, it can be concluded that out of the hybrids analyzed, best behaved the following hybrids from class FAO 300-400: RM10-IVS-3, RM10-IVS-9, PR36B08, RM10-IVS-7, ISH303, from class FAO 400-500, best behaved the following hybrids: RM10-IVS-21, RM10-IVS-22 and from class FAO 500, best behaved ISH 508 hybrid.

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RESEARCH ON THE DYNAMICS OF THE PRODUCTIVITY COMPONENTS IN *DACTYLIS GLOMERATA* L., UNDER THE CONDITIONS OF THE ROMANIAN PLAIN

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Abstract

Cocksfoot (Dactylis glomerata L.) is one of the most important species of perennial grass, with the highest frequency in the floristic composition of temporary grasslands. Its widespread occurrence as forage crop is due to the high productivity, great vivacity, ecological plasticity and various possibilities of use. The research conducted at Moara Domnească Experimental Farm between 2009 and 2011 concerned two varieties of cocksfoot, Regent and Ambassador and two types of culture, i.e pure culture and a mixture with alfalfa (Medicago sativa L.). Our research studied the elements that contributed to the cocksfoot yield, i.e. the leaf area index (LAI), the leaf area ratio (LAR), the specific leaf area (SLA), the leaf weight ratio (LWR) and the speed growth indices (net assimilation rate - NAR, crop growth rate – CGR and relative growth rate - RGR). During the experiments (2009-2011), on average, at the first cycle of harvest, both varieties of cocksfoot showed higher specific leaf area values between 11.99 and 22.55 $m^2.kg^{-1}$ at Regent variety and between 12.66 and 24.62 $m^2.kg^{-1}$ at Ambassador variety. The highest growth speed of cocksfoot plant was registered at the first harvest cycle, i.e 8.35 $g.m^{-2}.day^{-1}$ at Regent variety and 10.22 $g.m^{-2}.day^{-1}$ at Ambassador variety.

Key words: *dactylis glomerata*, *leaf area index*, *leaf surface, growth speed, yield.*

INTRODUCTION

Dactylis glomerata is a species native to Central and Western Europe, but it has been cultivated in Nord America for over 200 years [2]. Cocksfoot is one of the most common forage plants, found in the spontaneous flora of Europe, North America and the temperate zone of Asia and United States of America. In our country, this species has the largest ecological plasticity. It is widespread in areas of alfalfa crop, being the main partner in the mixture with the alfalfa crop [3].
Research conducted in our country has shown that *Dactylis glomerata* species adapts quite well to the conditions of the Romanian Plain, achieving high and stable production both as irrigation and irrigated culture [4].
The crop yield, in meaning of useful or economic production, and its quality is a result of the interaction between genetic characteristics of species and varieties, cultural factors and the changes that they suffer under the influence of cultural techniques applied [1].
Dactylis glomerata is one of the most productive perennial grasses of temperate regions, achieving annual yields between 15 and 20 $t.ha^{-1}$ DM. Also, this species conserve the great production potential regardless of the use system and compared with other species of perennial grasses, it remains productive both poor and unfertilized soils [5].

MATERIAL AND METHOD

For the dynamics knowledge of the elements that contribute to the yield, an experiment was organized at the Experimental Farm Moara Domnească with *Dactylis glomerata* in pure crop and mixed with 30% *Medicago sativa*, on a preluvosol soil.
The experiment used two varieties of *Dactylis glomerata* (Regent and Ambassador) in pure culture and mixed with variety of *Medicago sativa* La bella Campagnola. A uniform fertilization was achieved with 50 P_2O_5 and 100 N.

Climatic characteristics of the experimental area are the following: rainfall of 556.1 mm and an average annual temperature of 10.5 ^{0}C.

The experimental years (2009-2011) were characterized by deficient rainfall on the growing season and annual average temperatures higher than the multiannual average.

Usually, in these years has been a significant rainfall deficit in April and May, i.e in the period of the first harvest formation at perennial grasses, and in August and September at the third harvest.

The important yield elements of the *Dactylis glomerata* species, determined as dynamics on growing period were:

LAI – leaf area index (m^2 leaves/m^2 soil), through direct measurements = Density x Foliar area;

LAR – leaf area ratio ($m^2.kg^{-1}$) = LAI/ Dry Matter Production (DM) ($kg.m^{-2}$);

SLA – specific leaf area ($m^2.kg^{-1}$) = LAI / Dry Matter production of leaves (kg $DM.m^{-2}$);

LWR – leaf weight ratio (%) = Leaves mass x 100/ Dry Matter Production;

NAR – net assimilation rate ($g.m^{-2}$leave.day^{-1}) = Increase in dry matter production in a period (g $DM.m^{-2}$)/ Growth days x LAI;

CGR – Crop growth rate – (g m^{-2} soil.day^{-1}) = LAI x NAR;

RGR – Relative growth rate ($g.kg^{-1}.day^{-1}$) = LAR x NAR.

To interpret the results, there was performed statistical analysis of production data, and also the quantitative analysis of growth (after Amezaine, Hassan T., [1]) to determine the yield elements.

Every year, at the first harvest cycle, the determination was performed during apex -10 cm, and the last at early flouring. The following cycles, the determinations were made every 20 days until harvest.

RESULTS AND DISCUSSIONS

The dynamics of the yield elements in *Dactylis glomerata* are synthesized for the period 2009-2011 in Table 1.

The dynamics of the yield components, during the three experimental years, shows that, at the first cycle of harvest, the leaf area index (LAI), the leaf area ratio (LAR) and the specific leaf area (SLA) and the leaf weight ratio (LWR) registered significant increases as the vegetation grew.

At the other cycles, the values of the same yield elements decreased as the plants grew because of a lower share in the total production of dry matter.

Average values of leaf area index at the first cycle of harvest were between 1.2 and 3.7 at the variety of cocksfoot Regent and 1.3 -4.9 at Ambassador variety, the highest values were obtained in the heading phase of plants.

On average, during the experimental period, at the first cycle of harvest, the cocksfoot varieties showed a high specific leaf area, especially during the heading, namely 22.55 $m^2.kg^{-1}$ at Regent variety and 24.62 $m^2.kg^{-1}$ at Ambassador variety (Table 1).

At the beginning of the vegetation leaves represented 75-76% from total mass of plants, and with the increasing in vegetation, when the cocksfoot plants were in the heading phase, the leaves ratio decreased detrimental with strains representing 48-51%.

The absolute rate of growth for the cocksfoot plants showed maximum values between 8 to 13 of May in both varieties tested, when the plants were in the heading phase, namely 8.35 $g.m^{-2}.day^{-1}$ at Regent variety and 10.22 $g.m^{-2}.day^{-1}$ at Ambassador variety.

Correlations between the yield elements

Calculating the correlations between the main elements of yield during the experimental period led to the following results:

a) Between the leaf area index and the leaf area, in relation to total production of dry matter or to the total production of dry matter obtained only by leaves there are significant positive correlations (Fig. 1 and 2).

b)The determination coefficients had different values in the variety of *Dactylis glomerata*, respectively from 0.840 to 0.916 on Regent variety and from 0.893 to 0.988 on Ambassador variety.

Table 1. Productivity components at *Dactylis glomerata* in pure crop, first cycle of harvest, Moara Domnească 2009-2011

Year / Productivity components	Variety	2009		2010		2011		Average	
		Apex-10 cm	Heading	Apex-10 cm	Heading	Apex-10 cm	Heading	Apex-10 cm	Heading
LAI ($m^2.m^{-2}$)	Regent	1.60	7.20	0.90	1.70	1.00	2.10	1.20	3.70
	Ambassador	1.70	9.5	1.00	3.30	1.20	1.80	1.30	4.90
LAR ($m^2.kg^{-1}$)	Regent	12.31	21.18	6.43	7.17	7.69	6.56	8.81	11.64
	Ambassador	11.33	25.60	7.62	10.90	10.00	514	9.65	13.91
SLA ($m^2.kg^{-1}$)	Regent	17.78	34.29	8.18	17.20	10.00	16.15	11.99	22.55
	Ambassador	15.45	39.58	9.90	20.44	12.63	13.85	12.66	24.62
LWR (%)	Regent	69.00	62.00	79.00	42.00	77.00	41.00	75.00	48.00
	Ambassador	73.00	65.00	77.00	53.00	79.00	37.00	76.00	52.00
NAR $g.m^{-2}$ leave.day^{-1}	Regent	1.63	1.46	3.16	2.94	2.77	4.52	2.52	2.97
	Ambassador	1.76	1,16	2.60	2.65	2.14	6.11	2.17	3.31
CGR ($g.m^{-2}.day^{-1}$)	Regent	2.60	10,50	2.84	5.06	2.77	9.50	2.74	8.35
	Ambassador	3.00	11.00	2.57	8.67	2.57	11.00	2.72	10.22
RGR ($g.kg^{-1}.day^{-1}$)	Regent	20.00	30.88	20.29	21.08	21.28	29.69	20.52	27.22
	Ambassador	20.00	29.73	19.80	28.90	21.43	31.43	20.41	30.02

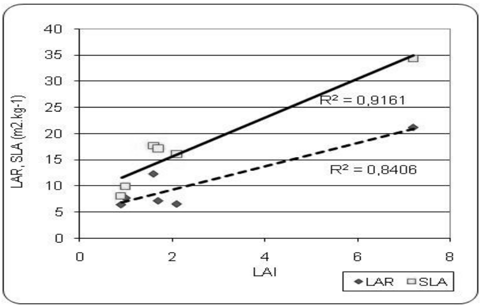

Fig. 1. Correlation between foliar elements on *Dactylis glomerata*, Regent variety, first cycle of harvest, Moara Domnească 2009-2011

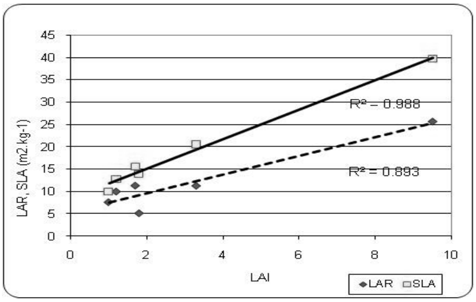

Fig. 2. Correlation between foliar elements on *Dactylis glomerata*, Ambassador variety, first cycle of harvest, Moara Domnească 2009-2011

b) The speed growth indices (net assimilation rate, crop growth rate and relative growth rate) positively correlate with the vegetation stages. The most significant correlation was between the leaf area index and the crop growth rate, determination coefficient being of 0.589 for the variety Regent and 0.416 for the Ambassador variety (Fig. 3, 4).

Correlation between the yield elements and the yield

The most significant correlation with the yield was identified for the leaf area. During the experiments, positive correlations were noticed between the leaf area index and the yield on both varieties of cocksfoot. The dry matter yield was determined by the leaf area index as follows: 54% at the variety of

Cocksfoot Regent and 44% at the Ambassador variety (Fig. 5, 6).

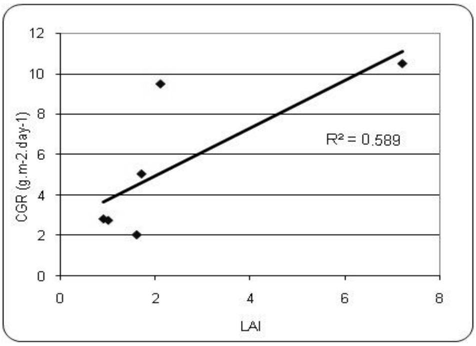

Fig. 3. Leaf area index influence on crop growth rate on *Dactylis glomerata*, variety Regent, first cycle of harvest, Moara Domnească 2009-2011

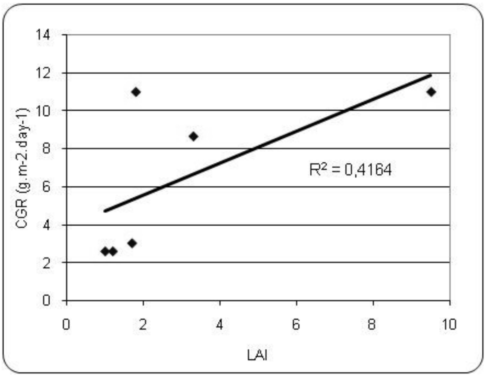

Fig. 4. Leaf area index influence on crop growth rate on *Dactylis glomerata*, variety Ambassador, first cycle of harvest, Moara Domnească 2009-2011

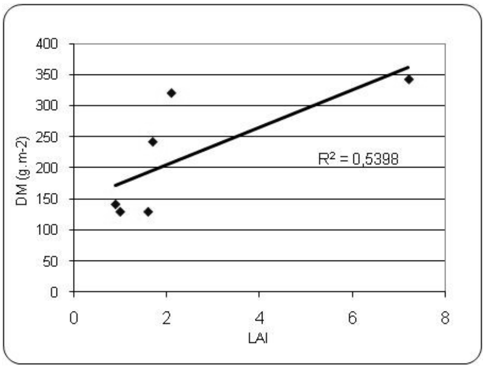

Fig. 5. The relationship between LAI and the yield in *Dactylis glomerata* variety Regent, first cycle of harvest, Moara Domnească 2009-2011

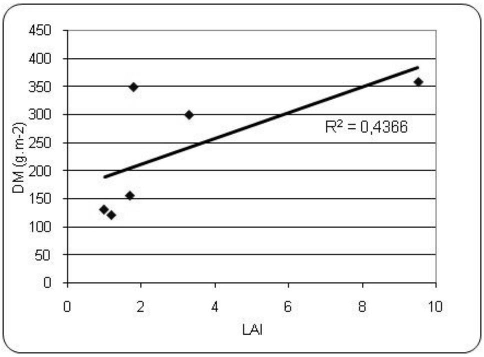

Fig. 6. The relationship between LAI and the yield in *Dactylis glomerata* variety Ambassador, first cycle of harvest, Moara Domnească 2009-2011

Dry mater production

The total dry matter yield produced by the *Dactylis glomerata* species in the three years of experiments, both in pure culture and mixed with *Medicago sativa*, was quite high for the conditions of the Romanian Plain.

In the mixed variants with *Medicago sativa,* the dry matter production was higher than in pure crop.

In pure culture, the dry matter yield ranged from 5.46 to 7.72 $t.ha^{-1}$ DM at the Regent cocksfoot variety and from 5.39 to 8.26 $t.ha^{-1}$ DM at the Ambassador variety (Table 2).

Mixed with *Medicago sativa*, the dry matter yield ranged between 5.85 and 8.90 $t.ha^{-1}$ DM at the Regent variety and between 5.82 and 8.31 $t.ha^{-1}$ DM at the Ambassador variety.

Table 2. Total dry matter production, Moara Domnească 2009-2011

Year	Crop type			
	Pure crop		Mixture with *Medicago sativa*	
	Regent	Ambassador	Regent	Ambassador
2009	7.72	8.26	8.90	8.31
2010	5.50	5.39	5.85	5.82
2011	5.46	5.83	6.17	5.96
Media	**6.23**	**6.49**	**6.97**	**6.70**

In the climate of the Experimental Farm Moara Domnească, during the period 2009-2011, the two experimental cooksfoot varieties do not differ significantly in terms of dry matter production from their average or each other (Table 3).

Table 3. Influence of the *Dactylis glomerata* variety on dry matter production (2009-2011)

Variety	Dry matter production		Diference		Semnification
	$t.ha^{-1}$	%	$t.ha^{-1}$	%	
Regent	6.60	100.00	-	-	
Ambassador	6.59	99.94	0.01	-0.06	
Average	6.60	Mt			

Dl 5% = 0.24 $t.ha^{-1}$
Dl 1% = 0.45 $t.ha^{-1}$
Dl 0.1% = 0.99 $t.ha^{-1}$

Based on the results obtained, we can say that, under the experimental conditions, any of the varieties of *Dactylis glomerata* can be grown in a mixture with *Medicago sativa*, without affecting significantly the dry matter production, the potential production of vegetation being determined by the weight of the alfalfa in the mixture structure.

CONCLUSIONS

Under the climate conditions at Moara Domnească Experimental Farm, the main elements that contributed to the yield of the *Dactylis glomerata* species were: the leaf area index, the leaf area and the indices of growth rate.

During the experimental period, the leaf area index was positively correlated with the leaf area expressed in $m^2.kg^{-1}$, the crop growth rate, the dry matter yield and negatively correlated with the specific leaf area.

The production potential of *Dactylis glomerata* species, averaged over the three years (2009-2011), both in pure culture and mixed with *Medicago sativa*, was decreased by deficient rainfall during the vegetation.

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THE RESPONSE OF SOME SUNFLOWER HYBRIDS IN LOW WATER-SUPPLY CONDITIONS IN THE CENTRAL DOBROGEA PLATEAU

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Abstract

Aim of the study: The response of some sunflower hybrids in low water-supply conditions. The central part of Dobrogea is chiefly characterized by a warm and droughty climate, with the medium annual temperature of 11ºC and medium annual rainfall of 432.2 mm, which are irregularly distributed during the whole year and therefore for the sunflower crop there isn't ensured a comfortable humidity regime for a normal development of plants. A decreased sunflower yield is drastic if there is an intervening of the hidric shortage. Taking into consideration the importance of the usage of some drought and torridity resistant genotypes, the work aims to find the most adequate germoplasm for obtaining some profitable crops in low water- supply conditions in the central Dobrogea Plateau. The method used: The sunflower trial was located at S.C.D.A Valu lui Traian, Constanta County in 2011; bifactorial type it was used the randomized blocks method, with the following factors and graduations: A Factor: Water-supply level (A_1 unirrigated; A_2 – irrigated with pedological norm of 700 m^3/ha; A_3- irrigated with 50% reduced pedological norm = 350 m^3/ha; B Factor: The hybrid (FAVORIT, SINGI, DELFI, PR64A89, TEKNY, KONDI). Results: 2011 proved to be a favourable one for the sunflower crop. The obtained yield while using the sunflower hybrids was influenced by the water-supply level, the average being 42.0 q /ha in unirrigated conditions, 50.4 q/ha taking into account the pedological norm of 700 m^3/ha and 45.7 q /ha, with 50% reduced the pedological norm. Conclusions: The classification of hybrids after the obtained yield in different water-supply conditions is: Singi, Kondi, Tekny, Favorit, Delfi and PR 64A89. The average seed- weight per head, 1000 –seed weight and the hectolitric mass varied in terms of the hybrid and the water-supply level.

Key words: *crop, genotype, pedological norm, tolerance, yield.*

INTRODUCTION

The pluviometric and termic rate in Romania, irregularly distributed on the territory and the drought periods in South, South-East and South-West in July and August, made necessary the introduction of irrigation in these ecological areas as well as the use of some drought and arid tolerant genotypes. There is a high reduction of sunflower yield when the hidric shortage appears and the sunflower leaves growth and development is significantly affected by the moderate hidric shortage. The appearing of the hidric stress before blooming leads to a decreased weight of sunflower plants, the reduction of stem and head diameters. There is a much reduced quantity of seeds/plant when the stress turns up in the blooming period. The hidric stress in the maturity stage leads to a low crop coefficient and there is a decreasing in what concern the oil-seed percent [3, 6]. The losses of dry substance yield can be 22-50% and the yield reduction is between 20% and 51% when there is a severe and moderate coefficient, the water consumption in the case of sunflower being with 20% or 47% less than the crop with an optimal water-supply level [1]. There is a negative correlation statistically ensured by the correlation coefficient $r=-0{,}586^{**}$ between the yield and rainfall in the period of bead grain formation, a period corresponding to July and August. If there is an increasing of rainfall over the limit of 130 mm in this period, then the yield decreases from an average potential of 29.8 q/ ha with 4.6 q/ha for each mm of excedentary rainfall [4]. Dobrogea region is characterized by an irregular distribution in time and space of rainfall, and that is why for the sunflower crop there is not provided a comfortable humidity rate corresponding to the normal development of plants. Taking into account the important use of some drought and torridity genotypes with tolerance to drought and torridity, the work aims to find the most adequate germoplasma for obtaining a profitable crop in low-water supply conditions in the central part of Dobrogea plateau.

MATERIAL AND METHOD

The research was developed and it was executed a sunflower trial, bifactorial type, located after randomized blocks method with the following factors and graduations: A factor – water insurance level: A_1 unirrigated (drought–tolerance), A_2 irrigated with pedological norm of 700 m^3/ha, A_3 irrigated with reduced pedological norm 50%=350 m^3/ha. The B factor: Hybrid- B_1 Favorit, B_2 Singi, B_3 Delfi, B_4 PR64A89, B_5 Tekny, B_6 Kondi. Before sowing there was fertilization with complex fertilizers 28:28:0. The fertilizers were incorporated into soil with disc harrow. The field preparation for sowing was executed before the actual sowing day with the cultivator. In the sowing day, the rows were delimitated with the seeding machine and the trial was marked with sticks according to the trial plan. The necessary seeds were treated with insecto-fungicide. The sowing was executed with the dibble distributing 3-4 seeds together, the depth of 4 cm and distance of 30 cm between the plants on the row. The sowing date was 27th of April 2011. After emergence the plants were spaced leaving, only a planting hole. The plot doesn't have holes. There were made observations and determination in the plot such as: the emergence date; number of days from sowing till emergence; blooming date; harvesting date; plant height; head diameter. The yield was established through the seed weighting on the field after the lateral and frontal elliminations were made. The seed yield was calculated on hectare, at STAS humidity parameters (11%). The 1000 - seed weight was determined by the counting of 500 seeds in two repetitions at each hybrid, their weighting and the reporting of the 1000 - seed medium weight. The hectolitric mass was determined taking into account the average of three executed weightings from the yield of each hybrid. The results were developed through statistical calculations, using the analysis of the variation for bifactorial field trials placed after the randomized blocks method and the correlation between different characters and water supply [5].

RESULTS AND DISCUSSIONS

The year 2011 was a favourable one for the sunflower crop, and this is reflected in the obtained yield. The influence of the different water-supply conditions over the sunflower hybrids' yield is presented in table 1. In comparison to the Favorit hybrid (Mt 1), cultivated under low-water supply conditions, which obtained a yield of 44.1 q/ha, the highest yield was obtained by Kondi 54.0 q/ha and Singi 53.5 q/ha hybrids under irrigation conditions with pedological norm of 700 m^3/ha, with significant differences in relation to the witness. Under the same water–supply conditions, Tekny and Delfi hybrids obtain signicant yield differences of 6.7 q/ha and respectively 6.4 q/ha in comparision to Favorit hybrid which is unirrigated. In comparison to Favorit hybrid, irrigated with pedological norm of 700 m^3/ha (Mt 2), only Kondi hybrid cultivated under the same water–supply conditions obtains a higher yield with 5.7 q/ha, significant. Under unirrigation conditions, the yield differences in relation to Favorit hybrid (Mt_2) were negative, and those of Kondi, Delfi and PR64A89, significant distinct, demonstrating the drought sensibility. By reducing with 50% the pedological norm, the yield decreased and the most affected were PR64A89 hybrid with 6.7 q/ha and Delfi with 6.6 q/ha, the differences being significant; in this way these hybrids prove their sensibility to the absence or water deficit. There was established a significant distinct relation between the water-supply and the sunflower hybrids yield, but this occurs only in case the crop is not irrigated (Fig. 1). The sunflower hybrids behaviour cultivated under different water supply conditions shows that 2011, was favourable for crop, the medium obtained yield was between 42.10 q /ha (PR64A89) and 49.20 q/ha (Singi). In comparison to the field trial average (Mt1) only PR64A89 hybrid obtained a lower yield with 3.9q/ha, significant difference. And in relation to Favorit hybrid (Mt2), PR64A89, had a lower yield with 3.6q/ha, significant difference (Table 2). The irrigation with pedologial norm of 700 m^3/ ha proved to be the most efficient for a high yield. This was with 4.4 q/ha higher comparatively to the field trial average, and with 8.4 q/ha comparatively to the unirrigated variant, very significant differences. There was also a yield increasing obtained of 3.7 q/ha under irrigation with pedological norm of 350 m^3/ha in comparison to unirrigated variant, significant distinct (Table 3). The climatic conditions in 2011 as well as the water-supply conditions marked the medium seed weight per head. Under irrigation with pedological norm of 700 m^3/ha, the seed-weight was the biggest (highest), between 90 g at Tekny hybrid and 103 g at Kondi hybrid (Fig. 2) By reducing the water pedological norm with 50% led to the decreasing of the medium seed weight per head at range between 88 g at Tekny hybrid and 98 g at Kondi hybrid. In what concern the unirrigated variant, the seed weight decreasing per head was the the highest, its range being of 86 g at Tekny hybrid and 97 g at Kondi hybrid.

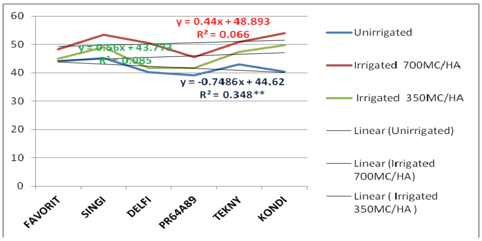

Fig. 1. The relationship between the sunflower hybrids yield and water supply

Table 1. The influence of water supply conditions different over the production of sunflower (2011)

Variant	Yield (q/ha)	Dif A1b1 (q/ha)	Significant Dif. A1b1	Dif. A2b1 (q/ha)	Significant Dif. A2b1
A1b1 unirrigate-Favorit	44.1	*Mt1*		-4.2	
A1b2 unirrigate -Singi	45.1	1.0		-3.2	
A1b3 unirrigate -Delfi	40.3	-3.8		-8.0	00
A1b4 unirrigate PR64A89	39.2	-4.9		-9.1	00
A1b5 unirrigate -Tekny	42.9	-2.2		-5.4	
A1b6 unirrigate -Kondi	40.4	-3.7		-7.9	00
A2b1 irrigated with pedological norm 700m^3/ha-Favorit	48.3	4.2		*Mt2*	
A2b2 irrigated with pedological norm 700m^3/ha--Singi	53.5	9.4	**	5.2	
A2b3 irrigated with pedological norm 700m^3/ha--Delfi	50.5	6.4	*	2.2	
A2b4 irrigated with pedological norm 700m^3/ha---PR64A89	45.5	1.4		-2.8	
A2b5 irrigated with pedological norm 700m^3/ha---Tekny	50.8	6.7	*	2.5	
A2b6 irrigated with pedological norm 700m^3/ha---Kondi	54.0	9.9	**	5.7	*
A3b1 irrigated with reduced pedological norm 50%:350m^3/ha-Favorit	44.9	0.8		-3.4	
A3b2 irrigated with reduced pedological norm 50%:350m^3/ha-50%:350m^3/ha -Singi	49.0	4.90		0.7	
A3b3 irrigated with reduced pedological norm 50%:350m^3/ha Delfi	41.7	-2.4		-6.6	0
A3b4 irrigated with reduced pedological norm 50%:350m^3/ha-PR64A89	41.6	-2.5		-6.7	0
A3b5 irrigated with reduced pedological norm 50%:350m^3/ha--Tekny	47.4	3.3		-0.9	
A3b6 irrigated with reduced pedological norm 50%:350m^3/ha--Kondi	49.8	5.7	*	1.5	

DL5% = 5.7 q/ha
DL1% = 7.6 q/ha
DL 0.1% = 10.1 q/ha

Table 2. The influence of the sunflower hybrid over the yield under different water supply conditions

Nr crt	Hybrid	Yield (q/ha)	Dif Mt_1 (q/ha)	Significant Dif. Mt_1	Dif. Mt_2 (q/ha)	Significant Dif.Mt_2
1	FAVORIT	45.7	-0.3		Mt_2	
2	SINGI	49.2	3.2		3.5	
3	DELFI	44.2	-1.8		-1.5	
4	PR64A89	42.1	-3.9	0	-3.6	0
5	TEKNY	47.0	1.0		1.3	
6	KONDI	48.0	2.0		2.3	
7	Average	46.0	Mt_1			

DL 5% = 3.3 q/ha
DL 1% = 4.4 q/ha
DL 0.1% = 5.9 q/ha

Table 3. The influence of water supply conditions over the production of sunflower

Nr crt	Water supply	Yield (q/ha)	Dif. Mt_1 (q/ha)	Significant Dif. Mt_1	Dif. Mt_2 (q/ha)	Significant Dif. Mt_2
1	Unirrigated	42.0	-4.0	0 0	Mt_2	
2	Irrigation with pedological norm of 700 m^3/ha	50.4	4.4	***	8.4	***
3	Iriigation with pedological norm 50%= 350 m^3/ha	45.7	-0.3		3.7	**
4	Average	46.0	Mt_1			

DL5% = 2.3 q/ha
DL1% = 3.1 q/ha
DL0.1% = 4.1 q/ha

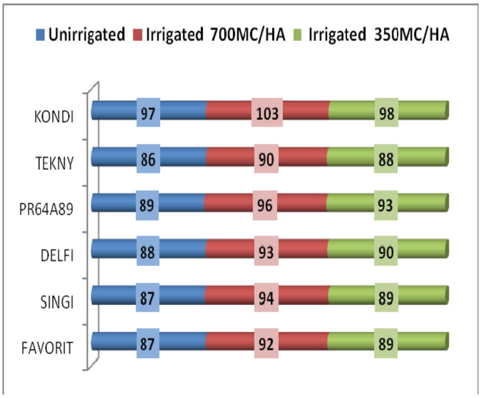

Fig. 2. The medium seed weight (g) per head of sunflower hybrids in terms of water supply level

There was established a significant correlation between the medium seed weight of the sunflower hybrids and the water-supply level, in conditions of irrigation with pedological norm of 700 m^3/ha and distinct significant in the case in which there is a 50% reduction of the pedological norm, as well as there is not any irrigation (Fig. 3).

The influence of the climatic and water-supply conditions was noticed in the 1000-seed weight range of the tested sunflower hybrids in 2011. The influence of irrigation with pedological norm of 700 m^3/ha was remarked while obtaining the highest 1000-seed weight range: 73 g at Kondi hybrid in contrast with 64 g for unirrigation conditions.

Significant differences were also obtained for the 1000- seed weight at the other hybrids comparatively to the irrigated variant with 50% reduced pedological norm or unirrigated variant (Fig. 4).

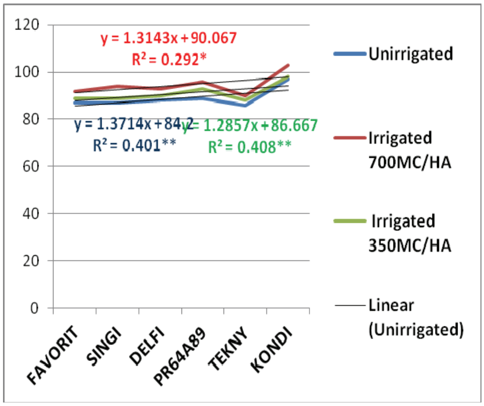

Fig. 3. The relation between the medium seed weight per head of the sunflower hybrids and the water supply level

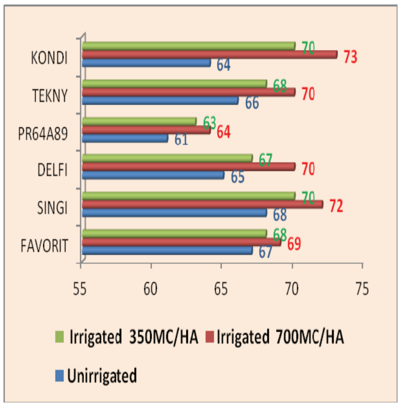

Fig. 4. The 1000-seed weight of sunflower hybrids in terms of water supply level

The crop irrigation determined the getting of a higher hectolitric mass in comparison with the situation in which the field was not irrigated. The hectolitric mass values were between 38 kg/hl (PR64A89 hybrid) and 40 kg/hl (Singi hybrid) for the irrigated variants with pedological norm of 700 m^3/ha, between 37.5 kg/hl (PR64A89 hybrid) and 38.6k g/hl (Kondi hybrid) for the irrigated variants with pedological norm of 350 m^3/ ha and between 36 kg/hl (PR64A89and Favorit hybrids) and 37.9

kg/hl (Tekny hybrid) for the unirrigated variant (Fig. 5).

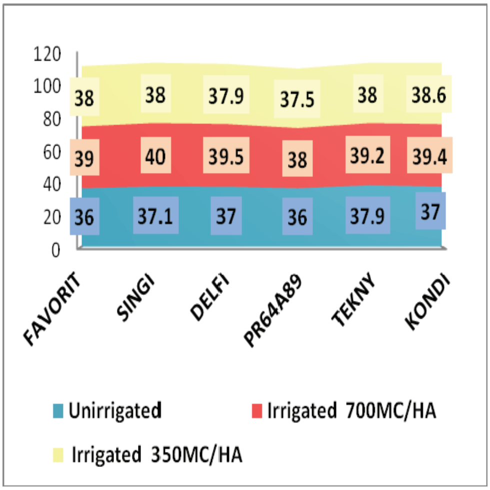

Figure 5. Hectolitric mass (kg/hl) of sunflower hybrids in terms of the water supply level

CONCLUSIONS

The central part of Dobrogea is characterized by warm and droughty climate with the medium annual temperature of 11ºC and medium annual rainfall of 432.2 mm which are irregularly distributed.

2011 proved to be a favourable year for the sunflower crop.

The obtained yield by the sunflower hybrids was influenced by the water-supply level, the values were between 39.20-44.10 q/ha for unirrigated conditions, 48.30-54.00 q/ha when the pedological norm was of 700 m^3/ha and 41.60-49.80 q/ha when the pedological norm was reduced with 50%.

There was established a distinct significant relation between the water-supply level and the obtained yield only if the crop was not irrigated.

The classification of hybrids taking into account the obtained yield under different water-supply conditions is: Singi, Kondi, Tekny, Favorit, Delfi and PR64A89.

There was established a significant correlation between the medium seed weight of the sunflower hybrids and the water-supply level, in conditions of irrigation with pedological norm of 700 m^3/ ha and distinct significant in the case in which there is a 50% reduction of the pedological norm as well as there is not any irrigation.

The average seed weight per head the 1000–seed weight and the hectolitric mass varied in terms of the hybrid and the water-supply level.

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CHARACTERISTICS OF AMPHIDIPLOIDS IN THE *TRITICUM-AEGILOPS-HAYNALDIA-AGROPYRON* GROUP

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Abstract

Amphidiploids in Triticum-Aegilops-Haynaldia-Agropyron group are an important part of the modern wheat breeding process, because of their valuable characteristics: resistance to biotic and abiotic stress factors. Sixteen amphidiploids and 25 synthetic wheat lines are observed for biotic and abiotic stress resistance. Observations (excluding germination of some amphidiploids seeds) are made under field conditions. In all amphidiploids and synthetic wheat lines no symptoms of powdery mildew (Erysiphe graminis DC.), leaf rust (Puccinia recondita Rob. et Desm.), septoria blotch (Septoria tritici Desm.) occur in tillering and adult plant phase. Synthetic wheats show low resistance to tan spot (Pyrenophora tritici-repentis (Died) Drechs.) in all phases of their development. The amphidiploids Chinese Spring x Haynaldia villosa, 45k (T. durum x Ae. speltoides), A1-6 (T. durum x T. boeoticum) and A3-8 (T. polonicum x T. boeoticum) possess very low frost tolerance (20-40%) as evaluated under field conditions. Lines developed from T. aestivum x Agropyron species crosses exhibit very good frost tolerance. Some of the observed lines (amphidiploid No.114, and (T. timopheevi x Ae. tauschii)), are not attacked by the cereal leaf beetle (Lema melanopa L.), probably because of the presence of well-developed trichomes on the leaves and stems. T. turanicum x T. timopheevi amphidiploid is determined with very fragile spikes and very low germination (12.5%). Low seed germination is registered in the T. durum x Agr. elongatum amphidiploid, too. In spite of some negative spike characteristics, the amphidiploids involved in this study, are important sources of genes which could be successfully utilized in wheat breeding.

Key words: *amphidiploids, bread wheat, resistance, Triticum-Aegilops-Haynaldia-Agropyron species.*

INTRODUCTION

Common winter wheat *Triticum aestivum* (2n=6x=42, AABBDD) is a major food crop for the main part of the world population. Obtaining high yields of it is a priority objective for agricultural production. Environmental factors related to agriculture are crucial to the production and quantitative and qualitative indices of the harvest. Modern breeding, through its methods, aims to create varieties that possess genes for resistance and tolerance to biotic and abiotic factors. Effective method in this regard is the development of distant hybrids.

Amphidiploids are plant form created by interspecific or intergeneric hybridization incorporating diploid chromosome complexes of the two parental components [5]. This plants species provide a valuable starting breeding material to produce added and substituted wheat lines through distant hybridization methods. Creating amphidiploids plants faced many difficulties such as non-viable embryos and the sterility of initial hybrids but they are successfully overcome by methods of tissue culture and by doubling the chromosome number by treatment of hybrid plants with colchicine solution [17]. Amphidiploids plants, unlike intergeneric and interspecific F_1 hybrids, which originating from, are characterized with large fertility and stable meiosis occurred. In a large number of similar forms, there is high resistance to fungal pathogens [13] and tolerance to insect pests [17]. Amphidiploids possess a number of negative qualities such as partial sterility possible occurrence of hybrid necrosis, fragile spikes, shriveled grains [5, 17].

Synthetic hexaploid wheat (SHW) (2n=6x=42, AABBDD) is an artificial form, involving the genomes of various tetraploid wheats (2n=4x=28, AABB) and D-genome of wild species *Aegilops tauschii* (2n=2x=14, DD). Obtaining this specific amphidiploid is associated with crossing the two parental species and the subsequent doubling of chromosome number by colchicine treatment. Obtained amphidiploids are characterized with wide variation in relation to the morphology and physiology defined phenotypic expression of certain properties [15]. The creation of SHW is a direction which is associated with breeding of valuable wheat lines after backcross with pollen from the same species [14]. The resulting bread wheat lines, grown in defined medium, effectively adapt to local conditions, and possess high levels of tolerance to abiotic and biotic stress.

Since the launching wide hybridization of Barelle in 1807 many developed amphidiploids of *Triticum-Aegilops-Haynaldia-Agropyron* group have been reported. Summary of results for obtained amfidiploids are reported by Sharma and Gill [11], Spetsov and Savov [13], Stoyanov [17]. The main directions of work with amphidiploidns plants is associated mainly with the transfer of valuable genes in the genome of bread wheat, as well as creating new cultural amphidiploids relevant to meet the new needs of agriculture and industry. Because of this it is necessary to characterize different amphidiploids and synthetic lines and to establish their morphological, ecological, biochemical, physiological, phytopathological, entomological properties. The large differences in parental components involved in the crosses refer to a wide variation in the factors listed above, depending on the genomic constitutions, chromosomal interactions and physiological processes. Therefore, it is important to determine the differences in accessions with a certain pedigree in the response to environmental conditions (biotic and abiotic factors). Despite the differences it should be also determined the similarities to the process of reaction to environmental conditions by establishing accessions representing a source of valuable genes in the selection of bread wheat in the country.

The main objective of this study is to identify key characteristics which determine the influence of biotic and abiotic stress factors in amphidiploid accessions of the group *Triticum-Aegilops-Haynaldia-Agropyron*, and to assess their suitability for a starting breeding material.

MATERIAL AND METHOD

Sixteen amphidiploid accession are used (presented in Table 1). It is also used twenty-five synthetic hexaploid wheat lines (SHW), which are obtained by the scheme shown in Fig. 1. Observed SHW plants are C_3-generation, obtained after double selfing of the initial amphidiploids. Parental tetraploid wheat forms 45390 and 45398 involved in the creation of maternal component (510), belong to the species *Triticum turgidum* ssp. *dicoccon*, and are derived from ICARDA – Syria, wheat collection. The used paternal parent belongs to the species *Aegilops tauschii*, accession № 19088, originating from IPGR-Sadovo.

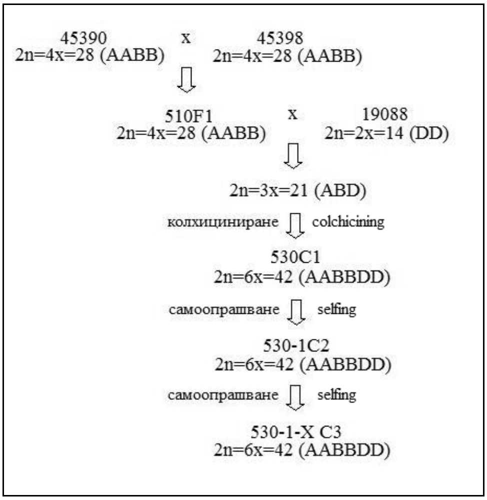

Fig. 1. Sheme of synthetic hexaploid wheat lines 530-1 obtaining generation C3

Under field conditions 15 seed from each sample were sown in scheme 30-5cm. Sowing under field conditions was carried out in the land of Stozher, Dobrich region, Bulgaria. Sowing dates are presented in Table 1. It is reported the number of plants grown (GN) and field germination (FG) on samples. To summarize the complex winter tolerance they are reported frosted (FN) and pulled-out (PN) plants. The influence of winter conditions (WCI) is presented as the ratio of the sum of the number of frosted and pulled-out plants to the number of germinated plants (GN) plants. It is reported the number of wintering plants (WN).

Table 1. Name of accessions, date of sowing and origin of plant material

No	Amphidiploid's name	Date of sowing	Origin	Form
1	Amphidiploid 114	29.10.2011	DAI-GT	N/A
2	45к C3 Zagorka x *Ae.speltoides*	29.10.2011	DAI-GT	N/A
3	*Tr. durum* x *Elytrigia elongatum*	29.10.2011	DAI-GT	N/A
4	*Tr. timopheevi* x *Ae. tauschii*	29.10.2011	DAI-GT	N/A
5	*Tr. turanicum* x *Tr. timopheevi*	29.10.2011	DAI-GT	N/A
6	Trakia x *Ae. ovata*	29.10.2011	DAI-GT	N/A
7	Chinese Spring x *H. villosa*	29.10.2011	UM-C	N/A
8	A1-6 *Tr. durum* x *Tr. boeoticum*	06.11.2011	DAI-GT	N/A
9	A3-8 *Tr. polonicum* x *Tr. boeoticum*	06.11.2011	DAI-GT	N/A
10	TRI 10365 *Tri.* x *Agr.* x *Agr.*	04.12.2011	IPK-G	W
11	TRI 10366 *Tri.* x Agr. x *Agr.*	04.12.2011	IPK-G	W
12	TRI 12911 *Tri.* x *Agr.*	04.12.2011	IPK-G	W
13	TRI 17927 x*Aegilotriticum erebuni*	04.12.2011	IPK-G	W
14	TRI 12087 *Ae. ven.* x *Tr. dicoccoides*	10.03.2012	IPK-G	S
15	TRI 12090 *Ae. ven.* x *Tr. carthlicum*	10.03.2012	IPK-G	S
16	TRI 11943 *Ae. ven.* x *Tr. dicoccum*	10.03.2012	IPK-G	S
17	Syntethic hexaploid lines	06.11.2011	DAI-GT	W

DAI-GT – Dobrudzha Agricultural Institute – General Toshevo, Bulgaria; IPK-G - The Institute of Plant Genetics and Crop Plant Research – Gatersleben, Germany; UM-C – University of Massachusetts – Columbia, th USA; N/A – no information; W – winter type; S – spring type.

In laboratory conditions seven amphidiploids were placed to germinate. After germination and reporting of laboratory germination (LG) seedlings are planted into pots and acclimatized in an unheated plastic greenhouse, and subsequently placed under field conditions. Sowing and planting dates are shown in Table 1. It is reported GN, FN, WN and WCI.

A statistical analysis of the total variability index for FG/LG and WCI is made as per accessions and groups of origin. To consolidate the data and variability analysis software Microsoft Excel 2007 is used.

At the same scheme are sown and reported data for standards for wheat cold resistance – Mironovska 808, Bezostaya 1, Rusalka, № 301, San Pastore, and standards for susceptibility to powdery mildew (*Erysiphe graminis*) - Sadovska ranozreyka, brown rust (*Puccinia recondita*) - Michigan Amber, septoria blotch (*Septoria tritici*) - Enola. A comparative analysis of winter tolerance and susceptibility to infection of phytopathogenic amfidiploidnite samples is made to those varieties of wheat.

It is summarized data of average daily temperatures during the period 01.10.2011 - 31.03.2011, the snow cover during the same period and the amount of rainfall in the period 31.10.2011-30.06.2012. Data of temperature and precipitation were obtained by measurements with an automatic weather station LaCrosse. Measurements were made twice daily at 07:00 and 19:00. Data of snow cover is determined using snowmeter precised to 0.5 cm.

The determination of phytopathogens attack is performed under field conditions, for powdery mildew (EG) using the methodology of Stoilova and Spetsov [16], for brown rust (PR) using the methodology of Ivanova [4], for septoria blotch (ST) using methodology of Eyal et al. [2], for tan spot (PTR) in methodology of Duveiller at al. [1]. Reporting is done by established: resistant (R), medium resistant (M) and susceptible (S) samples. Insects attack was confirmed by visual inspections.

RESULTS AND DISCUSSIONS

The results of conducted studies about establishing the influence of environmental factors on amphidiploids and synthetic lines are presented in Tables 2, 3, 5 and 6. In the tables it could be easily traced the diversity of response patterns to different climatic and biotic factors.

With regard to the field germination (Table 2, Table 5), four accessions (A1-6, A3-8, TRI10366, TRI17927) showed unsatisfactory results, 3 of them (A3-8, TRI10366, TRI17927) have demonstrated low germination outside the standard deviation. In synthetic hexaploid lines (Table 3, Table 5) 3 samples (530-1-3-1, 530-1-1-4, 530-1-1-3) showed lower scores on this indicator. With the best field germination are amphidiploids TRI10365, TRI12087, TRI12090 and TRI11943. In accession TRI12087, TRI12090 and TRI11943, high field germination is conditioned by the fact that they are spring forms and vegetate during March-April 2012, when the soil had sufficient moisture. In contrast, the highest germination in TRI10365 is proved by the ability of seeds to overcome the adverse conditions.

Table 2. Initial data about germination and winter condition influence for observed amphidiploids

No	Amphidiploid's name	SN	GN	WN (SuN*)	FN	PN	DN
1	Amphidiploid 114	6	5	2	3	0	-
2	45к C3 Zagorka x *Ae.speltoides*	6	6	1	5	0	-
3	Tr. durum x *Elytrigia elongatum*	1	0	0	0	0	-
4	*Tr. timopheevi* x *Ae. tauschii*	10	9	5	4	0	-
5	*Tr. turanicum* x *Tr. timopheevi*	8	1	1	0	0	-
6	Trakia x *Ae. ovata*	5	5	5	0	0	-
7	Chinese Spring x *H. villosa*	5	5	2	3	0	-
8	A1-6 *Tr. durum* x *Tr. boeoticum*	15	6	5	0	1	-
9	A3-8 *Tr. polonicum* x *Tr. boeoticum*	15	5	3	0	2	-
10	TRI 10365 *Tri.* x *Agr.* x *Agr.*	15	11	10	1	0	-
11	TRI 10366 *Tri.* x *Agr.* x *Agr.*	15	2	2	0	0	-
12	TRI 12911 *Tri.* x *Agr.*	15	11	9	2	0	-
13	TRI 17927 x*Aegilotriticum erebuni*	15	1	1	0	0	-
14	TRI 12087 *Ae. ven.* x *Tr. dicoccoides*	15	12	8*	-	-	4
15	TRI 12090 *Ae. ven.* x *Tr. carthlicum*	15	11	9*	-	-	2
16	TRI 11943 *Ae. ven.* x *Tr. dicoccum*	15	11	10*	-	-	1

SN – sown seeds number, GN – germinated seeds number, WN – wintered plants number, PN – pulled out plants number, FN – frosted plants number, DN – dead plants number. *SuN – survived plants number (only for summer forms).

In samples germinated in laboratory conditions, unsatisfactory results indicate *Tr. durum* x *Elytrigia elongatum* and *Tr. turanicum* x *Tr. timopheevi*. This is probably due to the incompatibility between the embryo and enodesperm, as evidenced the weak and shriveled seeds. Similar results in relation to laboratory germination are reported by Kolev [5] and Tsitsin [19].

Plants root poorly in slightly less depth, do not develop a sufficient number of tillers, which is a prerequisite for poor hardening. With regard to plants, grown in plastic pots, rainfall was important only indirectly associated with increased atmospheric humidity and the possibility of inoculation of pathogens, because of their weak root system needed regular watering to ensure rapid growth in a small volume of soil substrate.

Table 3. Initial data about germination and winter condition influence for observed synthetic hexaploid lines

No	Accession No	SN	GN	WN	PN	FN
1	67-530-1-1-1	15	9	8	0	1
2	67-530-1-1-2	15	12	10	1	1
3	67-530-1-1-3	14	0	0	0	0
4	67-530-1-1-4	15	4	0	0	4
5	67-530-1-1-5	15	8	3	0	5
6	68-530-1-2-1	15	8	3	1	4
7	68-530-1-2-2	15	13	7	1	5
8	68-530-1-2-3	15	9	6	1	3
9	68-530-1-2-4	15	12	8	1	3
10	68-530-1-2-5	15	15	12	0	3
11	68-530-1-2-6	15	10	8	1	1
12	69-530-1-3-1	15	5	3	0	2
13	69-530-1-3-2	15	12	10	1	1
14	69-530-1-3-3	15	6	4	0	2
15	69-530-1-3-4	15	10	8	0	2
16	69-530-1-3-5	15	9	7	1	1
17	69-530-1-3-6	15	11	4	1	6
18	70-530-1-4-1	15	12	9	0	3
19	70-530-1-4-2	15	10	6	0	4
20	70-530-1-4-3	15	7	5	0	2
21	70-530-1-4-4	15	10	7	0	3
22	71-530-1-5-1	10	4	1	0	3
23	71-530-1-5-2	15	6	5	0	1
24	71-530-1-5-3	15	15	14	0	1
25	71-530-1-5-4	15	11	10	0	1

SN – sown seeds number, GN – germinated seeds number, WN – wintered plants number, PN – pulled out plants number, FN – frosted plants number.

The data in Table 4 can help to trace the dynamics of rainfall during the growing season of plants. Stands to November 2011, which seems too dry, which is a cause for too variable field germination. Residual moisture from October 2011 initializes process of germination and subsequent drought cause very adverse effects on the seeds. As a result of these conditions, seed germination is too difficult and inharmonious, their growth has weakened.

Table 4. Precipitation in the period 10.2011 – 06.2012

Months	Precipitation, mm
October	162
November	3
December	55
January	101
February	23
March	24
April	48
May	190
June	22
Total	628

The data in Table 7 and Fig. 2 follow the dynamics of temperature and snow cover during the period 01.10.2011-31.03.2012. It clearly outlines the period of very low average temperatures which is below the threshold of biological development of plants the *Triticum-Aegilops-Haynaldia-Agropyron* group. This, combined with the dynamics in snow cover and a slight hardening creates conditions for damage caused by frost and pulling-out [18].

Table 5. Germination and winter condition influence data and conditions of growing

No	Amphidiploid's name	FG	LG	WCI	CGO
1	Amphidiploid 114	-	83.3%	60.0%	ppo
2	45к C3 Zagorka x *Ae.speltoides*	-	100.0%	83.3%	ppo
3	*Tr. durum* x *Elytrigia elongatum*	-	0.0%	-	-
4	*Tr. timopheevi* x *Ae. tauschii*	-	90.0%	44.4%	ppo
5	*Tr. turanicum* x *Tr. timopheevi*	-	12.5%	0.0%	ppo
6	Trakia x *Ae. ovata*	-	100.0%	0.0%	ppo
7	Chinese Spring *x H. villosa*	-	100.0%	60.0%	ppo
8	A1-6 *Tr. durum* x *Tr. boeoticum*	40.0%	-	16.7%	f
9	A3-8 *Tr. polonicum* x *Tr. boeoticum*	33.3%	-	40.0%	f
10	TRI 10365 *Tri.* x *Agr.* x *Agr.*	73.3%	-	9.1%	f
11	TRI 10366 *Tri. x Agr.* x *Agr.*	13.3%	-	0.0%	f
12	TRI 12911 *Tri.* x *Agr.*	73.3%	-	18.2%	f
13	TRI 17927 x*Aegilotriticum erebuni*	6.7%	-	0.0%	f
14	TRI 12087 *Ae. ven.* x *Tr. dicoccoides*	80.0%	-	*	f
15	TRI 12090 *Ae. ven.* x *Tr. carthlicum*	73.3%	-	*	f
16	TRI 11943 *Ae. ven.* x *Tr. dicoccum*	73.3%	-	*	f
17	67-530-1-1-1	60.0%	-	11.1%	f
18	67-530-1-1-2	80.0%	-	16.7%	f
19	67-530-1-1-3	0.0%	-	-	f
20	67-530-1-1-4	26.7%	-	100.0%	f
21	67-530-1-1-5	53.3%	-	62.5%	f
22	68-530-1-2-1	53.3%	-	62.5%	f
23	68-530-1-2-2	86.7%	-	46.2%	f
24	68-530-1-2-3	60.0%	-	44.4%	f
25	68-530-1-2-4	80.0%	-	33.3%	f
26	68-530-1-2-5	100.0%	-	20.0%	f
27	68-530-1-2-6	66.7%	-	20.0%	f
28	69-530-1-3-1	33.3%	-	40.0%	f
29	69-530-1-3-2	80.0%	-	16.7%	f
30	69-530-1-3-3	40.0%	-	33.3%	f
31	69-530-1-3-4	66.7%	-	20.0%	f
32	69-530-1-3-5	60.0%	-	22.2%	f
33	69-530-1-3-6	73.3%	-	63.6%	f
34	70-530-1-4-1	80.0%	-	25.0%	f
35	70-530-1-4-2	66.7%	-	40.0%	f
36	70-530-1-4-3	46.7%	-	28.6%	f
37	70-530-1-4-4	66.7%	-	30.0%	f
38	71-530-1-5-1	40.0%	-	75.0%	f
39	71-530-1-5-2	40.0%	-	16.7%	f
40	71-530-1-5-3	100.0%	-	6.7%	f
41	71-530-1-5-4	73.3%	-	9.1%	f

FG – field germination, LG – laboratory germination, WCI – winter conditions influence, CGO – conditions of growing; ppo – plastic pots outside; f – field conditions.

Plants grown in plastic pots, although they are developed properly, due to assuring of optimal conditions for their growth and development, exposure to the effects of low winter temperatures, is a prerequisite for easy frost, because their root system is not protected enough by powerful soil horizon. The roots are exposing to the action of temperatures close to ambient temperature. With regard to the plants damaged by the effects of the winter conditions the worst results exhibit three amphidiploids (Amphidiploid 114, 45k C3, Chinese Spring x *H.villosa*).

Table 6. Disease resistance data of observed accessions

No	Amphidiploid's name	EG	PR	ST	EG	PR	ST	P TR
		Tillering			Adult plants			
1	Amphidiploid 114	R	R	R	R*	R	R	R
2	45к C3 Zagorka x *Ae.speltoides*	R	R	R	R	R	R	R
3	*Tr. durum* x *Elytrigia elongatum*	R	R	R	R	R	R	R
4	*Tr. timopheevi* x *Ae. tauschii*	R	R	R	R	R	R	R
5	*Tr. turanicum* x *Tr. timopheevi*	R	R	R	R	R	R	R
6	Trakia x *Ae. ovata*	R	R	R	R	R	R	R
7	Chinese Spring x *H. villosa*	R	R	R	R	R	R	R
8	A1-6 *Tr. durum* x *Tr. boeoticum*	R	R	R	R	R	R	R
9	A3-8 *Tr. polonicum* x *Tr. boeoticum*	R	R	R	R	R	R	R
10	TRI 10365 *Tri.* x *Agr.* x *Agr.*	R	R	R	R	M	M	R
11	TRI 10366 *Tri.* x Agr. x *Agr.*	R	R	R	R	R	M	R
12	TRI 12911 *Tri.* x *Agr.*	R	R	R	R	M	M	R
13	TRI 17927 x*Aegilotriticum erebuni*	R	R	R	R	R	R	R
14	TRI 12087 *Ae. ven.* x *Tr. dicoccoides*	R	R	R	R	M	R	R
15	TRI 12090 *Ae. ven.* x *Tr. carthlicum*	R	R	R	R	M	R	R
16	TRI 11943 *Ae. ven.* x *Tr. dicoccum*	R	R	R	R	M	R	R
17	Syntethic hexaploid lines	R	R	R	R	R	R	S

Perhaps, these values of the indicator are due to two factors: growing them into pots and exposure of the root system at temperatures close to air temperature during the period of active low temperatures; maternal components involved in crossing to obtain amphidiploids are spring forms. The probability of the second hypothesis is more significant as well as amphidiploids *Tr. turanicum* x *Tr. timopheevi* and Trakia x *Ae. ovata* showed slight damage due to low temperatures - all plants survived, despite being grown in pots.

Wide variation was observed in relation to damage caused by the effects of winter conditions on the synthetic hexaploid lines. For them, only one sample 530-1-5-3 exhibit good values of winter tolerance. This is probably due to the alignment of the properties in the hybrid generation and differentiation of homozygous dominant organism refers to observed characteristic. This fact is demonstrated by

Limin [9] in conducting a similar study of such synthetic hexaploid lines.

Table 7. Average monthly temperature and total snow cover data in 01.10.2011-31.03.2012 period

Months	AMT, ºC	TSC, cm
October	10.80	0.0
November	3.75	10.0
December	4.00	30.0
January	-1.60	160.0
February	-3.57	110.0
March	5.77	10.0
April	3.19	-
Total	-	320.0

AMT – average monthly temperature, TSC – total snow cover.

The possibility of occurrence of phytopathogenic attack is very limited in the largest part of the vegetation of plants, due to relatively low temperatures and lack of moisture, which does not allowing initial inoculation. Therefore, before flowering, at all observed samples, including standards for the susceptibility of the pathogens no signs of the disease are occurred (Table 6). After flowering in May-June period 2012, due to the intense rainfall and high temperatures, on a concrete samples was observed only slight attack by powdery mildew, brown rust and septoria blight. Too high temperatures, however, inhibit the development of pathogens which caused the lack of significance in some accessions.

In the majority of the accessions during the tillering phase and after flowering, they show full resistance to pathogens of powdery mildew, brown rust and septoria blotch. In Amphidiploid 114 is observed very weak expression of powdery mildew expressed in the occurrence of some poorly developed pustules, with weak and undeveloped cleistotecia and mycelium. In the spring forms amphidiploids involving *Aegilops ventricosa*, is recorded occurrence of brown rust, expressed little uredinia on single leaves of plants, mainly on aging leaves.

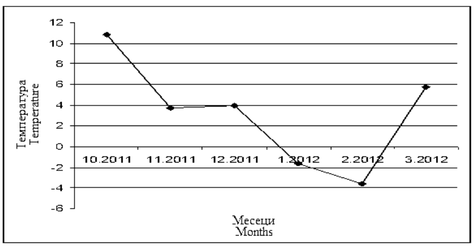

Fig. 2. Dynamics of average monthly temperature in 01.10.2011-31.03.2012 period

This is reason these amphidiploids to be classified as medium resistant to the pathogen. Such expressions show amphidiploids TRI12911 and TRI10365. Synthetic hexaploid lines indicate a high degree of natural resistance to the presence of pathogens of powdery mildew, brown rust and septoria blotch. However, all 25 samples are susceptible to the pathogen of tan spot throughout their whole period of development.

Studies on the reaction of amphidiploids to phytopathogens, indicate that they largely show resistance to powdery mildew and brown rust. Bred in DZI-GT, amfidiploids, referring to a *Triticum-Aegilops-Haynaldia-Agropyron* group in the period 1950-1990, possess a high degree of resistance to the listed pathogens [13]. Similar results are reported by Tsitsin [19], Kolev [5], Kwiatek [6], Sharma and Gill [11], Oliver et al. [10], Wang et al. [20], Lalkova et al. [7], in studies of amfidiploids from *Triticum-Aegilops-Haynaldia-Agropyron* group.

With regard to insects during vegetation it is found adults and larvae of *Lema melanopa* and *Lema lichensis*, with numbers below the threshold of economic harmfulness about common bread wheat [8]. In amphidiploids *Tr. timopheevi* x *Ae. tauschii* and Amphidiploid 114 damage from these insect pests is not observed. This is due to the strong pubescence of the plants of these two samples, and they are not preferred by insects [3, 12]. In all other samples is reported an attack by adult and larval forms of both enemies. In rare cases it is detected adult representatives of the family *Scutelleridae*.

The amphidiploid accessions *Tr. timopheevi* x *Ae. tauschii*, A3-8, A1-6, *Tr. turanicum* x *Tr. timopheevi* and Trakia x *Ae. ovata*, are determined with their very fragile spikes. The spikes break into single spikelets before maturing. The amphidiploid *Tr. turanicum* x *Tr. timopheevi* possess the most fragile spikes which break at the peduncle. The cause of spike fragileness is the presence of wild species' chromosome complex into the genome of amphidiploid plants [11, 15].

CONCLUSIONS

From the foregoing results the following conclusins can be drawn: Amphidiploids from *Triticum-Aegilops-Haynaldia-Agropyron* group, exhibit a wide variation in relation to reported field germination and demonstrated winter tolerance due to a combination of different parental genomes in hybrid plants. Synthetic hexaploid wheat lines exhibit a wide variation in field germination and winter tolerance caused by the hybrid nature of plants and their high heterozygosity. Many of the amphidiploids plants possess very fragile spikes due to adventitious genes from wild parental components. The studied amphidiploids exhibit resistance to the pathogens of powdery mildew, brown rust and septoria blotch, except for spring forms of *Aegilops venticosa*. Synthetic haxaploid lines are susceptible only to the pathogen of tan spot. Due to its strong pubescence on all plant organs, amfidiploids *Tr. timopheevi* x *Ae. tauschii* and Amphidiploid 114 possess tolerance to attack by cereal leaf beetle.

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UTILIZATION OF LARGE TESTING NETWORK TO ESTIMATE ANNUAL GENETIC GAIN FOR YIELD AND TOLERANCE OF CORN TO WATER STRESS IN A BREEDING PROGRAM FAO 480 AND FAO550

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Abstract

Results obtained in a large testing network in 2011 were used to estimate the efficiency of the corn breeding effort in early stage of testing (R1 and R2), by measuring the annual genetic gain for yield and tolerance of corn to water stress in maturities groups of interest for Romania. Linear regression between yield and harvest moisture, as well as between yield averaged over water stressed locations and yield averaged over non-stressed locations were used to estimate annual efficiency of the corn breeding program for FAO maturities 480 and 550. Results showed that the process of selection was efficient in improving yield, drought tolerance in both corn maturities groups (FAO 480 and 550) and all selection stages (R1, R2), producing significant genetic gains, and confirming thus the efficiency of the breeding process on short (annual) term.

Key words: corn, genetic gain, hybrids, *Zea mays* L.

INTRODUCTION

The present study is aimed to estimate the genetic gain obtained by newly introduced Pioneer hybrids R1 (FAO480 and FAO550) and R2 (FAO480 and FAO550) in 2011. Corn with a strong economic importance was, is and will be an object for research. The great discoveries of molecular genetics were applied to corn, achieving record production per unit area. At the same time, by setting chromosomal map, mechanisms of control of certain characters and traits of corn plants were discovered and applied in breeding programs. This allowed the creation of hybrids whose genetic basis not only ensures high production capacity and quality traits absolutely necessary for superior corn utilization.

Pioneer research activity began in the period when Pioneer hybrids were submitted for the first time to official registration testing in 1975. Since then to present a continuous flow of improved Pioneer hybrids have been tested, registered, introduced and grown by numerous Romanian farmers, Pioneer becoming meanwhile the first market player in Romania. This was possible due to the genetic superiority of the newly introduced Pioneer hybrids.

Long term genetic gain has been frequently reported in plant breeding literature. Romanian breeding companies published relevant data about the size of the genetic gain achieved by their breeding programs during long periods of time. Thus, in 1982 was reported a genetic gain for grain yield of 0.232 t/ha/year in irrigation conditions and 0.141 t/ha/year in dry land condition obtained by Fundulea Institute corn breeding program with the same maturities groups as those considered in this study [12]; similar data were published in 1986 - 0.218 t/ha/year in irrigated conditions and 0.205 t/ha/year in rainfed conditions [3], while later in 1998, communicated genetic gain values from Fundulea breeding program of 0.108 t/ha/ year under irrigation and 0.058 t/ha/year in non-irrigated conditions [2].

Numerous genetic gain studies were also published in USA and all over the world;

significant genetic gains in dry land yield, have been released during the last half century [1, 4, 6, 9, 10, 11, 13]. Genetic progress in yield under dry land conditions was linear, and was responsible for at least half of total yield gain obtained in farm production. Agronomic practices improvement is the source for the other half [7]. The studies are also consistent in showing that yield gain is associated with increases in tolerance to prevailing biotic and abiotic stresses [5, 6, 8, 14]. Reports on short term genetic gain are almost absent from plant breeding literature.

MATERIAL AND METHOD

Pioneer corn hybrids representing two maturities group, FAO480 and FAO550, two early testing stages (R1- first year of testing and R2- second year of testing) were tested in 2011 in different locations from Romania, France and Hungary. Differentiated managed irrigation regimes were applied, using small sprinkler equipment, to ensure the achievement of the two water stress levels, low water stress (full irrigation locations) and high water stress (limited irrigated and non-irrigated locations) (table 1).

Table 1. Pioneer R1 and R2 corn hybrids, representing 2011 year breeding, grouped into two maturities, number and irrigation regime of the testing locations.

Stage	R1		R2	
Maturity group	FAO 480	FAO 550	FAO 480	FAO 550
No. of hybrids tested	90	83	83	86
Total no.of locations	12	11	18	16
• Full irrigated - SH	5	5	8	8
• Limited irrigated - SA	3	3	5	4
• Non-irrigated - SA	4	3	5	4

Experimental plot consisted of 2 rows long of 6 m, distance between rows was 75 cm; entries were randomized or nested into experiment.
The filling seed bags for all locations was centralized, the same sources of seeds were used for planting all locations. High input technology was applied to trials in all locations. Trials were mechanically over planted and manually thinned to the desired plant populations at 6 leaves stage. Yield and other important agronomic traits were collected. Results were processed and were used for a normal advancement process. Short term-one generation genetic gain of the breeding program for FAO maturities 480 and 550 was estimated visually using a special graphic representation of the linear regression between yield – q/ha - (YLD) and harvest moisture -% - (MST) (genetic gain for yield capacity), as well as between yield (q/ha) averaged over water stressed locations (WS) and yield averaged over non-stressed locations (NS) (genetic gain for adaptation to a wide range of water stress levels). Additionally, frequency distribution of advanced hybrids in 2012 was graphically compared with that for all 2011 tested hybrids.

RESULTS AND DISCUSSIONS

- **Visually estimation of the genetic gain**

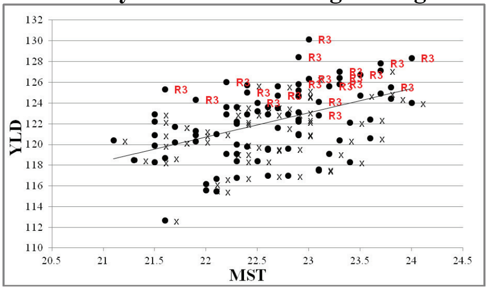

Fig. 1. Linear regression between YLD and MST, R2 hybrids, FAO480, 2011 testing.

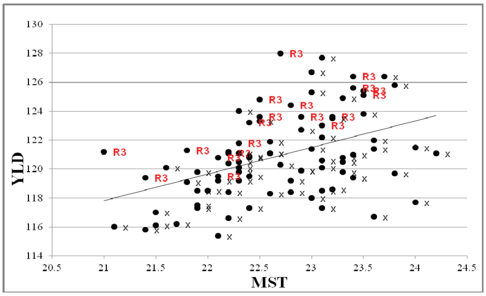

Fig. 2. Linear regression between YLD and MST, R2 hybrids, FAO550, 2011 testing.

In Fig. 1 and 2, showing the linear regression between YLD and MST of R2 hybrids submitted to 2011-2012 advancement process, the tags R3 (in red) represent the advanced R2 hybrids to R3 stage, while X represent the discarded hybrids for FAO group 480 and 550, respectively. An obvious genetic gain for yielding capacity could be observed visually since all R3 advanced hybrids are placed over the regression line in both maturity groups. In the process of advancement, other agronomic and disease traits than YLD and MST were taken into consideration, explaining the X hybrids placed also over the regression line.

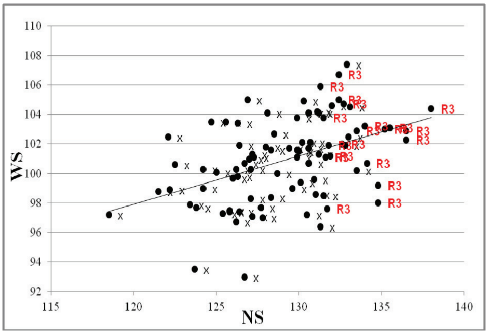

Fig. 3. Linear regression between WS and NS, R2 hybrids, FAO480, 2011 testing.

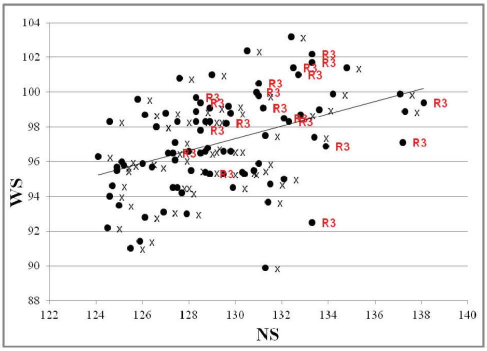

Fig. 4. Linear regression between WS and. NS, R2 hybrids, FAO550, 2011 testing

Similarly, the same graphic representation of the adaptation to a wide range of water stress levels of R2 hybrids are shown in figures 3 and 4 (linear regression between WS and NS). A good part of the newly advanced R3 hybrids (in red) are placed in the upper right quarter of the graph over regression line, showing a consistent gain for adaptation to all water stress conditions.

Position on the graphs of newly advanced R2 hybrids (in red in figure 5 and 6, showing the regession line between YLD and MST of R1, both maturity groups, tested in 2011) suggests also the efficiency of 2011 R1 to R2 advancement process, an important genetic gain for yielding capacity being visually noticeable (all R2 hybrids advanced from R1 are positioned over the regression line).

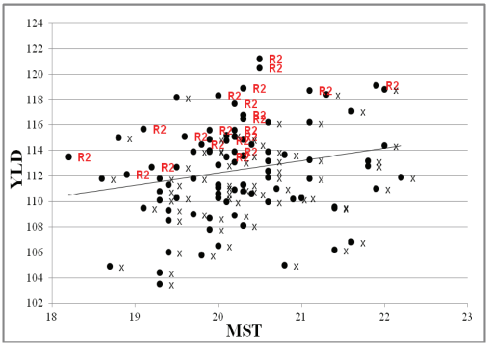

Fig. 5. Linear regression between YLD and MST, R1 hybrids, FAO480, 2011 testing.

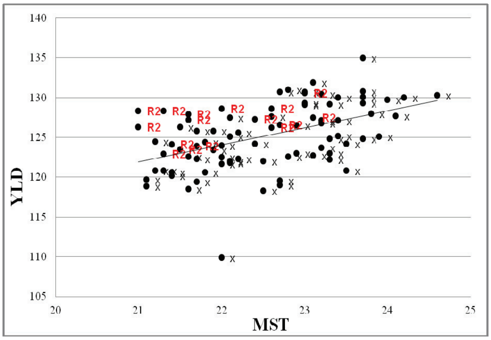

Fig. 6. Linear regression between YLD and MST, R1 hybrids, FAO550, 2011 testing.

Representation of R2 advanced from 2011 R1 (in red) in the graphs showing the adaptation potentiality to a wide range of water stress levels (regression lines between yield obtained in water stress conditions and non stress conditions in figures 7 and 8), make visually evidence of an significant genetic gain from one generation to the next one for a great part of advanced hybrids which are placed in the upper right quarter of the graphs, over the regression line, in both maturities.

- **Estimation of the genetic gain for yield by comparing frequency distributions.**

From Fig. 9 and 10, comparison of frequency distributions for YLD for R3 advanced hybrids versus all 2011 R2 tested hybrids for FAO480 and FAO550 maturities respectively, it could be observed that the mean of the population of R3 advanced hybrids moved towards higher yields with about 5 q/ha, proving a significant genetic gain for yield in both maturities groups from one generation to the next one.

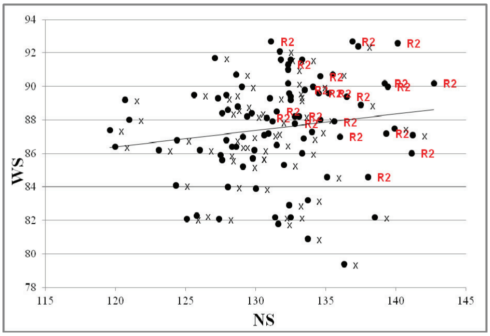

Fig. 7. Linear regression between WS and NS, R1 hybrids, FAO480, 2011 testing.

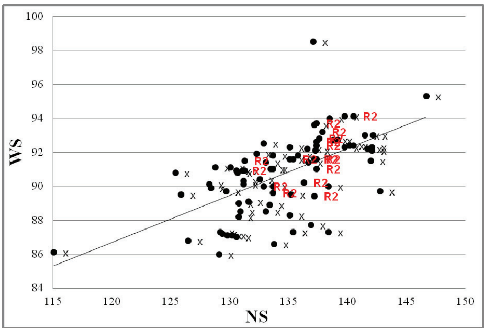

Fig. 8. Linear regression between WS and .NS, R1 hybrids, FAO550, 2011 testing.

Frequency of the promoted (advanced) hybrids in superior classes of yield increased till over 55% in 125-130 q/ha class and over 30 % in 130-135 q/ha class as compared with frequency of all tested hybrids of 20% and 1% respectively, in the case of 2011 R2 hybrids from FAO 480 group (figure 9). Considering 2011 R2 hybrids from FAO 550 group (Fig. 10) frequencies of newly advanced R3 from 2011 R2 hybrids in the superior yield class of 120-125 q/ha increased till 60% (versus around 40% for all R2 tested hybrids) and till more 22% in the highest yield class of 125-130 q/ha (versus around 10 % for all 2011 R2 tested hybrids).
Results of the frequency distributions of the yield of the newly advaced R2 hybrids versus all R1 hybrid tested in 2011 are presented in figures 11 and 12. Similarly to R2 hybrids, the mean of the promoted hybrids moved significantly to higer classes of yield with about 5 q/ha.

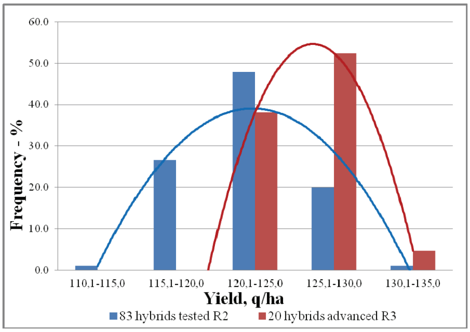

Fig. 9. Comparison of frequency distributions for YLD, of newly advanced R3 hybrids versus all R2 tested hybrids in 2011, FAO480.

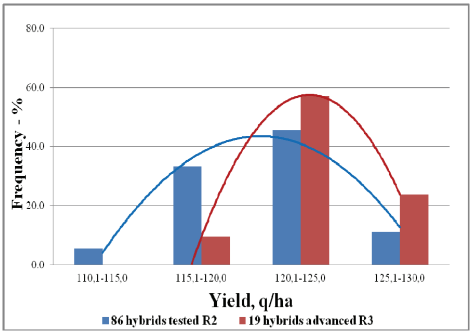

Fig. 10. Comparison of frequency distributions for YLD, of newly advanced R3 hybrids versus all R2 tested hybrids in 2011, FAO550.

This yield increasing of the mean yield of the population of newly advanced R2 hybrids can be considered as a significant genetic gain for yield on short term – from one generation to next one. As a consequence of this genetic gain, frequency distributions of the newly advanced R2 hybrids increased in the superiour yield classes. Thus, in the case of maturity group FAO480 (Fig.11), frequency of the newly advanced R2 hybrids increased to almost 60% (versus 20% for all R1 tested hybrids) in the superior yield class of 115-120 q/ha and to 10 % (versus around 2 % for all 2011 tested R1); in the case of maturity group FAO550, frequency of the newly advanced R2 hybrids increased to over 50% (versus 37% for all R1 tested hybrids) in the superior yield class of 120-125 q/ha.

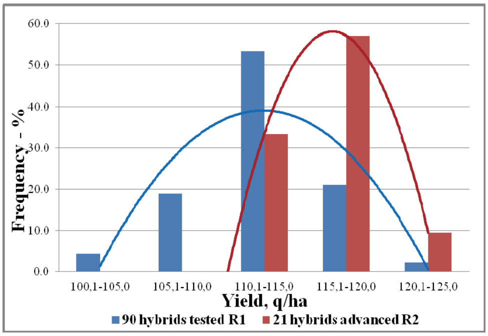

Fig. 11. Comparison of frequency distributions for YLD, of newly advanced R2 hybrids versus all R1 tested hybrids in 2011, FAO480

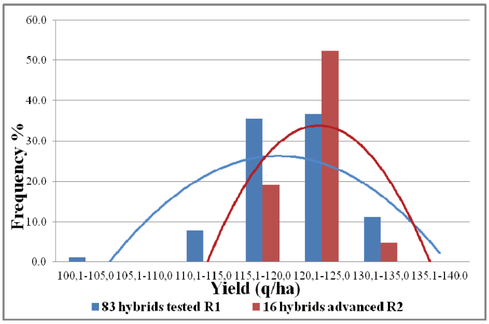

Fig. 12. Comparison of frequency distributions for YLD, of newly advanced R2 hybrids versus all R1 tested hybrids in 2011, FAO550

CONCLUSIONS

Estimation of short term – from one generation to the next one – genetic gain is extremely important for taking corrective actions to keep the efficiency of the breeding programs at an appropriate level and thus to reach the proposed breeding objective;

Very few if almost none reports on the estimation of this type of genetic gain have been published, being more an internal process of the breeding programs.

The results presented in this study showed that at least the breeding program taken into consideration – hybrids for grain, two maturities group, FAO480 and FAO550 - has a superior efficiency in early stages of hybrid testing in improving grain yield.

A significant genetic gain from one generation to the next one of 5 q/ha (4-5% yield increasing of the mean yield of the advanced (promoted) hybrids, versus mean yield of the population of all hybrids tested and submitted to advancement (selection) process.

Extension of such kind of analysis to advanced testing stages and to other important agronomic and disease traits would be extremely useful to appreciate in a complex way the efficiency of the breeding program and to take the appropriate corrective measure in case of lack or biased genetic gain.

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STUDIES ON QUALITY OF MULTIFOLIOLATE ALFALFA

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Abstract

Breeding programs are focused on developing varieties with higher productivity, improved quality of green mass, resistance to diseases and pests, durability, quick recovery after cutting and etc. In the selection of varieties with high quality For this purpose the breeders use methods that directly influence protein and fiber content or increasing the percentage of leaf with more than 3 leaflets per leaf. The development of new alfalfa generation – multifoliolate is the achievement in this direction. In this paper the results from studies on Bulgarian multifolilate alfalfa variety (Mnogolistna 1) are presented. Studied genotypes differ in content of crude protein, amino acids and neutral and acid-detergent fiber and digestibility of dry matter in different parts of plants.

Key words: *alfalfa, multifoliolate , forage quality.*

INTRODUCTION

Breeding programs of many countries have focused on developing varieties with higher productivity, improved quality, resistance to diseases and pests, quick recovery after cutting, and etc. [1]. Multifoliolate alfalfa (with more than 3 more leaflets per leave) are new generation of alfalfa varieties that have higher nutritional value and better *in vitro* digestibility compared to standard trifoliolate varieties [2, 4, 6, 7]. There a lot of studies about multifoliolate genotypes but the dates about proving their better quality are still under discussions [3, 5, 6, 8].
The objective of this study was to compare forage quality of Bulgarian trifoliolate and multifoliolate alfalfa genotypes.

MATERIAL AND METHOD

Forage quality of two Bulgarian trifoliolate varieties (Nadezda 2 and Victoria) and three Bulgarian multifoliolate genotypes – variety Mnogolistna 1, AX-93-5 (dominate 5 leaflets/leave), AX-93 (3+5+7) was studied.
The field experiment was carried out in the research field of Agricultural University-Plovdiv in a randomized block design in four replications and size of 10 m^2. The soil was alluvial-meadow type, having pH from 6.5 to 7.1 (in H_2O) and average supply of basic nutritive elements.
Chemical analyses were performed on average samples taken in the second year of the crop life. Samples for the whole plant analysis were taken from spaced plants of all genotypes. Sample weight was 500 g of green forage. Plant materials were dried at 60°C for about 48 hours.
The analyses for crude protein (CP), crude fiber (CF) and amino acids were carried out by using standard methods in Acreditated laboratory of Agricultural University – Plovdiv.
The analyzes for neutral detergent fiber (NDF), acid detergent fiber (ADF) and in vitro dry matter digestibility (IVDDM) were performed in the lab of Plant Breeding Institute, Belgium.

RESULTS AND DISCUSSIONS

The studied trifoliolate varieties and multifoliolate genotypes differed significantly in chemical composition.
In our study it was found (Tabl. 1 and 2) that multifoliolate alfalfa genotypes in all cuts contain more protein in dry matter in comparison with trifoliolate varieties, regardless of the year of the crop. Multifoliolate genotypes have the highest protein content in all cuts.

Table 1.Crude protein and fiber (% of dry matter) – first year alfalfa crop

Variety	Ist cut		IId cut		IIId cut	
	CP	CF	CP	CF	CP	CF
Nadezda	20.62	27.11	18.75	31.35	21.43	27.98
Victoria	19.78	27.86	18.99	31.67	21.12	27.76
Mnogolistna	22.75	22.08	23.31	30.09	23.12	26.69
AX-93-5	21.62	23.67	22.68	29.37	22.37	27.61
AX-93 (3+5+7)	22.00	23.97	23.50	29.15	22.43	27.77

Table 2.Crude protein and fiber (% of dry matter) – second, third and fourth year alfalfa crop

Variety	Ist cut		IId cut		IIId cut	
	CP	CF	CP	CF	CP	CF
Nadezda	20.25	24.83	18.06	28.81	18.75	32.47
Victoria	19.22	25.11	18.10	29.88	18.06	33.56
Mnogolistna	22.81	24.88	20.37	26.54	21.25	28.35
AX-93-5	19.25	24.67	19.00	31.60	20.06	30.69
AX-93 (3+5+7)	19.68	24.88	20.37	28.88	19.25	30.18

The protein content of the variety Mnogolistna 1 is 22.75% in first cut, 23.31% in second cut and 23.12% in third, that is respectively 2.13%, 3.75% and 1.69% more the standard variety Nadezda 2. The studies genotypes differed in crude fiber contains for all cuts. All multifoliolate genotypes contain less fiber than standard variety Nadezda 2. Perhaps the higher protein and lower fiber contain in dry matter due to the higher leave ratio in the total herbage.
All studied genotypes differed in content of crude protein, neutral- and acid-detergent fiber and in vitro dry matter digestibility in different parts of the plant (Table 3). All multifolilate genotypes compared with trifoliolate varieties. They had higher protein content in both leaves and stems and lower levels of neutral-detergent fiber and acid detergent fiber in the same parts of the plant. Low content of fiber (neutral-and acid-detergent) in total biomass is not related to multifoliolate expression. Leaves from all genotypes accumulate high contents of crude protein (from 30.27 to 32.87). Also, the fiber content (NDF and ADF) is significantly lower in alfalfa leaves than in stems. Neutral detergent fiber mean values in leaves ranged from 17.31 (variety Victoria) to 19.64 (AX-93-3,5,7) with no significant differences observed among genotypes. These results proves the importance of leaves preservation during storage of alfalfa for high quality of hay and haylage. The same tendency was observed for the concentration of NDF and ADF for the stems and total herbage. The lower NDF and ADF, the more feed an animal can digest. Low values are desirable and are associated with increased dry matter intake.
This is confirmed by our other results obtained by harvesting trifoliolate and multifoliolate alfalfa genotypes in different phases. In bud stage multifolilaote genotypes contain more crude protein (220-224 g/kg in dry m) compared with variety Nadezda (206-207 g/kg in dry matter), which reduces during the flowering where, again Mnogolistna 1 had higher protein content in herbage [3].
Our results for the quality of alfalfa leaves, stems and whole plants are in agreement with those from previous studies[8].
Our dates showed that leaves and stems of all multifoliolate genotypes had higher in vitro dry matter digestibility compared to sdandard varieties.

Table 3. Crude protein, NDF, ADF and IVDDM (%)

Genotypes	Plant parts	CP	NDF	ADF	IVDDM
Nadezda 2	Leaves	30.27	18.36	14.74	75.67
	Stems	10.89	65.34	51.57	40.79
	Total herbage	21.26	49.03	38.82	-
	Leaves	30.76	17.31	14.18	74.97
Victoria	Stems	11.50	62.93	52.28	42.38
	Total herbage	19.20	44.67	37.04	
	Leaves	30,87	18,80	15,04	75.92
Mnogolistna 1	Stems	12.28	59.30	47.40	45.34
	Total herbage	23.19	41.40	33.09	
	Leaves	31,08	18,77	15,25	74.72
AX-93-5	Stems	11.94	59.64	48.93	45.10
	Total herbage	23.08	48.18	33.80	
	Leaves	31.75	19.64	15.66	75.81
AX-93-3,5,7	Stems	11,35	62,81	50,38	43.68
	Total herbage	21,45	47,62	34,09	

Our results confirmed conclusions of the other authors that the decrease of digestibility is the consequence of the reduction of the highly digestible component (leaves) because of an increase of the less digestible component (stems) and the decreasing average digestibility of the stem component, with more NDF and lignin [9, 10].

Multifoliolate genotypes had a higher content of essential amino acids than the standard variety Nadezda and higher content of lysine, leucine and phenylalanine, but lower content of glycine and proline (Table 4).

Variety Mnogolistna had the highest content of lysine – 1.61 % of dry matter.

Similar results were obtained from other studies [1], which established a high content of glutamic acid, leucine and phenylalanine and lower levels of glycine, alanine and proline in multifoliolate genotypes than standard trifoliolate varieties.

Table 4. Amino acids content (% in dry matter)

Genotypes Aminoacids	Nadezda 2	AX-93-5	Mnogo listna 1	AX-93 (3,5,7)
Lysine	1.55	1.58	1,61	1.60
Threonine	1.10	1.12	1.14	1.12
Valine	1.11	1.12	1.12	1.11
Methionine	0.12	0.13	0.13	0.13
Isoleucine	0.87	0.92	0.94	0.89
Leucine	1.75	1.78	1.81	1.76
Phenylalanine	1.16	1.20	1.21	1.22
Total:	***7.66***	***7.85***	***7.88***	***7.83***
Histidine	0.53	0.55	0.56	0.57
Arginine	1.20	1.22	1.26	1.20
Asp.acid	2.87	2.98	3.00	3.00
Serine	1.02	1.0 4	1.06	1.03
Glutamic acid	2.39	2.40	2.42	2.37
Proline	1.38	1.31	1.31	1.30
Glycine	1.06	0.96	0.96	0.93
Alanine	1.25	1.20	1.21	1.20
Cystine	0.12	0.12	0.13	0.13
Tyrosine	0.85	0.86	0.87	0.86
Total	**20.33**	**20.49**	**20.66**	**20.41**

CONCLUSIONS

The contents of proteins, crude fiber, NDF, ADF and IVDDM varied among the studied genotypes and plant part.

In all studied genotypes high content of crude protein was registered in alfalfa leaves, while significantly high fiber content (NDF, ADF) were registered in alfalfa stems.

Significant differences were observed am components.

Multifoliolate genotypes had higher content of protein and essential amino acids and lower content of fiber compared to standard trifoliolate varieties.

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RESEARCH REGARDING THE RESPONSE OF RAPESEED HYBRIDS TO PATHOGENS

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Abstract

One of the major factors which play a limiting role in rapeseed culture is represented by a number of pathogens that attack under favourable conditions (provided by abiotic factors), resulting in lower production. Five hybrids were tested: Elite, Elvis, ES Hydromel, ES Artist and ES Saphir, and observations were made under natural contamination in non-treatment variants, in order to analyze the reaction of the hybrids to major pathogens in 2009, 2010 and 2011. The results of the tests carried out during the three years of research on the five hybrids showed that the main diseases of rape, in order of economic importance, were: a).White rot on rape (Sclerotinia sclerotiorum Lib. De Bary); b) Early blight of rape (Alternaria brassicae Berk-Sacc.); c) Dry rot and canker of crucifers (Phoma lingam Tode ex Schw. Desm.); d) Powdery mildew of rape (Erysiphe communis Wallr.-Link). Research was conducted in the experimental fields of a private farm located at Fundulea. From the analysis of the data concerning the behaviour of rapeseed hybrids to pathogens investigated during the three years of study, we concluded that the order of pathogen occurrence in the field was: Phoma lingam, Alternaria brassicae, Erysiphe communis and Sclerotinia sclerotiorum; the most favourable conditions for most diseases were recorded in 2011, excepting common powder mildew (2009). From the present paper, it can be concluded that phytosanitary factors are among the main limiting factors of the rapeseed crop, particularly the attack produced by the fungi Sclerotinia sclerotiorum, Alternaria brassicae, Phoma lingam and Erysiphe communis.

Key words: *hybrids, pathogens, rapeseed.*

INTRODUCTION

One of the major factors which play a limiting role in rapeseed culture is represented by a number of pathogens that attack under favourable conditions (provided by abiotic factors), resulting in lower production [4].
Given the growing importance of rape crop in Romania, the study of pathogens that attack the crop has a particular importance in obtaining top quality and high quantity yields.
Two of the most important diseases of rape are white rot and early blight.
In rainy years, white rot on rape causes great damage in large European countries that grow rapeseed.
In Romania, the disease is found in plants alone or in small hearths in rapeseed crops [3].
Early blight of rape is a common mycosis in rape crops [1]. *Alternaria brassicae* is transmitted from one year to another through the seed produced by diseased plants and the plant remains left on the field after harvest.
Primary infections are produced by the conidia present in the plant remains on the field or the diseased seed.
The environmental conditions favour the growth and development of phytopathogenic agents, the evolution of the disease and plant resistance to various infection pathogens. Soil can be a source of inoculum for different phytopathogenic agents, for example the sclerotia of *Sclerotinia sclerotiorum* are further sources of infections and epidemics [5].
This paper presents the behaviour of five rapeseed hybrids to the pathogens attack.

MATERIAL AND METHOD

Visual observation is the fastest method of identifying a disease based on signs and symptoms shown by infected plants; it involves a high degree of subjectivity, depending largely on the diagnosing person's level of knowledge.

The scoring attack for a disease has a particular importance for the rapeseed culture in establishing the need for chemical treatments during the vegetation period [2].

The attack value is represented by frequency (F%), intensity (I%) and attack degree (AD%). Frequency is the percentage of plants attacked to all cases examined. Attack intensity indicates the degree to which the plant is attacked under examination. Intensity was noted directly in percentage.

The attack degree referred to the severity of disease in the crop and was calculated using frequency and intensity. The intensity of the pathogen attack was evaluated by using the quarter method.

The determination of the seed fat content (Soxhlet method) under the influence of *Sclerotinia sclerotiorum* attack was in accordance with the quality standards used in the laboratory for the determination of total lipids from seeds and other vegetable products (SR-ISO-7970/2001) with the Soxhlet apparatus-SER 148.

We also performed the analysis of productivity.

The hybrids used for the tests were produced by Rustica.

Their tolerance to pathogenic agents was estimated according to the Björling scale.

The experimental lots were established as one-row blocks. The harvesting area of one lot was 20 square metres. For all the experimental years observations were made at the end of June.

RESULTS AND DISCUSSIONS

Five hybrids were tested: Elite, Elvis, ES Hydromel, ES Artist and ES Saphir, and observations were made under natural contamination in non-treatment variants, in order to analyze the reaction of the hybrids to major pathogens in 2009, 2010 and 2011.

Research was conducted in the experimental fields of a private farm located at Fundulea.

Table 1 presents the data on the behaviour of the hybrids investigated.

One can notice that all hybrids recorded a similar behaviour to the intensity degree of the dry rot attack; frequency was the factor that made the difference. The evolution of the attack during the three experimental years was increasing from the lowest values in 2009 to the highest attack in 2011. Thus, in 2011, Elite and ES Hydromel hybrids recorded an attack degree of 29.75% and 19.5%, respectively, Elvis and ES Saphir 21.0%, while ES Artist hybrid showed the highest tolerance to *Phoma lingam*, with an attack degree of 17.5%. The symptoms typical of the pathogen *Phoma lingam* occurred almost simultaneously in all hybrids at the same in the three years of research, i.e. the first decade of April.

Concerning the powdery mildew attack (Table 2), the hybrids recorded an almost identical behaviour in the intensity of attack, varying between 15.0% and 20.0%, which shows differences in the mean frequency of the mildew attack. In this case, powdery mildew recorded a reverse trend, compared with the dry rot attack, as the highest values occurred in 2009, then decreased by 2011.

The highest values of the degree of attack by *Erysiphe communis* were found in the hybrid Elite, while the hybrid ES Saphir proved to be the most tolerant. Powdery mildew symptoms appeared in the rape crop in late April and were present only in the lower half of the plant leaves.

Early blight of rape was the second disease after dry rot which appeared in the crop in mid-April. The degree of attack decreased from ES Hydromel, Elite, Elvis, ES Artist to ES Saphir. Based on relatively constant intensity but different frequency values of the early blight attack from one year to another, we found a progressively increasing attack degree during the three years of research (Table 3). The five hybrids investigated showed typical symptoms early blight only in the siliques.

Table 1. Response of rapeseed hybrids to *Phoma lingam*

Hybrid	Average attack								
	F (%)			I (%)			A.D. (%)		
	Year								
	2009	2010	2011	2009	2010	2011	2009	2010	2011
ELITE	65	75	85	30	35	35	19.5	26.25	29.75
ELVIS	50	60	65	30	30	30	15.0	18.0	19.5
ES HYDROMEL	70	80	85	35	35	35	24.5	28.0	29.75
ES ARTIST	45	45	50	30	35	35	13.5	15.75	17.5
ES SAPHIR	55	55	60	30	30	35	16.5	16.5	21.0

Table 2. Response of rapeseed hybrids to *Erysiphe communis*

Hybrid	Average attack								
	F (%)			I (%)			A.D. (%)		
	Year								
	2009	2010	2011	2009	2010	2011	2009	2010	2011
ELITE	35	30	25	20	20	20	7.0	6.0	5.0
ELVIS	30	30	25	15	15	15	4.5	4.5	3.75
ES HYDROMEL	30	25	25	15	15	15	4.5	3.75	3.75
ES ARTIST	30	30	20	20	20	15	6.0	6.0	3.0
ES SAPHIR	25	20	20	15	15	15	3.75	3.0	3.0

Table 3. Response of rapeseed hybrids to *Alternaria brassicae*

Hybrid	Average attack								
	F (%)			I (%)			A.D. (%)		
	Year								
	2009	2010	2011	2009	2010	2011	2009	2010	2011
ELITE	60	65	70	20	20	25	12.0	13.0	17.5
ELVIS	55	60	70	15	15	20	8.25	9.0	14.0
ES HYDROMEL	65	70	75	20	20	25	13.0	14.0	18.75
ES ARTIST	50	55	65	10	10	15	5.0	5.5	9.75
ES SAPHIR	50	55	60	10	10	15	5.0	5.5	6.0

Table 4. Response of rapeseed hybrids to *Sclerotinia sclerotiorum*

Hybrid	Average attack								
	F (%)			I (%)			A.D. (%)		
	Year								
	2009	2010	2011	2009	2010	2011	2009	2010	2011
ELITE	20	25	32	15	20	25	.	5.0	8.0
ELVIS	20	25	30	15	25	35	3.0	6.25	10.5
ES HYDROMEL	18	24	30	15	25	30	2.7	6.0	9.0
ES ARTIST	18	30	32	15	20	30	2.7	6.0	9.6
ES SAPHIR	16	25	30	15	15	20	2.4	3.75	6.0

Table 5. The influence of *Sclerotinia sclerotiorum* pathogen on quantitative and qualitative components of rape crop production (Elvis hybrid)

Specification	Number of siliques	Size of siliques (mm)	Number of seeds/ silique	Seeds weight (g)	TGW (g)	Sclerotia weight (g)	Humidity at harvest (%)	Dry matter (%)	Seed fat content (% dry matter)
Healthy plants	857	7.12	27.95	76.2	5.45	0	5.9	96.32	49.01
Diseased plants	496	5.45	13.07	23.12	3.94	0.47-0.81	5.9	96.5	44.55
Difference	361 (42.12%)	1.67 (23.46%)	14.88 (54.0)	53.08 (69.7)	1.51 (27.7%)	0.47-0.81 (47.0-81.0%)	0	-0.18	4.46 (9.1%)

The first symptoms of white rot occurred in early June. The data shows that, during the three years of experiments, the weather conditions in 2011 were more favourable to its occurrence while the lowest values were recorded in 2009 (Table 4). The hybrid ES Saphir showed the highest degree of tolerance to *Sclerotinia sclerotiorum* (6.0% degree of attack). The decreasing order in terms of hybrid rapeseed tolerance to white rot was the following: Elite, ES Hydromel, ES Artist and the most sensitive was Elvis with an attack degree of 10.5%. Apart from the inconvenient agricultural tehnique (rape must not be grown in crop rotations that include soybean and sunflower), *Sclerotinia sclerotiorum* creates problems related to the quality and amount of the yields (Table 5).

Thus, in the hybrid Elvis, we observed: The average number of siliques decreased in the diseased plants by about 42.12%, compared with the healthy ones. The siliques size of the plants attacked by *Sclerotinia sclerotiorum* was lower (23.46% on average), compared with the siliques of the uninfected plants. The average number of seeds/silique decreased by 54.0% in the diseased plants, compared with the healthy plants. The reduced size and number of seeds/silique of the diseased plants compared with the healthy ones automatically reflected negatively on the average weight of the infested seed/plant. This was 69.7% lower than the mass of seeds from healthy plants. The Thousand Grain Weight (TGW) of the diseased plants decreased by 27.7%, compared with the healthy plants. The weight of the sclerotia infected plants ranged from 0.47 to 0.81 g. Seed humidity at harvest time was not affected neither in the diseased plants nor in the healthy ones. The dry matter content was lower in the seeds of the healthy plants, compared with the dry matter content of the seeds the rape plants infected with *Sclerotinia sclerotiorum*. The seed fat content of the diseased plants was on average 9.1% lower, compared with the seed fat content of the healthy plants. The data above show that the pathogen *Sclerotinia sclerotiorum* drastically affects the good quality and high amount of rapessed yield, resulting in smaller siliques, less and smaller seeds, lower fat content of the seeds. This can be explained by the fact that, unlike other pathogenic agents, *Sclerotinia sclerotiorum* needs to create its specific resistance organs (sclerotia) in order to survive.

CONCLUSIONS

One of the major factors which play a limiting role in rapeseed culture is represented by a number of pathogens that attack under favourable conditions (provided by abiotic factors), resulting in lower production.

The results of the tests carried out during the three years of research show that the main diseases of rape, in order of economic importance, are the following: the white rot of rape (*Sclerotinia sclerotiorum*), the early blight of rape (*Alternaria brassicae*), dry rot and canker of crucifers (*Phoma lingam*), and the powdery mildew of rape (*Erysiphe communis*).

The hybrid ES Saphir showed the highest degree of tolerance to the pathogen *Sclerotinia sclerotiorum* (6.0% degree of attack).

The order of pathogens occurring in the field was: *Phoma ligam*, *Alternaria brassicae*, *Sclerotinia sclerotiorum* and *Erysiphe communis*.

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RESEARCH ON PRODUCTIVITY AND YIELD QUALITY OF *SALVIA OFFICINALIS* L. SPECIES GROWN IN ORGANIC AGRICULTURE CONDITIONS

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Abstract

Organic agriculture is an alternative to conventional farming system, promoting environmentally friendly agricultural technologies which exclude synthetical chemicals, and provid healthy agricultural products that contribuite to consumers' health, environmental protection and conservation of natural resources. Organic agriculture production system is particularly important as it includes medicinal and spice crops which are intended primarily to guarantee consumers' health; by definition, these plants must be free of synthetic chemical residues, originating from fertilizers or pesticides. Research had been performed on Salvia officinalis L. species grown in organic agriculture condition, in Moara Domnească Experimental Field, Ilfov County – Romania, situated on a reddish preluvosoil, over three years (2009-2011). The three years of experiments show a positive reaction of Salvia officinalis L. species to the tested ecological fertilizers, i.e. peat and Tecamin Max (leaf fertilizer), which are fertilizers accepted in organic agriculture. The reaction of Salvia officinalis L. species to fertilization consists in important production increases, in comparison with unfertilized crop. The highest average multiannual production of Salviae folium was of 11,624.21 kg/ha fresh matter, or 3,407.99 kg/ha dry matter and the highest average multiannual production of Salviae herba, was of 13,343.72 kg/ha fresh matter, or 4,387.10 kg/ha dry matter. The yield quality of Salviae herba was reflected in 95.63% dry matter and 2.11% volatile oil content. It is to recommende the fertilization of Salvia officinalis L. organic crop grown on the reddish preluvosoil from South Romania with Peat 10,000 l/ha or Tecamin Max 3 l/ha.

Key words: *organic agriculture, Salvia officinalis L., organic fertilizers*.

INTRODUCTION

Organic agriculture has become an important alternative to intensive, conventional farming. International understanding of organic agriculture as a production and processing management system is based on the standards set up by International Federation of Organic Agriculture Movements (IFOAM), national and community lows and programs [1].

The production and use of medicinal and spice plants in the organic agriculture system is an alternative to the conventional farming system, promoting environmentally friendly agricultural technologies which exclude synthetical chemicals. Also, it is providing healthy agricultural products that ensure consumers' health, environmental protection and conservation of natural resources. *Salvia* is a fascinating plant genus. *Salvia officinalis* L. species is one of the widest-spread members of *Labiatae* family, its features are prominently in the pharmacopoeias of many countries throughout the world [3].

Sage originates in the sub-mountainous areas of the Mediterranean, from where it was spreaded to the coast areas and further to European, Asian and North African countries. It has been known as a medicinal plant since antiquity. Today, sage is much cultivated in Southern Europe and less in Central Europe, the UK, and the US. In Romania, it is less used as food and, therefore, it is occasionally grown by amateurs on small areas, especially in Southern and South-Western regions.

Sage is a perennial species that is maintained in culture for 5-6 years. The previously crops

must be removed from the land earlier and leave the soil in good fertility conditions.
Sage is grown for its leaves (*Salviae folium*) or for herba (*Salviae herba*). The volatile oil content is 0.38% in fresh leaves and 0.38-2.5% in dry leaves [2].

MATERIAL AND METHOD

The experiments on *Salvia officinalis* L. species, grown in an organic agriculture conditions in Moara Domnească Experimental Field were organized according to rigorous rules and methodologies.
Experiments were carried out over a three-year period (2009, 2010 and 2011).
The experiments on *Salvia officinalis*, genotype "De Răzmireşti" were established by seedling planting on the experimental field on 15th of October 2007.
The following variants were tested: Control-unfertilized; Peat fertilization, 10,000 l/ha; Leaf fertilization with Tecamin Max, 3 l/ha; Leaf fertilization with Tecamin Max, 3 l/ha + Peat fertilization with 10,000 l/ha.
The *Salvia officinalis* L. crop density was of 40,816 plants/ha, with 70 cm distance between rows and 35 cm distance between plants.
Observations and measurements
The following morphological measurements were performed: number of offshoots/plant; offshoots length; number of leaves/offshoot; number of leaves/plant; lamina size (length and width); number of inflorescences/plant.
The following productivity measurements were performed on *Salviae folium* fresh matter and dry matter, and on *Salviae herba* fresh matter and dry matter.
Morphological and biometric measurements were performed in the first and second year of cultivation while productivity measurements were analysed in all three years of the experiments.
Yield quantity analysis included dry matter and volatile oils content.
Laboratory analysis methods were according to the quality standards used to measure total lipids content from seeds and other vegetal products – SR EN ISO/CEI 17025:2005 for physical, chemical and microbiological analysis of food products.

RESULTS AND DISCUSSIONS

Research conducted during 2009-2011 on *Salvia officinalis* L. species grown in organic agriculture conditions, was based on the genotype "De Răzmireşti", in the Moara Domnească Experimental field.
The research carried out shows *Salvia officinalis* L. positive reaction to the tested ecological fertilizers, i.e. Peat and Tecamin Max (leaf fertilizer), which are fertilizers accepted in organic agriculture.
The reaction of the *Salvia officinalis* L. species to fertilization results in important yield increase (statistically assured from significant to highly significant), compared to unfertilized plants.
Salvia officinalis L. plants recorded following average morphological characteristics: 42 branches (offshoots/plant), 23.54 cm average shoot length, 10 leaves/shoot, 431 leaves/plant, 5.58 cm lamina length and 1.65 cm lamina width, and 42 inflorescences/plant.
Between 2009 and 2011, two harvests were performed in *Salvia officinalis* L. in each year of experimentation: the first harvest in June-July, and the second in September-October.
Results obtained in 2009. The highest average annual yield (16,272.10 kg/ha) of *Salviae folium* fresh matter, was obtained in the experimental variant V_3 – "Leaf fertilization with Tecamin Max, 3 l/ha"; after drying, the highest average annual yield was 4,432.84 kg/ha *Salviae folium* – dry matter, obtained in the experimental variant V_4 – "Leaf fertilization with Tecamin Max, 3 l/ha + Peat fertilization with 10,000 l/ha". *Salvia officinalis* L., organically grown in the experimental field of Moara Domnească, produced an average of 13,430.75 kg/ha *Salviae folium* fresh matter; after drying, the result was 3,701.19 kg/ha *Salviae folium* dry matter, with an average rate on drying of 3.63:1 (Table 1).
The highest average annual yield (21,482.39 kg/ha) of *Salviae herba* fresh matter, was obtained in the experimental variant V_4 – "Leaf fertilization with Tecamin Max, 3 l/ha + Peat fertilization with 10,000 l/ha"; after drying, the highest average annual yield was 6,609.88 kg/ha *Salviae herba* dry matter, obtained in the

experimental variant V_3 – "Leaf fertilization with Tecamin Max, 3 l/ha".

Salvia officinalis L., organically grown in the experimental field of Moara Domnească, produced in average 18,228.43 kg/ha *Salviae herba* fresh matter; after drying, the result was 5,561.44 kg/ha. *Salviae herba* dry matter, with an average rate on drying of 3.29:1 (Table 2).

Results obtained in 2010. The highest average annual yield in the second year was 9,413.69 kg/ha *Salviae folium* fresh matter; after drying, the highest average annual yield was 3,000.69 kg/ha *Salviae folium* dry matter, obtained in the experimental variant V_4 – "Leaf fertilization with Tecamin Max, 3 l/ha + Peat fertilization with 10,000 l/ha".

In the second year, *Salvia officinalis* L., organically grown in the experimental field, produced in average 7,931.85 kg/ha *Salviae folium* fresh matter; after drying, the result was 2,536.19 kg/ha *Salviae folium* dry matter, with an average rate on drying of 3.13:1 (Table 3).

Table 1. Influence of fertilization on *Salviae folium* yields fresh matter and *Salviae folium* yields dry matter in the first experimental year (2009)

Nr. crt.	Experimental variants	**Yield of *Salviae folium* – fresh matter**			**Yield of *Salviae folium* – dry matter**		
		Yields		**Difference (kg/ha)**	**Yields**		**Difference (kg/ha)**
		kg/ha	**%**		**kg/ha**	**%**	
V_1	Control-unfertilized	9,206.41	100	Mt.	2,492.75	100	Mt.
V_2	Peat fertilization, 10,000 l/ha	12,270.58	133.28	3,064.17	3,471.42	139.26	978.67
V_3	Leaf fertilization with Tecamin Max, 3 l/ha	16,272.10	176.75	7,065.69 **	4,407.74	176.82	1,914.99 **
V_4	Leaf fertilization with Tecamin Max, 3 l/ha + Peat fertilization with 10,000 l/ha	15,973.93	173.51	6,767.52 **	4,432.84	177.83	1,940.09 **
Average		**13,430.75**	**DL 5% = 3,738.73 kg/ha / 40.61% DL 1% = 5,376.49 kg/ha / 58.40% DL 0.1% = 7,907.57 kg/ha / 85.89%**		**3,701,19**	**DL 5% = 980.08 kg/ha / 39.32% DL 1% = 1,409.40 kg/ha / 56.54% DL 0.1% = 2,072.91 kg/ha / 83.16%**	

Table 2. Influence of fertilization on *Salviae herba* yields fresh matter and *Salviae herba* yields dry matter in the first experimental year (2009)

Nr. crt.	Experimental variants	**Yield of *Salviae herba* – fresh product**			**Yield of *Salviae herba* – dry product**		
		Yields		**Difference (kg/ha)**	**Yields**		**Difference (kg/ha)**
		kg/ha	**%**		**kg/ha**	**%**	
V_1	Control-unfertilized	13,561.39	100	Mt.	3,948.46	100	Mt.
V_2	Peat fertilization, 10,000 l/ha	17,438.32	128.59	3,876.93 *	5,324.88	134.86	1,376.42 *
V_3	Leaf fertilization with Tecamin Max, 3 l/ha	20,431.64	150.66	6,870.25 **	6,609.88	167.40	2,661.42 ***
V_4	Leaf fertilization with Tecamin Max, 3 l/ha + Peat fertilization with 10,000 l/ha	21,482.39	158.41	7,921.00 ***	6,362.53	161.14	2,414.07 ***
Average		**18,228.43**	**DL 5% = 3,259.63 kg/ha / 24.04% DL 1% = 4,687.52 kg/ha / 34.57% DL 0.1% = 6,894.26 kg/ha / 50.84%**		**5,561.44**	**DL 5% = 1,101.28 kg/ha / 27.89% DL 1% = 1,583.70 kg/ha / 40.11% DL 0.1% = 2,329.26 kg/ha / 58.99%**	

In 2010, the highest average annual yield of *Salviae herba* fresh matter, was 10,778.39 kg/ha; after drying, the highest average annual yield was 3,880.80 kg/ha *Salviae herba* dry matter obtained in the experimental variant V_4 – "Leaf fertilization with Tecamin Max, 3 l/ha + Peat fertilization with 10,000 l/ha".

In the second year *Salvia officinalis* L., organically grown in the experimental field, produced in average 9,651.19 kg/ha *Salviae herba* fresh matter; after drying, the result was 3,201.08 kg/ha *Salviae herba* dry matter, with an average rate on drying of 3.03:1 (Table 4).

Results obtained in 2011. In 2011, the highest average annual yield of *Salviae folium* fresh matter was 9,787.31; kg/ha; after drying, the highest average annual yield was 2,978.49 kg/ha *Salviae folium* dry matter, obtained in the experimental variant V_4 – "Leaf fertilization with Tecamin Max, 3 l/ha + Peat fertilization with 10,000 l/ha”.

Salvia officinalis L. organically grown in the experimental field of Moara Domnească, produced in average 8,154.46 kg/ha *Salviae folium* fresh matter; after drying, the result was 2,412.95 kg/ha *Salviae folium* dry matter, with an average rate on drying of 3.42:1 (Table 5).

In the third year the highest average annual yield of *Salviae herba* fresh matter, was 7,770.39 kg/ha, after drying, the highest average annual yield was 2,917.96 kg/ha *Salviae herba* dry matter obtained in the experimental variant V_4 – “Leaf fertilization with Tecamin Max, 3 l/ha + Peat fertilization with 10,000 l/ha”.

Table 3. Influence of fertilization on *Salviae folium* yields fresh matter and *Salviae folium* yields dry matter in the second experimental year (2010)

Nr. crt.	Experimental variants	Yield of *Salviae folium* – fresh matter			Yield of *Salviae folium* – dry matter		
		Yields		Difference (kg/ha)	Yields		Difference (kg/ha)
		kg/ha	%		kg/ha	%	
V_1	Control-unfertilized	5,799.62	100	Mt.	1854.54	100	Mt.
V_2	Peat fertilization, 10,000 l/ha	7,700.86	132.78	1,901.24	2,451.80	132.21	597.26
V_3	Leaf fertilization with Tecamin Max, 3 l/ha	8,813.21	151.96	3,013.59 *	2,837.75	153.02	983.21 *
V_4	Leaf fertilization with Tecamin Max, 3 l/ha + Peat fertilization with 10,000 l/ha	9,413.69	162.32	3,344.07 *	3,000.69	161.80	1,146.15 **
Average		**7,931.85**	**DL 5% = 2,435.20 kg/ha / 41.99% DL 1% = 3,501.94 kg/ha / 60.38% DL 0.1% = 5,150.55 kg/ha / 88.81%**		**2,536.19**	**DL 5% = 713.41kg/ha / 38.47% DL 1% = 1,025.92 kg/ha / 55.32% DL 0.1% = 1,508.90 kg/ha / 81.36%**	

Table 4. Influence of fertilization on *Salviae herba* yields fresh matter and *Salviae herba* yields dry matter in the second experimental year (2010)

Nr. crt.	Experimental variants	Yield of *Salviae herba* – fresh matter			Yield of *Salviae herba* – dry matter		
		Yields		Difference (kg/ha)	Yields		Difference (kg/ha)
		kg/ha	%		kg/ha	%	
V_1	Control-unfertilized	6,998.45	100	Mt.	2272.81	100	Mt.
V_2	Peat fertilization, 10,000 l/ha	10,791.17	154.19	3,798.72	3,347.08	147.27	1,074.27 *
V_3	Leaf fertilization with Tecamin Max, 3 l/ha	10,036.77	143.41	3,038.32	3,303.63	145.35	1,030.82 *
V_4	Leaf fertilization with Tecamin Max, 3 l/ha + Peat fertilization with 10,000 l/ha	10,778.39	154.01	3,779.94	3,880.80	170.75	1,607.99 **
Average		**9,651.19**	**DL 5% = 4089.94 kg/ha / 58.44% DL 1% = 5881.55 kg/ha / 84.04% DL 0.1% = 8650.41 kg/ha / 123.60%**		**3201.08**	**DL 5% = 963.19 kg/ha / 42.38% DL 1% = 1385.12 kg/ha / 60.94% DL 0.1% = 2037,19 kg/ha / 89.63%**	

Salvia officinalis L., organically grown in the experimental field, produced an average of 6,099.35 kg/ha *Salviae herba* fresh matter; after drying, the result was 2,253.02 kg/ha *Salviae herba* dry matter, with an average rate on drying of 2.72:1 (Table 6). It is remarkable the experimental variant V_3 – “Leaf fertilization with Tecamin Max, 3 l/ha”, with the average multiannual yield of 11624.21 kg /ha *Salviae folium* fresh matter (Fig. 1). The average multiannual yield was mainly influenced by the yield of the first experimentation year (2009); after drying, the highest average multiannual yield was 3,407.99 kg/ha *Salviae folium* dry matter (Fig.2). The highest average multiannual yield was 13,343.72 kg/ha *Salviae herba* fresh matter (Figure 3), after drying, the highest average multiannual yield was 4,387.10 kg/ha *Salviae folium* dry matter (Fig. 4), obtained in the experimental variant V_4 – “Leaf fertilization with Tecamin Max, 3 l/ha + Peat fertilization with 10,000 l/ha”.

Table 5. Influence of fertilization on *Salviae folium* yields fresh matter and *Salviae folium* yields dry matter in the third experimental year (2011)

Nr. crt.	Experimental variants	Yield of *Salviae folium* – fresh matter			Yield of *Salviae folium* – dry matter		
		Yields		Difference (kg/ha)	Yields		Difference (kg/ha)
		kg/ha	%		kg/ha	%	
V_1	Control-unfertilized	5,435.28	100	Mt.	1,473.89	100	Mt.
V_2	Peat fertilization, 10,000 l/ha	8,145.44	149.86	2,710.16 **	2,455.57	166.60	981.68 **
V_3	Leaf fertilization with Tecamin Max, 3 l/ha	9,787.31	180.07	4,352.03 ***	2,978.49	202.08	1504.60 ***
V_4	Leaf fertilization with Tecamin Max, 3 l/ha + Peat fertilization with 10,000 l/ha	9,249.80	170.18	3,814.52 **	2,743.84	186.16	1269.95 ***
Average		**8,154.46**	**DL 5% = 1,813.69 kg/ha / 33.37% DL 1% = 2,608.18 kg/ha / 47.99% DL 0.1% = 3,836.03 kg/ha / 70.58%**		**2,412.95**	**DL 5% = 588.45kg/ha / 39.93% DL 1% = 846.22 kg/ha / 57.41% DL 0.1% = 1,244.60 kg/ha / 84.44%**	

Table 6. Influence of fertilization on *Salviae herba* yields fresh matter and *Salviae herba* yields dry matter in the third experimental year (2011)

Nr. crt.	Experimental variants	Yield of *Salviae herba* – fresh matter			Yield of *Salviae herba* – dry matter		
		Yields		Difference (kg/ha)	Yields		Difference (kg/ha)
		kg/ha	%		kg/ha	%	
V_1	Control-unfertilized	4,095.80	100	Mt.	1,466.36	100	Mt.
V_2	Peat fertilization, 10,000 l/ha	5,747.01	140.31	1,651.21 **	2,136.45	145.70	670.09 **
V_3	Leaf fertilization with Tecamin Max, 3 l/ha	6,784.18	165.64	2,688.38 ***	2,491.29	169.90	1,024.93 ***
V_4	Leaf fertilization with Tecamin Max, 3 l/ha + Peat fertilization with 10,000 l/ha	7,770.39	189.72	3,674.59 ***	2,917.96	198.99	1,451.60 ***
Average		**6,099.35**	**DL 5% = 856.29 kg/ha / 20.91% DL 1% = 1,231.39 kg/ha / 30.06% DL 0.1% = 1,811.09 kg/ha / 44.22%**		**2,253.02**	**DL 5% = 422.20 kg/ha / 28.79% DL 1% = 607.14 kg/ha / 41.40% DL 0.1% = 892.96 kg/ha / 60.90%**	

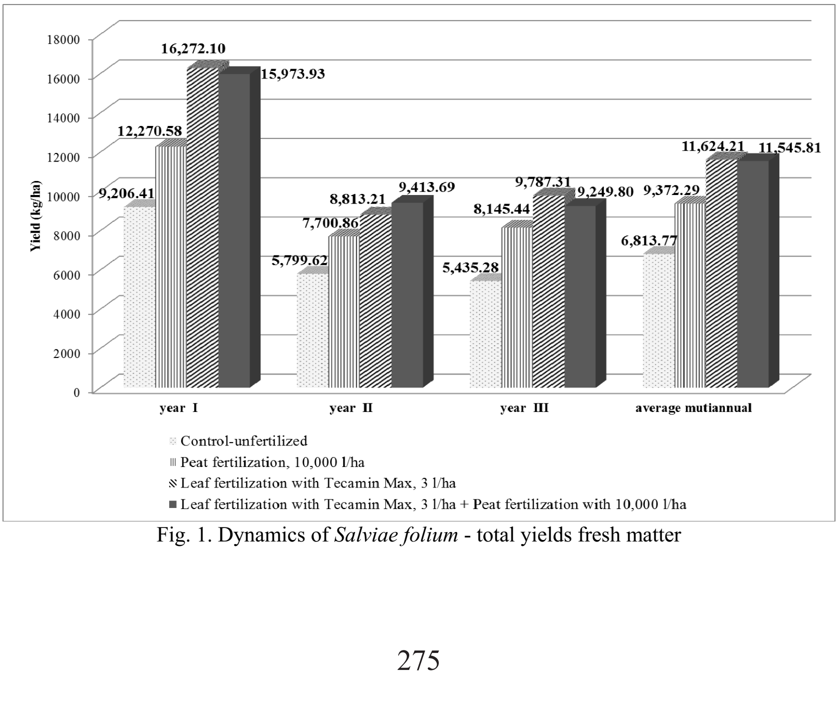

Fig. 1. Dynamics of *Salviae folium* - total yields fresh matter

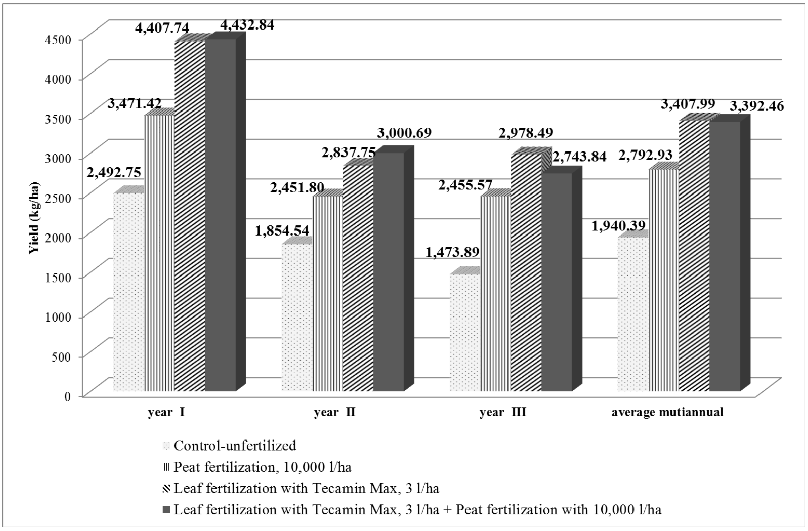

Fig. 2. Dynamics of *Salviae folium* – total yields dry matter

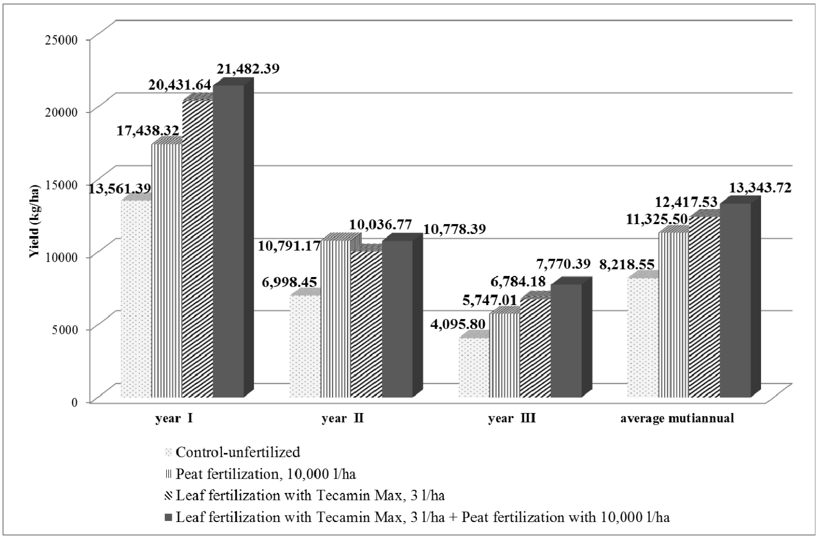

Fig. 3. Dynamics of *Salviae herba* – total yields fresh matter

Yield quality. The *Salviae herba* yield quality, air dried matter, resulted in the pedoclimatic conditions of Moara Domnească, was represented by: 4.37% moisture, 95.63% dry matter and 2.11% volatile oil.

A decreasing content in volatile oil was noted in the experimental variants that had been treated with fertilizers. The application of organic fertilizers favoured no accumulation of volatile oil in *Salviae herba* product; however, higher yields were obtained, which can supply singificantly higher amounts of volatile oil.

The average production of volatile oil in *Salviae herba*, dry matter, was 49.78 l/ha. The highest yields of volatile oil resulted from the experimental variant V_4 – "Leaf fertilization (Tecamin Max, 3 l/ha) + Peat fertilization (10,000 l/ha)", i.e. 64.23 l/ha, while the lowest yield of volatile oil was recorded in variant V_1 – "Control-unfertilized" (34.49 l/ha), even though the percentage of volatile oil in this variant was 2.24%. In the variant V_3 – "Leaf fertilization with Tecamin Max, 3 l/ha", the amount of volatile oil was 56.16 l/ha, 8.07 l less than the experimental variant V_4 – "Leaf fertilization with Tecamin Max, 3 l/ha + peat fertilization with 10,000 l/ha" and 12.74 l more than the variant V_2 – "Peat fertilization, 10,000 l/ha", where the yield of volatile oil was 43.42 l/ha.

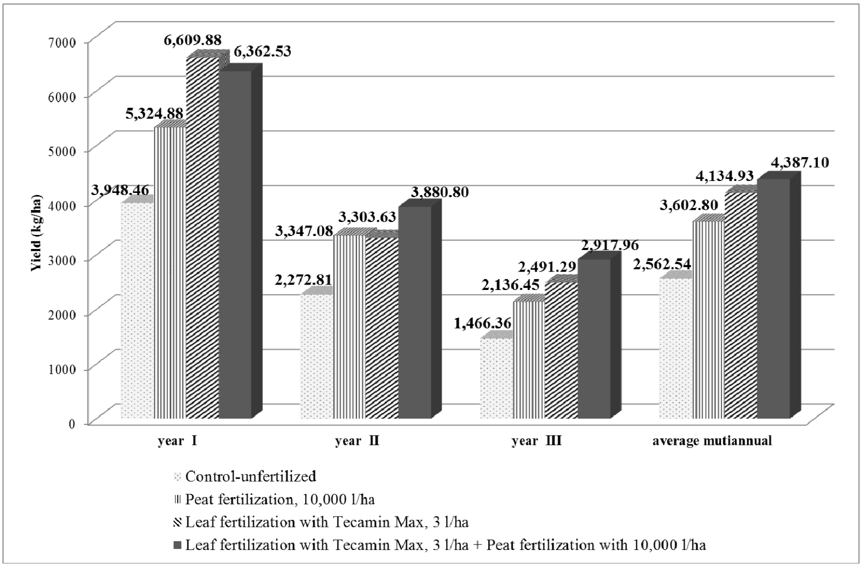

Fig. 4. Dynamics of *Salviae herba* – total yields dry matter

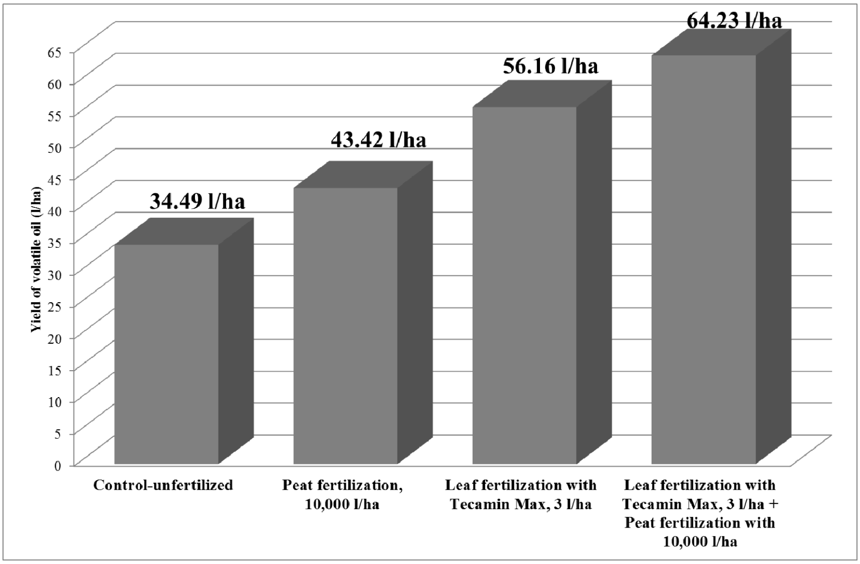

Fig. 5. Average essential oil yields (l/ha) at *Salviae herba*

CONCLUSIONS

The research carried out in the period 2009-2011 on *Salvia officianalis* L. species grown in organic agriculture conditions and under the influence of the organic fertilizers, resulted in the following conclusions:

- The area from South Romania, situated on a reddish preluvosoil where research was performed meets favourable conditions for the growth and development of *Salvia officinalis* L. species, both in terms of climate and soil characteristics. Therefore, this species can be grown in organic agriculture condition.
- *Salvia officinalis* L. plants grown in organic agriculture conditions recorded a positive reaction to the tested organic fertilizers, i.e. peat and Tecamin Max (leaf fertilizer) i.e., both fertilizers accepted in organic agriculture system. The reaction of the *Salvia officinalis* L. species to fertilization resulted in important yield increase (statistically assured from significant to highly significant), compared with the unfertilized plants.
- The application of organic fertilizers favoured no accumulation of volatile oil in the *Salviae herba* product; however, a higher amount of plant biomass was obtained, which can supply significantly higher amounts of volatile oil.

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MANAGEMENT OF ORGANIC WASTE IN CONTEXT ENVIRONMENT PROTECTION

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Abstract

Management of organic waste is a difficult, complex and intractable in Moldova, according to international standards. Acute problem of organic matter from livestock sector waste is generated by storing them in unauthorized areas. Organic waste management strategies require different methods. One of them is organic waste bio conversion technology by worm's cultivation. Wormculture is biological method converting the organic wastes with the help of worms (wormgrowing), which use organic wastes as food and vital environment. Before, organic wastes must be held to fermentation, in order to regulate the level of active acidity and of the content of azoth – ammoniac. The investigation performed bellow has the goal of showing how the ecological situation can be improved through wormculture, meaning the bioconversion of organic offal. This can be achieved by obtaining valuable organic fertilizers and ecological agricultural production by wormculture. Tecnology of wormculture included: the preparation of nutritional substratum; the production of worm's compost and wormculture; the utiluzation of worm's compost. The object of technology: the complexe bioconversion of wastes; obtaining organic enrichemnts with long-time action; the reanimation of damaged soils; the growth of the agricultural production; obtaining ecological production; the protection of the environment. In order to improve the ecological, sanitary-veterinary, epidemiological and epizootic situation, the bioconversion of organic wastes through wormculture method is strongly recommended.

Key words: *earth worm, nutrient substrate, organic wastes, wormculture, worm's compost.*

INTRODUCTION

Organic waste management includes all activities of collection, transport, treatment, and recovery of waste disposal. Principles of sustainable development and recycling of waste management is reflected by: prevention, and reversing the growth slow down provides waste generation the rate of, reuse and recycling means using waste as secondary raw materials or without Auxiliary (reuse) processing or with further processing (recycling) of waste recovery is to extract material values inclusive using combustible fraction of waste as alternative fuel, eliminating what is inhumation in landfills components that can not be recovered [3].

Effective planning of waste management is based on morphological composition including solid organic waste and the animal. Management system animal waste include: pastures and farms, where animal manure are left to decompose on land and are not collected, stored and used, scattering or dispersion which provides daily animal waste collection and subsequent scattering, regularly on the field; in solid form storage in animal droppings are collected and stored in solid form for a long time before being stored pens where manure formats are allowed to dry as periodically removed in the dry state and used by destination, liquid systems represented by artificial basins where manure in liquid form or suspension are stored over six months and more, is then applied on the land, anaerobic lagoons or ponds which are systems that use water for transporting livestock manure to lagoons/ponds, which are held by 30 to 200 days, and water can be recycled or used for irrigation and fertilization of agricultural land, storage and preservation in pits where liquid manure comes from growing pigs are kept for more than 30 days before the used [7].

Realization of adequate management of waste which have objective both for reduction volume of waste obtained and reuse as a maximum is priority of environmental problems. The main objectives in managing organic waste is recovered and neutralization. Technology of wormculture is effective method of solving the main objectives in the management of organic waste.

The successful realization of waste management is necessary: public awareness about the danger to health from inadequate waste management, proactively in practice selective collection and stimulate economic activity and Waste Management [4].

The above demonstrates that organic waste processing is a current problem and perspective. Currently the world are developed methods and technologies for future bioconversion process of organic waste. One of these methods is the processing of organic waste by worm culture. Biological worm cultivation is the method processing of organic waste with rhyme (worm culture), using as food and living environment of livestock organic waste and plant growing. Previously, organic waste should be subject to fermentation, to regulate active acidity levels of nitrogen and ammonia.

It is known that worm cultivation technology plays an important role in solving the acute problems of the environment and organic farming.

Technology of bioconversion of organic waste by worm culture is based on biological capacity the rhyme of the solid fraction of organic waste used as substrate and source of nutrients. By using worm cultivation in a relatively short period of time is obtained valuable organic fertilizer (worm's compost), which contribute to increasing crop yields, has a high biological activity, are concentrated a large number of macro-and microelements , stimulating growth, vitamins and others [3, 5, 6].

Technology of bioconversion of organic waste by worm culture is method of perspective for sustainable development of agriculture can be practiced in households with divert property types (public, farmers and private). It involves the use of organic waste, animal waste, plant, which has undergone partial fermentation process [4].

MATERIAL AND METHOD

Study of organic waste management was made under the practical conditions of Technological-experimental station "Maximovca". For recovery and neutralization of organic waste was held territory for worm culture, which included five sections with dimensions 1 m x 50 m for worm cultivation. Each sector was divided into 25 sections with dimensions of 1m x 2m. Research materials were served cattle manure, and were under investigation by California red hybrid rhyme (Eisenia foetrida andrei), biotransformed of organic waste.

In sectors prepared for the recovery and disposal of organic waste, which was initially placed 5-7 cm layer of straw and then 125 tons of organic waste, in recital 25 tons or one ton at each sector. Organic waste used as a nutrient substrate in advance for six months, were subjected to fermentation. Nutrient substrate thickness for worm cultivation. Sector was 25-35 cm. In the course of a month in the sectors of food substrate were sprayed for a week-daily and then once a week. After the spraying, the substrate prepared for worm cultivation was tested for analysis performed by the purpose of determining the quality and nutritional value. Initially and during experimental both, nutrient nutrition substrate used for worm culture and in the final product (worm's compost) obtained as a result of organic waste of bioconversion were determined following indices: active acidity (pH), ammonia nitrogen content, total nitrogen, organic matter, potassium, calcium, magnesium, phosphorus and bacterial flora (Table 1).

Also for determining the quality of nutritional substrate was used the test "50 rhymes". According to test, a box of dimension 50 cm x 50 cm were placed 3 kg of nutrient substrate, and in it were placed 50 rhymes. If within 24 hours rhymes do not leave the substrate and they are active, then it is confirmed that nutritional substrate is beneficial for worm cultivation [7]. Initially, and during the experimental period, was made weighing of organic waste used for worm cultivation, and at the end of the experiment - obtained worm compost.

In prepared nutritive substrate was placed worm culture (rhymes), reasons 50 thousand mature individuals at a station. The experiment was six months. During experimental nutrient substrate was sprayed with water (to the extent necessary). Sectors for worm cultivation were covered with straw in order to reduce the evaporation.

After 30 days of the beginning of the experiment, then every 15 days sectors was carried additional nutrition of worm culture. During the experimental period to make an additional nutrition were used 50 kg of nutrient substrate. Adding additional food was held 12 times. So, in a section were added 600 kg of nutrient substrate addition, and in an area 15 tons. In general, the experimental period was used 200 tons of organic waste [1, 2].

Analysis of nutrient substrate quality and of worm's compost was performed according to the methods listed below: active acidity - with pH-meter, total nitrogen - using the Kjeldahl method, ammonium nitrate, calcium, phosphorus, and potassium - according E.Petuhova.

RESULTS AND DISCUSSIONS

Experiment on the organic waste management in practical conditions of Technological-Experimental Station "Maximovca" started in april and lasted six months. In the experiment for the recovery and neutralization of organic waste were used 200 tons of cattle manure. At the initial stage and during the experimental period were collected samples of nutrient substrate, where they underwent biochemical analysis to determine the quality of organic waste used for worm cultivation. From making multiple analyzes of nutrient substrate, it was found that all parameters are the same requirements set forth in bio conversion technology of organic waste by cultivation of worms. Results are presented in Table 1.

As a result of analyzes it was found that basic nutritional value and substrate parameters used in additional nutrition, prepared for worm cultivation corresponding the values admissible provided by worm cultivation technology, except for maximum the values of some parameters.

Analysis of the results on the quantity of organic waste recovered in the experiment has been found that during the six months were processed by worm cultivation 200 tons of organic waste. Originally used for worm cultivation five sectors were placed 125 tons of nutrient substrate and when making additional nutrition during the experiment were placed in sectors 75 tons of organic waste.

Table 1. Chemical composition of the nutrient substrate

No	Indices	Values admisibile M ± m	Values obtained in nutrient substrate, M ± m	
			minimum	maximum
1	Active acidity (pH), units	7.57 ± 0.08	6.80 ± 0.06	7.20 ± 0.08
2	Ammoniacal nitrogen, mg / kg	5.56 ± 0.57	4.30 ± 0.09	17.00±0.57
3	Total nitrogen, %	0.83 ± 0.63	0.81 ± 0.12	3.00 ± 0.63
4	Organic substanc, %	30.35±0.60	30.00±0.56	40.00±0.60
5	Magnesium, %	1.17 ± 0.52	0.50 ± 0.11	2.50 ± 0.52
6	Phosphorus (P_2O_5), %	0.65 ± 0.32	0.60 ± 0.08	2.50 ± 0.32
7	Potassium (K2O), %	0.68 ± 0.01	0.20 ± 0.01	1.50 ± 0.01
8	Calcium, %	0.55 ± 0.35	0.50 ± 0.09	4.00 ± 0.35

So, during the experiment on the farm Technological - Experimental Station "Maximovca" were recovered a considerable amount of organic waste.

As a result of bio conversion technology use by worm cultivation of waste was obtained valuable organic fertilizer - worm's compost. The quantity and quality depended on the quality of nutritional substrate. The literary sources mentioned that a tonne of organic substances are produced 400-600 kg of worm's compost [5]. The quantity of worm's compost obtained in the experiment was about 124 tons. Thus, the share of worm's compost obtained from a ton of organic waste in the experiment was 62%.

The worm's compost is one of the final products of bio conversion of organic waste by worm cultivation. It consists of small granules of dark brown color, no smell, is hygroscopic and can be stored in dry years without losing its qualities.

In Table 2 are exposed worm's compost quality indices of the result obtained by worm cultivation organic of waste management.

Comparing values of worm's compost with initially nutrient substrate found that active acidity, content of total nitrogen, calcium, magnesium, potassium and phosphorus in the fraction 0.25 of worm's compost is obtained exceed that of the nutrient substrate, respectively 3.17%; 31.33%; 12.70% from 3.82 times to 2.11 times, and 1.0 mm fraction, respectively 6.74%, to 3.61 times, 6.90 times, 2.14 times, 3.67 times and 3.84 times.

Table 2. Quality indices of worm's compost obtained from cattle manure

No	Indices	Fractions and values of worm's compost, M ± m	
		Fraction, 0.25 mm	Fraction, 1.00 mm
1	Active acidity (pH), units	7.81 ± 0.03	8.08 ± 0.02
2	Organic substance, %	24.39± 0.45	27.41± 0.41
3	Total nitrogen, %	1.09 ± 0.01	3.00 ± 0.04
4	Potassium (K_2O), %	1.92 ± 0.02	2.50 ± 0.03
5	Magnesium, %	1.18 ± 0.03	2.50 ± 0.04
6	Phosphorus (P_2O_5), %	1.37 ± 0.08	2.50 ± 0.06
7	Calcium, %	0.62 ± 0.02	3.80 ± 0.05
8	Humus, %	29.66± 1.40	35.91± 1.90
9	Nonpathogenic bacterial flora, colonies	$2x10^{12}$	$2x10^{12}$

Organic matter content decreased in the fractions investigated, respectively 19.64% and 9.69%. The results of the investigations it was found that worm's compost contains 100 times more non-pathogenic microflora ($2x10^{12}$ colonies) than regular compost.
In the worm's compost is well-balanced content of macro-and microelements which allows the dose reduction by incorporation into the soil of 8-12 times compared with ordinary compost. Effectiveness of the action of worm's compost kept over a period of 3-4 years. In worm's compost are concentrated quantities of enzymes, vitamins and stimulating growth.
According to the results found that worm's compost is superior nutritional substrate. Organic matter during the bioconversion turned into humus.
The worm's compost can be used for cultivation of all agricultural plants, positive impact on their development needs at different stages of vegetation and harvest per unit of surface.
The incorporation into the soil of worm's compost is made considerable savings taking into account that the 6.3 tons per hectare using the worm's compost compared with 40-70 t / ha of traditional compost.
So, bioconversion technology of organic waste by worm cultivation resolves a number of problems that are present in agriculture: of organic waste recovery and neutralization, environmental protection, improving soil fertility, obtaining an ecological agricultural production.

CONCLUSIONS

In the results of the investigations it was found that:
- Bioconversion of organic waste by worm cultivation is one of effective methods in organic waste management.
- Bioconversion technology of organic waste by worm cultivation resolves a number of problems that are present in agriculture: recovery and neutralization of organic waste, environmental protection, improving soil fertility, obtaining an ecological agricultural production.
- In the worm's compost is well-balanced content of macro-and microelementswhich allows the dose reduction by incorporation into the soil of 8-12 times compared with ordinary compost.

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PRINCIPLES OF ORGANIC AGRICULTURE

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Abstract

In Romania, organic farming has gained more ground being desired, today, by all farmers and also consumers. Most want healthy products without added different chemicals, no additives or pesticides, which could endanger their lives. In this paper discusses the differences between organic farming and conventional farming, given that in 2012 more and more opting for agriculture "bio" or "eco" as they are called now. Even if you do not get the same products as in conventional agriculture issues, the organic agriculture worth because the products have taste, natural color and can be collected at maturity without any problem. Organic farming and organic products that are increasingly used and required both nationally and internationally, being regarded as an opportunity for Romanian export of organic products. As a main conclusion, it is considered that this agriculture could help protect the environment, biodiversity and lead to develop country bringing high-income if the standards are observed.

Key words: *natural, organic, pesticides, products, Romania.*

INTRODUCTION

"Organic agriculture", protected term and attributed of E.U. to Romania to define the agricultural system is similar to the terms of „ecological agriculture" or "biological agriculture" used in other member states [1].
The role of organic farming is to produce pure food, more appropriate to human metabolism, the full correlation with environmental conservation and development. One of the main goals of organic farming is the production of agricultural and food products fresh and authentic, processes designed to respect nature and its systems [2, 6].
In organic farming is not allow to use pesticides, additives, antibiotics, various chemicals, genetically modified organisms, of substances which speed up plant growth. We all saw vegetables and fruits of special sizes, of fantastic colours but, unfortunately bland. This is because vegetables are not mature at the time of collection, although looks ripe. The organic farming represents an important value for Romania and also increases the interest in the countryside [4].
All rules concerning the definition method of production, principles and all the objectives for organic agriculture are found both in community law and national legislation. Because a product can be considered "organic product", producers must complete a rigorous process and comply with specific characteristics, and to be marketed as an "organic products" must undergo a conversion period of two years [5].
In Romania, the control and certification of organic products is currently provided by private inspection and certification bodies. They are approved by the Ministry of Agriculture, Forests and Rural Development, on the basis of independence, impartiality and competence established by Order No. 65/2010 for approving the rules for the system organization of inspection and certification, approving the inspection and certification bodies and inspection the activities of monitoring bodies [15].
Organic agriculture in Romania in recent years known an increasing trend, both in the vegetable and animal production sector.
The most important condition of organic farming is to promote the concept of organic farming for consumers to understand the benefits of organic products. The beneficial effects of organic agriculture are reflected on the environment, on the livestock, on the economy and society [7, 5].
Organic farming involves the *production management system* that promotes and

enhances agro-ecosystems health, including biodiversity, biological cycles and soil biological activity [3].

An organic production system is designed so that:

- to improve the biological diversity from the whole system;
- to increase soil biological activity;
- to maintain long-term soil fertility;
- to recycle wastes of plant and animal, restore soil nutrients, thus minimizing the non-renewable resources;
- be based on renewable resources that can be organized locally in agricultural systems;
- to promote healthy use of soil, water and air and minimize all forms of pollution wich results from agricultural activities;
- to handle agricultural products with an emphasis on careful processing methods to maintain organic integrity and vital qualities of the products at all stages;
- to be stable in any farm in a period of transformation, the corresponding duration of which is determined by specific local factors as history of land, type of crops and livestock produced [2, 3].

Organic market

Organic products market has greatly expanded from 1990 until now, U.S.A. is currently the largest market for organic products. In Romania, being a developing country, organic market is still small, but there were registered increases. In E.U. the most important policy on organic agriculture is the European Action Plan for Organic Agriculture and Food Products started in 2004 by the European Commission.

They want to develop as much organic agriculture and three important steps are followed:

1. increasingly organic market development;
2. improve existing standards on organic agriculture;
3. stronger support for organic agriculture for rural development increased [14].

Also need to be realized a support of consumers and should be informed more about the existing organic products by providing information and by publicity about organic products [6].

For example, *traceability* is a very important part for certification of organic products, but is not perceived as an obstacle to producing and certification of organic products. Organic products must have a label on them stating that they are really produced under organic production methods. In 2001 the U.E. introduced a voluntary labelling organic logo (Fig. 1) [8].

Fig.1. U.E. mark for organic products [8]

Certification of a organic products not consist only to look at the product and testing it, but also consist in documentation and control the entire process of production [16].

In Romania, areas under organic system evolved in 2008. The most important cultivated plants are cereals, vegetables, forage plants, oilseeds and organic area cultivated in 2008 was 140,132 ha (Fig. 2 and Fig. 3) [16].

Organic products market was and is still influenced by the offer, first brought to market organic products are small farmers. Also meet obstacles in buying organic products. The main obstacles are the prices, underperforming and distribution of our products, no information about organic products and doubts that arise about the integrity of organic products.

Organic products are sold at a premium price from the conventional. Another factor that influences the price of organic products is the balance between supply and demand of organic products [4, 9].

Has established six essential conditions for development of markets for organic products:

1. Large emand;
2. Growing involvement of all food companies
3. International promotion;
4. To be a dominant brand;
5. Sales through supermarkets;
6. Acceptable prices to organic products [4, 6].

The distribution of organic products can be (Fig. 4).

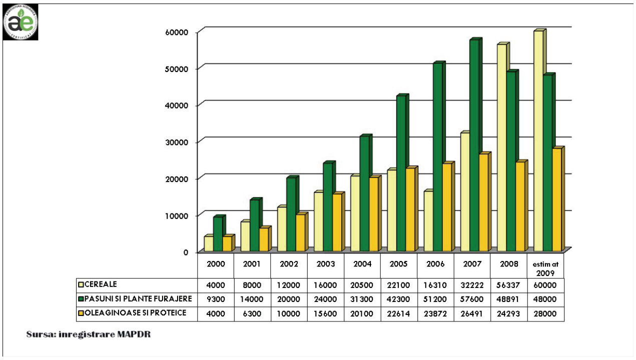

Fig. 2. Structure crops in organic farming (1) [16]
Permanent pasture and forage crops 60,000 ha (20%), cereal with 56,000 ha (18%) and oil and protein by about 30,000 ha (14%), collection and certification of plants and flowers of flora spontaneous 59,000 ha.

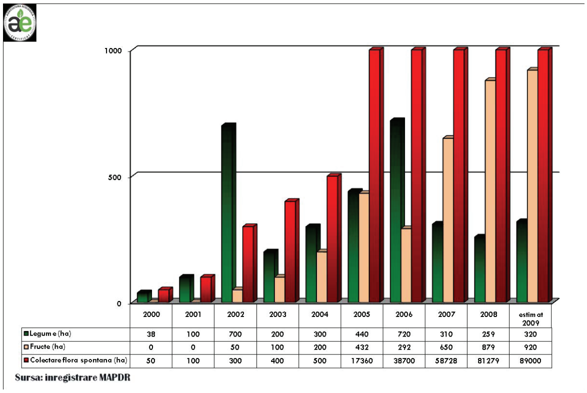

Fig. 3. Structure crops in organic farming (2) [16]

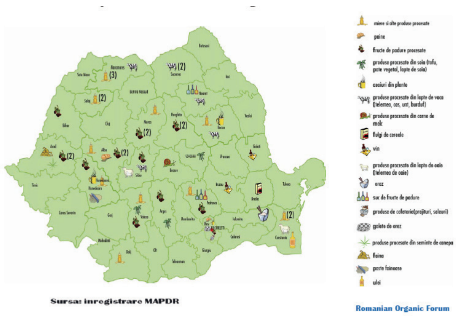

Fig.4. Repartion of the organic foodstuffs (MAPDR)[16]

Principles of organic agriculture

According to the definition proposed by the Codex Committee Food, organic farming is a production management system that promotes and enhances agro-ecosystem health. It further emphasizes the use of management practices of off-farm inputs, taking into account that regional conditions require locally adapted systems.

Organic farming is an alternative to traditional agriculture, following its malfunction and causes that brought down the resistance of plants, animal health and soil quality and thus human health. Organic farming is based, in principle, on increasing soil organic matter content by using natural organic fertilizers [1].

Organic farming is based on the following principles:

- Long-term protection of soil fertility, by maintaining organic matter levels, encouraging biological and careful mechanical intervention;
- Indirect supply of nutrients for crops, using relatively insoluble nutrient sources to the plant reached by the action of soil microorganisms;
- Sufficiency of nitrogen, through legumes biological nitrogen-fixing and efficient

recycling of organic materials, crop residues and manure;

- Biological control of weeds, pests and diseases in particular through crop rotation, predators, diversity, organic fertilizer, resistant varieties, the thermal and chemical interventions as limited;
- Extensive management of livestock, with attention to their evolutionary adaptation, behavioral needs and animal comfort, in terms of nutrition, housing, growth, development and reproduction;
- Special attention to the agricultural system impact on the environment and biodiversity conservation, of wildlife and natural habitats [16].

Objectives of organic agriculture

Organic farming is based on a number of objectives, as well as on best practices designed to minimize human impact on the environment:

- Crop rotation as a premise to effective use of farm resources;
- Limitation with strictly the use of chemical fertilizers and synthetic pesticides because of their potentially harmful effect on the environment;
- Not use genetically modified organisms;
- Encouraging a diverse ecosystem, to maintain soil fertility and control of pests by natural means (such as use of manure as fertilizer from animals and provenders produced on farm);
- Choice of different plant species and animal breeds that are better adapted to local conditions and potential problems related to pests and diseases;
- Livestock in freedom or open shelters and feeding them with organic provenders;
- Use of animal husbandry practices adapted to each race in hand [8].

In conventional farming is practiced especially monoculture their entire agricultural area, crop rotation is greatly reduced, using fertilizers and pesticides widely synthetic while producing a great degradation of soil, pollute nearby streams and endanger extinction some species of birds or insects.

Therefore, it is necessary to change the traditional methods of producing food, injurious to fauna and flora, with other less harmful methods of their organic farming methods promoted [13].

The bio or organic farms put great accent on work with the environment. Obviously the agriculture never can be 100% harmless to the environment, but by bio practice is trying to decrease its negative effects [10].

In our days, manufacturers tend to organic crops from which results products are not so good looking, but are healthy, and keep the smell and the taste specific.

Switching from conventional to organic farming is done gradually, so that economic structures do not feel the effects of decreased productivity, and producers to gain confidence in organic systems.

Thus, to be recognized by the Ministry of Agriculture and Rural Development of Romania, the transition from conventional to organic farming is done by following the conversion period, which the lasts crop production two years for annual crops and three years for crops perennial.

Steps for the transition from conventional to organic agriculture, established by the Ministry of Agriculture and Rural Development officials in Romania and recommended to any willing producer are: information, testing opportunity, conversion planning and implementation of conversion.

The major disadvantage of organic farming is the actual time of plant growth. It is longer, vegetables and fruits being forced to mature. Production costs are lower than when using chemicals [11].

Organic products are more expensive than the conventional products, are difficult to obtain but are the healthiest. Organic farming is the new trend in agriculture and in Romania was expanded rapidly. Consumers are becoming more and more aware of the importance of healthy food and the need to protect the environment [12].

CONCLUSIONS

Organic farming is a better alternative to the conventional, because nonconformities which appear and the causes that brought down the resistance of the plants, quality of soil and also human health. Organic farming refers and is based primarily on soil productivity by using natural organic fertilizers.

The future of agriculture is based on the production of healthy, tasty, optimizing the surroundings, protection of soil pesticides and chemicals, also take care by the food safety. Compared with conventional agriculture is practiced only in monoculture and pesticides and fertilizers used in large amounts, organic farming is gaining more ground as it takes care of the environment, the health of consumers. A disadvantage of organic farming is that the products need more time to growth and also have a higher price compared to the conventional.

The most consumers are aware that the most important is health.

Organic agriculture can also leads to increase incomes and also increase agricultural productivity using technology with reduced costs and required so as to not cause environmental damage.

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THE PREMISES OF ECOLOGICAL AGRICULTURE DEVELOPMENT IN THE REPUBLIC OF MOLDOVA

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Abstract

The purpose of this work is the presentation of premises of ecological agriculture development in the Republic of Moldova. The working methods applied to this study are: analysis and synthesis, as well as other methods and processes which enabled the identification and highlighting essence of the problem investigated. The research denotes a very important result: agriculture is the main economical sector of Republic of Moldova, and it always has played a very important role in the state economy. In this context, agriculture must bring valuable contribution in the state economical development.

Keywords: *ecological agriculture, organic food, ecological production.*

INTRODUCTION

According to the report of the Food and Agriculture Organization of the United Nations (FAO) and World Health Organization, the ecological development of agriculture, natural resources and ecological balance are recognized as priority sectors to solve the problem of global sustainable development. Also, it is mentioned that food security and population health are directly proportional to food quality and natural resources which they depend on (soil, water, air, light, genetic resources, etc.). National concept of ecological agriculture, production and marketing of ecological and genetically unmodified food products is elaborated on the basis of the Decree no. 1287-11 from December 29, 1999 issued by the President of the Republic of Moldova. Unlike the conventional agriculture, ecological agriculture follows the principles of a biotechnology excluding the technologies of industrial origin, and relying exclusively on natural ecological processes. The production activity in ecological agriculture develops using organic fertilizers, cultivating leguminous crops used in crop rotations, controlling diseases and pests using integrated ecological methods, totally excluding the chemicals produced by industry (fertilizers, pesticides, stimulants) and giving up any application of genetic engineering.

MATERIAL AND METHOD

The role of this agricultural system is to produce healthier food, more suitable for human body's metabolism, but also in correlation with environmental conservation and development, using various methods, procedures and techniques. For the purpose of an adequate analysis of commerce with organic food products of Republic of Moldova, it is used a series of methods and proceedings as: analysis, comparative method, analogy and synthesis, observation, grouping, table method and consultation the specialized literature, which allowed researching the topic essence and drawing some conclusions which we consider will present an interest for the sustainable development of the country. In this study, the analyzed period is 2006-2010.

RESULTS AND DISCUSSIONS

Agriculture is the main economical sector of Republic of Moldova, and it always has played a very important role in the state economy. In this context, agriculture must bring valuable contribution in the state economical development.

What is ecological agriculture? Ecological agriculture (which is also classified as organic or biological agriculture) is a modern method of growing plants, fattening livestock and producing food by using those methods and technologies that are very close to the laws of nature - it doesn't use fertilizers and synthetic pesticides, growth regulators and stimulants, hormones, antibiotics and intensive systems of animal breeding [2]. In this regard, ecological agriculture differs fundamentally from conventional agriculture. The process and procedures of obtaining ecological products are regulated by strict rules and principles of production, which begin from taking into consideration the quality the land must have and up to the effective achievement of the final product. The process of transition from conventional to the ecological agriculture is not a short one. This transition is gradual, going through a transitional period, called "conversion period". This is the period when farmers have at their disposal time to adapt their business management to the rules of ecological agriculture.

Ecological agriculture is in full development on the global scale. It is practiced on the all five continents, on an agricultural area of about 26.5 millions of hectares.

Public health and food safety are directly proportional to the quality of food and natural resources. Ecological agro-alimentary production represents a way of sustainable development in agriculture, which allows the efficient resolution of a number of social, ecological and economic problems [1]:

a) social level:

- promoting a healthy alimentation and obtaining the agro-alimentary production on the basis of traditional conditions and experience;
- ensuring food safety and agro-alimentary products quality.

b) ecological level:

- environmental protection;
- protecting, preserving and increasing soil;
- development and use of correct models of animal husbandry;
- conserving natural resources.

c) economic level:

- meeting market needs with ecological agro-alimentary products;
- recommending an alternative source of economic development for rural areas;
- elaborating an agricultural form favorable for national economy.

At the same time, the market of ecological products has the share of 2.5-3% from the total of agricultural products [2]. Some of the main objectives regarding the development of ecological agriculture in the Republic of Moldova are the following:

- performing the evaluation and feasibility study on Moldova's premises to implement the technologies to obtain ecological and genetically unmodified agro-alimentary products;
- drafting national legislation and standards in accordance with international standards in this area;
- elaborating eco-pedological indices necessary to delimit the lands that are suitable to obtain and produce ecological agro-alimentary products;
- implementing the systems of crop rotation, fertilization and anti-erosion protection of soil according to the ecological agriculture standards;
- planting varieties and hybrids with biological plasticity, resistance to diseases and pests;
- integrated monitoring of all segments within the system of ecological agriculture and production of ecological and genetically unmodified food products.

International Market of ecological products is always on the increase. This element has contributed to the ecological agriculture development in the Republic of Moldova and to accelerate the export of agro food products.

Encouraged by the legislation elaborated by the Government of the Republic of Moldova, the Moldavian farmer interest has increased, as well as of the economical agents concerning the organic food production. The ecologically certified areas for ecological agro-alimentary production, constitute about 11,000 ha, and its volume is estimated up to 30,590 tones. The premises of ecological agriculture development in the Republic of Moldova are the following:

1. Ecological conditions of the Republic of Moldova are favourable for the cultivation of a wide range of valuable agricultural crops (horticultural, ethero-oleaginous, etc.).
2. Soil surface with a high productive potential and a great self-purification capacity ensure high and qualitative yields of the listed crops.
3. Satisfactory quality of water resources allows applying irrigation without the danger to pollute the soils and crops or to cause land degradation, and ensures a high quality of the agricultural production.

The national scientific and technical potential is able to provide the necessary scientific support to obtain and produce ecological products.

On December 17, 2010, the national brand "Ecological Agriculture - Republic of Moldova" was officially presented. It will be applied only to those agro-alimentary products that are compliant with the rules of ecological production. The national brand "Ecological Agriculture - Republic of Moldova" is used for labelling and presentation of ecological products and it is applied only to those agro-alimentary products that were inspected and certified throughout the production cycle by inspection and certification bodies authorized by the Ministry of Agriculture and Food Industry.

Organic food production areas of the Republic of Moldova, ecologic certified, from about 11 thousand hectares, which volume is estimated at 30,590 tones.

Organic food production is at the global scale. It is practiced in about 154 countries from all the continents, on about 31,584,720 ha, out of which 42.9 % in Oceania (Australia), 23.8 % in Europe, 23.5 % in Latin America, 5.5% in North America, 2.8 % in Asia and 1.6% in Africa.

In Europe, at present, there are cultivated about 7.6 million ha with ecological crops, in about 178 940 farms, of which Austria 12%, 9%, Finland 7.22%, Italy 6.86%, Sweden 6.8%, Greece 6.24%, Denmark 6.2%, Czech Republic 5.97 %, Estonia 4.59%, Slovenia 4.6%, Great Britain 4.42%, Germany 4.3%. The world market of organic food products is about 3.1-4.3%.

In the same time, organic food production is a sustained form of production of food products without those of chemical synthesis usage (insecticides, fungicides, herbicides and mineral fertilizer), which are based on the maintenance of a fertile soil through its fertilization with organic fertilizers, crop rotation and balanced alternation of crops, as well as disease and pest control through biological methods.

The animal ecological production is based on animal health and the methods of farm management, which will prevent the necessity of a veterinary doctor.

Strategically, the qualitative purpose of the sector is the positioning of the ecological agriculture in the centre of the national agriculture, as a pivot for the sustainable development in the rural environment. The main purpose of EU agricultural policy concerning the rural development is the promotion and development of a compatible relation between agriculture and environment [3].

Ecological agriculture has a main contribution to the sustained economical development and has an important role in the improvement of environmental conditions, soil preserving, water quality improvement, bio diversification and nature protection. Thus, promoting and developing the ecological agriculture could be a starting point in the rural economy and to make it viable through the extension economical activities with high value added and through generation of jobs in rural zones. Quantitative purpose is to extend the cultivated zone through ecological methods and creating an inner market with ecological products. The republic of Moldova has great opportunities of ecological agriculture promotion and development due to an agricultural area of about 1.8 million hectares and of unpolluted soils.

For the Republic of Moldova, organic food production and its commercialization represent a real chance to penetrate foreign markets which are supersaturated with products from conventional agriculture and endure lack of ecological products. The value-added to the ecological products production and commercialization, together with reduced expenses for their obtaining, allow the income increase amassed by rural communities for solving socio-economical problems in rural zones.

In such a way, the supporting of ecological agriculture promotion and development is a new fundamental element - a rural development policy, meant to encourage numerous rural initiatives, helping, in the same time, the farmers to reorganize their farms, to diversify the product range, as well as to penetrate in different markets. In the last years it increased the inner economical agent's interest concerning organic food production, confirmed by the areas and volume rise of this production.

Pedo-climatic conditions of the Republic of Moldova are favourable for cultivating a wide range of agricultural crops having both ecological and biological value (vegetables, fruits, grapes, ethero-oleaginous plants etc.).

Thus, the efficient use of existing priorities: fertile and productive soil, moderate use of synthetic chemical plant protection products and related technologies, gives the possibility for Moldovan traditional agriculture to create conditions for the development of ecological agro-alimentary products.

At the same time, the qualitative purpose foresees the organic food production placement in the centre of Moldavian agriculture as a factor of its sustainable development. So, the main parameters which can be mentioned are the producers' growing number, as well as organic food production volume predestined for local market development and the penetration of markets at the exportation of these products.

In order to achieve sustainable development of the agro-ecological sector and to improve the competitiveness of ecological products both on local and export markets, there was elaborated a table that shows volume increase of ecologically certified vegetal products on the period 2009-2015 [5] (Table 1).

For promoting the trade with foods it is necessary to apply the systems of organic food production and of alternative systems to conventional agriculture which differ through the reduction of industrial pressures on the ecosystem. It is necessary to mention from the beginning that in the globe poor areas which face serious problems of food safety, practically, we cannot talk about an alternative agriculture when even the traditional one does not function at the appropriate level.

Table 1. Prognostic regarding volume increase of ecologically certified vegetal products

	Measuring unit	**Years**	
		2009 real	**2015** prognostic
Total quantity *(of which:)*	Tones	24,546	98,488
Cereals	Tones	13,860	31,460
Oleaginous and proteic	Tones	4,146	16,450
Beekeeping products	Tones	10	75
Fruits (cherries, sweet cherries, apricots)	Tones	280	750
Berries, mushrooms	Tones	450	850
Other crops	Tones	5,800	48,903

For the Republic of Moldova the necessity of lifting the living standards through satisfaction with cheap foods oblige the intensification of traditional agriculture; and the European integration context impose the conversion to an alternative agriculture, by complying with the Community legislation.

In these conditions going on with the development of intensive agriculture by using all the possibilities in starting organic food production. Regardless of these two directions, the promotion of ecological agriculture implies the organization of a series of measures starting with the producer and ending with the consumer. It already has proved the beneficial influence of producers associations of ecological products which facilitates their production, processing and commercialization through local and international trade networks.

A contribution to this direction can be the traditional food products re-evaluation and commercialization, for their realization the preparatory measures are easier. It is necessary to mention the fact that, in the developing conditions of the Republic of Moldova, the ecological product, offered both by “supermarket” network as well as by local agricultural market, can bring important contributions to the increase of these products attractiveness.

For sustainable development of agro ecological sector and for improving ecological products competitiveness on the local and export markets it should be identify and implement the following measures:

- Recovery and development of ecological and biological value-added (EBVA) component at the national level, by the orientation of production to the consumers demand, primary products commercialization and those intended for processing.
- Local market development, as well as promoting ecological products for exportation by covering the existing market niche, also identifying a new export market and consolidating the existing markets.
- Creating producers and processors associations for the production and markets extension.

The advantages of ecological agriculture in the Republic of Moldova are the following:

- air, water and less contaminated agro-alimentary products;
- safe working conditions for farmers;
- biodiversity;
- fertile and healthy soil;
- reduced soil erosion;
- efficient use of water;
- nutritional quality of the ecological products;
- environmental protection;
- reduced use of non-renewable resources;
- reduced farmers risks;
- protecting future generations.

As disadvantages of ecological agriculture in the Republic of Moldova we can mention:

- low yields;
- the cost for ecological products valorification is higher than the one for conventional products;
- necessity to support ecological agriculture;
- ecological products are often suspected to be toxic;
- certain agricultural products sometimes lack organoleptic characteristics (appearance, taste);
- existence of false ecological products on the market;
- control and certification process must be improved;
- lack of research and extension systems for ecological agriculture.

The development system of organic food exportation consists in: economical agents from agro food production may be part of the second system, even if they do not have the necessary logistics or are not enough informed about the existing links between the trade networks.

Ecological products exportations are designed for importing product enterprises or wholesale importers. It is very important to make the correct choice of commercial partner, because the enterprise success is specially based on importer's reputation, as well as on his ability to commercialize the product on that market. The chosen partner must offer, among others, correctness and professional integrity guarantees, because these human qualities are essential for duration and association success formed by exporter and importer.

CONCLUSIONS

Ecological agriculture makes a great contribution to long-term economic development and plays an important role in improving environmental conditions, soil preservation, water quality improvement, biodiversity development and nature protection. In order to develop the agro-ecological sector and to improve the competitiveness of ecological products on the export markets, the following conditions must be identified and implemented:

1- establishing and maintaining the value chain by orienting the production and sales towards primary products and processed products as well as promoting local ecological products for export;
2- creating an appropriate system of production, processing and marketing for the ecological products designed to meet the needs of internal and external markets;
3- promoting the export of local ecological products by developing the research activity and improving professional training of all the persons involved in the ecological sector;
4- creating organized groups of producers to enlarge the production and market. Strategically, the qualitative objective of this sector consists in positioning the ecological agriculture at the heart of

national agriculture, as a basis for long-term development of rural areas.

Maintenance of local offer of agricultural products implies the increasing the assortment of plant and animal production. In order to diminish the existing gap between plant production and average outputs of cereal, technical, fruit and vegetable growing crops acquired from country with those registered in worlds states, it is necessary to modernize these branches by technical endowment of agricultural entities, irrigation extension, optimization of agricultural establishment structures and the increase of the range of cultivated agricultural crops, creating the supply units with modern and qualitative inputs for agriculture and those of agricultural products collection.

Republic of Moldova has a number of favourable conditions for organic agriculture development: the proximity of the biggest consumer of organic products - EU, farming land with a low chemical, lack of harmful chemical industries, processing food industry relatively well developed, a high interest from outside and a developing the legislative framework.

For increasing the quality of export offers it is necessary to continue the implementation of quality management systems HACCP, ISO, EUROGAP in order to correspond to the European quality standards and food safety.

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RESEARCH ON THE PRODUCTIVITY AND YIELD QUALITY OF MAIZE (*ZEA MAYS* L.) – PUMPKIN SPECIES (OIL PUMPKIN – *CUCURBITA PEPO* VAR. *OLEIFERA* L., MUSK PUMPKIN – *CUCURBITA MOSCHATA* DUCH.) INTERCROPPING, IN THE ORGANIC AGRICULTURE SYSTEM

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Abstract

The paper researches the productivity and yield quality of maize and two species of pumpkin (for instance oil pumpkin and musk pumpkin), in the intercropping system, in order to evaluate their adaptability to the natural conditions of South Romania and to organic cultivation. The experiments were carried out between 2007 and 2009, at Moara Domneasca Experimental Field, on reddish preluvosoil, in randomized variants, in 4 replications. The seeds used for the experiments were of organic type. The maize was sown at 70 cm distance between rows and the pumpkin species were sown in beds, at 1x1 m distance and 3-4 cm depth. When intercropped, the maize had a density of 5 plants/m^2 and the pumpkin species of 2 plants/m^2. The productivity compounds, the land equivalent ratio, the yields and the chemical composition of seeds were determined. The maize grown in monoculture had a yield of 34.25 q/ha. For comparison, the maize intercropped with oil pumpkin produced 31.68 q/ha and the maize intercropped with musk pumpkin had 31.17 q/ha. The oil pumpkin produced a yield of 6.57 q/ha when grown in monoculture; when intercropped, the yield was 2.69 q/ha smaller than when grown in monoculture (40.95%). The musk pumpkin gave 8.09 q/ha when grown in monoculture and produced 4.91 q/ha when intercropped with maize. The seeds from the maize intercropped with oil pumpkin contained 11.70% proteins, 4.98% fats and 66.23% starch and the maize intercropped with musk pumpkin contained 11.34% proteins, 5.08% fats and 66.12% starch. The oil pumpkin seeds in the intercrops had 35.48% proteins, 39.63% fats and 7.25% starch, and the musk pumpkin seeds had 27.66% proteins, 36.23% fats and 7.66% starch. The extension of those crops to a large scale is conditioned by the land weed infestation level and pest control, and also by maintaining and raising agricultural land fertility through organic agriculture measures (incorporation of crop residues; crop rotation with grain legumes; organic manure management).

Key words: *intercropping, organic agriculture, maize, oil pumpkin, musk pumpkin.*

INTRODUCTION

Nowadays, in the developed regions of the world, conventional agriculture, which is more and more pure crop-oriented, modifies landscapes and hurts ecosystems, including biodiversity.

Organic agriculture methods are considered to be more environmentally friendly than intensive agriculture, which is dependent on the routine use of herbicides, pesticides and inorganic nutrient applications in the production of crops and animals. The recent research suggests that organic agriculture results in less leaching of nutrients and higher carbon storage [3], less erosion [6] and lower levels of pesticides in water systems [4, 5].

Intercropping can be seen as the practical application of diversity, competition and facilitation in arable cropping systems. The practice of intercropping maize with other plant species knew a great expansion in Romania in the past years, the statistical data showing over 2000 thousand ha between 1960-1965 and 800 thousand ha in 1985-1989. Also, in our country, there were noticed almost 300 thousand ha of pumpkin intercropped with maize [2].

Besides their nutritional value, pumpkins may have other benefits when intercropped with other species such as maize. Being a prostrate, vining and dense crop, pumpkins have the potential to act as live mulch, suppressing weed germination and growth, and reducing the loss of moisture from the soil, under the cereal canopy [1].

The aim of the research was to study the behavior of some field crops when intercropped in the organic agriculture system and to observe the complementarity between plant species and their yield output, thereby revealing the degree of interspecific competition. Observing how the yield potential and the crop quality are affected by the competition between maize and oil pumpkin or musk pumpkin is also of great interest.

MATERIAL AND METHOD

The research was carried out between 2007 and 2009, in Moara Domneasca Experimental Field, under the pedoclimatic conditions of red preluvosoil area of the central part of the Romanian Plain and in the organic agriculture system. The experiments were organized in blocks, in randomized variants, in 4 replications. The sown area of an experimental plot was 14 m² (width – 2.8 m, length – 5 m). The ecological genotypes subject to experiments were as follows: maize (*Zea mays*) – early hybrid Turda 200; oil pumpkin (*Cucurbita pepo* var. *oleifera*) and musk pumpkin (*Cucurbita moschata*), both from the Faculty of Agriculture in Maribor (Slovenia).

The maize from the monoculture and the one intercropped with pumpkin species were sown at 70 cm between rows and 28.6 cm between plants/row, the sowing depth being of 5 cm, and the density 5 plants/m^2.

Oil pumpkin and musk pumpkin from monoculture were sown in beds, at 1x1 m, the sowing depth being 3-4 cm, and the density 2 plants/m^2. When intercropped with maize, both pumpkin species were sown between maize beds, in each second row. The distance between the beds and between the pumpkin plants per row was 1 m, while the plant density was of 1 plants/m².

In these experiments, a program of phenological observation and biometrical measurements was developed and a series of parameters were followed, such as: agronomical parameters (productivity compounds and seed yields), quality parameters (protein, starch and fat contents of seeds) and competition parameters (land equivalent ratio).

The values obtained from the analyses were processed by calculating averages and limits of variation for each parameter analyzed. The production data were statistically analyzed using the analysis of variance and the calculation of limit differences.

RESULTS AND DISCUSSIONS

A. *Results for maize*. In the 3 years of experiments, the cobs had an average length of 20.6 cm in case of maize grown in monoculture, 19.9 cm in case of maize intercropped with oil pumpkin and 19.1 cm in case of maize intercropped with musk pumpkin. On average there were 14 grain rows per cob in all three experimental variants.

The variants showed differences in terms of number of grains/cob. The smallest number of grains/cob was registered when the maize was intercropped with musk pumpkin, i.e 516.5 grains, compared to 530.3 grains/cob when intercropped with oil pumpkin and 590 grains when grown in monoculture.

The grain yield/cob was bigger when the maize was grown in monoculture, i.e. 164 g. It was 7.6 g smaller when the maize was intercropped with oil pumpkin and 12 g smaller when intercropped with musk pumpkin. The grain weight, expressed as TGW, was of 267 g in case of maize intercropped with musk pumpkin, 271.2 g in case of maize intercropped with oil pumpkin and 277.7 g in case of maize grown in monoculture (Table 1).

Table 1. Productivity compounds of maize, when grown in monoculture and intercropped

Productivity compounds	**Maize monoculture**	**Maize-oil pumpkin intercrop**	**Maize-musk pumpkin intercrop**
	Average 2007-2009		
Cob length (cm)	20.6	19.9	19.1
Number of grain rows/cob	14.6	14.0	14.0
Number of grains/row	40.3	38.0	37.0
Number of grains/cob	590.0	530.3	516.6
Grain yield/cob (g)	164.0	156.4	152.0
TGW (g)	277.7	271.2	267.0

The yield data show the favorability of Moara Domneasca area for those two types of intercrops. Among all the intercropping combinations, it was the maize intercropped with oil pumpkin which behaved best, producing 31.68 q/ha, i.e. 2.57 q/ha less than the control (7.51%). When intercropped with musk pumpkin, the maize produced 31.17 q/ha, i.e. 3.08 q/ha less than the control (9.0%) (Table 2).

Table 2. Average yields of maize, when grown in monoculture and intercropped

Type of crop	Maize (*Zea mays*)			
	Yield (q/ha)	Difference as to monoculture		Significance
		q/ha	%	
Monoculture	34.25	Mt.	100	-
Maize-oil pumpkin intercrop	31.68	-2.57	92.49	-
Maize-musk pumpkin intercrop	31.17	-3.08	91.00	o

Dl 5%= 2.705 q/ha
Dl 1% = 4.054 q/ha
Dl 0.1% = 6.521 q/ha

B. *Results for oil pumpkin*. The oil pumpkin intercropped with maize formed 2 fruits/plant, 143.8 full seeds/fruit, and the TGW was of 174.3 g (Table 3).

The oil pumpkin produced 6.57 q/ha when grown in monoculture and 3.88 q/ha when intercropped, which means the yield was 2.69 q/ha smaller than the control (40.95%) (Table 4).

Table 3. Productivity compounds of oil pumpkin, when grown in monoculture and intercropped with maize

Productivity compounds	Oil pumpkin monoculture	Maize-oil pumpkin intercropping
	Average 2007-2009	
Number of fruits/plant	2.1	2.0
Number of seeds/fruit	200.5	179.8
Number of full seeds/fruit	164.6	143.8
Number of sterile seeds/fruit	35.9	36.0
Fruit weight (g)	2492.9	2055.4
Seeds weight/fruit (g)	53.3	46.5
TGW (g)	180.7	174.3

Table 4. Average yields of oil pumpkin, when grown in monoculture and intercropped with maize

Type of crop	Oil pumpkin (*Cucurbita pepo* var. *oleifera*)			
	Yield (q/ha)	Difference as to monoculture		Significance
		q/ha	%	
Oil pumpkin - monoculture	6.57	Mt.	100	-
Maize-oil pumpkin	3.88	-2.69	59.05	o

Dl 5%= 2.212 q/ha
Dl 1% = 3.387 q/ha
Dl 0.1% = 5.321 q/ha

C. *Results for musk pumpkin*. On average, the musk pumpkin formed 1.6 fruits/plant and 170.6 full seeds/fruit, while the TGW was of 231.8 g (Table 5).

Table 5. Productivity compounds of musk pumpkin, when grown in monoculture and intercropped with maize

Productivity compounds	Musk pumpkin monoculture	Maize-musk pumpkin intercrop
	Average 2007-2009	
Number of fruits/plant	2.0	1.6
Number of seeds/fruit	213.3	222.4
Number of full seeds/fruit	180.1	170.6
Number of sterile seeds/fruit	46.3	51.7
Fruit weight (g)	2968.7	2789.4
Seeds weight/fruit (g)	64.6	67.6
TGW (g)	237.9	231.8

When grown in monoculture, the musk pumpkin produced 8.09 q seeds/ha compared to when it was intercropped - 4.91 q/ha, i.e. 3.18 q/ha more (Table 6).

Between 2007 and 2009, the highest LER value, namely 1.52, was registered at the maize-musk pumpkin intercrops. At the maize-oil pumpkin intercrops, the leaf area index had an average value of 1.50. These results show that in order to obtain the same yields the amount of land for monocultures should be 50%, respectively 52% higher than for intercrops (Fig.1).

Table 6. Average yields of musk pumpkin, when grown in monoculture and intercropped with maize

Type of crop	Musk pumpkin (*Cucurbita moschata*)			
	Yield (q/ha)	Difference as to monoculture		Significance
		q/ha	%	
Monoculture	8.09	Mt.	100	-
Maize-musk pumpkin	4.91	-3.68	54.51	ooo

DL 5%= 1.018 q/ha
DL 1% = 1.559 q/ha
DL 0.1% = 2.436 q/ha

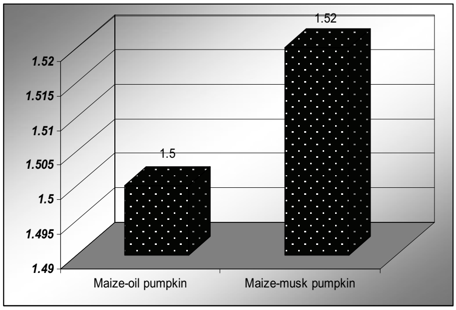

Fig. 1. Land equivalent ratio for the maize-oil pumpkin and maize-musk pumpkin intercrops

In terms of chemical composition, the maize intercropped with oil pumpkin had 11.70% proteins, 4.98% fats and 66.23% starch and the maize intercropped with musk pumpkin contained 11.34% proteins, 5.08% fats and 66.12% starch. The oil pumpkin contained 35.48% proteins, 39.63% fats and 7.25% starch and the musk pumpkin seeds had 27.66% proteins, 36.23% fats and 7.66% starch (Table 7).

The best protein yield (5.51 q/ha) was obtained at the maize-oil pumpkin intercrops.

At the maize-musk pumpkin intercrops, the total protein yield was of 4.95 q/ha (Table 8).

Table 7. Chemical composition of maize, oil pumpkin and musk pumpkin, in monoculture and in intercropping

Type of crop	**Moisture (%)**	**Protein (% d.m.)**	**Fat (% d.m.)**	**Starch (% d.m.)**
Maize (monoculture)	13.20	10.17	5.15	66.50
Oil pumpkin (monoculture)	8.30	37.39	40.07	7.67
Musk pumpkin (monoculture)	9.25	28.09	36.84	8.08
Maize (intercropped with oil pumpkin)	13.67	11.70	4.98	66.23
Maize (intercropped with musk pumpkin)	13.40	11.34	5.08	66.12
Oil pumpkin (intercropped with maize)	8.57	35.48	39.63	7.25
Musk pumpkin (intercropped with maize)	8.60	27.66	36.23	7.66

Table 8. Protein yields at maize, oil pumpkin and musk pumpkin, in monoculture and in intercropping

Type of crop	**Seed yield (q/ha)**			**Total yield (q/ha)**	**Protein yield (q/ha)**			**Total protein yield (q/ha)**
	M	OP	MP		M	OP	MP	
Maize monoculture	35.34	-	-	35..34	3.59	-	-	3.59
Oil pumpkin monoculture	-	8.83	-	8.83	-	3.30	-	3.30
Musk pumpkin monoculture	-	-	10.4	10.40	-	-	2.92	2.92
Maize-oil pumpkin	31.03	5.31	-	36..34	3.63	1.88	-	**5.51**
Maize-musk pumpkin	30.83	-	5.28	36.11	3.49	-	1.46	**4.95**

Legend: M – maize; OP – oil pumpkin; MP – musk pumpkin

CONCLUSIONS

The following are recommended for the maize-oil pumpkin intercrops: pumpkin sowing between maize beds, at each second row; 70 cm distance between maize rows and 1 m distance between pumpkin plants; the density for maize of 5 plants/m^2 and for pumpkin of 1 plant/m^2; weed management through 3-4 manual weeding and hand hoeing. There can be obtained yields of 31.68 q/ha at maize and 3.88 q/ha seeds at oil pumpkin and a total seed yield of 35.56 q/ha. Also, 5.51 q/ha protein can result in intercropping.

For the maize-musk pumpkin intercrops, the same parameters are recommended as for the maize-oil pumpkin intercrops. Under these conditions there can be obtained yields of 31.17 q/ha at maize, 4.91 q/ha seeds at musk pumpkin and a total seed yield of 36.08 q/ha. Also, 4.95 q/ha protein can result.

The land equivalent ratio value was on average of 1.52 for the maize-musk pumpkin intercrops, and 1.50 for the maize-oil pumpkin intercrops. These results show that in order to obtain the same yields the amount of land for monocultures should be 50%, respectively 52% higher than for intercrops.

The extension of those crops in production is conditioned by the land weed infestation level and pest control, and also by maintaining and raising agricultural land fertility through organic agriculture measures (incorporation of crop residues; crop rotation with grain legumes; organic manure management).

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THE ANALYSIS OF WEED COMMUNITIES FROM A RAPE CROP IN FUNDULEA (COUNT CĂLĂRAŞI)

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Abstract

Since under normal vegetation conditions in rape crops there are not treatment methods for dicotyledonous weed control, we analyzed a weed community installed in a rape field, in the specific climatic conditions of the Fundulea village (count Călărași). Our goal was to highlight the floristic composition, flowering period, annual/ perennial dicotyle - monocotyle ratio, bioforms spectrum, species general spread, species spectrum requirements for environmental factors and the degree of fidelity to the crop. Through spring mapping a predominance of annual dicotyledonous, flowering in spring (Lamium purpureum, Veronica pollita, Thlaspi perfoliatum, etc.) and a number of perennial species with high possibilities of vegetative propagation and summer flowering (Cirsium arvense, Convolvulus arvensis) were found. In terms of requirements for environmental factors, the species are indifferent to soil pH, adapted to local conditions: predominantly xero-mesophilic, micro-mesothermal.

Key words: *rape crop, species spectrum, weeds communities.*

INTRODUCTION

In addition to the direct competition for light and water, weeds' presence in a rape crop can cause difficulty of harvesting, increase the price of treatments applied to enhance the drying process of the silicva or seed infestation. In the spring, dicotyledonous weeds uncontrolled for by autumn herbicide may hinder the growth of the rape plants, which will not branch out and will produce fewer fruits [7].

One aspect of weed control is species affinity for rape crops. This "is not absolute and is determined by the agro technique used and by the effectiveness of weed management" [1] and local conditions. If we use as a landmark rape crops in the UK, frequently encountered species are: *Alopecurus myosuroides* (in our country it appears mainly in cereal crops in oak forests up to beech forests [2]), *Galium aparine, Sinapis arvensis, Sonchus asper, Matricaria perforata, Cirsium arvense* [6]. In our country, in an experience carried out to determine the influence of biotic and abiotic factors on the production of rape on red preluvosoil in the Romanian Plain, in the spaces without herbicides were identified four dicotyledonous weed species: *Sinapis arvensis, Anthemis arvense, Xanthium italicum, Cirsium arvense* and on sprayed ground, after 15 days post-treatment were recorded specimens of the following species: *Sinapis arvensis, Convolvulus arvensis*, as well as *Anthemis arvense* and *Xanthium italicum*, the last two as a result of reinfection [5]. Spring through mapping we can assess the effectiveness of treatments applied in the fall and predict the subsequent weed and establish measures to limit the negative effects due to weed presence. In this paper we envisioned an analysis of weed communities identified by mapping in the spring, in the conditions specific to the town of Fundulea (Calarasi county).

MATERIAL AND METHOD

Field research was conducted during April 2011 in a rape crop (hybrid Hexagon) established the previous autumn, on a field in the BASF company's land. All species encountered in the experimental variants were recorded and the weed community was analysed in terms of plant composition, class and life span, groups (according to the classification system developed by C. Chirila [1]), biological forms, the phytogeographical element and ecological requirements [4]. In terms of local conditions, the land located in the Fundulea area (Calarasi county, in the eastern part of the Romanian Plain, in the area of separation between the South Baragan and Vlasiei Plains, on the stream of Mostiştea), is located on a cambic cernosiom soil type, under continental climate, with an average temperature of 10.5° C and rainfall of 571 mm.

The scientific denomination of the species and their systematic classification was made according to the classification of V. Ciocârlan [3].

RESULTS AND DISCUSSIONS

Weed species recorded during the spring mapping, together with their biological features are noted in Table 1.

In terms of floristic composition, the weed community is represented by 21 species classified in 12 families. The species distribution on families was as follows: four species of the family *Brassicacea* respectively *Asteraceae*, 3 species of *Scrophulariaceae*, one species of *Papaveraceae* family, *Caryophyllaceae*, *Amaranthaceae*, *Fabaceae*, *Apiaceae*, *Geraniaceae*, *Convolvulaceae*, *Boraginaceae*, *Rubiaceae*.

It is worth noting that representatives of the *Poaceae* (*Gramineae*) family were missing, and that the presence of species from other families is consistent with the general information on cormophytes weeds in Romania [1].

This observation is complemented by data on species' range according to class and life: 16 out of 21 species are dicotyledonous annual and 5 are perennial dicotyledonous, the monocots being absent (Table 1). In terms of species distribution according to biological form, therophyte species predominate (9 species) and species undergoing annual life cycle, from germination to the formation of new seeds in one growing season and undergo unfavourable periods as seeds. These are followed by the hemytherophyte group (7 species) which includes bisannual and winter annual species. The hemicryptophytes are represented by three species, and geophytes species and those with intermediate behaviour (hemicryptophyte - geophytes) by one specie each. These are groups that are perennials with vegetative buds located right at the soil surface or with perennating stems located in the soil (Table 1).

This data is supplemented by weed classification according to their response to specific control measures [1]. The following distribution of weed species groups was identified (Table 1):

Group 1 weeds with very early spring flowering and short growing season: 1 species.

Group 2, weeds with early flowering and long growing season, sensitive to 2,4-D: 1 species.

Group 3, weeds with early flowering and long growing season, medium resistant to 2.4-D: 1 species.

Group 4, Spring weeds resistant to 2.4-D: 6 species.

Group 5, spring weeds from the family *Brassicaceae* (*Cruciferae*), with early flowering, susceptible to 2.4-D, resistant to trifluralin: 2 species.

Group 7, weeds of the *Fabaceae* (*Leguminosae*) family, capable of recovery after herbicide: 1 species.

Group 8, summer weeds, nitrophilous with optimum development in hoes crops: 1 species.

Group 11, biennial weeds: 3 species.

Group 21, weeds with taproot: 1 species.

Group 23, weeds with root with buds: 3 species.

Analysis shows that the community includes three cosmopolitan species, with general spread in the world overall, two species are adventives, 9 species are Eurasian confirming that this category is best represented in the flora of our country [4], a species is of Europe, one is Pontic-Caucasian, one is circumpolar and one central European.

By grouping species according to soil moisture requirements, the predominant species are identified to be the xero-mesophilous species (they vegetate well on dry-moist - moist soils) - 10, followed by mesophilous species (require moist up to wet soils) - 9 and in small numbers the xerophile species (vegetation on dry- dry-moist soil) -2 (Table 1). In terms of the temperature factor requirements, for most species of weeds vegetate appropriately at temperatures between 4.5 and 7.5^{o}C-12, followed by those with wide requirements from the heat factor - 5 and those with higher requirements from air temperature, ranging from 7.5 to 10.5^{o}C -3. One species exhibits low temperature requirements (Table 1). As a response to the soil reaction factor, most species (11) show a large ecological amplitude, followed by species that grow on soils with pH between 6.8-7.2 (8) and those that can withstand a pH range of 6-6.8 (2) (Table 1).

Table 1. The main biological characteristics of the weed species encountered in spring mapping in the experimental field of BASF in Fundulea – Calarasi county

No. crt.	Scientific name/ Family	Class/ Life span	Biological form	Group of weeds	Areal	Ecological characteristics		
						U	T	R
1.	*Papaver rhoeas* **Papaveraceae**	Da	Th - HTh	4	Eua	**3**	**3.5**	**4**
2.	*Stellaria media* **Caryophyllaceae**	Da	Th -HTh	4	Cosm.	**3**	**0**	**0**
3.	*Amaranthus retroflexus* **Amaranthaceae**	Da	Th	8	Adv.	**3**	**3**	**0**
4.	*Vicia sativa* **Fabaceae**	Da	Th-HTh	7	Eua	**3**	**0**	**0**
5.	*Daucus carota* ssp.*carota* **Apiaceae**	Da	Th-HTh	11	Eua	**2.5**	**3**	**0**
6.	*Descurainia sophia* **Brassicaceae**	Da	Th	5	Eua	**2.5**	**2.5**	**4**
7.	*Capsella bursa-pastoris* **Brassicaceae**	Da	Th	5	Cosm.	**3**	**0**	**0**
8.	*Thlaspi perfoiatum* **Brassicaceae**	Da	Th	1	Eua	**2**	**3**	**4**
9.	*Cardaria draba* **Brassicaceae**	Dp	H	23	Eua	**2**	**4**	**4**
10.	*Geranium pussilum* **Geraniaceae**	Da	Th-HTh	11	Eur	**2.5**	**3**	**0**
11.	*Convolvulus arvensis* **Convolvulaceae**	Dp	H-G	23	Cosm	**2.5**	**3.5**	**3.5**
12.	*Anchusa ochroleuca* **Boraginaceae**	Dp	H	-	Pont-cauc.	**1.5**	**4**	**4**
13.	*Lamium amplexicaule* **Lamiaceae**	Da	Th	3	Eua	**2.5**	**3.5**	**0**
14.	*Veronica hederifolia* **Scrophulariaceae**	Da	Th	4	Eua	**2.5**	**3**	**4**
15.	*Veronica persica* **Scrophulariaceae**	Da	Th	4	Adv.	**3**	**4**	**4**
16.	*Veronica polita* **Scrophulariaceae**	Da	Th	4	Eua	**2.5**	**3.5**	**4.5**
17.	*Galium aparine* **Rubiaceae**	Da	Th	4	Cp	**3**	**3**	**3**
18.	*Senecio vulgaris* **Asteraceae**	Da	Th-HTh	2	Cosm.	**3**	**0**	**0**
19.	*Cirsium arvense* **Asteraceae**	Dp	G	23	Eua	**2.5**	**3**	**0**
20.	*Lactuca serriola* **Asteraceae**	Da	Th-HTh	11	Centr.-eur.	**1.5**	**3**	**0**
21.	*Taraxacum officinale* **Asteraceae**	Dp	H	21	Eua	**3**	**0**	**0**

Da- annual dicotyledonous; Dp – perennial dicotyledonious; Th – Therophyta; Th-HTh – Hemytherophyta; G – Geophyta; H – Hemicryptophyta; Adv. – adventive; Cosm – cosmopolite; Centr.-eur. – Central Europe; Cp – circumpolar; Eua – Eurasia; Eur. – Europe; Pont.-cauc. – Pontic-Caucasian; U 1.5 – xerophile; U 2; U 2.5 – xero-mesophilous; U 3 – mesophilous; U 4 – meso-hygrophilous; T 0 – eurytherme; T – 2.5 microtherme; T3; T3.5 – micro – mesotherme; T 4 – moderate termophilous ; R 0 – euriionic; R 3; R 3.5 – acid neutrophilous; R 4 – weak acid - neutrophilous

CONCLUSIONS

The 21 species of dicotyledonous plants, results of the floristic composition analysis from the spring mapping, shows that the weed community contains species from the major families with representatives in Romania's flora. The lack of monocotyledonous weeds, highlighted by the relationship between species depending on class and life span, is due to pre and post-emerging treatments applied in the autumn.

Therophyta species dominate the classification based on biological form and most of them belong to groups of spring weeds with varying degrees of sensitivity to 2.4 D. Analyzing the general spread of weed species with their requirements to environmental factors shows that they are adapted to a continental climate with warm summers and low rainfall.

Spring mapping, accompanied by weeds' species biological features analysis provides the data necessary to establish a weed control strategy for rape crops.

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ORGANIC BEEKEEPING AND BEE PRODUCTS

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Abstract

Romania is well known in the delivery field of bee products and beekeeping, is known for this ancient occupation. Beekeeping in Romania leads to large amounts of bee products. As the main purpose of ecological beekeeping is obtaining quality products without the use of other replacement substances. To achieve organic beekeeping must follow these steps: organizing a hive, the first step in beekeeping, apiary hearth choice, choice of hive type, bee families purchase. Both conventional and ecological beekeeping have similarities and differences. Conventional beekeeping is losing ground to the ecological because now customers consume more and more eco products without various additives and is more natural. To be considered ecological bee products must pass a period of one year; in this time these products are not considered ecological. In ecological beekeeping rules need to be observed and also labor is different from that used in conventional beekeeping. Also, nutritional value and quality of ecological products are different from conventional. As a conclusion, both types of beekeeping are differentiated by the process of obtaining the product, but are similar in the principles for achieving sustainable production. The ecological beekeeping and the conventional need collaboration at the national and international level for these industries to develop more and more.

Key words: *conventional, nutritional value, organic, Romania, quality.*

INTRODUCTION

As a scientific discipline, bioagriculture was founded by Italian Girolamo Azzi, in 1920, in Research Committee report from the Academy of Italy, who said that: "this branch of science", ecology can claim to have its own existence in biology, which presents a character and a scientific purposes, because they study the plant as an organism that grows in the environment that surrounds him [6].

In 2010, the main producer of honey in the world was China with 398,000 tones, followed by Turkey with 81.115 tones. Romania ranks only 22,222 tones, but the importance of development on organic beekeeping places our country on the second place in Europe with 7.70% organic hives from total of 84,700 hives, after Italy with 8.00% organic hives from total 103,000 hives [1].

In the context of globalization, beekeeping takes a new connotations, with its practice, not only the economic importance but also important scientific, ecological and social aspects.

The main objective of organic beekeeping is to obtain pure bee products of the best quality, avoiding the use of synthetic chemicals [2]. Also, another goal is to obtain food with authentic taste and quality but also safe to consumers approved by the inspection organisms. To realize this objective, is essential to increase the quality of honey, which can be achieved by permanent collaboration of several producers. In consequence, we see that there is a strong link between conservation and continuous improvement of the genetic local beekeeping and making technologies to maintain the bee families to implement a sustainable management of the farms and bee resources according to E.U. requirements [3].

Starting with 2007, untill 2010, forecasts indicate a 6.5% growth of bee colonies number and the number of beekeepers being estimated at 45,000 [1].

For ecological apiculture is necessary to identify areas with honey polluting or non-polluting resources and to increase the organic production, but for this organic beekeeping requires new collaborations both nationally and internationally to attract different sources of financing necessary to achieve the objectives listed above.

Steps to organic beekeeping

Beekeeping is an activity that gives practitioners many satisfactions. Those who love this activity have in common: love for bees and nature. In beekeeping exists a material side where we obtain honey, pollen, wax and propolis, but there exists a spiritual side and a professional qualifications. For beekeepers framing ecological systems, must follow several steps:

Organizing a hive: the provision of hives, bee families, bee equipment and materials, must be made carefully after a preliminary research and documentation. The first step in beekeeping usually starts with a limited number of hives (2-3 pieces), and as you gain experience, apiary will increase the number and the quality. In 3-4 years we can lead to have created powerful families of bees, apiary productions bring important quantity of honey and other bee products, but for that it need to have patience.

Election precincts apiary is based on several criteria. It is important to know that the bee is flying range of 3 km, and this area should provide a rich harvest, highly active throughout the active season. It sits more than 30 beehives on a hearth considering that a family consumes 90 kg of honey and 30 kg of bee pollen in a year. In a good year from a hive can get 25-30 kg of honey, 800 g of wax and 3-4 kg of pollen out of what bees consume [4].

Beehives are placed facing south-east, at a distance of 2 m between them and 4-5m between rows. Between two neighboring apiaries, there must be a distance of 2-3 km (depending on the potential honey in that area). They should be placed in a sunny area during spring and autumn, near the big rivers, far away from high traffic roads and polluting sources.

Choosing the type of hive: there are two kinds of hives: horizontal and vertical, both being used for apiculture. They must be sturdy, well made after specific standard and, last but not least, efficient [4].

Care must be taken to the choosen of hives because the bees need conditions of living as close to those of nature. Horizontal hive is suitable for stationary beekeeping, while the vertical to the pastoral beekeeping [4].

A big influence on the apiary has the location. For example, in the south spring is accelerated, beekeepers recommendation is to use multi-hives, and in hilly, mountainous and northern hives with vertical and horizontal storage.

Purchase of bee families: the bees must be strong and young, healthy and more adapted to the area where they are located. And swarms are good, the necessary condition is to be equipped with a queen young and productive.

Comparison between organic and conventional beekeeping

Both conventional and ecologial beekeeping have in common principles of sustainable production, but there are specific aspects that differentiate them.

Unlike conventional beekeeping, the ecological one has an important role in obtaining pure bee products with high quality. Thus, conventional beekeeping losing ground because the population has turned its interest to progressive bio products, naturally derived, without use of synthetic chemicals.

The organic beekeeping principles are: to get a good product, but also to be careful by the treatment of hives, environmental quality, conditions of extraction, processing and storage of its product. However, organic beekeeping is currently more expensive than the conventional, which increases the price of the finished product. It is found a considerable increase in sales but organic honey, not only in our country, but also outside, which shows that people understand the nutritional superiority and eco products.

Between the organic and conventional beekeeping exists significant differences: the organisms genetically modified, the pesticides and synthetic fertilizers, the growth stimulators and hormones, the antibiotics applied to intensive beekeeping are prohibited. In ecological beekeeping focus is

mainly on product quality and nutritional value.
Organic beekeeping has a labor force bigger than the conventional, because the process of obtaining a bio product cover through a longer period, which is another advantage of organic beekeeping by creating new work places.
From the conventional to the organic beekeeping there is a conversion period of one year, time in wich bee products obtained can not be sold as organic products. Hence to differentiate the conventional by the organic product, on his label is necessary to maintain the mode of production (ecologic or conventional) and the code of inspection organism that issued the organic product.
In organic beekeeping some rules need to be respected concerning the choice and location of hives, to achieve a strong link between environment and bees. The location should be placed in unpolluted area and it should not allow for external factors to intervene on living beings and their habitat. Therefore bio product is used mainly in the pharmaceutical component entering certain creams, medicines or syrups. Conventional products are used more in natural state, many people choosing them especially for their low prices, which are directly proportional to their nutritional value.
In conclusion both organic beekeeping and conventional are based on the principles of sustainable production, but are differentiated by the complexity of obtaining the goods ecologically superior product quality, achieved naturally, without using synthetic chemicals.

Honey organic certification laws
Organic honey is obtained in accordance with the rules and principles of ecological beekeeping decided by EU and national legislation in the field. These rules applyed by the beekeepers are checked by inspection and certification body, their actions applies for the entire chain of honey process.
General principles: pursuant to Section I of HG 917/2001, Article 21, paragraph 3, we can say that if an operator runs several beekeeping units in the same area, it is imperative that all units meet the requirements of these methodological norms. Otherwise, the product is not sold as organic.
All this article refers to qualifications of bee products to be obtained by organic production methods (treatments applied to hives, environmental quality, conditions of extraction, processing and storage of beekeeping products) [5].
In Section 4 of HG 917/2001, Article 24 speaks about the location of hives, namely: to ensure that bees have sufficient natural sources of nectar, sweet secretions, pollen and water, to keep a distance enough to all non-agricultural production sources that can cause pollution to ensure that within a radius of 3 km around the site hives, pollen and nectar sources are made of organically produced crops and / or vegetation or the cultures that do not meet these methodological rules, but are subjected to treatments that have little impact on the environment [5].
Section 7 has all of the HG 917/2001, Article 27 reads:
"(1) The destruction of bees in the combs as a method associated with the harvesting of beekeeping products.
(2) Mutilation of bees as, for example, cutting off the wings queen bees is prohibited.
(3) Allows the replacement queen bees by killing the old queen.
(4) Destruction of male brood is permitted only to limit infection with Varroa jacobsoni.
(5) Is forbidden the use of chemical synthetic repellents during the honey extraction operations.
(6) The area where hives are placed is registered with the identification of the hives. Inspection and certification bodies should be informed of any movement of them, within agreed.
(7) In order to guarantee operation extraction is given special attention for processing and storage of beekeeping products it should be recorded all steps taken to comply with these methodological rules [5].
(8) Remove the upper layers of wax and honey extraction operations shall be recorded in each registry hive. "

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INFLUENCE OF DEPTH PLACEMENT AND DURATION OF STAY IN THE SOIL OF *AMARANTHUS* SPECIES SEEDS ON REST AND GERMINATION

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Abstract

Influence of depth placement and duration of stay in the soil of seeds of Amaranthus retroflexus L. and Amaranthus hybridus L. on rest and germination was determined. In the methodology is reported ***Omami*** *field germination, number of laboratory germination and sprouting seeds after treatment with growth regulator. It was found that where the seeds of both amaranth species: Amaranthus retroflexus L. and Amaranthus hybridus L., are left for 3, 6, 9 or 12 months at depths of 2.5, 5, 10, 20 and 30 cm, they remained latent and no germination was observed. They remain latent and this is a condition for potential growth of this weed. Under controlled laboratory conditions, the highest germination of Amaranthus retroflexus L. (8-15%) was observed in seeds left buried for 12 months; between 0.5% and 6.3% in seeds buried for 9 months and only 0.3% in seeds buried for 6 months. Hybrid amaranth has shown higher germination under laboratory conditions than common amaranth. The germination rate varied from 32.4% to 43.8% at depths of 20 and 30 cm to the difference of depths of 2.5 and 5 cm, which has been statistically proven. The germination rate (50%) was the highest where the seeds were buried for 6 months. The lowest germination rate under laboratory conditions was observed when the seeds were buried for 3 months at a depth of 30 cm.*

Keywords: *A. retroflexus L., A. hybridus L., germination at rest.*

INTRODUCTION

Amaranthus is distinguished through high plasticity and adaptability to a wide range of climatic and edaphic combinations, which together with the short life cycle creates an opportunity for spreading over large areas. They are dangerous competitors of crops in relation to vegetation factors (moisture, light, heat and nutrients). Forms large seed generation with extended period of germination, and sometimes resistant forms to some commonly used modern herbicides. Under the conditions of contemporary agriculture, species of the genus *Amaranthus* control is a top issue and in order to be successful an appropriate bioecological study of their characteristics is recommended.

MATERIAL AND METHOD

Field microtrail was carried out on the method of fractional plots with seeds of *Amaranthus retroflexus L.* and *Amaranthus hybridus L.* [1]. The influence of duration of seeds stay in the soil (3, 6, 9 and 12 months) and their depth of bury (2.5, 5, 10, 20 and 30 cm) on their dormancy and germination. Using Omami's methodology [5] is reported:

1. Number of germinated seeds in the field (in situ) - field germination.

2. Number of germinated seeds under controlled conditions (ex situ) - laboratory germination (in dark and light at different temperatures).

3. Number of germinated seeds after treatment with growth regulator IAA (indolyl - 3 - acetic acid) [2].

The data were statistically determined using method ANOVA.

RESULTS AND DISCUSSIONS

Once in the soil weed seeds are exposed on changes influenced by light, temperature, moisture, oxygen and other elements as well as damages caused by soil fauna [5]. These factors contribute in different degrees and in different ways and often cause cyclical changes in dormancy of the seeds [4]. According to Omami [6] the seed dormancy can be affected by many factors including genetic characteristics of species, environmental conditions during the ripening of the seed and soil conditions.

The results of the conducted two-factor learning field microtrail during 2003-2005 years showed that in both species of amaranths - *Amaranthus retroflexus* L. and *Amaranthus hybridus L.* seeds stayed in soil, respectively - 3, 6, 9 and 12 months and depth – 2.5 cm, 5 cm, 10 cm, 20 cm and 30 cm, their dormancy was not affected and no germination was recorded. Field microtrail was set on alluvial-meadow, formerly waterlogged soil which mechanical composition was characterized by lamination and low permeability. During the test period no mechanical and chemical treatments of soil were made, which could alter the depth of seed placement or harm their seed coat. With this may give explanation concerning maintaining dormancy of seeds and lack of field germination of either investigated amaranths species. After evaluation the field germination, weed seeds were placed under controlled laboratory conditions in an incubator (7 days in the dark at 12°C and 14 days of light at 35°C) to provoke the dormancy brake. The results indicated that the seeds of common amaranth, stayed 3 months in the soil retain its state of dormancy, independent of their depth position. After 6 month stay in the soil laboratory germination was recorded only 0.3% on the depth of 10 cm, and after 9 months - germination was 0.5% on the depth of 20 cm, 2.5% from 10 cm and 6.3% from 5 cm. When staying in the soil for 12 months, the seeds of common amaranth had laboratory germination from 8% to 15% from the different depths positions in the soil, the highest was reported by 2.5 and 5 cm. Growth regulator IAA stimulated further germination of seeds of *Amaranthus retroflexus* L. from 2.3% to 5%.

For *Amaranthus hybridus* L. the highest average value of the character laboratory germination showed seeds digged out from a depth of 5 cm ($\bar{x}$ = 43.875) and those located at a depth of 2.5 cm ($\bar{x}$ = 43.250) - Table 1.

Table 1. The differences between depth of bury of seeds *Am. hybridus* in the soil related to the character laboratory germination, %

Variants	$\bar{x}$,%	Difference with				
		A_2	A_1	A_3	A_5	A_4
A_2 - 5 cm	43.875	-	n.s 0.625	n.s 6.0	+ 10.0	++ 11.5
A_1 - 2,5 cm	43.250		-	n.s 5.375	+ 9.375	++ 10.87
A_3 – 10 cm	37.875			-	n.s 4,0	n.s 5.5
A_5 – 30 cm	33.875				-	n.s 1.5
A_4 – 20 cm	32.375					-

$gD_{P5\%}$ = 7.9 $gD_{P1\%}$ = 10.52 $gD_{P0.1\%}$ = 13.7

Duration of the seeds stay in the soil also had an influence on their laboratory germination (Table 2). For 6 months stays of seeds in the soil, germination was the highest ($\bar{x}$ = 50.00).

Table 2. The differences between stay duration of seeds of *Am. hybridus* in the soil related to the character laboratory germination, %

Variants	$\bar{x}$, %	Difference with			
		B_2	B_3	B_4	B_1
B_2 – 6 *months*	50,000	-	+++ 13.9	+++ 15.95	+++ 17.15
B_3 – 9 *months*	36,100		-	n.s 2.05	n.s 3.25
B_4 - 12 *months*	34,050			-	n.s 1.20
B_1 – 3 *months*	32,850				-

$gD_{P5\%}$ = 7.07 $gD_{P1\%}$ = 9.41 $gD_{P0.1\%}$ = 12.25

Lowest laboratory germination in a combination on depth of buried on 30 cm (a_5) and remained duration of the seeds into the soil for 3 months (b_1) - Table. 3.

Table 3. The differences between combinations of factors, %

№	Variants	$\bar{x}$	Proven	Grade
1.	**A_2B_2**	56.75	A	I
2.	**A_1B_2**	55.25	A	I
3.	**A_3B_2**	52.25	A	I
4.	**A_4B_2**	47.50	A	I
5.	**A_2B_3**	44.75	A	I
6.	**A_1B_3**	44.00	A	I
7.	**A_3B_3**	42.50	A	I
8.	**A_5B_2**	42.50	A	I
9.	**A_4B_3**	41.25	A	I
10.	**A_5B_3**	39.00	A	I
11.	**A_1B_4**	38.25	A	I
12.	**A_2B_4**	36.25	A	I
13.	**A_4B_4**	35.25	Ab	II
14.	**A_3B_4**	34.25	Ab	II
15.	**A_5B_4**	34.00	Ab	II
16.	**A_2B_1**	29.50	Abc	III
17.	**A_1B_1**	29.00	Abc	III
18.	**A_3B_1**	28.00	Abc	III
19.	**A_4B_1**	22.25	Abcd	IV
20.	**A_5B_1**	12.50	Abcdf	V

$gD_{P5\%} = 15.81$ $gD_{P1\%} = 21.05$ $gD_{P0.1\%} = 27.39$

The analyses of the third stage of evaluation - treatment of the seeds with growth regulators (IAA) to promote braking dormancy showed that germination increased from 6.67% to 12.00%, but there are no difference between levels of factor A (depth burial of seeds) - Table 4.

Table 4. The differences between depth of burial of seeds in soil *Am. Hybridus*), after treatment with IAA related to the characteristic germination, %

Factor A	$\bar{x}$	**Difference with**				
		A_2	A_1	A_4	A_3	A_5
A_2	12.0	-	n.s	n.s	n.s	n.s
A_1	11.33		-	n.s	n.s	n.s
A_4	10.67			-	n.s	n.s
A_3	10.42				-	n.s
A_5	6.67					-

$gD_{P5\%} = 6.28$ $gD_{P1\%} = 8.85$ $gD_{P0.1\%} = 11.31$

The highest values were recorded in seeds remained in the soil for 3 months ($\bar{x} = 30.4$), ie IAA stimulates the most germination of seeds passed through the shortest dormancy period (Table 5).

Table 5. The differences between duration of remaining of seeds in the soil from *Am. hybridus* after treatment with IAA in regarding the characher germination, %

Factor A	$\bar{x}$	**Difference with**			
		B_1	**B_2**	**B_3**	**B_4**
B_1	30.4	-	++	++	++
B_2	0.25		-	n.s	n.s
B_3	0			-	n.s
B_4	0				-

$gD_{P5\%} = 12.61$ $gD_{P1\%} = 18.05$ $gD_{P0.1\%} = 25.39$

CONCLUSIONS

Where the seeds of both amaranth species: *Amaranthus retroflexus* L. and *Amaranthus hybridus* L., are left for 3, 6, 9 or 12 months at depths of 2.5, 5, 10, 20 and 30 cm, they remained latent and no germination was observed. They remain latent and this is a condition for potential growth of this weed.

Under controlled laboratory conditions, the highest germination of *Amaranthus retroflexus* L. (8-15%) was observed in seeds left buried for 12 months; between 0.5% and 6.3% in seeds buried for 9 months and only 0.3% in seeds buried for 6 months.

Hybrid amaranth has shown higher germination under laboratory conditions than common amaranth. The germination rate varied from 32.4% to 43.8% at depths of 20 and 30 cm to the difference of depths of 2.5 and 5 cm, which has been statistically proven. The germination rate ($\bar{x}$= 50%) was the highest where the seeds were buried for 6 months. The lowest germination rate under laboratory conditions was observed when the seeds were buried for 3 months at a depth of 30 cm.

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RESEARCH REGARDING PRODUCTION POTENTIAL OF LUCERNE IN ECOLOGICAL CROP

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Abstract

Ecological farming is a sector that is relatively new, but great prospects for Romania, which aims to ensure and enhance the health of soil, plants, animals and, last but not last, the health of people. Natural resources offered by the vegetal cover is a way by which man satisfies his own needs and interests in full harmony with the lawe of nature. The vegetation cover consists of perennial grasses and leguminouses, as a natural resource with practical use to man, gets new content, circumscribed concept of sustainable development concept evolving. Lucerne is an essential component of agricultural ecosystem in lowland regions. In the context of sustainable agriculture use value of this crop should be evaluated as strictly agronomic and economic indicators, but also in terms of ecological indicators: environmental protection, landscape and ecological compensation effect. Value in use of lucerne as a feed resource is determined by the useful of this culture, food quality and conservation facility. The results of this paper are the subject of doctoral theme and presents total dry matter yields from variants of ecological culture of lucerne, lucerne mixture dual species: Dactylis glomerata and Trifolium alexandrinum or triple mixture of the aforementioned species. Results are presented on the influence of culture and fertilization on dry matter production.

Key words**:** *ecological, ecosystem, lucerne, production.*

INTRODUCTION

Ecological farming is a sector that is relatively new, but great prospects for Romania, which aims to ensure and enhance the health of soil, plants, animals and, last but not last, the health of people [4, 5].

The vegetation cover consists of perennial grasses and leguminouses, as a natural resource with practical use to man, gets new content, circumscribed concept of sustainable development concept evolving.

Sustainable development of agriculture requires, inter alia, multifunctionality, biodiversity, yield stability, environmental compatibility, ensuring the balance between tolerance ability of ecosystems and economic interests, soil sustainability of natural resources [2].

Lucerne is an essential component of agricultural ecosystem in lowland regions [3].

In the context of sustainable agriculture use value of this crop should be evaluated as strictly agronomic and economic indicators, but also in terms of ecological indicators: environmental protection, landscape and ecological compensation effect [1]. The paper present the results of this paper are the subject of doctoral theme and presents total dry matter yilds from variants of ecological culture of lucerne, lucerne mixture dual species: *Dactylis glomerata* and *Trifolium alexandrinum* or triple mixture of the aforementioned species. Results are presented on the influence of culture and fertilization on dry matter production.

MATERIAL AND METHOD

The research was conducted in locality Toporu (Giurgiu county).

Experimental variants were the culture system (*Medicago sativa*-pure culture; *Medicago sativa* - 18 kg/ha + *Trifolium alexandrinum* - 4 kg/ha; *Medicago sativa* -16 kg/ha+*Dactylis glomerata* - 6 kg/ha; *Medicago sativa* - 16 kg/ha+*Dactylis glomerata* - 6 kg/ha+ *Trifolium alexandrinum* - 4 kg/ha) and fertilization system (N_0P_0 kg/ha; N_0P_{70} kg/ha; $N_{70}P_{70}$ kg/ha; manure - 40 t/ha).

For comparison were placed in 2 variants of conventional culture (N0P70 kg/ha, N70P70 kg/ha), a variant without fertilization, considered organic (N0P0 kg/ha) and one organic fertilized variant (manure-40 t/ha). The varieties used were: Pomposa for lucerne, Tigri for *Trifolium alexandrinum* and Magda for *Dactylis glomerata*.
Organic fertilizer was applied once the crop establishment (in 2004). Every autumn, at the end of vegetation were applied phosphorus fertilizer. Nitrogen fertilizers were manage their spring before the vegetation.
Were conducted to determine hervesting efficiency as follows: first sew the earing grass and early flowering lucerne, and taking the next installment every 6-7 weeks.

RESULTS AND DISCUSSIONS

On total dry matter yield can be observed after analyzing the behaviour of lucerne in the experimental variants, in terms of total annual yield, stronger influence of climatic conditions that occurred during the research. Thus, the highest dry matter yield was achieved in 2005, amid a regime of very high precipitation during the vegetation for plain Burnazului. The average dry weight of 2005 was 18.5 t/ha, 54% higher than 2004 production and 27% higher than the average in the three experimental years (Table 1). Average production of all variants during the years of research was 14.46 t/ha.
Ecological culture of lucerne variants (variant fertilized and fertilized with organic fertilizers) have achieved the lowest production in each of three years of research. These yields exceed an average 9-10 t/ha, which ensures economic efficiency however this culture system.
By comparison with lucerne in pure culture, mixed with *Dactilis glomerata* proved to be the most productive both in terms of ecological fertilization, especially in the variants of fertilization with chemical fertilization. Mixture we refer to production increases achieved by 11-26% on average for three years.
Analyzing the separate influence of culture system on dry matter yield (Table 2) shows that on average only three years of orchard grass and lucerne mixture provides a significant increase of production by 14% compared to pure culture from the other mixtures studied. Lucerne in pure culture made 13.69 t/ha DM, while the mixture with *Dactylis glomerata* made 15.68 t/ha DM.
Influence of fertiliyation on dry matter production presented in Table 3 show that variants with mineral fertilizer production increases have been very significant.
Within each fertilization variants (Table 4-6) to show the superiority of mixture with *Dactilys glomerata* at chemical fertilization (significant production increases by 15-16% compared to lucerne in pure culture with the same doses of fertilizers). This mixture is higher and ecological variants of fertilization, but statistically uninsured increases.
The data from Table 7 show that application of phosphorus at a dose of 70 kg/ha statistically determined production increases (7-13% compared to unfertilized variant) in all variants of lucerne culture system and when phosphorus and nitrogen is accompanied dose of 70 kg/ha, significant effects on production (increase of 9% compared to unfertilized variant) are found only in mixture with *Trifolium alexandrinum* and at the *Dactylis glomerata*.
Organic fertilization has an insignificant effect, similar to unfertilized variant.

CONCLUSIONS

In the ecological culture, the usefulness of lucerne acquires new values as follows: besides the role of forage resource, vegetal cover consists of lucerne in pure culture or mixed with *Trifolium alexandrinum* and the *Dactylis glomerata* is reserve conservation of biodiversity and contribute to improving the quality landscape.

Table 1. Production of dry matter, years 2004-2006

Species/ The mixture	Fertilization variants	2004	2005	2006	Media 2004-2006	
					t/ha	%
Medicago sativa	N_0P_0	10.3	17.4	12.2	13.3	100
	N_0P_{70}	11.8	18.4	13.1	14.4	108
	N_{70} P_{70}	11.4	17.8	12.9	14.0	106
	Manure 40 t/ha	9.8	17.2	12.0	13.0	98
Medicago sativa + Trifolium alexandrinum	N_0P_0	12.2	18.8	12.0	14.3	108
	N_0P_{70}	13.4	19.9	12.8	15.4	116
	N_{70} P_{70}	13.8	18.9	14.1	15.6	117
	Manure 40 t/ha	11.9	18.5	12.3	14.0	107
Medicago sativa + Dactylis glomerata	N_0P_0	12.7	19.2	12.6	14.8	111
	N_0P_{70}	15.3	20.9	14.2	16.8	126
	N_{70} P_{70}	14.8	19.8	14.0	16.2	122
	Manure 40 t/ha	13.7	18.5	12.4	14.9	112
Medicago sativa + Trifolium alexandrinum + Dactylis glomerata	N_0P_0	9.3	17.9	12.7	13.3	100
	N_0P_{70}	11.7	18.3	13.3	14.4	108
	N_{70} P_{70}	10.2	17.9	13.5	13.9	104
	Manure 40 t/ha	9.6	17.2	12.9	13.2	99
Average results	t/ha	12.0	18.5	12.9	14.46	-
	% towards 2004	100	154	107	121	-
	% towards average years	83	127	89	100	-
DL 5% mixtures	Similarly fertilized variants					1.8
	Average fertilized variants					1.7
DL 5% fertilization	Similar mixtures					0.8
	Average mixtures variants					0.4

Table 2. The influence of culture on dry matter production, years 2004-2006

The mixture	Dry matter production		The difference (t/ha)	Significance
	t/ha	%		
Medicago sativa	13.69	100	-	Mt. (witness)
Medicago sativa + Trifolium alexandrinum	14.88	109	1.19	-
Medicago sativa + Dactylis glomerata	15.68	114	1.99	*
Medicago sativa + Trifolium alexandrinum + Dactylis glomerata	13.71	100	0.02	-
DL 5% = 1.69 t/ha	DL 1% = 2.56 t/ha		DL 0.1% = 4.11 t/ha	

Table 3. The influence of fertilization on dry matter production, years 2004-2006

Fertilization variants	**Dry matter production**		The difference (t/ha)	Significance
	t/ha	**%**		
N_0P_0	13.94	100	-	Mt.
N_0P_{70}	15.26	109	1.32	***
N_{70} P_{70}	14.93	107	0.99	***
Manure 40 t/ha	13.83	99	-0.11	-
DL 5% = 0.38 t/ha	DL 1% = 0.51 t/ha		DL 0.1% = 0.69 t/ha	

Table 4. The influence of culture system within each fertilization variants, years 2004-2006

The mixture	Relative production of dry matter (%)				The difference of culture (t/ha)			
	N_0P_0	N_0P_{70}	$N_{70}P_{70}$	G40	N_0P_0	N_0P_{70}	$N_{70}P_{70}$	G40
Medicago sativa	100	100	100	100	Mt.	Mt.	Mt.	Mt.
Medicago sativa + Trifolium alexandrinum	108	106	111	109	1.03	0.94	1.57	1.23
Medicago sativa + Dactylis glomerata	111	116	115	114	1.53	2.37*	2.17*	1.87
Medicago sativa + Trifolium alexandrinum + Dactylis glomerata	100	100	99	102	0	0	-0.16	0.23
DL 5% = 1.81 t/ha			DL 1% = 2.7 t/ha			DL 0.1% = 4.27 t/ha		

Table 5. The influence of fertilization in each culture system, years 2004-2006

Fertilization variants	Relative production of dry matter (%)				The difference of production (t/ha)			
	M.s.	M.s.+ T.a	M.s.+ D.g.	M.s.+ T.a.+ D.g.	M.s.	M.s.+T. a	M.s.+ D.g.	M.s.+T.a.+ D.g.
N_0P_0	100	100	100	100	Mt.	Mt.	Mt.	Mt.
N_0P_{70}	108	107	113	108	1.13**	1.04**	1.97***	1.13*
N_{70} P_{70}	105	109	109	104	0.73	1.27**	1.37**	0.57
Manure 40 t/ha	98	99	100	99	-0.3	-0.1	0.04	-0.07
DL 5% = 0.76 t/ha			DL 1% = 1.03 t/ha			DL 0.1% = 1.38 t/ha		

Ecological culture of lucerne variants (variant unfertilized and fertilized with manure) have achieved the lowest production in each of the three years of research.

By comparison with lucerne in pure culture, mixted with *Dactilis glomerata* proved to be the most productive both in terms of ecological fertilization, especially in the variants of fertilization with chemical fertilization. This mixture has achieved production increases of 11-26% on average for three years.

The ecological lucerne crop which ensures high returns for feed use in environmental condition and aesthetic quality of the vegetation cover, are based either on the absence of any fertilization or the organic fertilization (40 t/ha manure).

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RESEARCH REGARDING QUALITY OF LUCERNE IN ECOLOGICAL CULTURE

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Abstract

Carpet plant used as temporary grassland is an essential component of forage systems applied in regions lacking natural grasslands (permanent), as is Burnazului plain. It provides the cheapest animal feed during the growing and most balanced in terms of nutrient feed for a period of calves. For quality measurements and analyzes I performed in the dynamic field floristic composition, the vegetation cover density, the permanence, the aesthetic appearance of the vegetation and landscape and I have harvested plant material for laboratory testing and the amount of dry matter content of macro and micronutrients. Based on botanical analysis I found that the mixtures in organic fertilized variants, lucerne reaches a weight of 70-80%. Structure determinations on the vegetative organs of the species yield components shows that both the pure culture of lucerne, and mixtures with Dactilis glomerata variants leaf share increase from cycle 1 to cycle 3-century. Crude fibre content of plants, indicator of consumption and digestion, is very low, 20-28% of dry matter. The lowest values of 20-22%, occurred in pure culture variant lucerne and Trifolium alexandrinum version, fertilized with manure. Microelement content in plants falls within normal parameters.

Key words: *grassland, lucerne, testing, quality.*

INTRODUCTION

Carpet plant used as temporary grassland is an essential component of forage systems applied in regions lacking natural grasslands (permanent), as is Burnazului plain. It provides the cheapest animal feed during the growing and most balanced in terms of nutrient feed for a period of calves [1, 3].
Medicago sativa, *Trifolium alexandrinum* and *Dactilys glomerata* are three species feed has an imporant economic and ecological value [5].
Lucerne is the most important perennial legumes for forage-use composition of the vegetation in lowland areas or in pure culture or mixed with perennial grasses [2].
Has a high resistance to frost and drought, high production capacity, outstanding quality for animal nutrition, good longevity (5-6 years) and the ability to enrich the ground-nitrogen biologically [4].
Clover of Alexandria is a legume forage with an architecture similar to that of lucerne, but with a growth rate more intensely, covering the ground after a short period of emergence. Clover is valuable forage quality by the high content of protein and digestible energy. It is also a valuable honey plant. Has an important role in preventing pollution by excluding nitrogen fertilizers.
Dactilys glomerata is the species with the greatest ecological plasticity in Romania, is resistant to drought and feed use in all know forms: mowing, grazing, mixed. Form a closed vegetation cover, with great longevity.

MATERIAL AND METHOD

For quality measurements and analyzes I performed in the dynamic field floristic composition, the vegetation cover density, the permanence, the aesthetic appearance of the vegetation and landscape and I have harvested plant material for laboratory testing and the amount of dry matter content of macro and micronutrients.
Experimental variants were the culture system (*Medicago sativa*-pure culture; mix 1: *Medicago sativa* - 18 kg/ha + *Trifolium alexandrinum* - 4 kg/ha; mix 2: *Medicago*

sativa - 16 kg/ha+*Dactylis glomerata* - 6 kg/ha; mix 3: *Medicago sativa* - 16 kg/ha+*Dactylis glomerata* - 6 kg/ha+ *Trifolium alexandrinum* - 4 kg/ha) and fertilization system (N_0P_0 kg/ha; N_0P_{70} kg/ha; $N_{70}P_{70}$ kg/ha; manure-40 t/ha).
For comparison were placed in 2 variants of conventional culture (N_0P_{70} kg/ha, $N_{70}P_{70}$ kg/ha), a variant without fertilization, considered organic (N_0P_0 kg/ha) and one organic fertilized variant (manure-40 t/ha). The varieties used were: Pomposa for lucerne, Tigri for *Trifolium alexandrinum* and Magda for *Dactylis glomerata*.

RESULTS AND DISCUSSIONS

Based on botanical analysis I found that the mixtures in organic fertilized variants, lucerne reaches a weight of 70-80%.
Structure determinations on the vegetative organs of the species yield components shows that both the pure culture of lucerne, and mixtures with *Dactilis glomerata* variants leaf share increase from cycle 1 to cycle 3-century.
At harvest, 1-2005 cycle, the average fertility variants, biomass structure is differentiated on the two components of mixtures studied species. Thus, the *Dactilys glomerata* leaves predominantes (52%) to the mix *Medicago sativa*-16 kg/ha+*Dactylis glomerata*-6 kg/ha and 60% in the mix *Medicago sativa*-16 kg/ha+*Dactylis glomerata*-6 kg/ha+ *Trifolium alexandrinum*-4 kg/ha (Fig. 1).
At lucerne strains although prevail (53-54%), the difference is quite small that it can be said that the report leaves/stem close to the value 1 (Fig. 2). Cycles II and III are found in the structure prevailing lucerne leaves harvested biomass that is, increasing the percentage of leaves about 50% from cycle I to 60-65% in the third cycle (Fig. 3).
There were no significant differences in fertilization variants in terms of report leaves/stems. These results lead us to suggest that dry matter yields are good quality in terms of animal nutrition.
Based on chemical analyzes performed at the first harvest in 2005, that in terms of animal nutrition all experimental variants fall within normal parameters.

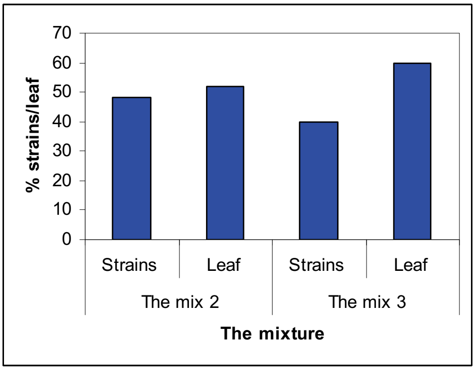

Fig.1. Production components in *Dactylis glomerata*, the first cycle-2005

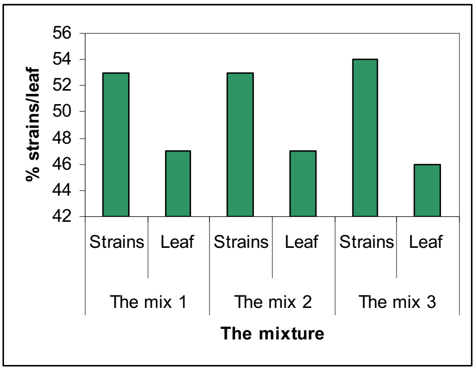

Fig.2. Production components in *Medicago sativa*, the first cycle-2005

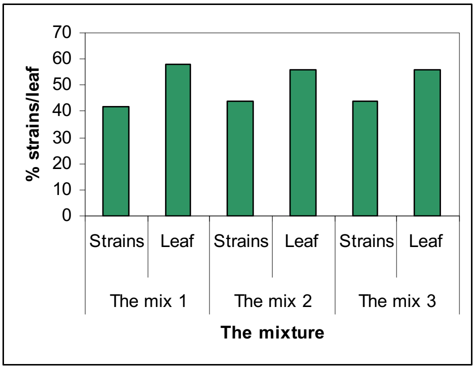

Fig. 3. Production components in *Medicago sativa*, the third cycle-2005

Table 1. The chemical composition of plants, first harvest cycle, 2005

Variant fertilization	Minerals											
	(%)	mg/100 g SU										
		K	Ca	Mg	Na	Fe	Zn	Mn	Cu	Al	B	Ba	Pb
Medicago sativa-pure culture													
Unfertilized	7.17	1329	1894	342	176.51	19.47	11.84	3.47	0.63	26.97	3.89	2.82	0.09
$N_{70}P_{70}$	7.12	1299	1938	346	178.61	19.37	11.07	3.39	0.89	20.78	3.89	2.74	0.10
Manure 40 t/ha	7.24	1369	1947	372	160.34	22.90	11.28	3.69	0.98	36.39	3.97	3.02	0.10
Medicago sativa + Trifolium alexandrinum													
Unfertilized	8.28	1938	418	187	44.49	5.50	12.14	7.93	0.66	3.62	0.42	0.65	0.10
$N_{70}P_{70}$	8.01	1983	401	186	46.55	5.26	12.92	7.92	0.36	4.24	0.48	0.74	0.09
Manure 40 t/ha	9.02	2190	469	213	62.54	7.59	12.44	8.84	0.40	15.33	0.52	0.83	0.10
Medicago sativa + Dactylis glomerata													
Unfertilized	7.21	1474	1538	311	121.70	22.31	9.86	4.88	0.65	29.03	2.94	2.54	0.16
$N_{70}P_{70}$	7.07	1484	1566	307	145.65	23.28	9.47	4.35	0.75	31.53	3.03	2.91	0.16
Manure 40 t/ha	7.28	1469	1529	308	134.47	22.02	9.85	4.41	0.68	32.33	2.82	2.75	0.17
Medicago sativa + Trifolium alexandrinum + Dactylis glomerata													
Unfertilized	7.21	1229	1620	321	162.27	21.63	11.12	5.13	0.63	40.47	3.35	2.53	0.16
$N_{70}P_{70}$	7.22	1303	1677	320	145.94	22.26	11.31	5.31	0.63	45.95	3.18	2.91	0.15
Manure 40 t/ha	7.26	1393	1695	332	134.06	19.77	10.77	4.97	0.63	18.43	3.19	2.73	0.18

Crude fiber content of plants, indicator of consumption and digestion, is very low: 20.0-28.0% of dry matter. The lowest values (20.0-22.0%) were recorder in variant pure culture lucerne and in variant with *Trifolium alexandrinum* fertilized with manure. All chemical elements assayed (Table 1) some of which are essential in plant nutrition (Ca, K, Mg) were insignificant deviations from the critical level specific to each element. Microelement content in plants is normally.

Ecological compensation capacity is one of the most important attributes of ecological culture systems, essentially characterized by multifunctionality, biodiversity, environmental compatibility, stability yields, soil sustainability of natural resources. The ability of ecological compensation areas planted with lucerne and lucerne mixtures and perennial grasses are flora and fauna biodiversity severely affected by prevailing technologies arable land prevailing in the agricultural area of the plain Burnazului.

Regarding the spontaneous flora diversity, floral and analysis of report botanical collection made on each cycle revealed the protective role of vegetation cover consisting of lucerne and orchard grass for survival and perpetuation unite large number of wild grass species. For example in variant of lucerne pure culture and mixed with *Trifolium alexandrinum* variant has been the presence of 15-20 species of plants (other than those sown), 90% of them nonexistent in the neighbouring field experimental cultures. Species with higher abundence-dominance (15-25%) were *Taraxacum officinale* and *Veronica persica*, the laster being tackled weed permanent crops on arable land, but harmless in the carpet of grass and leguminous perennial plant.

Landscape quality of the carpet plant species varies with species. Thus, increased drought orchard grass growth stalling, losing their green colour and the leaves are dried in a high proportion, depending on the length of drought. Most resistant species is Medicago sativa. Carpet plant dominantes lucerne (ecological variants) retains density, leaf color and viability.

CONCLUSIONS

In terms of production components in ecological variants data suggest that in pure culture of lucerne at harvest, leaf weight in the structure of yield increases from about 50.0%

of the first cycle to 60.0-65.0% in third cycle. These results demonstrate the high quality of feed, which is confirmed by chemical analysis.

Based on chemical analyzes performed at the first harvest in 2005 that in terms of animal nutrition all experimental variants fall within normal parameters. Crude fiber content of plants, indicator of consumption and digestion is very low, 20.0-28.0% of dry matter.

In variant of lucerne pure culture and mixed with *Trifolium alexandrinum* variant has been the presence of 15-20 species of plants (other than those sown), 90% of them nonexistent in the neighboring field experimental cultures.

In period of severe drought *Dactylis glomerata* growth stalling, losing their green color and the leaves are dried in a high proportion, depending on the lenght of drought.

Vegetal cover consists of *Medicago sativa* and lucerne mixtures retain density, leaf color and viability regardless of years of growing season rainfall.

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AN INVESTIGATION INTO THE ERGONOMICS OF TRACTOR SEAT POSITION

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Abstract

Considerable research has been carried within the automotive and trucking sector in order to provide an optimum driver or operator seating position. There is little available data for the agricultural sector, this combined with a high number of reported lower back problems, associated with agricultural workers, in particular tractor drivers, has been the driving force behind this specific area of research. The ergonomic layout of a typical tractor cab has been critically examined in order to establish the effect of repetitive working practices on operator stress levels and muscular injury. Three student volunteers were selected in order to obtain a range of data specific to body size. In order to carry out this investigation the services of a professional physiotherapist needed to be engaged in order to monitor the effects on each of the volunteers' health. The outlined results proved that when an operator is sat in a too close position to the machine controls and pedals, considerable muscular discomfort is caused to the upper and lower legs and the lower back. Operator concentration increased when the driving; due to the operators stating they were more concerned with safety and were aware they sat in a compromising position. Had the operators been unaware they were taking part in the experiment all stated they would not have been concerned with safety aspects and carried on regardless. The results for the research are presented in table form and clearly identify the potential for potential long term health problems developing.

Key words: *ergonomics, tractor seat position, health and safety.*

INTRODUCTION

A Seat position and ergonomics is a vital factor in choosing a machine to use when using it to do a repetitive job usually on a daily basis [1]. Seat positioning is a factor which requires a considerable amount of investigation as to whether it affects operator performance and operator fatigue. This is in relation to driving Agricultural vehicles, when operators are using said machines for regulated periods of time using a number of common tasks [2]. Using three test subjects this investigation will seek to prove the value of a machine having a variable seat position. Using the said three test subjects for the investigation 'Does Seat Positioning Affect Operator Performance and Fatigue?' it should be possible to determine the long term and short term effects of bad cab ergonomics on the operator. The specified positions of the seat are set in the following positions: too high, too low, set right for the operator.

There is no doubt the importance of Ergonomics in relation to safety within the agricultural industry, but there is a tendency on the part of some ergonomists to assume that a machine will be safe just because it is designed on certain ergonomic principles. This assumption can be often justified – but not always [3]. Agricultural Vehicles have been pushed into the spotlight in the past fifty years due to the diminishing of manpower and entering into the era of the 'Mechanised Industry', it is no longer a case of matching person to machine it is now perceived that one machine can be suitable for all users [4] or is this really the case? Is it possible for one machine to be selected to not cause long term/short terms discomfort to all its operators? [5]. Agricultural vehicles suddenly had to adapt, as they now perform more tasks, are used more regularly and have new purposes thus creating more controls for the specialist implements. All these new controls had to be fitted into cabs all the while creating a comfortable environment for the operator who was now spending up to twelve hours a day in a machine [6]. This investigation is relevant to contractors, farmers and machine operators that spend almost every day of the week performing mundane and relentless tasks from tractor cabs.

MATERIAL AND METHOD

Three test subjects were chosen for the investigation to have an example of one type of each male (as all subjects had to be the same sex to create a fair test,) an average eighteen year old male, a taller than average seventeen year old male and a shorter than average seventeen year old male. An average male is described as the sample of males within the general population taken for analysis; the average is derived from the measurements taken from the specific anthropometric data [7]. All participants in the test had to be born in the same year but their age varied slightly as this would create a benchmark situation for the test. A physiotherapist judged the subject's suitability for the tests before the examination took place. Three students were selected who volunteered to assist in the collection of data.

After discussions with the physiotherapist and test subjects it was decided fifteen minutes would be sufficient to gain readings and show preliminary muscle damage and Repetitive Strain Injury (RSI) complaints. After fifteen minutes the Straight Leg Raise (SLR) would be dramatically affected either way (showing and increase in the SLR or a decrease in the SLR) this would give good data [8].

For the driving experience a set route was drawn up which tested driving skills in real life situations; the route chosen made full use of the College campus and public roads, plus a practical exercise.

Each student was subjected to a preliminary examination conducted on body charts. Each subject had to ensure that they had no ongoing complaints from such problems as RSI pains, muscular discomfort in the back, legs or neck areas and skeletal (joint) pain. On-going complaints of RSI would affect the current results this is because RSI pains can last for; in some severe cases several years it may not always be diagnosed until the latter stages of its development [9]. This was why it was important for the physiotherapist to establish that the subjects were not suffering unknowingly with RSI pains.

Each subject had to take part in the SM test repeatedly pushing the clutch up and down for fifteen minutes in each seating position; a body check along with a SLR had to be conducted before and after each test to establish a change in range of movement in each subject's legs.

All seat positions, TCP, OP and TFP, had to take into consideration the three working areas of Ergonomic design:

- The Immediate work area;
- The Intermediate work area;
- The Outer work area.

Each set of controls and devices has their own wok area these three areas are applied to any situation not just tractor and vehicle cabs. They are used daily by ergonomists to establish the most common problem areas [10]. (Most problems are mainly discovered in the immediate and outer work areas, this was due to the over and under reach of operators' limb capabilities [11].

All results were recorded in tabular format, video evidence was taken of SM test to view for further analysis, and in addition still photos were taken of the different leg positions of each test subject. These were taken so the physiotherapist could establish where the different pressure points amalgamated together or whether they moved position.

The driving situation test had to be conducted on a different day so the previous SM results didn't interfere with the current results required. The seating positions were again set up in the following positions, too close, too far and optimum for the operator. A route was then set up that involved road driving, on campus driving and driving track driving plus one simple task hitching up a trailer; It is important that the driving was as real to life as possible as MSD's and RSI concerns caused by long term driving make up 75% of patient complains to GP's in the year 2000 [12]. Drivers used to be a commodity for businesses as manpower was diminishing, but now due to more comfortable machines coming into operation more people are willing to drive these long and demanding hours [13] thus it was important that this test was true to real life.

RESULTS AND DISCUSSIONS

Table 1. Cab Measurements (average size person)

Seat Position	Pelvic Bone to Steering Wheel Console (CM)	Centre of Stomach to the Centre of the Steering Wheel (CM)	Pivotal Joint of the Elbow to the Gear Controls (CM)	Straight Leg Raise Score Left Right
Before Test				57° 50°
Optimum	40.5	20.2	20.5	56° 45°
Too Close	37	17	17	31° 50°
Too Far	42.4	22	22	40° 44°

This table demonstrates all the different measurements taken of the first test subjects positioning in the Same 110 Cab. The left leg SLR score at the worst was affected by 26° in the TCP, this is a drastic result according to the Physiotherapist showing that the pain felt must have been extreme, research conducted into SLR's and anthropometric data suggests that a drop in more that 10° in an Active ROM SLR is an excessive reading [14]. A difference of 3.5 cm is only small between the OP and the TCP yet this showed the most impressive result. The right leg in the SLR was only affected minimally as the right leg was not in use in the test. This would suggest though, that pain travelled along the lower back to the right leg in the sciatic nerve, the longest nerve in the body that travels from the back of the pelvis along the buttocks and down both legs [15].

Table 2. Cab Measurements (taller than average size)

Seat Position	Pelvic Bone to Steering Wheel Console (CM)	Centre of Stomach to the Centre of the Steering Wheel (CM)	Pivotal Joint of the Elbow to the Gear Controls	Straight Leg Raise Score Left Right
Too Close	38.5	16	11	61˚ 51˚

The left leg Active SLR dropped by 13˚ and the right leg dropped 9˚. As Sarfit and Wood (1989) [14] suggest a 13˚ drop is again a very excessive reading showing a positive result. A negative ROM result occurs when an Active SLR reading is a higher degree after exercise than it was before [16].

The position the second subject is in is a highly dangerous situation, the knee is touching the steering wheel in the clutch release position and the quadriceps muscle is touching the steering wheel in the clutch depressed position. The muscles are extremely over tightened; the fulcrum point is taking a drastic pressure increase in both release and depressed position this is often the cause of many cartilage problems in the future [17]. This subject cannot achieve a closer seated position due to the size of the cab, they are one centimetre and a half away from the average males closest seated position. The seat in this particular cab cannot accommodate a person of this size in a comfortable position.

Table 3. Cab Measurements (smaller than average size)

Seat Position	Pelvic Bone to Steering Wheel Console (CM)	Centre of Stomach to the Centre of the Steering Wheel (CM)	Pivotal Joint of the Elbow to the Gear Controls	Straight Leg Raise Score Left Right
Too Far	40	22	20	60˚ 30˚

The smaller than average male had a negative Active SLR result the left leg went up by 19˚, this could have been cause by a previous injury making the muscles weaker which causes them; instead of tightening to relax, this is know an overuse injury and happens after an injury when a muscle has not had chance to repair itself properly [18]. In the depressed position the subject's entire body has gone rigid the resistance pushing up and the force pushing down will be immense on the not only the fulcrum point but the ankle as well. The ankle now becomes a Ground Reaction Force (GRF). The GRF is indicative of the body positioning and dynamics and acts as the ground point of the second class lever [19]. This was a compromising position for the subject both in concepts of safety and comfort.

The HP Score was most affected after the TFP. The OP score was the highest result; as this was a test situation it is often common for a subject to suffer from nervousness during the first testing procedure until the process is known thus affecting the results [20]. The overall best score was achieved after the OP, showing that increased concentration levels and better time perception (speed at which subject registered the oncoming hazard in the test) are achieved when the operator is comfortable and not feeling any pain [21]. The improved concentration levels have also been achieved overseas in active concentration tests (also computer based similar to the HP test) performed after long stretches of driving periods [22]. The biggest drop was in the TFP for the smaller than average male. Surprisingly the taller than average male achieved very similar scores.

Table 4. hazard perception (average size driver)

Subject	Hazard Perception Test Score Before Analysis	Hazard Perception Test Score After Optimum Position	Hazard Perception Test Score After Too Close Position	Hazard Perception Test Score After Too Far Position
Average Male	67%	72%	61%	50%
Taller Than Average Male	67%	70%	70%	
Smaller Than Average Male	70%	89%	80%	38%

Table 5. Hitching and un-hitching trailer

Seat Position	Time To Hitch Trailer	Attempts To Hitch Trailer	Time To Drop Of Trailer (mins)	Attempts To Drop off the Trailer
Average sized person; optimum position	1.35	1	1.40	1
Average sized person too Close	2.11	2	2.07	1
Averaged sized person too Far	1.57	1	0.22	2
Smaller than average too close	2.05	2	1.44	2
Smaller than average to far	1.37	1	2.54	3
Taller than average to close	1.50	2	2.05	4

The seat positions were set the same again for the driving tests. This was important to establish an overall rounded result; the entire test has to give an equal result in terms of time, effort and fairness [23].

The amount of attempts to hitch up the trailer and reverse it back into the designated space, increased in both the TCP and the TFP interestingly the results show that it was harder to drop off the trailer in the too far position and harder to pick up the trailer in the TCP.

This result may have been due to increased blind spots in the TCP making it impossible to keep the foot on the clutch whilst trying to view the pick up hitch; it was also harder to raise the body out the too close position to remove them from the cab. There was also a loss of throttle control causing the machine to jerk into undesired areas, ruining the pattern of reverse this was supported by a concept from motor vehicle drivers that in correct seat position cause loss of foot pedal controls [24].

Table 6. Effect on heart rate during hitching exercise

Subject	Heart Rate Before	Heart rate optimum	Heart rate too far	Heart rate too close
Average Male	102	139	136	140

As the table shows the average males heat rate rose to 140 BPM at the highest end of the scale. A normal average male's heart rate should rest between 70 to 80 BMP but this will naturally increase to 100 - 200 BMP (in a twenty year old) during excitement, activity or anxiety [25]. The subject had a high heart rate before the test this was due the subjects' trepidation about taking part in the investigation. This would explain the high increase to 140 BPM the higher the start BPM the higher the increase. Blood oxygen uptake has to increase by 200% to compensate for the high heart rates displayed in the table [26]. Anything above a 300% increase is dangerous and can cause cardiac arrest in an unfit male as the stress placed on the heart is too extreme, the results provide an indication of the relative stress placed on the subject's heart [27].

The additional comments for this table are written as described by the subject. The most areas in pain were in the too far seating position, yet the pain rating scale (NHS Foundation Trust) revealed that the most pain felt in each area was in the too close position. One of the most concerning points being the increased blind spots described in the too close position this is a highly dangerous situation to occur form incorrect seating.

Table 7. Pain rating (average size operator)

Subject	Before Test	Optimum Seating Pain Register	Too Far Seating Pain Register	Too Close Seating Pain Register	Additional Comments
Average Male	No Pain	No Pain 0 /10	Leg Area 3/10 Lower Back 2/10 Neck (Top of Spine) 2/10	Leg Area 7/10 Lower Back 5/10	Too far trouble with the gear control as with the clutch and throttle Too Close increased blind spots, difficulty with steering and indicator controls very awkward and painful

CONCLUSIONS

According to Same Tractors the seat should be able to accommodate any drivers 'Stature and Personal Preference' [28] this was proven not to be the case.

The original Hypothesis has shown that Yes there is a correlation between seat positioning and the mental fatigue of the operator. The investigation has also proved definitively that seat position does affect the operator in terms of comfort, and long and short term health defects. Due to pain receptors in the brain this will undoubtedly affect the operator's performance, the operator loses the aptitude to take part in simple tasks effectively this is the cause of mental stress and loss of concentration for many an hour after the process has finished [29]. This correlation found has been supported in other sectors of the industry, where HGV drivers were tested for lower back pain in relation to seat positioning. It was found similar to this investigation that Transient (lasts less than one week) pain was discovered in the lower back when the seat was in a too close position [30].

The enquiry was successful in demonstrating the need for more adequate seating positions within agricultural vehicles as is has been discovered that the population is changing and therefore requires further seating specifications for the safe operation of all agricultural machinery.

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List of Abbreviations	
BPM- Beats per Minute	RSI- Repetitive Strain Injury
ES- Ergonomics Society	ROM- Range of Movement
HP- Hazard Perception	SLR- Straight Leg Raise
KE- Kinetic Energy	SM –Static Motion
MSD- Muscular Skeletal Disorders	TCP- Too Close Position
OP- Optimum Position	TFP- Too Far Position

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THE EXPERIMENTATION OF THE TC 5050 NEW HOLLAND COMBINE HARVESTER IN WINTER WHEAT CROP HARVESTING

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Abstract

The work presents the results of laboratory experiments and field studies in winter wheat crop harvesting with the New Holland TC 5050 combine harvester. The combine's harvesting performance was monitored on the level and slope field by determining the work quality indexes and the energetic and operating indexes of the combine studied. When driving on sloping land on the valley-hill direction, grain losses have exceeded the maximum allowable limit, reaching values over 6%. When movement was along level curves, the grain loss had registered values close to maximum allowed limit (2.5%), being therefore the recommended method. Fuel consumption has increased considerably when driving on sloping land compared with driving on the level field. In order to achieve a quality harvesting work, combine harvesters should be adjusted and operated in accordance with land condition and with the agrobiological characteristics of the crops.

Key words: *combine, grain losses, fuel consumption, winter wheat, work indexes.*

INTRODUCTION

The straw grains combine harvesters are complex agricultural machinery capable to perform all the technological stages that are needed to obtain the main product (grains). It should be noted that even if those machines were initially designed only for mechanized harvesting of the straw grains, over the years they have been gradually equipped with new working boddies in order to harvest other crops: maize, sunflower, soybean, rapeseed, beans, peas, etc. [3].
This paper studies the performance of the TC 5050 New Holland combine in winter wheat harvesting on the level and slope land. A special attention should be paid to the level of seed losses, which tend to be very high when harvesting is done on slopping fields.
This paper aims to identify the optimum operating procedures for harvesting winter wheat according to the land condition and to highlight the links and the relationship between the work quality, energetic and operating indexes.

MATERIAL AND METHOD

The experimental research took place in 2011 at the Ezăreni Farm, which belongs to the University of Agricultural Sciences and Veterinary Medicine "Ion Ionescu de la Brad" Iaşi, on plots with winter wheat Alex variety.
The agrobiological characteristics of the winter wheat crop on which the experimental research were carried out are presented in Table 1.

Table 1. The crop's agrobiological characteristics

Specification	M.U.	The average value of the biological characteristics
Grain moisture	%	14.5
Plants' density	plants/m^2	376
Plants' average height	cm	75.1
Total mass of the plants:	g/m^2	991.25
- grain mass	g/m^2	441.61
- straw mass	g/m^2	468.59
- weed mass	g/m^2	81.05
Recumbent plants percentage	%	0.67
Grain production per hectare	kg/ha	4467.3
Average straw production per hectare	kg/ha	4698.5
Grain-straw ratio	-	0.94
The 1000 seeds mass	g	47.05
Mass per storage volume	kg/hl	78.6

Operating measurements were conducted under normal production conditions. The plots on which the experiments took place had shapes and sizes that would ensure the mechanized harvesting. The grain moisture at harvest was within the regulatory limit of 14-16%.
The work quality indexes, the energetic and operating indexes of the TC 5050 New Holland combine in winter wheat harvesting were measured.
The main technical and functional features of the TC 5050 New Holland combine can be found in table 2.

Table 2. The main technical and functional characteristics of the TC 5050 New Holland combine

The characteristic name	M.U.	New Holland TC 5050
Header – number of rows	-	4
Beater - width - diameter - number of rails - rotation speed concave - number of rails - wrapping angle	- mm mm - rot/min - degrees	 1040 607 8 430-1037 14 111
Rotary separator		no
Cleaning - cleaning surface - total area under air flow	 m^2 m^2	 5.80 3.27
-cleaning area - number of shackers	m^2 -	4.00 4
Chopping equipment	-	yes
Bunker - capacity	l	4,000
Engine - cylinders' capacity - fuel tank capacity	- l l	New Holland 6.80 300
Transmission	-	hidrostatic – 3 speeds
-length with header - length without header -width - maximum height	m m m m	10.72 8.13 3.00 4.00
Combine's mass	kg	7600

The combine used in experimental research was the TC 5050 New Holland combine, equipped with header for harvesting straw cereals with a 4.5 m width.
Daily stages of the combine working process were photographed and daily worksheets have been prepared. In those particular sheets were recorded the following: the experiments' location, the crop, the time when the work has started, the operations and the duration of each operation, the time of completion the work, the plot's draw and the plot's area which have been harvested, the quantity of the grains harvested, the cutting height, the fuel consumption and the grain moisture.
The combine was tested in operation conditions on the level and slope land: on the hill-valley direction, the valley-hill direction and along the contour, in first gear and the second gear. For each gear were used rotation speeds of 1500 rpm and of 1800 rpm and for each rotation speed, a number of three repetitions were done [1].
In the experimental research were also used: metric frame, electronic scale, moisture meter, tilt to collect grains and vegetal residues, plastic bags to collect the grain samples, stopwatch, and daily monitoring sheets.
The working capacities have been measured and calculated on an 8 hours shift, at a normal working combines' speed, which provided an optimal feeding flow, specific to each combine [2].

RESULTS AND DISCUSSIONS

The work quality indexes were calculated according to the land's slope, to the combine's movement direction and to the combine's speed. The average values of the total losses, purity and broken grains obtained by the TC 5050 New Holland combine in winter wheat harvesting are grouped in table 3, 4 respectively 5.

Table 3. The total losses of the TC 5050 New Holland combine in winter wheat harvesting

Working speed			Total losses (%)			
Gear	rpm	Km/h	Level land	Level curves	Hill-valley	Valley-hill
I	1500	4.1	0.88	2.56	6.79	7.33
	1800	5.3	0.71	3.19	6.90	7.66
II	1500	6.8	0.65	2.62	6.68	7.47
	1800	9.3	1.10	3.39	7.14	7.59

When driving on sloping land on the hill-valley direction and on the valley-hill direction, the grain losses have exceeded the maximum allowable limit, reaching values over 6.5%.

When movement was along the contour, grain losses have been close to the maximum allowable limit (2%).

Table 4. The grains' purity obtained by the TC 5050 New Holland combine in winter wheat harvesting

Working speed			Purity (%)			
Gear	rpm	Km/h	Level land	Level curves	Hill-valley	Valley-hill
I	1500	4.1	98.73	96.51	94.33	95.75
	1800	5.3	98.09	96.32	94.05	95.15
II	1500	6.8	99.19	97.15	94.29	96.09
	1800	9.3	98.29	96.40	93.76	95.45

The purity of the grains was very high when the combine's movement was on the level land, but fell below the minimum allowable limit of 98% when combine's movement was on the slope field, reaching values below 94%.

Table 5. The percentage of broken grains obtained by the TC 5050 New Holland combine in winter wheat harvesting

Working speed			Broken grains (%)			
Gear	rpm	Km/h	Level land	Level curves	Hill-valley	Valley-hill
I	1500	4.1	3.25	3.49	3.66	3.65
	1800	5.3	3.11	3.11	3.42	3.29
II	1500	6.8	2.59	2.90	3.21	3.16
	1800	9.3	2.44	2.54	2.84	2.65

The percentage of broken grains showed higher values when the combine have been driven at lower speeds, due to the weak flow of grains which have been feeding the threshing apparatus.
The average values of the operating coefficients of the combine studied are shown in table 6.

Table 6. The operating coefficients of the TC 5050 New Holland combine in winter wheat harvesting

Specification	Symbol	Value
Operational time usage coefficient	K02	0.86
Production time usage coefficient	K04	0.76
Shift time usage coefficient	K07	0.55
Turns coefficient	K21	0.93
Technological service coefficient	K23	0.88
Technical care coefficient	K31	0.96
Technological safety coefficient	K41	0.98
Technical safety coefficient	K42	0.88
Operational safety coefficient	K4	0.83

The operating indexes of the combines tested were calculated based on the timing sheets prepared during the operating experiments.
The values of the main operating coefficients of the TC 5050 New Holland combine were: the operational safety coefficient 0.83; the technological safety coefficient 0.98; the technical safety coefficient 0.88; the turns coefficient 0.93.
The hourly work capacity on shift time of the TC 5050 New Holland combine has recorded a decrease on average by 15-23% at harvesting on sloping land compared to on the level land harvesting, due to the slope, which reduced working speed by 16-27% which led to a decrease of the shift time usage coefficient to 0.55.
The work capacities and the fuel consumption average values of the TC 5050 New Holland combine can be found in table 7.

Table 7. The work capacities and the fuel consumption of the TC 5050 New Holland combine in winter wheat harvesting

Specification	Symbol	M.U.	Value
Hourly work capacity on effective time	Wef	t/h	7.78
Hourly work capacity on operative time	W02	t/h	6.79
Hourly work capacity on production time	W04	t/h	6.58
Hourly work capacity on shift time	W07	t/h	5.34
Work capacity on a 8 hours shift	Wsch	t/sch	42.72
Fuel consumption per reference unit	Gc	l/t	6.10

The fuel consumption of the TC 5050 New Holland combine obtained in winter wheat harvesting on the sloping land has increased on average by 17-28% comparing to the fuel consumption obtained on the level land movement.
During the experimental research, we have seen that the combine's safety is not ensured on the hill-valley movement balance facing valley, especially on slopes above 22% and when the bunker had a load over 1,500 kg of grains.

CONCLUSIONS

The TC 5050 New Holland combine had the total grain losses below the allowable limit of 2% when driving on the level and just above this limit when the combine's movement was on the slope land along the contour. When driving the combine on the hill-valley, and on the valley-hill directions, the combine's total grain losses have exceeded the allowed limit, reaching values of 7.66% at the most.

The percentage of broken grains was reverse proportional to the speed of the combine and has not been explicitly influenced by the slope.

In the experimental research, the 5050 TC New Holland combine has reduced its work capacity by 15-23% and has increased fuel consumption by 17-28% when driving on the slope land comparing to the level land movement.

The time for technical fixes has immobilized the combine 14-19 min./shift on average, which drew reduction of the shift time usage coefficient to 0.55, and the operational safety coefficient to 0.83.

In order to achieve a quality harvest work, the combines should be adjusted and operated in accordance with land condition and with the agrobiological characteristics of the crops.

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RESEARCH REGARDING THE PERFORMANCES OBTAINED BY THE 560 AND THE 750 CLAAS LEXION COMBINES IN SUNFLOWER HARVESTING

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Abstract

This work presents the results of laboratory experiments and field studies in harvesting of the sunflower crop by two combine harvesters: Claas Lexion 560 and Claas Lexion 750, both made in Germany. There are differences between this two combines at both constructive level and the degree of automation. This work has tracked the impact of the existing automation elements in the construction of the combines on the growth of their performance, by determining the work quality indexes and the energetic and operating indexes of the combines studied. The major difference has been done by both the values of the working capacity indexes and the values of the operating coefficients, which were higher for the Claas Lexion 750 combine, to the values obtained by the Claas Lexion 560 combine. Overall, the Claas Lexion 750 combine has been proven better performance, the higher level of automation of this combine had done the difference.

Key words: *combines, harvesting, performance, sunflower, work indexes.*

INTRODUCTION

Since the sunflower harvest period is relatively short, it is important that all harvesting operations run on time to avoid significant grain losses. In order to use sunflower harvesters effectively, the combines need to satisfy certain parameters. The purity percentage of the grains collected has to be at least 97% [1]. Moreover, it is necesary that the shaken grains on the top of the the ground to be less than 1 g/m^2 and the percentage of broken grains to be below 5% [3].

MATERIAL AND METHOD

The experimental research were conducted in 2011 at "SA Zimbrul SA", in the farm no. 2 of the "Ialomita Pond" (Făcăeni - Ialomiţa) on plots with sunflower hybrid Cobalt MK.

The measurement and the calculation of the work quality indexes, the energetic and operating indexes of the Claas Lexion 560 and the Claas Lexion 750 combines have been done according to the specifications.

The measurements were taken in three variants, represented by the three feeding flows of each combine. For each variant a total of three repetitions were performed. The working capacity indexes have been measured and calculated on an 8 hours shift, at a normal working combines' speed, which provided an optimal feeding flow, specific to each combine.

Table 1. The crop's agrobiological characteristics

Specification	The measurement unit	The average value of the biological characteristics
Grain moisture	%	11.20
Plants' density	thousands plants/ha	51.29
Plants' average height	cm	168.92
Average number of leaves per plant	-	19.5
Average stalk diameter	cm	1.8
Recumbent plants percentage	%	3.6
Average grain production per hectare	kg/ha	3409.94
Hectoliter mass	kg/hl	43.04
The 1000 seeds mass	g	59.11

Operating measurements were conducted under normal production conditions. The experiments took place in plots with shapes and sizes that could ensure the mechanized harvesting.

The air temperature was 30°C, without rainfall in the last 24 hours at the Claas Lexion 560 combine testing and the air temperature was 28°C, without rainfall in the last 24 hours at the Claas Lexion 750 combine testing.

The main technical characteristics of the combines tested are listed in table 2.

Table 2. The main technical and functional characteristics of the combines tested

The characteristics' name	M. U.	Combine	
		CLAAS LEXION 750	CLAAS LEXION 560
Header – working width	m	7.5	7.5
Beater	-		
- width	mm	1680	1680
- diameter	mm	600	600
- number of rails	-	8	8
- rotation speed	rot/min	395-1150	395-1150
concave	-		
- number of rails		10	10
- wrapping angle	degrees	90	90
Rotary separator	-	yes	no
First ceaning			
- cleaning area	m^2	5.80	5.80
Second cleaning	-	yes	yes
- number of shackers		2 rotory	6
- separation area	m^2	3.00	9.85
Chopping equipment	-	yes	yes
Bunker - capacity	l	10500	10500
Engine - model	-	Caterpillar C-13	Caterpillar C-10
- cylinders' capacity	l	12.5	10.3
- Fuel tank capacity	l	800	800
Transmission - number of speeds	-	3x2	3x2
-rear tires' size		600/55 - 26.5	16.5/85 - 24
-front tires' size	-	800/65 R 32	650/75 R32 R1
-length with header	m	11.42	11.42
- length without header	m	9.2	9.2
-width	m	3.5	3.5
- maximum height	m	4.85	4.85
Combine's mass	kg	17320	15655

Grain moisture was within the acceptable limits of 10-13% during the harvest [2]. The combines' working process stages were photographed daily and the daily worksheets were prepared. In these records were recorded: the experiments' location, the crop, the time when the work started, the operations and the period of each operation, the time when the work has ended, the plot's drawing and harvested area, the quantity of the grains harvested, the cutting height, the fuel consumption and the grain moisture.

In the experimental research were also used: metric frame, electronic scale, moisture meter, sheet to collect grains, vegetable scrap, plastic bags to collect the grain samples, stopwatch, daily monitoring sheets.

RESULTS AND DISCUSSIONS

The work quality indexes were calculated based on the feeding flows of the combines. The working quality indexes obtained by the combines in sunflower harvesting are grouped in table 3.

Table 3. The work quality indexes obtained by the Claas Lexion 560 and the Claas Lexion 750 combines in sunflower harvesting

Specification	M.U.	Average values					
Combine	-	Lexion 560			Lexion 750		
Average speed	Km/h	3.21	4.19	5.51	4.23	6.12	7.78
Feeding flow	kg/s	3.55	5.41	6.46	4.88	5.84	7.75
Total losses	%	0.99	1.83	1.58	0.85	0.98	1.88
Purity	%	98.06	98.40	97.78	98.16	97.19	95.93
Broken grains	%	3.94	3.15	2.87	4.57	2.98	2.90

For the feeding flows on which the combines were tested, the losses value did not exceed the maximum allowable limit of 2%. There were, however, significant losses on both combines for the biggest feeding flows in the experiments. Yet, although both combine reported losses to bigger feeding flows, losses percentage were higher in Claas Lexion 560 case.

To be metioned the fact that for a feeding flow of 7.78 kg/s achieved by the Claas Lexion 750 combine in sunflower harvesting the grain purity value fell below the minimum allowable limit of 97%.

The operating indexes of the combines tested were calculated based on the timing sheets prepared during the operating experiments.

The average values of the operating coefficients of the combines studied are shown in table 4.

As it can be seen on table 4, the Claas Lexion 750 combine recorded higher values at almost all of the coefficients compared to the Claas Lexion 560 combine.

The Claas Lexion 750 combine registered lower values for the operational safety coefficient and for the technical safety coefficient in sunflower harvesting, but the differences were insignificant.

Table 4. The operating coefficients of the Claas Lexion 560 and the Claas Lexion 750 combines in sunflower harvesting

Specification	Symbol	M.U.	Specification	
Combine	-	-	Lexion 560	Lexion 750
Hourly work capacity on effective time	Wef	t/h	11.18	11.31
Hourly work capacity on operative time	W02	t/h	9.17	14.98
Hourly work capacity on production time	W04	t/h	8.30	13.79
Hourly work capacity on shift time	W07	t/h	7.37	12.71
Work capacity on a 8 hours shift	Wsch	t/sch	58.96	101.68
Fuel consumption per reference unit	Gc	l/ha	8.67	9.39

The work capacities and the fuel consumption average values of the both combines can be found in table 5.

Table 5. The work capacities and the fuel consumption of the Claas Lexion 560 and the Claas Lexion 750 combines in sunflower harvesting

Specification	Symbol	M.U.	Specification	
Combine	-	-	Lexion 560	Lexion 750
Hourly work capacity on effective time	Wef	t/h	11.18	11.31
Hourly work capacity on operative time	W02	t/h	9.17	14.98
Hourly work capacity on production time	W04	t/h	8.30	13.79
Hourly work capacity on shift time	W07	t/h	7.37	12.71
Work capacity on a 8 hours shift	Wsch	t/sch	58.96	101.68
Fuel consumption per reference unit	Gc	l/ha	8.67	9.39

The Claas Lexion 750 combine had registered better values on the work capacities, compared to Claas Lexion 560 combine in sunflower harvesting. The fuel consumption per reference unit was higher on the Claas Lexion 750 combine, then the one registered on Claas Lexion 560 combine, mainly due to the bigger quantity of material threshed and to the bigger cylinders' capacity of the Claas Lexion 750 combine's engine.

CONCLUSIONS

From experimental research results can be observed a directly proportional relationship between the feeding flow and the total grains losses of the combines, and a reverse relationship between the feeding flow and the percentage of broken grains.
The grains losses did not exceed the maximum allowable limit of 2%, this fact is actually proving a quality and a reliability of both combines' construction, especially on threshing and cleaning systems' performance.
The Claas Lexion 750 combine, had performed better than the Claas Lexion 560 combine, the major difference being made by the working capacity indexes and the operating coefficients values. Higher values of those indexes registered in operation by the Claas Lexion 750 combine were due to the existence in its construction of the separating rotors that have replaced the classic walkers and the existence of the automation elements, namely: the combine's automatic routing by the chain's edge, the automatic control system of the working speed according to the chain's characteristics and the automatic control of grains losses.

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AGGREGATE FOR PLOWING AND SOWING OF BLEND SPECIES AND HELP IN THE FORESTS

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Abstract

The paper presents the possibilities of achieving an aggregate provided with working soil loosening with or without inverting the furrow while carrying out the sowing of seeds of certain blend species and help (ash, maple, linden, maple, tartaric maple, hawthorn, dogwood, etc.) in the gaps occurring between trees, as a result of illness, planned or unplanned cutting, to combat deforestation and soil erosion in hilly or mountainous areas as a result of massive and uncontrolled deforestation. The aggregate is fitted with one or two rolling wheels with independent adjustment possibilities, depending on the position and the slope of the field which ensures the aggregate's position during the work and driving through a bevel gear mechanism of the distribution device. The distribution device has the ability to set the distance between nests and the number of seeds in the nest.

Key words: *seeders, seeds, gully, nursery, forestry species.*

INTRODUCTION

When using sowing for the species forestry enterprises in nurseries decreases the volume of force of manual labor, increases productivity and creates possibility of making motorized and the other the maintenance work [3].
Also, it is held constant depth of sowing and uniform spacing between rows and even the distance between the seeds at a time. Seeders for the work proposed, uses components that can be found on some machines the sowing small seeds carried out at national and international level [4, 5].
Variation in amount of seed per meter of ditch is ensured by the movement on the bezel of the transport wheels that transmit movement and to the timing. It was intended to continue agitation of the material out of the box in order to supply the distribution of the permanent [1, 2].

MATERIAL AND METHOD

Studies carried out to implement a seeders which achieve can be used in the creation of specific crops in forestry nurseries followed by realization began in the autumn of 2009 at the nursery forestry Valley's Bogdan.
To this end have been studied part of existing seeders nationally and internationally and their possibilities to adapt to the establishment of forestry nurseries. Also have been studied and some characteristics of seed of certain species, forestry machinery, namely: *Picea Abies alba*, excelsa (spruce, FIR, red molift), *Larix decidua* (larch tree, larch, Lily), *Pinus sylvestris* (*Pine Sylvester*), in the forestry nursery crops of technique, outlined below:
Abies alba, has large seeds of 7-9 mm long, triangles, having a wide triangles whole wing, which breaking irregularly. As you are doing autumn, runs ploughing soil at 20-25 cm deep, levelled and grind well soil in layers late 1.2 m width, and the seed is simple, like in the trenches at 15 cm equally spaced from each

other, at a depth of 2.5 cm. Standard seed is 12 g m de gully, when seed is 50%, or 20-25 g m when germination is 25-30%. In gully seeds are covered with forest humus.

Picea excelsa, spruce multiplies easy from seed, but can be used and multiplying by cuttings. It is grown in nurseries of the mountain, but also in the lower altitudes of nurseries and even plain. It is recommended that the sowing to layer, in the trenches simple late 1-2 cm to 15 cm equally spaced, sowing grouped in rows, with two simple trenches, equally spaced between them to 4 cm and distance between groups of trenches is 20 cm. Rule of seed which is used is 12 g per metre of gully, depth sowing seeds is 2 cm.

Larix decidua [1] nurseries for culture laricelui choose areas altitudinal 550-600 m and above, with soils ground by Waterside, very fertile. Before sowing, seed is soaked in water for 12-14 hours. To avoid sticking during sowing seed between them or of the walls of the seed is proposed to achieve a surface drying. To avoid sticking during sowing seed between them or of the walls of the seed is proposed to achieve a surface drying. The era of sowing is the optimum of the second half of May. The era of sowing is the optimum of the second half of May.

Rule of the seed used to meter is 14 g seeds and sowing depth of 1-1.5 cm. Scheme of sowing in narrow trenches is with the distance between the trenches of 20-25 cm. Sowing cover with a layer of humus, those is indicated as the sowing to make blended seed plus humus.

Pinus silvestris**,** the sowing seeds in nurseries, working technique is akin to the spruce River. Seeds are alike in narrow trenches, equally spaced at 20 cm, depth of sowing being 1.5-2 cm. Rule of seed used is 2 g per metre of gully.

As a result of the characteristics of some species has passed at forestry study on depth of sowing, uniformity of sowing, on the distance between rows and between seeds per row.

Documenting and began studies at the Faculty of Agriculture, Craiova, together with specialists from the INMA of Bucharest, Bucharest Polytechnic University.

Studies in order to achieve sowing took into consideration the following:

- dimensions of the beam of forestry nurseries, length, width, thickness of the frame;
- possibilities of equipment of sowing with seeds with volume variable depending on the species;
- possibilities of tuned very small 1.5-2.5 cm;
- possibilities for adjusting the flow of seed 2-4 g/m gully;
- achievement of transmissions through the chain to ensure that a large number of reports of transmission;
- possibilities to adjust the distance between rows, minimum 5 cm or multiples of 5 cm.

RESULTS AND DISCUSSIONS

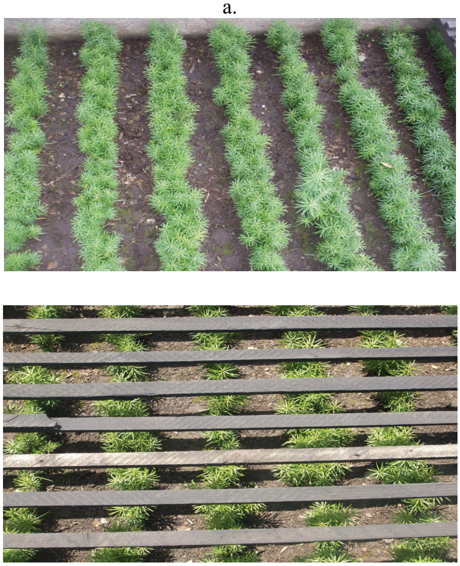
Establishment of forestry nurseries begins with the work of ploughing the soil to a depth of 20-25 cm, executed with the known agricultural aggregate in most cases with reversible ploughs followed by shredding soil, cannot and his depression.

In figure 1, shows a frame from the nursery with a length of 12 m, width 1 m, 5 cm thick frame. Bed preparation, soil and germinated raised depression can be achieved before mounting frames of wood, using agricultural tools, machines and raised, levelled soil. Mounting frames as seen in the figure is carried out manually [3].

In figure 2, we see the front of the sowing machine, that machine distribution, transport wheels, frame and chain transmission by Gall through the 24 gear ratios. Lever we indicate that the movement bezel and energizing sowing on device distribution is done through human action manually.

The outer seed with variable volume caused by changing the height of the side parts thereof. Mechanical Stirrer sat down at the bottom of the box helps to supply continuous distribution apparatus, and in the bottom frame is observed for catching support with shutters.

a.



b.

Fig. 1. Frames ready for sowing (a, b)

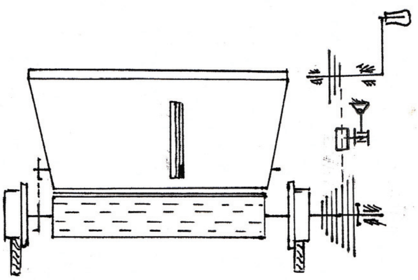


Fig. 2. Overview of the sowing machine

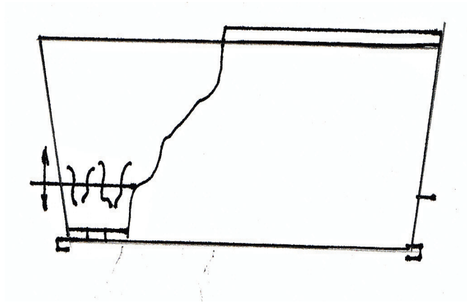


Fig. 3. Seed box

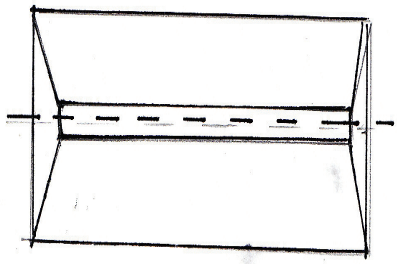


Fig. 4. Seed box, top view

Support with shutters, with bandwidth 45 mm, each fastened to adjust the distance between rows and opening in order to adjust the standard of seeds per metre of gully.

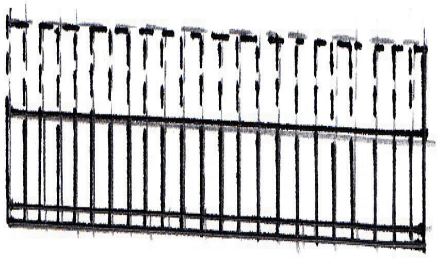


Fig. 5. With Support for adjusting the flow shutters seeds and distance between rows

The framework allows replacement of wheels sowing of transport depending on depth of sowing and the two active elements and distribution device roller occupies by their length 1.2 m of the total of 1. m in side wooden frame, the distribution of type drum with the honeycomb in front and roller with sieve to cover the seed and soil surface compaction rear.

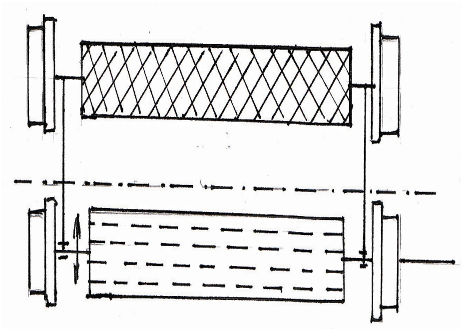


Fig. 6. Sowing machine trolley

CONCLUSIONS

Sowing achieved can only be used on small areas with small widths due to the volume small reduction ratio of the seeds.

How fitting sowing machine can ensure the generation of very small depths of sowing.

Adjustment rule of seeds is done quickly, easily and manual work, as well as its movement.

Exploitation does not require additional preparation sowing for service personnel.

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AGRO-FORESTRY
AND
CLIMATE CHANGES

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PRACTICAL CONSIDERATIONS REGARDING THE WORK CAPACITY OF STIHL BT 121 MOTTO-BORER, EQUIPPED WITH A 150MM DRILL, FOR DRILLING HOLES FOR PLANTING SAPLINGS

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Abstract

The present research displays the results obtained after the digging of holes for planting saplings in a previously unprepared soil, following the steps to carry them out according to some physical-mechanical properties of the soil. The research was carried out on a horizontal ground in the O.S. Iuliu Moldovan, in two arranged unities (parcels) 31 C and 32 A, in a previously unprepared ground, on two types of soil: gley-soil (the muddy subtype) and alluvial soil (the vertical-gleyed subtype), and in O.S. Radna, u.a. 74, on a brown typically luvic soil, using the Stihl BT 121 motto-borer with a 150 mm drill. The objectives of the research were to make a comparative determination, on different types of soil, of the qualitative parameters, among which the most important ones are: degree of loosening of the soil taken and left in the hole, resistance to penetration, resistance to shearing, timing of drilling holes, degree of scattering of the soil taken out from the hole, degree of evacuation of the soil from the hole, gas consumption for the drilling of the hole, using the Stihl BT 121 motto-borer in order to establish its technical efficiency. In order to observe the influence which the drilling of holes has on its walls, we measured the resistance to penetration and resistance to shearing every 10 cm at a 30cm depth, the proper depth for planting small-sized saplings, on two opposing sides, so that we could get the most probable values of these physical-mechanical properties of the soil. After taking the measures in order to establish the compaction degree of the wall and of the bottom of the hole by the borer in that interval, it was judged that in conditions of normal humidity, if the borers have sharp knives and are well conceived and executed from a technical point of view, there are no big values of the resistance to penetration which could affect the subsequent development of the saplings. The usefulness of the present paper stays in the research data collected, processed, analyzed and valorized in order to offer a pertinent study material, which could indeed be used by specialists in designing the process for obtaining, through a mechanized means, the holes for planting small-sized saplings on a horizontal ground, using the Stihl BT 121 motto-borer.

Key words: *motto-borer, resistance to penetration, average time of drilling, degree of scattering, degree of evacuation.*

INTRODUCTION

There is a general concern for introducing and extending the motto-borers for drilling holes in the sylvan field even in other countries. In our country, people tried several types of motto-borers without being extended in the production [11].
The designing and construction of some borers with adequate parameters for the requirements of the sylvan field need continuous scientific research which can establish the optimal types from a technical and economical point of view.
The objectives of the research carried out were to comparatively determine on different types of soil, the qualitative parameters, among which the most important ones are: degree of loosening of the soil taken and left in the hole, resistance to penetration, resistance to shearing, time of drilling holes, degree of scattering of the soil taken out from the hole, degree of evacuation of the soil from the hole, gas consumption for the drilling of the hole, using the Stihl BT 121 motto-borer in order to establish its technical efficiency.
In order to obtain pertinent results, the research was done according to a complex methodology, with a novelty character in this domain, which gave the possibility to study different technical aspects of usage of the motto-borer.
The soil represents the material subjected to the processing by tools and equipment according to

the agro-technical requirements. As material, the soil has different mechanical properties which differ according to the type of soil, its texture and its state [1].
Because of the compaction, while digging holes for planting saplings, there are several phenomena of friction occurring which increase the resistance to penetration through the walls of the hole. For the same reason, the soil offers resistance to some mechanical, exterior forces, presenting resistance to compression, shearing and penetration [8].
During the drilling of the holes with a motto-borer, there are two categories of friction forces. The first category is represented by the friction forces which occur among the soil particles, which come in contact with them, and the second one by the shearing forces given by the soil particles with the metallic part (the drill) [3].
At the mechanized execution of holes for planting saplings, one needs to act to reduce the friction forces between the soil and the active organs, because, if on the contrary, there is registered a supplementary consumption of energy [6].

MATERIAL AND METHOD

The research was carried out on a horizontal ground in the O.S. Iuliu Moldovan, in two arranged unities (parcels) 31 C and 32 A, in a previously unprepared ground, on two types of soil: gley-soil (the muddy subtype) and alluvial soil (the vertical-gleyed subtype), and in O.S. Radna, u.a. 74, on a brown typically luvic soil, using the Stihl BT 121 motto-borer with a 150 mm drill.
The technical characteristics of the motto-borer used in our research are given in Table 1, and its photography appears in Fig. 1.
The present research displays the results obtained after the digging of holes for planting saplings in a previously unprepared soil, taking into consideration the following aspects: time needed to dig holes according to some physical-mechanical properties of the soil, degree of aeration of the soil taken out and left in the hole, the degree of scattering of the soil taken from the hole, the degree of evacuation of the soil in the hole, the gas consumption for digging holes.

Fig. 1 Stihl BT 121 motto-borer
Motoburghiul Stihl BT 121, [12]

Table 1. Technical data of the Stihl BT 121 motto-borer

Cylindrical capacity	30.8 cm^3
Weight	9.4 kg
Power	1.3/1.8 kW/CP
Level of vibrations left/right	2.2/2.5 m/s^2
Speed of rotation	190.0 1/min
Level of acoustic pressure	103.0 dB(A)
Level of acoustic pressure	109.0 dB(A)

The physical-mechanical properties were determined by using the method of cylinders with a constant volume of 100 cm^3, carrying out five repetitions at different depth, from 10 to 10 cm until the depth of 30 cm. The determination of the resistance to penetration was made with the aid of a penetrometer and that of the resistance to shearing was made with the aid of the equipment for shearing through rotation.
The methods of analysis and interpretation of the results as well as the work procedure for the determination of the physical – mechanical properties are those indicated in the specialized literature [2].
In order to observe the influences which the digging of holes have on their walls, we measured the resistance to penetration and the resistance to shearing on the holes' walls from 10 to 10 cm until the depth of 30 cm, on two opposing sides, so as to get the most probable values for these physical-mechanical properties of the soil, depth sufficient enough for the planting of small-sized saplings.

The placement of samples for the resistance to penetration and shearing on the walls of the holes is given in Fig. 2.

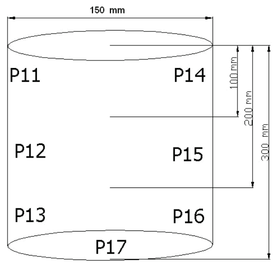

Fig. 2. Placement of samples for the resistance to penetration and shearing on the walls of the holes

The degree of scattering of the evacuated soil from the hole was expressed by the ratio of the maximum diameter of scattering or of the diameter at which is deposited most of the quantity of soil, at the diameter of the hole. The degree of evacuation of the soil from the hole was expressed by the ratio between the volume of the soil evacuated from the hole and the volume of the soil left in the hole at a 30 cm-depth. The elements measured for the determination of these qualitative indexes are given in Fig. 3.
In order to accomplish the objectives we have dug 50 holes for each type of soil chosen for the experiment, placed on a horizontal ground, previously unprepared, using the Stihl BT 121 motto-borer with a 150 mm drill.

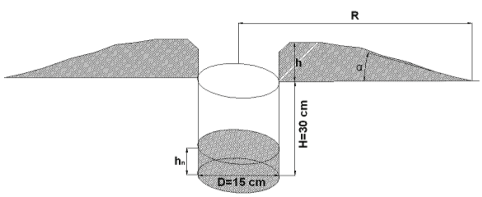

Fig. 3. Determination of the degree of scattering and degree of evacuation of the soil in the hole
(H – depth of digging, hn – height of the un-evacuated soil, h – height of the soil bed evacuated, D – diameter of the hole, α - angle of setting of the evacuated soil, R – radius of scattering of the evacuated soil.

RESULTS AND DISCUSSIONS

To establish the quality of the work carried out with the Stihl BT 121 motto-borer with a 150 mm drill, we made the following measurements:

a) Degree of aeration of the soil taken and left in the hole;
b) Resistance to penetration and shearing of the walls and of the bottom of the hole;
c) Average time for the digging of a hole;
d) Degree of scattering of the soil taken out from the hole;
e) Degree of evacuation of the soil from the hole;
f) Gas consumption for the execution of a hole.

a) Physical properties

The state of aeration of the processed soil and in the natural setting can be expressed through specific issues: apparent density and total porosity [9].
The three types of soil on which the research was carried out are: gley-soil (the muddy subtype), alluvial soil (the vertical-gleyed subtype), and a brown typically luvic soil. The physical properties determined during the execution of the holes like the granulometry of the soil are presented with average values in Table 2 and 3.

b$_1$) Resistance to penetration

The results of the research carried out, [5] demonstrate that the resistance to compression and cutting of the soil increase while the humidity of the soil is reduced to under 14% and goes even lower while its humidity increases to values over 28%.

In the situations in which the humidity is reduced under the minimum threshold shown, the active organs of the equipment take out clods and the aggregates are being highly stressed, which leads to the increase of specific consumption for materials (gas and metal). If humidity goes above the threshold of 28%, the soil begins to lose its organs. Consequently, it is recommended that the mechanic execution of the holes for planting to be done when its humidity is found in an optimal state (18-24%) [7].

Another important aspect is related to the resistance to penetration in connection with the study of the development and penetration in the soil of the root system of the saplings. The experimental research shows that at values under 10-15 kgf/cm^2 the resistance to penetration does not influence negatively the penetration in the soil of the roots, while at values over 35-50 kgf/cm^2 it is almost null [10].

Table 2. Average values of the physical properties of the soil analyzed

Depth of prelevation of the sample, cm	**Natural humidity, %**	**Apparent density, g/cm^3**	**Total porosity, %**
SOIL 1: GLEYSOIL – MUDDY (u.a. 31 C, O.S. IULIU MOLDOVAN)			
0-10	24.11	1.62	37.89
10-20	22.73	1.69	37.43
20-30	20.09	1.72	36.45
SOIL 2: ALLUVIALSOIL– VERTICAL GLEYED (u.a. 32 A, , O.S. IULIU MOLDOVAN)			
0-10	20.75	1.70	36.97
10-20	19.46	1.75	35.73
20-30	17.38	1.73	35.19
SOIL 3: BROWN TYPICALLY LUVIC (u.a. 74, , O.S. RADNA)			
0-10	22.43	1.69	37.43
10-20	21.10	1.71	36.31
20-30	18.74	1.73	36.09

Table 3. Average values of the granulometric analysis at different depths of prelevation

Depth of prelevation of the sample	Sand		Dust		Clay
	Coarse	Fine	I	II	
SOIL 1: GLEYSOIL – MUDDY (u.a. 31 C, , O.S. IULIU MOLDOVAN)					
0-10	0.74	36.04	16.94	16.94	29.54
10-20	2.34	45.44	12.54	12.54	27.34
20-30	1.84	39.34	16.54	13.84	28.64
SOIL 2: ALLUVIALSOIL– VERTICAL GLEYED (u.a. 32 A, O.S. IULIU MOLDOVAN)					
0-10	1.74	39.04	14.54	24.24	20.64
10-20	1.84	37.54	14.14	23.04	23.84
20-30	2.44	39.54	14.54	18.54	25.24
SOIL 3: BROWN TYPICALLY LUVIC (u.a. 74, , O.S.RADNA)					
0-10	1.24	37.54	15.74	20.59	25.09
10-20	2.09	41.49	13.34	17.79	25.59
20-30	2.14	39.44	15.54	16.19	26.94

The resistance to penetration was also measured on the walls of the hole from 10 to 10 cm until de 30 cm-depth, on two opposing directions, (at the depth from 0 to 10 we obtained the values P11 and P14), but also at the bottom of the hole after the soil had been totally evacuated. The values obtained are given in a graphic in Figure 4 to 6.

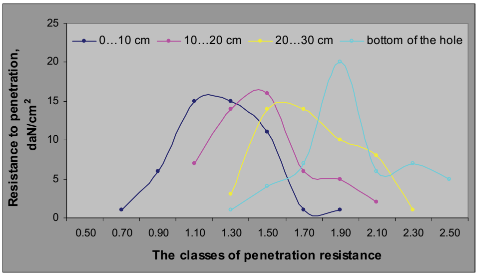

Fig. 4. Variance of resistance to penetration for soil 1

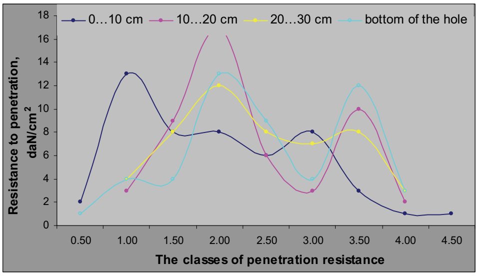

Fig. 5. Variance of resistance to penetration for soil 2

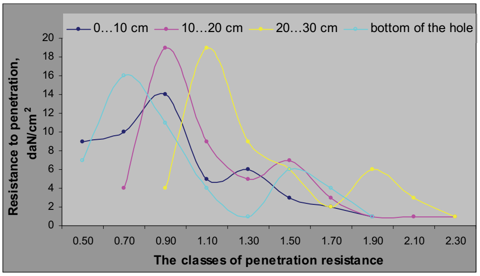

Fig. 6. Variance of resistance to penetration for soil 3

b$_2$) Resistance to shearing

The existence of the points of compliance in the mass of earth determines the redistribution of the surplus of unitary efforts to the neighbouring material points, thus generating a progressive breakage. Once the value of the tangential unitary efforts increase, these points multiply and group, allowing for a certain compliance zone called gliding zone or breakage zone. This zone, being reduced in dimensions as compared to the mass of earth, may be approximated with a surface called the breakage surface. Knowing the resistance to shearing allows avoiding the apparition of the breakage phenomenon [4].

Resistance to shearing was measured on the walls of the hole from 10 to 10 cm until the depth of 30 cm, on two opposing directions, (at the depth 0…10 cm the values obtained were R11 and R14), but also at the bottom of the hole after the soil was totally evacuated. The representation of these values under a graphical form is given in Figure 7 to 9.

c) Duration of drilling

In order to establish the economic efficiency of the Stihl BT 121 motto-borer, at the boring of the holes for planting, we registered the number of drilled holes for each variant of work and established the average time of execution of a hole for every type of soil included in the experiment.

For a better representation of the periods of execution of a hole we formed classes from second to second or, in the case of the 2nd soil, from five to five seconds, where we added up the drilled holes which belong to each class.

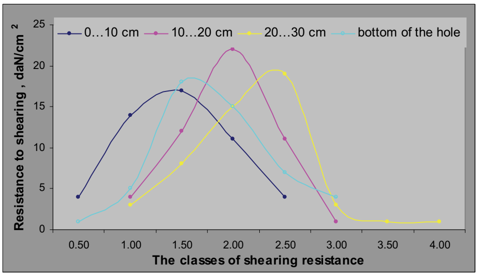

Fig. 7. Variance of resistance to shearing for soil 1

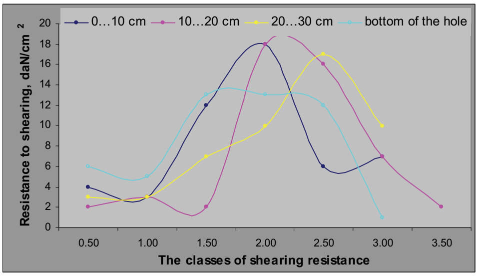

Fig. 8. Variance of resistance to shearing for soil 2

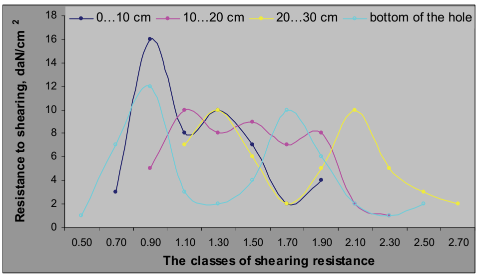

Fig. 9. Variance of resistance to shearing for soil 3

We can notice the enormous periods of execution for the holes in the 2nd soil, this fact being easily explainable because in this case we observed a more frequent presence of the roots, but also of the parental material and, in addition, bigger values of the resistance to penetration in comparison with the other types of soil which were included in the experiment.
The allure of the connection is that of the polynom of II degree and the equations are given in Fig. 10 to 12.

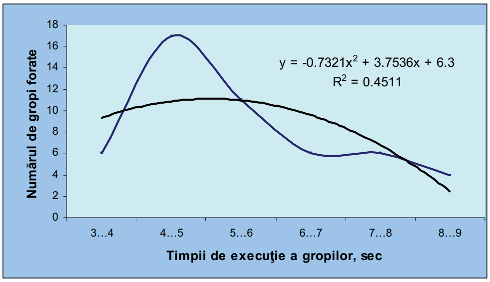

Fig. 10. Variance of the periods of execution of the holes with a 150 mm-drill for the 1st soil

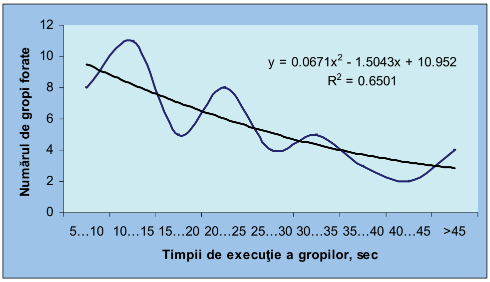

Fig. 11. Variance of the periods of execution of the holes with a 150 mm-drill for the 2st soil

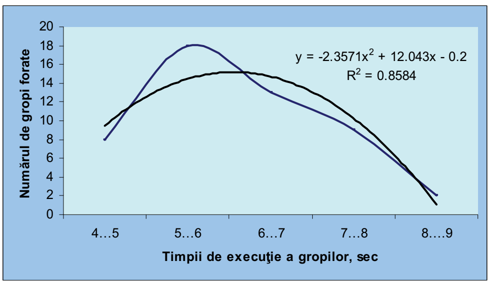

Fig. 12. Variance of the periods of execution of the holes with a 150 mm-drill for the 3st soil

d) Degree of scattering of the soil taken from the hole

The degree of scattering of the soil taken out from the hole can be expressed through the ratio between the maximum diameter of scattering (or the diameter at which point most of the quantity of evacuated soil is scattered) and the diameter of the hole. The registered values for the determination of those qualitative indexes are given in Table 4.

e) Degree of evacuation of the earth from the hole

The degree of evacuation of the soil from the hole is expressed in the ratio between the quantity (volume) of soil evacuated from the hole and the quantity of soil left in the hole at a 30 cm-depth.

f) Gas consumption for the digging of a hole

The measurements regarding the gas consumption were taken in conditions of ground previously unprepared, on a plain country where the study took place and the results are presented in Table 4.
The gas consumption was determined by introducing in the tank a known quantity of gas (0.5 l), with which there were made 106/90/110 holes, according to the type of soil. Relating the quantity of gas introduced in the tank to the number of holes dug we obtained the average quantity of gas for the digging of a hole, until the depth of 30 cm, which has the following values: 4.72 ml for the 1st type of soil, 1, 5.56 ml for the 2nd type of soil and 4.55 for the 3rd type of soil.

Table 4. Data regarding the quality of work with the Stihl BT 121 motto-borer on a horizontal ground

Type of soil	Ratio between the diameter at which point most of the quantity of evacuated soil is scattered and the diameter of the hole	Ratio between the maximum diameter of scattering of the soil and the diameter of the hole	Ratio between the quantity of soil evacuated and the quantity of soil left in the hole	Average gas consumption, ml
Soil 1	1.14	1.21	2.46	4.72
Soil 2	2.29	2.43	3.54	5.56
Soil 3	1.25	1.38	2.85	4.55

CONCLUSIONS

From all of the above, we can infer the following conclusions regarding the qualities and the behavior of the Stihl BT 121 motto-borer with a 150 mm drill in the sylvan field of activity, on a horizontal ground:

- After taking all the measurements for establishing the degree of compaction of the wall and bottom of the hole by the motto-borer during the work, it was inferred that in condition of normal humidity, if the motto-borers have sharp knives and are well conceived and executed from a technical point of view, do not register big values of resistance to penetration which could affect the ulterior development of the saplings.
- During the research, it was inferred that the wall of the hole is also compacted because of the wearing out of the spires of the helicoidal transporter or of the knife placed at the base of the last spire. Another possible cause for compaction occurs when the active diameter of the motto-borers' knife is cut because of the wearing out, which can lead to the exaggerate compaction of the walls or of the bottom of the hole.
- The small values of the resistance to penetration and shearing were obtained also because of the optimal values of the soil humidity during the drilling of the holes, these values oscillating between 19.20 % and 22.31 %.
- Analyzing the granulometric composition of the three types of soil included in the experiment, we can say that the fact that the soils present a sand-dust-clay-like composition, also mentioning that the quotas of participation of the fraction "dust" in the 32 A parcel (2nd soil) is by far superior to the same fraction from the other parcels. Thus, we can explain the average time of execution of the hole as being bigger in this parcel than in the rest of the parcels included in the experiment.
- In the pedological conditions of these three parcels included in the experiment the average time of execution of the holes are: 5.41 sec. for the 1st type of soil (gley-soil- the muddy subtype), for the 2nd type of soil (alluvial soil - the vertical-gleyed subtype) the average time was 23.42 sec, while for the 3rd soil (brown typically luvic soil) the average time was 6.08 sec for the 150 mm drill.
- The ratio between the diameter at which one can find scattered the biggest amount of soil evacuated and the diameter of the hole varies according to the type of soil as it follows: 1.14 for the 1st soil, 2.29 for the 2nd soil and 1.25 for the 3rd soil.
- The ratio between the quantity of soil evacuated and the quantity of soil left in the hole registers values between 2.46 and 3.54.
- The average gas consumption necessary for digging a hole until the 30cm-depth is 4.72 ml for the 1st type of soil, 1, 5.56 ml for the 2nd type of soil and 4.55 for the 3rd type of soil.

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RESEARCH FOR OPTIMIZATION OF GREEN SPACES DESIGN AND IRRIGATION IN BUCHAREST'S PLAIN

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Abstract

Turf and ornamental plants are considered an integral part of worldwide ecological landscape. Since antiquity, they are used by people to enhance the form and value of their environment. In these meaning green spaces industry and its irrigation must prove the ability to manage the efficiently and effectively administration of water to the plants. Irrigation water management depends on the soil and climatic conditions, landscape plants type and type of irrigation system. The purpose of the research, namely the development of green areas with irrigation systems in Dobroieşti park in Bucharest, have been the depth study and analysis of soil parameters, climatic conditions (rainfall) and water consumption (ETRO) of outdoor ornamental plants in Bucharest Plain. These results were correlated to the topography of the site in order to develop a technical project for landscape construction, to set the elements of the irrigation regime and to determine the optimal plants watering program. The results have been materialized, in establishing by water balance in soil method, the values of the irrigation norm for lawn, floral elements, trees and shrubs, the optimal timing for application of irrigation, the design of the technical elements of irrigation system and its running parameters for a sustainable exploitation.

Key words: *design, evapotranspiration, irrigation, green spaces, sprinkler.*

INTRODUCTION

The development of green spaces constitutes a major and indispensable chapter in the evolution of urban and rural development, both globally and nationally for Romania, being treated as a long-term national strategy for improving the environmental quality in populated areas [1, 2, 3].
In the last years' Romania, by adopting and implementing the European strategies on the Community environmental policies, the national efforts were intensified both administratively and economically and socially regarding the programming, design and green spaces development activities in cities, both as new sites and rehabilitation and expansion of the existing ones [4].

The purpose of the research study was the landscaping development with irrigation systems of a land located in the 2nd District, Bucharest, in the public domain, alongside the Dobroiesti Lake in Pantelimon neighbourhood, with an area of 21,900 square meters. The land is characterized by a marked level difference from south to north, towards the lake plane, of about 10 m, according to the surveying study. The maximum altitude is about 74 m and the minimum about 64 m.
In terms of this research study, we were concerned that of the portion allocated to the global freshwater consumption of the capital, a part thereof, related to the water for domestic use (drinkable and household water) and the industrial water, must be responsibly used for irrigating the green spaces [5].

According to the studies made by John H. Lowry Jr. et al. in 2011, the estimates of water consumption vary greatly depending on climate, evapotranspiration, soil conditions, economic and social specificities of the region. In this regard the irrigation system must be designed and operated in optimal hydrodynamic parameters and to provide the necessary irrigation water needed for the plant development [6].

MATERIAL AND METHOD

During the research study, many working methods have been applied, such as: consulting the specialized references, maps, geographical and surveying studies, evaluating the initial site condition, field measurements, hydrodynamic calculation and two-dimensional technical design, to achieve the proposed objectives by the chosen theme. Thus, specific methods have been applied depending on the objectives pursued for:

- researching the landscape;
- establishing the irrigation elements for designing the landscape planning solution and the irrigation system [7];
- specifying and analyzing the technical landscape development solutions and determining the technical watering elements required in the design and operation of the green spaces in the studied site [8].

To calculate the irrigation and development, *"The Soil Water Balance Method"* has been applied [9]. The method has been established for the growing season of component ecosystems, i.e. April 1 to September 30 for lawn, trees and shrubs and April 15 to September 30 for herbaceous flowers.

Thus, according to the method presented by Jinga et al. in 2009, using the hydrologic balance equations for the growing season, the monthly and annual irrigation water demand has been determined by the following general formula [10]:

$$\text{“}\boldsymbol{\sum_m = ETRO - P_v - A_f - (R_i - R_f) \quad (m^3/ha)}$$

where:

- $\sum m$ - is the annual demand (irrigation rate) of irrigation water in m^3/ha;
- ETRO - optimal real evapo-transpiration or total water consumption during the growing season through the plant transpiration and evaporation at the soil surface of an ecosystem, cultivated in a soil moisture which ensures the viability and normal development of plants, in m^3/ha;
- P_v - useful amount of rainfall during the growing season to ensure 80%, in m^3/ha;
- A_f - water input of underground water, in case of the closed circuit balance (Rota de Jos), in m^3/ha;
- R_i - soil water reserve at the beginning of the growing season, in m^3/ha;
- R_f - soil water reserve at the end of the growing season, in m^3/ha."

RESULTS AND DISCUSSIONS

In the context of the site integration in the reference pedoclimatic area, the natural framework of the area, where they conducted researches, has been researched. The data have been reported to relief, topoclimate, geological and pedological structure of soil, hydrology, hydrogeology and social and economic structure of the area.

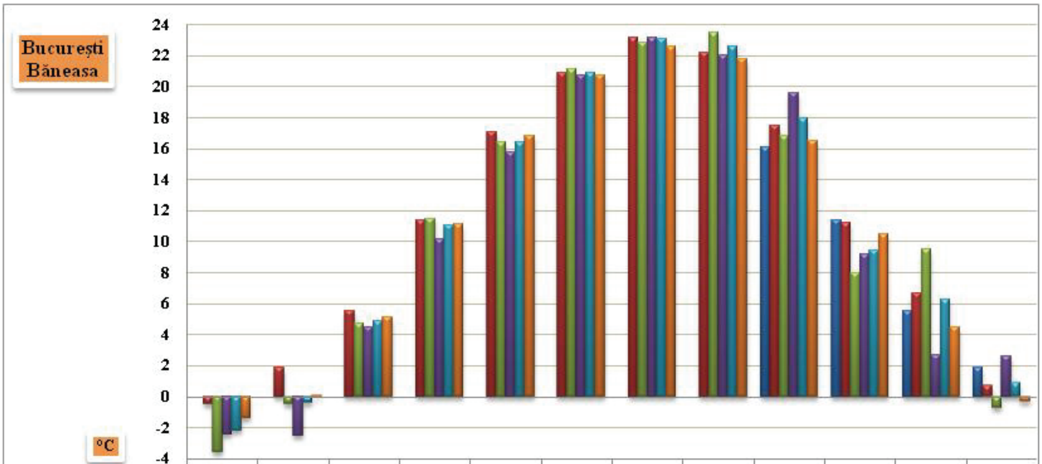
Thus, the relief in Bucharest Plain presents in its majority as a river-lake plain, covered with loesoid deposits with a tabular or undivided form and divagation and Holocene plain looking as a major bed. The form of piedmont-terminal plain, strongly provided with earthworks and many tablelands bordered by terse face and field is predominant in the city of Bucharest. It is slit at north by Colentina Lake meadow and in centre by the Dambovita meadow [11].

From the climatic point of view, Bucharest Plain integrates in the specific nature of Vlasia Plain, similar to the topoclimate in Titu-

Potlogi divagation Plain, Titu-Sarata Plain respectively.

In the Romanian Plain its central position is definitely reflected by a transition character of the climatic particularities from the attenuated oceanic and sub-Mediterranean particularities with moderate nature to the eastern ones which are excessively continental and with character of aridity. On the other hand, Bucharest central presence in the plain provides an anthropical climatic protection. Also the metropolis changes the climatic parameters form, giving them a concentric and circular form of Bucharest [12, 13].

In the past 30 years, namely during 1980-2011, the average annual air temperature in Bucharest Plain and the city of Bucharest strengthened around 10.7^{o}C. The monthly values of average air temperature measured at the Bucharest-Baneasa meteorological station, between September 1, 2008 - December 31, 2011 and the multi-annual values during 1980 - 2010 are presented in Figure 1.



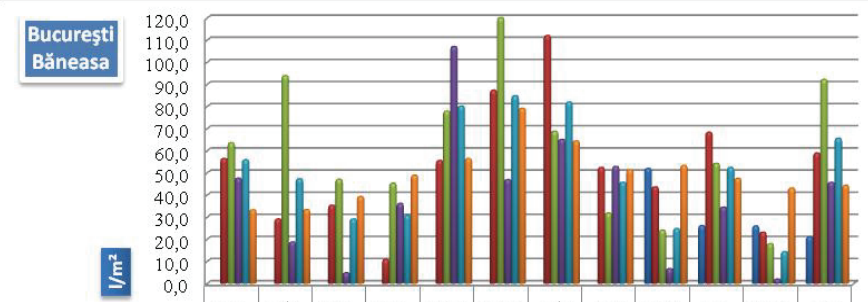
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
2008									16,1	11,4	5,5	1,9
2009	-0,5	1,9	5,5	11,4	17,1	20,9	23,2	22,2	17,5	11,2	6,7	0,7
2010	-3,6	-0,5	4,7	11,5	16,4	21,1	22,8	23,5	16,8	8,0	9,5	-0,7
2011	-2,4	-2,5	4,5	10,2	15,8	20,7	23,2	22,0	19,6	9,2	2,7	2,6
Average 2009-2011	-2,2	-0,4	4,9	11,0	16,4	20,9	23,1	22,6	18,0	9,5	6,3	0,9
Average 1980-2010	-1,4	0,1	5,1	11,1	16,8	20,7	22,6	21,8	16,5	10,5	4,5	-0,3

Fig. 1. Evolution of average air temperature (^{0}C) in Bucharest Plain.
Monthly average measured at the meteorological station Bucharest-Băneasa

The annual average rainfall in Bucharest Plain, measured by the Bucharest-Baneasa meteorological station during the reference period 1980-2010, had values of 593.6 l/m^{2}. The average monthly rainfall values measured by Bucharest-Baneasa meteorological station between September 1, 2008 and December 31, 2011 and the multi-annual values during 1980-2010 are presented in Figure 2.

From the pedological point of view, the reddish brown soil streaked by two large alluvial soil strips along the Dambovita and Colentina Rivers' meadows in the downstream of Dobroiesti is specific to the Bucharest Plain. In the meadow of the chain of lakes of Colentina River in the upstream of Dobroiesti, brown alluvial soils have been abundantly identified [14].

In the west side of the city, in Ciorogarla and Chitila localities and in the east side, in Cernica, reddish brown podzolic soils have been identified. In the north-eastern side of the capital city, in Afumati-Sindrilita area, chernozem-type soils (levigated chernozem), and in the north side of the city, strong levigated chernozems strongly alternating with reddish brown and reddish brown podzolic soils have been identified in islands.



	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
2008									51,9	26,1	25,9	21
2009	56,4	29,1	35,3	10,8	55,5	87,3	112,0	52,3	43,6	68,3	23,1	58,9
2010	63,5	93,8	47,0	45,2	77,8	120,0	68,7	31,7	24,0	54,2	17,9	92,1
2011	47,5	18,7	4,8	36,1	107,0	46,9	65,0	52,8	6,6	34,4	1,9	45,6
Average 2009-2011	55,8	47,2	29,0	30,7	80,1	84,7	81,9	45,6	24,7	52,3	14,3	65,5
Average 1980-2010	33,2	33,3	39,2	48,8	56,4	79,1	64,3	51,3	53,3	47,4	43,0	44,3

Fig. 2. Monthly rainfall (l/m^2) in Bucharest Plain.
Monthly average, measured at the meteorological station Bucharest-Băneasa

The hydrographic network of Bucharest Plain is relatively dense and with significant volumes compared with its relatively small area.

The Bucharest Plain is situated in the Arges River drainage area, at its north side. The north side is bounded by Pasarea temporary watercourse, whose meadow is closed in the east side, in the confluence area with the Dambovita River.

The analyzed internal network from north to south is dominated by the permanent rivers: Colentina, Dambovita, and Ciorogarla. They evolve on the north-west south-east direction and are complemented by the temporary watercourse – Sindrilita in the northeast side, from Cocioc and Sabar (Rastoaca) in south and Calnau in east. A series of 15 semi-natural lakes in the form of chain resulted from the works for regulating the water flow of Colentina River that occurred during 1933-1939 is specific to Bucharest. They spread along a surface of 54 km with a level difference of 49 m, a total area of 1,500 ha and a volume of 44 million m^3. These also include Dobroiesti Lake. The area is closed by Cernica Lake, being the largest in size between them..

The hydrological regime of the main over-ground watercourses which frame and cross the Bucharest Plain is described in Table 1.

Along the entire area of Bucharest Plain, three underground bodies of water have been identified: body of underground water ROAG03-Colentina and bodies of groundwater ROAG11 Bucharest-Slobozia and ROAG13 – Bucharest [15].

The social, economic and demographic elements in Bucharest Plain are strongly influenced by the presence of the metropolis in that area, being characterized by a large number of inhabitants, over 5.000, there being cases where they exceed 20,000 inhabitants (Voluntari, Buftea, Mogosoaia, Jilava, Magurele, Cornetu etc.). The main activities of the inhabitants of Bucharest Plain are industry, services and agriculture.

According to the Bucharest City Hall web site, it states that as a result of the 2008 census, Bucharest had a total of 1,943,981 inhabitants (just over 9% of the country's population) of which 51% is the active population. Of these, 18.5% work in industry, 18.6% in commerce, 12.3% in construction, 3.4% are civil servants, 5.5% work in education, 5.3% in health, 3.9% in finance, banking and insurance, 14.2% work in real estate, rental and services for enterprises and 18.3% in other areas [16].

The density of population in Bucharest alternates by area and administrative sector, with values less than 5,000 inhabitants/km^2 in areas of Kiselef Boulevard and Ferentari and Cotroceni neighbourhoods, up to over 40,000 inhabitants/m^2 in the crowded areas of Pantelimon, Titan, Berceni, Militari and Colentina neighbourhoods [17].

Based on the data obtained from the territory investigation, the irrigation elements have been determined. They were the basis for the calculation of the irrigation system for flowers, trees, shrubs, and lawn in Bucharest Plain by using the "Soil Water Balance Method", (Tables 3-5).

The irrigation elements have been calculated using the soil hydro-physical properties which are specific to Bucharest Plain and the city of Bucharest. They have been determined and calculated, according to the methodology developed by ICPA, on the thickness of the active layer of soil which is characteristic to the area (loamy and clayish reddish brown soil), without the addition of groundwater. Their values are summarized in Table 2.

Table 1. Hydrological regime of major rivers in Plain Bucharest

No. Crt.	River	Hydrometric station	The length of river (km)	Area (km2)	Annual average flow (m^3/s)	Monthly flow to ensure: (m^3/s)			Qm/QM (m^3/s)
						80%	90%	95%	
1	Sabar	Poenari	111	883	2.294	0.4	0.32	0.26	0/2.294
2	Sabar	Vidra	157	1212	8.443	0.368	0.14	0.084	0.06/8.443
3	Ciorogârla	Bragadiru	44	103	5.362	0.095	0.045	0.036	0.024/5.362
4	Colentina	Colacu	38	150	0.586	0.018	0.01	0.007	0.006/0.586
5	Dâmboviţa	Dragomireşti	241	1391	0.601	0.011	0.005	0.002	0/0.601
6	Argeş	Grădinari	243	3830	21.786	10	8.5	7.9	0.12/21.786
After: Adminsitraţia Naţională "Apele Române", Administraţia Bazinală de Apă Argeş-Vedea [18]									

Table 2. Hydrophysical indexes of soil in Bucharest Plain and Bucharest city

Ecosystem	Vegetation	Active thickes of soil layer	Apparent density (Da)	Wilting coefficient (CO)		Water field capacity (CC)		Active humidity range (IUA=CC–CO)		Minimum limit of humidity (p.min)	
		(m)	(t/m^3)	% gr.	m^3/ha	% gr.	m^3/ha	% gr.	m^3/ha	% gr.	m^3/ha
Flowers	15.04-31.09	0.40	1.44	12.40	893.00	23.50	1692.00	11.10	799.00	19.80	1425.67
Trees and shrubs	01.04-31.09	0.75	1.46	12.80	1270.67	23.23	2255.33	10.43	984.67	19.76	1927.11
Turfgrass (lawn)	01.04-31.09	0.75	1.46	12.80	1270.67	23.23	2255.33	10.43	984.67	19.76	1927.11

Table 3. Calculation of monthly and annual irrigation water needs of flowers in Bucharest Plain and Bucharest city

Statement (Vegetation:15.04-30.09)	**Month**						
	IV	**V**	**VI**	**VII**	**VIII**	**IX**	**IV – IX**
Monthly ETRO (m^3/ha)	285	1085	1470	806	1209	990	5845
Monthly rainfall (m^3/ha)	185	429	601	489	390	405	2499
Groundwater contribution (m^3/ha)	-	-	-	-	-	-	-
Deficiency (-) (m^3/ha)	100	656	869	317	819	585	3346
Excess (+) (m^3/ha)	-	-	-	-	-	-	-
Water balance in soil (m^3/ha)							
Original reserve of water - Ri	1293	1444	1537	1419	1601	1532	1293
Final reserve without irrigation – Rf (Ri + E) or (Ri – D)	1194	787	669	1101	782	947	-
Minimum limit of humidity	**1426**						
Water needs (Pmin – Rf)	232	638	757	324	644	478	-
Amount of watering norms - Σm	**250**	**750**	**750**	**500**	**750**	**500**	**3500**
Final reserve with irrigation – Rfi (Rf + Σm)	1444	1537	1419	1601	1532	1447	1447
Watering dates (day of the month) $T_1 = (R_i - p_{min})/(ETRO_z - P_z)$ $T_2 = T_1 + m/(ETRO_z - P_z)$	-8	1	2	-7	-6	3	-
	-	9	7	11	8	11	-
	-	17	12	-	15	-	-
	15.IV;	01;09,17.V;	02;07;12.VI;	01;11.VII;	01;08;15.VIII;	3;11.IX;	14 waterings
Review	Σm = ETRO + Rf – Ri – Pv					Σm=	3500

Table 4. Calculation of monthly and annual irrigation water needs of trees and shrubs in Bucharest Plain and Bucharest city

Statement (Vegetation:01.04-30.09)	Month						
	IV	V	VI	VII	VIII	IX	IV – IX
Monthly ETRO (m^3/ha)	660	868	1230	1612	1426	750	6546
Monthly rainfall (m^3/ha)	371	429	601	489	390	405	2684
Groundwater contribution (m^3/ha)	-	-	-	-	-	-	-
Deficiency (-) (m^3/ha)	289	439	629	1123	1036	345	3862
Excess (+) (m^3/ha)	-	-	-	-	-	-	-
Water balance in soil (m^3/ha)							
Original reserve of water - Ri	2370	2081	2042	2213	1889	2053	2370
Final reserve without irrigation – Rf (Ri + E) or (Ri – D)	2081	1642	1413	1089	853	1708	-
Minimum limit of humidity	1927						
Water needs (Pmin – Rf)	-	286	514	838	1074	219	
Amount of watering norms - Σm	**-**	**400**	**800**	**800**	**1200**	**400**	**3600**
Final reserve with irrigation – Rfi (Rf + Σm)	2081	2042	2213	1889	2053	2108	2108
Watering dates (day of the month) **$T_1 = (R_i-p_{min})/(ETRO_z-P_z)$** **$T_2 = T_1+m/(ETRO_z-P_z)$**	-	6	3	6	-1	5	-
	-	-	13	14	10	-	-
	-	-	-	-	19	-	-
	-	06.V	03;13.VI	06;14.VII.	01;10;19.VIII	05.VIII	9 waterings
Review	Σm = ETRO + Rf – Ri – Pv					Σm= 3600	

Table 5.Calculation of monthly and annual irrigation water needs of turfgrass (lawn) in Bucharest Plain and Bucharest city

Statement (Vegetation: 01.04-30.09)	**Month**						
	IV	**V**	**VI**	**VII**	**VIII**	**IX**	**IV – IX**
Monthly ETRO (m^3/ha)	420	1054	1440	1674	1364	780	6732
Monthly rainfall (m^3/ha)	371	429	601	489	390	405	2684
Groundwater contribution (m^3/ha)	-	-	-	-	-	-	-
Deficiency (-) (m^3/ha)	49	625	839	1185	974	375	4048
Excess (+) (m^3/ha)	-	-	-	-	-	-	-
Water balance in soil (m^3/ha)							
Original reserve of water - Ri	2145	2096	1871	1832	1846	2072	2145
Final reserve without irrigation – Rf (Ri + E) or (Ri – D)	2096	1471	1032	646	872	1697	-
Minimum limit of humidity	**1927**						
Water needs (Pmin – Rf)	-	457	895	1281	1055	230	-
Amount of watering norms - Σm	**-**	**400**	**800**	**1200**	**1200**	**400**	**4000**
Final reserve with irrigation – Rfi (Rf + Σm)	2096	1871	1832	1846	2072	2097	2097
Watering dates (day of the month) **$T_1 = (R_i-p_{min})/(ETRO_z-P_z)$** **$T_2 = T_1+m/(ETRO_z-P_z)$**	-	5	-1	-2	-2	6	-
	-	-	10	9	10	-	-
	-	-	-	17	19	-	-
	-	5.V	1.10. VI	01;10,1 7.VII	01;10;19. VIII	06.IX	10 waterings
Review	Σm = ETRO + Rf – Ri – Pv					Σm= 4000	

Subsequently, the irrigation system installation technical plans shown in Fig. 4 and Fig. 5 and Summary Table (no. 6) of the irrigation system operating program prepared on the basis of the functional parameters of watering equipment, which are the system components, have been drawn up according to the irrigation data.

The irrigation system installed for watering the plants in the Dobroiesti ecological park of the capital, shown in Fig. 3, has been designed based on certain operation limiting factors, that is the large area of land, its shape and slope, the flow available to water (13 m^3/ha) and its pressure in the water supply pipe (55 mca). Thus, the irrigation system was designed to operate in order to implement a gross irrigation standard (average of the gross watering standards of constituent ecosystems) of 350 m^3/ha, by administering a daily irrigation water volume of 15 l/m^2 with a daily operating time of 21 hours in three consecutive rounds, 3 calendar days respectively.

Fig. 3. Layout of the Dobroiesti ecological park

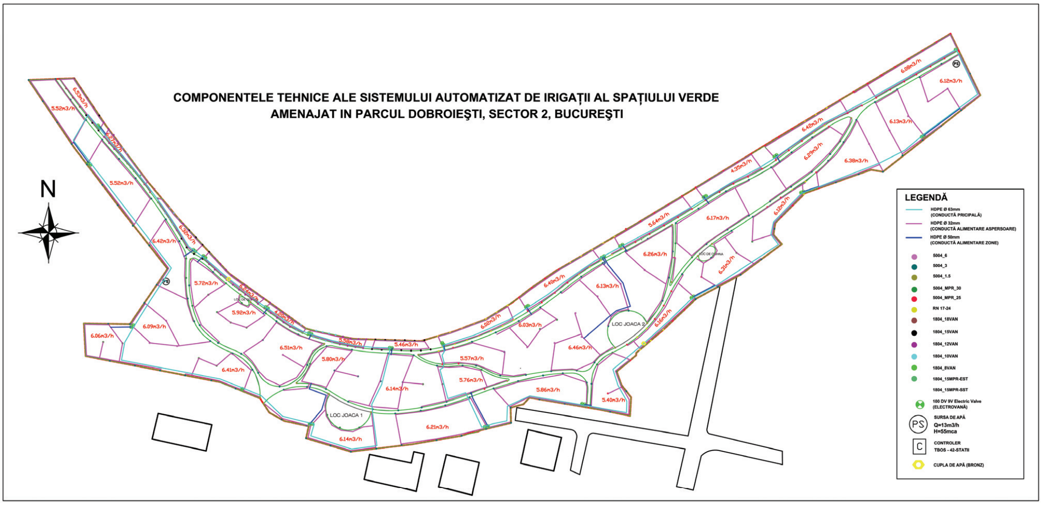


Fig. 4. Layout of pipes, flow areas and watering equipment location of the Dobroieşti irrigation system

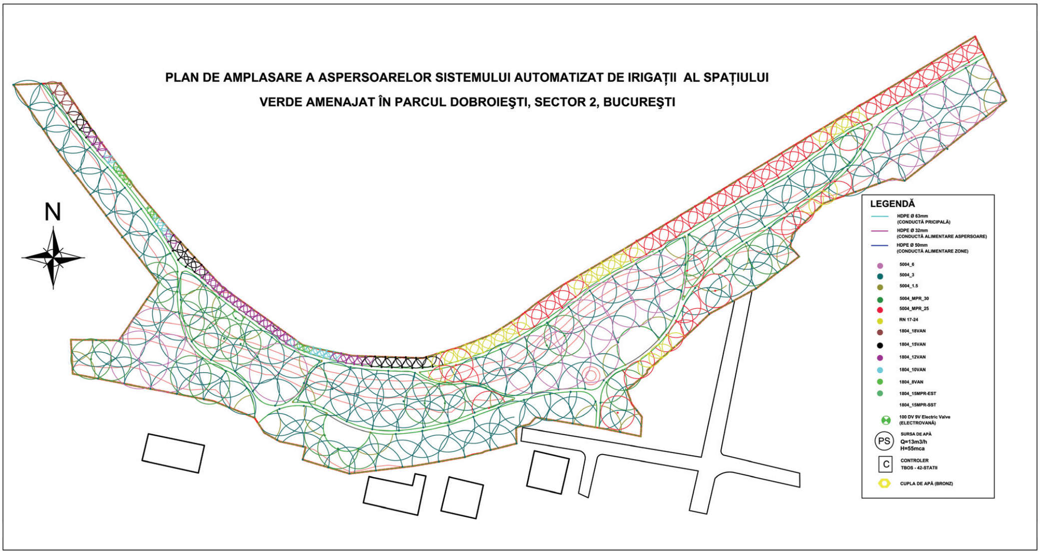


Fig. 5. Angle range and location plan design of sprinklers of the Dobroieşti irrigation system

Table 6. Operation features and technical parameters of watering equipment designed and executed in green park Dobroieşti

Total area for irrigation 20.000 m^2	**Gross watering standards (watering norms) - m**			**m^3/total green area f(m)**
	Ecosystem	**m^3/ha**	**l/m^2**	
Daily irrigation water volume 15,00 l/m^2	Flowers	250	25	500
	Trees and shrubs	400	40	800
Minimum water supply parameters 13 m^3/h; 55 mca	Turfgrass (lawn)	400	40	800
	Average standards (norms)	350	35	700

Nozzle type	**Sprinkler type**	**Range / Sector**	**No. pcs.**	**Sprinklers neto water consumption (m^3)**	**Nozzle flow* (m^3/h)**	**Nozzle rainfall * (mm/h)**	**Sprinkler operating time (min./day)**
18VAN_Q	Spray	5.5m / 90 degrees	2	0,18	0,30	50	18,0
18VAN_H	Spray	5.5m / 180 degrees	6	1,08	0,60	50	18,0
15VAN_H	Spray	4.6m / 180 degrees	25	3,15	0,42	50	18,0
12VAN_H	Spray	3.7m / 180 degrees	45	4,05	0,30	50	18,0
10VAN_H	Spray	3,1m / 180 degrees	20	1,24	0,33	80	11,3
8VAN_H	Spray	2,4m / 90 degrees	16	0,81	0,27	80	11,3
15EST	Spray	1,2m x 4,6m streak	2	0,08	0,14	50	18,0
15SST	Spray	1,2m x 9,2m streak	4	0,32	0,27	50	18,0
RN17-24H	Multijet	6m / 180 degrees	39	11,99	0,41	20	45,0
5004-6.0	Rotor	13.6m / 30-360 degrees	14	17,59	1,34	16	56,3
5004-3.0	Rotor	12.1m / 30-360 degrees	154	132,83	0,69	12	75,0
5004-1.5	Rotor	10.6m / 30-360 degrees	22	14,03	0,34	8	112,5
5004_30_H	Rotor	9.1m / 180 degrees	18	10,05	0,67	18	50,0
5004_30_F	Rotor	9.1m / 90 degrees	14	15,40	1,32	18	50,0
5004_25_F	Rotor	7.6m / 360 degrees	4	2,90	0,87	18	50,0
5004_25_H	Rotor	7.6m / 180 degrees	67	25,13	0,45	18	50,0
5004_25_Q	Rotor	7.6m / 90 degrees	2	0,38	0,23	18	50,0

Volume of irrigation water necessary every day (m^3):	241,20	m^3
Time spent every day irrigation (hours):	21	hours
Number of days allocated for the application of a gross watering standards:	3	days
Pumping capacity (13% reserve for pumping capacity)	13	m^3/h
System performance index	1,29	

*after Rain Bird[19] catalog for placement in square with a 1/2 overlap diameter at the designed pressure (sprinkler working pressure: 3.0-3.1 bar for rotors and amd 2.1 bars for sprays

These data have been determined by correlating the time of operation of sprinklers in relation to the rain-measurement and flow of nozzles, at a working pressure of the sprinkler of 3 and 3.1 bars for rotors and 2.1 bars for sprays, as presented in Table 6.
According to the calculations, namely the summation of net water consumption of all sprinklers, a total volume of 241.20 m^3 of irrigation water needed to be distributed throughout the entire area (2 ha) has resulted.
To administer a gross watering standard, the time required for applying the 3 calendar day rule has been calculated, which led to the establishment of a system performance index of 1.29.
This index reflects the fact that the system provides in certain areas a larger quantity of water than that provided by the watering standard. Given the pronounced slope of the land, this is not a negative effect on plants, since the intensity of irrigation is inferior to the speed of soil water infiltration.
Thus, according to the data presented in Table 6, the optimal operation of solenoid valves serving the system watering wings (areas) are:

- 18 minutes / day in areas whose majority components include the spays equipped with nozzles series 18 NAV, 15 NAV, 12 VAN, 15 EST and 15 SST;
- 11 minutes for areas whose majority components include the spays equipped with nozzles series 10 VAN and 8 VAN;
- 45 minutes for areas whose majority components include the spays equipped with revolving nozzles series RN 17-24;
- 56 minutes for areas whose majority components include the rotors 5004 equipped with nozzles series 6.0.

CONCLUSIONS

The area chosen for the research on the landscape development with irrigation systems has been analyzed in terms of landscape, determining the local pedoclimatic conditions, in close connection with the site location and the compliance with the prevailing landforms, natural vegetation, geological structure, hydrology, hydrogeology and social and economic and demographic elements.
Based on the pedological and geological structures of the area, the soil hydro-physical properties determined according to the protocol developed by ICPA, depending on the soil active layer thickness and subsequently determined by the watering standards, have been established.
Applying the soil water balance method, using as input data the average useful rainfall during the growing season, the monthly actual evapotranspiration optimal values (ETRO), the soil water supply and monthly and annually irrigation water demand, the number of necessary watering, the theoretical irrigation standards and the watering time have been established for the three studied ecosystems, as they are presented in Table 7.
These values proved useful since the design phase, for determining the irrigation system operating programs and the volumes of distributed water.

Table 7. Review of the irrigation regime elements in Bucharest Plain and Bucharest city

No. crt.	Plants/ Ecosystem	Watering standards (norms) (m^3/ha)		Watering dates	No. of waterings	Irrigation norms - Σm (m^3/ha)	
		neto	bruto			neto	bruto
1.	**Flowers**	213	**250**	15.IV; 01;09,17.V; 02;07;12.VI; 01;11.VII; 01;08;15.VIII; 3;11.IX;	14	2982	3500
2.	**Trees and shrubs**	380	**400**	06.V; 03;13.VI; 06;14.VII; 01;10;19.VIII; 05.VIII	9	3420	3600
3.	**Turfgrass (lawn)**	380	**400**	5.V; 1.10.VI ; 01;10,17.VII ; 01;10;19.VIII ; 06.IX	10	3800	4000

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LYCIUM BARBARUM L. – A NEW SPECIES WITH ADAPTABILITY POTENTIAL IN BUCHAREST'S AREA

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Abstract

The adaptability potential of Lycium barbarum L., a species with significant health-promoting properties, in Bucharest's area hasn't been studied until now. This paper aims to present the evolution of the elements belonging to the juvenile plant's architecture (number and length of shoots) and the stages of fructification (first floral buds and flowering sightings, number of flowers on shoots, fructification period, fruit quality) during the first two years from planting (2011-2012). Two phenotypes (V_1 and V_2) were planted and observed in the research field at U.Ş.A.M.V.'s Campus in Bucharest. At the end of 2011, newly-grown shoots per plant were between 10 and 40 for V_1 and between 18 and 33 for V_2. Their maximum number was 69 for V_1 and 81 for V_2. 2012's values are 20 to 60 for V_1, and 20 to 70 for V_2. The maximum value for V_1 is 108 and 85 for V_2. At the end of 2011, the average length of the shoots was 10 to 50 cm for V_1, with a maximum of 62 cm. For V_2, these values were 20-80 cm, with a maximum of 99 cm. In 2012, V_1's new sprouts are 5 to 30 cm and V_2's are 9-40 cm long. In 2011, for V_1, flower buds first appeared at the middle of June and flowering occurred at the end of the same month. V_2 plants flowered in august, and bore far less flowers. Both phenotypes flowered until late November. The average number of flowers per shoot was between 5 and 40. Fruits set in at the end of June, less than a year's time from cultivation. Production peaked in August and September. Fructification continued, for both phenotypes, until the end of November. V_2 shrubs had fewer but bigger fruit, fructification started later and was less frequent. The average results at the quality tests were 16-20% dry substance per berry. The minimum value was 11%, the maximum 24%. Quality was slightly better for V_2 fruit. In 2012, the first floral buds appeared on a V_2 plant at the beginning of May and in a few days they were also seen on V_1 plants. Days later, the first flowers appeared and in a week's time, fruits also set in although they had not ripened yet. The average number of flowers and buds, per branch, is 5 to 50, with a maximum of 70. The significance of these results is that the studied phenotypes belonging to the Lycium barbarum L. species have shown a strong adaptability potential in Bucharest's area.

Key words: *adaptability, fructification, juvenile, Lycium barbarum L. (Goji), plant architecture.*

INTRODUCTION

Lycium barbarum L., commercially known as Goji, is a deciduous shrub belonging to the Solanaceae family. It is native to Asia and south-eastern Europe having been introduced, over the years, to many regions of the world. Different parts of the plant have been used in Asian countries as traditional herbal medicine and functional food [7, 9]. The species' popularity has been constantly growing in the last years, especially in western countries, due to marketing claims that call Goji a "super-fruit". Though there have been some exaggerations in these claims, scientific research has shown that the fruit's nutritional value and health-promoting properties are quite remarkable [1, 3].

Some of Goji's beneficial effects on the human body are: anti-ageing properties, anti-diabetic effects, anti-oxidant activity, cardiovascular benefits, eye health promoter and immuno-modulatory functions [2, 5, 6].

In Romania, *L. barbarum* hasn't been thoroughly studied yet, though given its growing popularity in our country, cultivating this shrub could prove to be a profitable investment. Moreover, in order to benefit from the fruit's full health-promoting properties, the consumer is advised to eat Goji fruit in their fresh, unprocessed form. Unfortunately, this is impossible at present time as most of the fruit reaching our country is imported from China, in a dried or processed state. This is why this paper aims to study the adaptability potential of the species in Bucharest's area by presenting the evolution of the elements belonging to the juvenile plant's architecture (number and length of shoots) and the stages of fructification (first floral buds and flowering sightings, number of flowers on shoots, fructification period, fruit quality) during the first two years from planting (2011-2012).

MATERIAL AND METHOD

In order to study *L. barbarum's* adaptability potential in Bucharest's area, two phenotypes (V_1 and V_2) were planted, in a non-random block experiment with 6 repetitions (3 for V_1 and 3 for V_2), within the research field at USAMV's Campus in Bucharest.

The plants were regularly measured and the fructification stages were closely observed. The fruit were measured, weighed and tested. Both sensorial and chemical properties were analyzed. Some of the tools that were used are: WAA analytical balance/scales, portable refractometer and binocular eyeglass.

The collected data was processed using Microsoft Office Excel™, according to Pena A. [8] and Cociu V., Oprea S. [4] research methods, in order to illustrate the Goji plants' growing and development stages.

RESULTS AND DISCUSSIONS

The evolution dynamics of the Lycium plants' architecture

Plant height. The average height of the potted plants, at the date of their planting (19.11.2010), varied between 17.86 cm and 44.25 cm. The highest plants were those in the first and third repetitions. When comparing the two phenotypes (V_1 and V_2), the average heights of the first three repetitions were greater than those of the other three. This means that the V_1 phenotype had taller plants than V_2. For V_1, the average height was between 36.86 cm and 44.25 cm, while for V_2 the average values were between 17.86 and 21.57 cm (Fig.1).

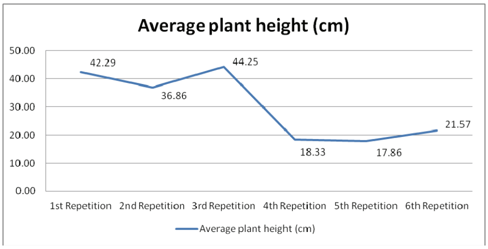

Fig. 1. The average heights of the *Lycium* plants at planting time

After 12 months from planting, the interpretation of the histograms corresponding to repetitions 1-3 (V_1) and to repetitions 1-3 (V_2) have shown significant differences, regarding growth and survival rates, between the two phenotypes. V_1 plants had a greater survival rate, but the average heights, at the end of the first year, did not exceed 64.2 – 73 cm for R_1, 78.4 – 92 cm for R_2 and 61.8 – 73 cm for R_3 (Fig.2). The V_2 plants had a more luxuriant growth, but lower survivability levels. The average heights of the second phenotype were: 178.2 – 198 cm for R_1, 105.5 – 127 cm for R_2 and 194.4 – 216 cm for R_3 (Fig.3).

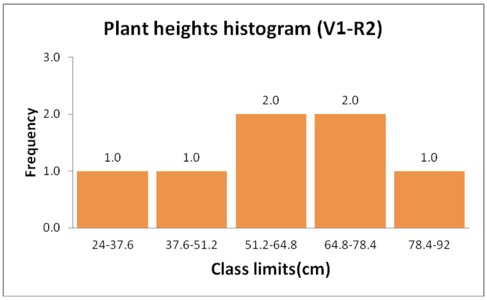

Fig. 2. Histogram of the average heights of the *Lycium* plants in V_1's 2nd repetition, 12 months from planting

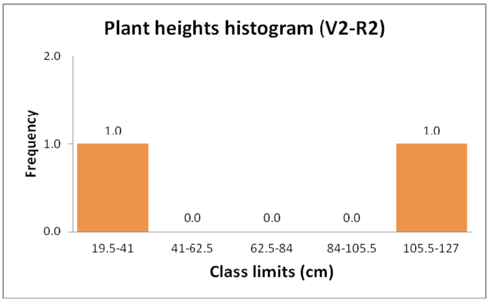

Fig. 3. Histogram of the average heights of the *Lycium* plants in V_2's 2nd repetition, 12 months from planting

Number of shoots. Shoot growth is a phenotypic trait of a given cultivar, but it is also influenced by environmental factors, just like any other quantitative trait. The dynamics of this characteristic have been studied for every phenotype, repetition and plant in the research field. Three major stages were observed in the first year from planting. May represented the growth debut, June-August represented the months with the most intensive growth rate and November marked the end of the shoots' growth.

In May 2011, the histograms' and frequency polygons' analysis, pointed out a series of interesting facts. The distribution of the newly-grown shoots' numbers amongst the class limits and centres, were different from one phenotype to the other and also between repetitions. For example, in R_1, 43% of the plants had grown between 7 and 10 new shoots, with a peak in class centres around 9. In R_2, 57% of the individuals had grown 3 to 4 new shoots, though there were plants that had up to 10 new shoots and the class centre of the frequency polygon reached 9.3 for almost 29% of the plants. R_3 individuals were evenly distributed between 4 of the 5 variation classes. The class limits were between a minimum of 1-2 and a maximum of 8-10 new shoots. V_2's repartitions had fewer individuals with new shoots and also the number of newly-grown shoots per plant reached a maximum value of only 6.

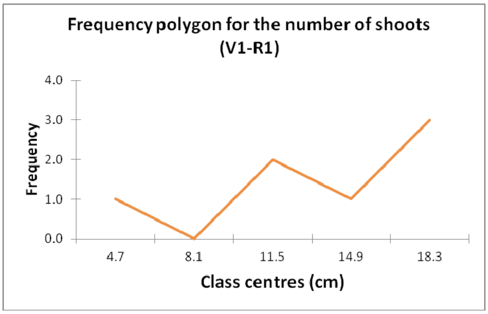

Fig. 4. The frequency polygon for the number of shoots in V_1's 1st repetition, 12 months from planting

At the end of 2011, newly-grown shoots per plant were between 10 and 40 for V_1 (Fig. 4) and between 18 and 33 for V_2 (Fig. 5). Their maximum number was 69 for V_1 and 81 for V_2. May 2012's values are 20 to 60 for V_1, and 20 to 70 for V_2. The maximum value for V_1 is 108 and 85 for V_2.

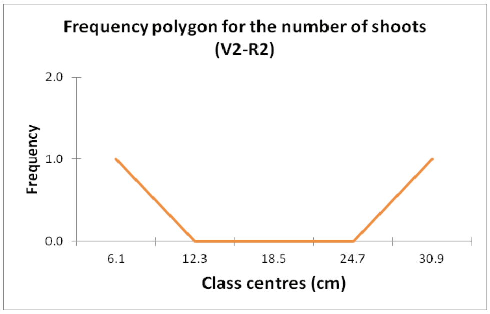

Fig. 5. The frequency polygon for the number of shoots in V_2's 2nd repetition, 12 months from planting

Length of shoots. At the end of 2011, the average length of the shoots was 10 to 50 cm for V_1, with a maximum of 62 cm. For V_2, these values were 20-80 cm, with a maximum of 99 cm. In May 2012, V_1's new sprouts were 5 to 30 cm and V_2's were 9-40 cm long.

Evolution of fructification stages for the two Lycium barbarum phenotypes

Flowering. In the first year from planting, on V_1 individuals, flower buds first appeared at the middle of June and flowering occurred at the end of the same month. V_2 plants flowered in august, and bore far less flowers. Both phenotypes flowered until late November. The average number of flowers per shoot was between 5 and 40.

In 2012, the first floral buds appeared on a V_2 plant at the beginning of May and in a few days they were also seen on V_1 plants. Days later, the first flowers appeared. The average number of flowers and buds, per branch, was 5 to 50, with a maximum of 70.

Fructification. Fruits first appeared at the end of June 2011. Production peaked in August and September. Fructification continued, for both phenotypes, until the end of November. V_2 shrubs had fewer but bigger fruit; fructification started later and was less frequent.

In 2012, fruiting started earlier than the first year, towards the middle of May. At that time, fruits appeared on a V_2 individual, although they had not ripened yet. The most important aspect regarding *Lycium barbarum's* fructification is the fact that the shrubs bore fruit in less than a year's time from their planting. This revealed a precocity trait in the new species' fructification in Romania's pedo-climatic conditions. The average fruit yield per plant, in the first year from planting, was around 64 g for the V_1 phenotype (Fig. 6). If planting distance is 2x2 m^2, the plant's nutrition area is 4 m^2, so the approximate number of plants per ha would be 2500. Therefore, the estimated fruit yield per ha of Goji-cultivated land, would be 160 kg, just on the first year from planting.

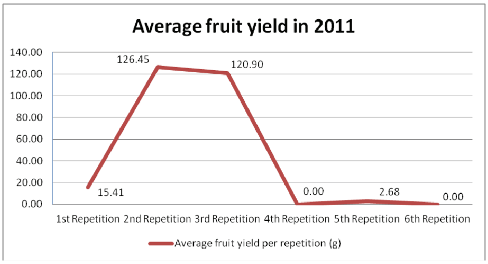

Fig. 6. The average fruit yield per repetition, 12 months from planting

The first year, average results at the quality tests were 16-20% dry substance per berry. The minimum value was 11%, the maximum 24%. Quality was slightly better for V_2 fruit. This year, the minimum value in the quality tests for V_1 fruit were 7.6 % dry substance, while the maximum value for this phenotype was 17.4 % dry substance. For V_2 individuals, values spanned between 13.6% and 32.4 %. It is important to mention that the fruits were harvested at different maturation stages.

CONCLUSIONS

The plants belonging to both studied phenotypes presented a discontinuous variability of their architectural elements. While V_1 individuals showed higher survival rates, V_2 individuals presented a more luxuriant growth. V_1 plants had a larger number of newly-grown shoots and V_2 plants had a greater length of their shoots.

Both phenotypes manifested precocity in fructification, having born fruit the first year from planting. V_1's fruits were smaller, more elliptical but greater in number than those of V_2 who were fewer and more round.

The quality of the fruit also revealed differences between size, taste and dry substance levels. V_2 fruit were bigger, sweeter and had a higher level of dry substance than those of V_1. All in all, the two studied phenotypes, belonging to the *Lycium barbarum L.* species, have shown a strong adaptability potential in Bucharest's area.

ACKNOWLEDGEMENTS

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DETERMINATIONS OF THE CONTENT OF VITAMIN C, CAROTENE AND PROTEIN IN DIFFERENT LOCAL POPULATIONS OF HOT PEPPER FOR USE IN THE PHARMACEUTICAL INDUSTRY

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Abstract

To demonstrate the importance of biochemical compounds in peppers, 47 variants were studied; each variant is represented by a local population, each with three repetitions, populations derived from Oltenia. Since the study performed is more complex, in this paper we will present the content in carotene, vitamin C and protein in 6 variants. Experience was located in the area of Almaj and Teasc in ecological cultivation system. Biochemical determinations and methods applied were conducted in the Central Laboratory of the Faculty of Agriculture of Craiova; the biochemical determinations were made from pepper fruit at physiological maturity. Local populations were observed: T2, T3, T4, A4 - for vitamin C content, T4 and A4 - for protein content and T1, T2, T6, A2, A3 for carotene content. To interpret the results, statistical calculations were performed and the reporting was done by the average of variations [5].

Key words**:** *physiological maturity, local population, statistical calculations.*

INTRODUCTION

The pepper (*Capsicum annuum* L) originates from Central America and South America. Christopher Columbus found the pepper in Haiti, where it was brought from, to Europe [2]. The pepper is grown in Europe for the first time mid way through the 16th Century in Spain and Portugal, followed by Germany, England and Hungary. The pepper reached Romania much later, being brought here by Bulgarian gardeners in the 18th Century. It was fist grown in the South of the country, and was later taken to other more favourable regions [1].
Ascorbic acid is found in large quantities in the fruit of the pepper, this varies according to species, variety or the maturity of the fruit, reaching levels of 139-160mg/100g of raw substance for fruits arriving at technological maturity and 211-300mg/100g of raw substance for fruits arriving at physiological maturity, some species of the Capsicum variety may reach higher levels up to 400mg/100g of raw substance – for the *Capsicum frutescent* species [1].
The high levels of ascorbic acid and capsaicin in the Capsicum variety give it the status of medicinal plant. The human body requires a minimum of 100mg of ascorbic acid daily, which can be easily ensured by a daily intake of pepper in our diet, consumed raw or in salads, and by no means heat-processed.
This paper aims to recommend some Romanian varieties of long pepper for raw consumption, according to their levels of ascorbic acid and carotene.

MATERIAL AND METHOD

The biological material studied in this paper consists of 13 local populations grown in Oltenia, namely 7 local populations cultivated (in the field) in Teasc and 6 local populations cultivated in the area of Almaj, Dolj county. Recognizing the importance of peppers and the beneficial effects on the human body through the components it contains, experiments aimed at conducting analyses and measurements on the chemical composition of local populations of these fruit. The main chemical analysis conducted on the chemical composition of pepper fruit were: vitamin C content, protein content and carotene content.

These reviews were conducted in the Central Laboratory of the Faculty of Agriculture, Craiova. The analysis methods used were: the titrimetric method for vitamin C, Kjeldahl method for protein and the spectrophotometer method for carotene [3, 4].

To test the significance between local populations studied, the variant analysis was used [5].

RESULTS AND DISCUSSIONS

The results on vitamin C content of pepper fruits in the local populations studied are presented in Tables 1 and 2. From these data it is observed that local populations grown in the area of Almaj showed an average vitamin C content higher with 0.69% compared to those grown in the area of Teasc.

Among local populations cultivated in the area of Teasc were noted: T3 local population which recorded a very significant content compared with the sample (average experience), T4 local population which recorded a significantly distinct content and T2 local population which recorded a significant content of vitamin C compared with the sample. Among local populations cultivated in the area of Almaj, only A4 population was noted which has overcome significantly the sample experience (the average) regarding the vitamin C content.

Table 1. The significance of vitamin C content of the 7 local populations studied, grown in the area of Teasc

Local population	Content of vitamin C (mg/100 g)	%	± Diference dry Mt	Significance
T1	352.00	100	+0.78	ns
T2	403.16	115	+54.94	*
T3	468.10	133	+116.88	***
T4	420.30	120	+69.08	**
T5	245.30	70	-105.92	000
T6	382.46	109	+31.24	ns
T7	187.23	53	-163.99	000
Mean (control)	351.22	100	-	-

$DL_{5\%} = 42.96$
$DL_{1\%} = 60.31$
$DL_{0.1\%} = 85.14$

Fig. 1. Preparation of samples for the production of vitamin C

Table 2. The significance of vitamin C content of the 6 local populations studied, grown in the area of Almăj

Local population	Content of vitamin C (mg/100 g)	%	± Diference dry Mt	Significance
A1	269.43	76	- 84.25	00
A2	318.73	90	- 34.95	ns
A3	375.57	106	+ 21.89	ns
A4	419.88	119	+ 66.20	*
A5	335.14	95	- 18.54	ns
A6	403.32	114	+ 49.64	ns
Mean (control)	353.68	100	-	-

$DL_{5\%} = 54.0$
$DL_{1\%} = 76.0$
$DL_{0.1\%} = 110.0$

In terms of protein content (Table 3 and 4) of pepper fruit, local populations in the area of Teasc have registered an average of 15 mg/100 g s.u., higher with 4.2% compared to those grown in the area of Almaj which registered an average of 14.39 mg/100g s.u. Local populations T4 and A4 recorded a significantly distinct protein content compared to the sample.

Table 3. The significance of protein content of the 7 local populations studied, grown in the area of Teasc

Local population	Content of protein (mg/100g)	%	± Diference dry Mt	Significance
T1	16.12	107	+1.12	ns
T2	13.66	91	-1.34	0
T3	14.02	93	-0.98	ns
T4	16.76	112	+1.76	**
T5	15.31	102	+0.13	ns
T6	13.87	92	-1.13	ns
T7	15.27	102	+0.27	ns
Mean (control)	15.00	100%	-	-

$DL_{5\%} = 1.19$
$DL_{1\%} = 1.68$
$DL_{0.1\%} = 2.37$

Table 4. The significance of protein content of the 6 local populations studied, grown in the area of Almăj

Local population	Content of protein (mg/100 g)	%	± Diference dry Mt	Significance
A1	12.24	85	- 2.15	00
A2	15.39	107	+ 1.00	ns
A3	13.15	91	- 1.24	ns
A4	16.73	116	+ 2.34	**
A5	15.21	106	+ 0.82	ns
A6	13.63	95	- 0.76	ns
Mean (control)	14.39	100%	-	-

$DL_{5\%} = 1.31$
$DL_{1\%} = 1.87$
$DL_{0.1\%} = 2.70$

Fig. 2. Extracts used for the determination of protein

The carotene content in pepper fruit widely varies from one place to another, the highest concentration occurring in local populations grown in the area of Almaj.

Local populations were observed: T1, T2, T6 and A3 which registered a very significant content of carotene in comparison with the sample. The local population A2 also registered a significantly distinct carotene content compared to the sample experience.

Table 5. The significance of carotene content of the 7 local populations studied, grown in the area of Teasc

Local population	Content of carotene (mg/100 g)	%	± Diference dry Mt	Significance
T1	4,78	178	+2.10	***
T2	6,07	227	+3.39	***
T3	0,60	22	-2.08	000
T4	0,60	22	-2.08	000
T5	0,23	9	-2.45	000
T6	3,80	142	+1.12	***
T7	2,70	101	-0.02	ns
Mean (Control)	2.68	100	-	-

$DL_{5\%}= 0.318$
$DL_{1\%}= 0.446$
$DL_{0.1\%}= 0.630$

Table 6. The significance of carotene content of the 6 local populations studied, grown in the area of Almăj

Local population	Content of carotene (mg/100 g)	%	± Diference dry Mt	Significance
A1	3.73	96	- 0.15	ns
A2	5.39	139	+ 1.51	**
A3	10.09	260	+ 6.21	***
A4	0.23	6	- 3.65	000
A5	3.31	85	- 0.57	ns
A6	0.54	14	- 3.34	000
Mean (control)	3.88	100	-	-

$DL_{5\%} = 0.896$
$DL_{1\%} = 1.274$
$DL_{0.1\%} = 1.845$

Fig.3. Preparation of samples for the determination carotene

CONCLUSIONS

The local populations grown in the area of Teasc had a greater concentration of vitamin C and carotene in comparison with those grown in the area of Almaj.

In terms of chemical composition the following local populations were observed:

- T2, T3, T4, A4 – for vitamin C content;
- T4 and A4 - for protein content;
- T1, T2, T6, A2, A3 - for carotene content.

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DETERMINATION OF NPK IN SOME LOCAL POPULATIONS OF PEPPER IN ORDER TO OBTAIN ADEQUATE FOOD COMPLIANT WITH THE EU FOOD SAFETY RULES

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Abstract

In some food products, we can encounter pesticides, in some cases accidental or intentionally by the manufacturer (insecticides, herbicides, defoliants, etc.) that can cause allergic, neurotoxin, teratogenic and carcinogenic effects. Given the requirement of Law 312/2003, which governs agricultural policy in agriculture on the production and use of fresh vegetables for consumption or industrial processes, they must not contain residues of pesticides and heavy metals, nitrates or other products exceeding the maximum permissible levels.
Due to the high content of vitamins and capsaicin in peppers and due to the beneficial effects it has both as food and as therapy, knowing the admitted contents of NPK in the pepper fruit is of major importance in obtaining high-quality vegetables, especially among individual small producers that use crops from local populations. The physiological and biochemical determinations were performed in the Central Laboratory of the Faculty of Agriculture of Craiova, and the material under study was brought from 5 areas of Oltenia.

Key words: *pepper fruits, phosphorus content, parameters evolutions.*

INTRODUCTION

The pepper (*Capsicum annuum* L) originates from Central America and South America. Christopher Columbus found the pepper in Haiti, where it was brought from, to Europe [2, 3].
The fruit of the pepper present a high value as an aliment, due to its elevated content of natural sugars and vitamins and the fact that it is habitually consumed as raw, state in which these components are processed directly, by the human body [1, 3].
Elevated levels of capsaicin are characteristic to hot/chili pepper varieties. While in the 70s the consumption of hot/chili peppers was linked to a series of illnesses of the digestive tract and of the blood vessels, recent studies taken place in Australia, Hungary and the USA (countries where the pepper is highly consumed) have reveled that, in truth, the chili pepper prevents cardio-vascular diseases, cures some illnesses of the digestive tract, prevents prostate cancer and type II diabetes. Recently, the chili pepper has started being used in cosmetic products targeting cellulite and has proven to be a great success [4, 5].
On top of ascorbic acid, the fruits of the pepper contain other vitamins, such as B_1 şi B_2, PP and E. Capsaicin, active component in peppers, give it the hot/chili taste, characteristic to many varieties [4].
The levels of Capsaicin defers according to species and variety, between 0.27 and 1.12mg/100g of raw substance for hot/chili fruits, and minute quantities for sweet varieties [3].

MATERIAL AND METHOD

The biological material studied was represented by twenty local populations of pepper that have been grown in 2009, under field conditions, in five regions of Oltenia, namely: Dabuleni (D1, D2, D3, D4), Bailesti (B5, B6, B7, B8), Daneti (D9, D10, D11, D12), Teasc (T13, T14, T15, T16) and Dobresti (D17, D18, D19, D20).
To express the fruit quality in terms of food, the content of some quality indicators was taken into account, namely: nitrogen, phosphorus and potassium. Analyses were performed at the technological maturity of the pepper fruit in the Central Laboratory of the Faculty of Agriculture, Craiova.
The analysis method used for nitrogen was the classical method Kendall, the colorimetric method for the others and the potassium was analyzed by flame photometry.
The links between the parameters studied were analyzed in terms of correlation coefficients (r) [6].

RESULTS AND DISCUSSIONS

The nitrogen content of the pepper fruits ranged from 2.16% to local populations D1, B5 and 2.94% to local populations T16, D20 (Fig. 1, Table 1).

Table 1. The nitrogen content in the crops of pepper fruit studied

Variant	Local population	Nitrogen %100g
D1	DABULENI	2.16
D2	DABULENI	2.67
D3	DABULENI	2.64
D4	DABULENI	2.57
B5	BĂILEŞTI	2.16
B6	BĂILEŞTI	2.49
B7	BĂILEŞTI	2.19
B8	BĂILEŞTI	2.4
DA9	DANEŢI	2.54
DA10	DANEŢI	2.7
DA11	DANEŢI	2.61
DA12	DANEŢI	2.76
T13	TEASC	2.82
T14	TEASC	2.4
T15	TEASC	2.46
T16	TEASC	2.94
DO17	DOBREŞTI	2.49
DO1845	DOBREŞTI	2.7
DO19	DOBREŞTI	2.58
DO20	DOBREŞTI	2.94

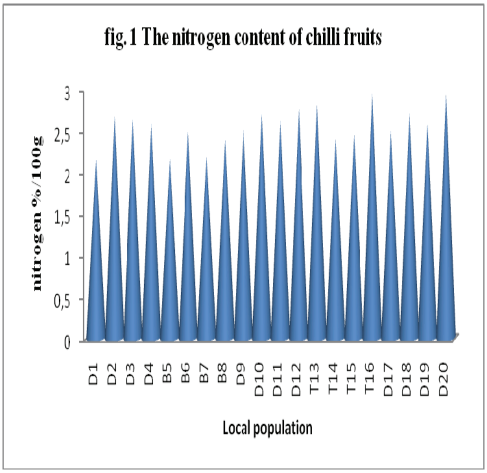

Fig. 1. Representation of the nitrogen content in the crops of pepper fruit studied

Phosphorus existent in pepper fruits ranged from 0.7% to local populations B5, B8 and 1.8% to local population D17 (Fig. 2, Table 2).

Table 2. The phosphorus content in the crops of pepper fruit studied

Variant	Local population	Phosphorus P_2O_5 %100g s.u
D1	DABULENI	0.8
D2	DABULENI	0.9
D3	DABULENI	1.28
D4	DABULENI	0.17
B5	BĂILEŞTI	0.7
B6	BĂILEŞTI	1.4
B7	BĂILEŞTI	0.9
B8	BĂILEŞTI	0.7
DA9	DANEŢI	1.1
DA10	DANEŢI	0.9
DA11	DANEŢI	1.2
DA12	DANEŢI	1
T13	TEASC	1.6
T14	TEASC	1.15
T15	TEASC	0.9
T16	TEASC	1.5
DO17	DOBREŞTI	1.8
DO1845	DOBREŞTI	1.3
DO19	DOBREŞTI	1.4
DO20	DOBREŞTI	1.5

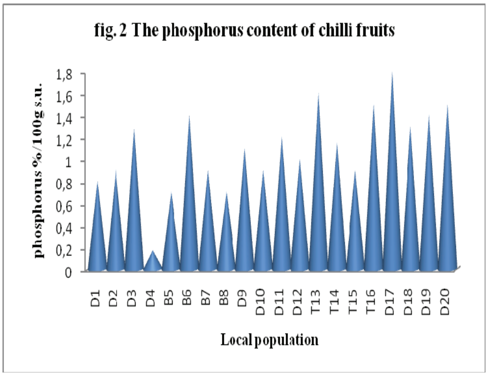

Fig. 2. Representation of the phosphorus content in the crops of pepper fruit studied

The potassium content of pepper fruits ranged from 0.68% to local populations B6, T14 and 1.16% to local population T15 (Fig. 3, Table 3).

Table 3. The potassium content in the crops of pepper fruit studied

Variant	Local population	Potassium K_2O %100g.s.u
D1	DABULENI	0.75
D2	DABULENI	0.88
D3	DABULENI	0.78
D4	DABULENI	0.87
B5	BĂILEŞTI	0.79
B6	BĂILEŞTI	0.68
B7	BĂILEŞTI	0.76
B8	BĂILEŞTI	0.83
DA9	DANEŢI	0.93
DA10	DANEŢI	0.83
DA11	DANEŢI	0.76
DA12	DANEŢI	0.88
T13	TEASC	0.93
T14	TEASC	0.68
T15	TEASC	1.16
T16	TEASC	1.01
DO17	DOBREŞTI	0.97
DO1845	DOBREŞTI	1.06
DO19	DOBREŞTI	0.93
DO20	DOBREŞTI	0.98

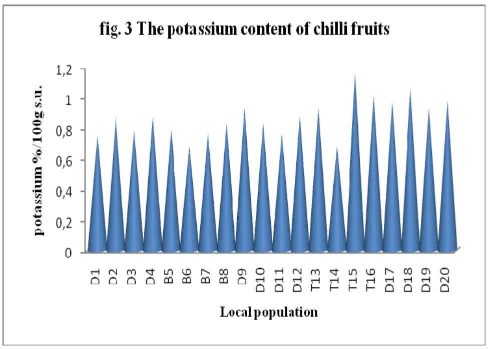

Fig. 3. Representation of the potassium content in the crops of pepper fruit studied

Fig. 4. Influence of nitrogen on plants taken in the study

Correlations between analyzed parameters (Table 1) show a significant positive connection between the content of nitrogen and phosphorus content (r = 0.464) and also between nitrogen and potassium content (r = 0.471) of pepper fruit.

Tabele 4. Correlations between analyzed parameters

	Nitrogen	Phosphorus	Potassium
Nitrogen	-	0.464*	0.471*
Phosphorus		-	0.235
Potassium			-

$P_{5\%}$= 0.44
$P_{1\%}$= 0.56

Fig. 5. Influence of phosphorus on plants taken in the study

CONCLUSIONS

Based on research undertaken we believe that most local populations studied meet quality standards.

The local population was noted by the highest content of nitrogen in Teasc T16, potassium in T16 Teasc and phosphorus in Dabuleni D3 of 1.28.

The nitrogen content of pepper fruits is correlated positively with the phosphorus and potassium content.

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NEEDS ASSESSMENT OF EFFICIENCY AND PROMOTION OF PHYSICAL EDUCATION ACTIVITY IN EDUCATION ACADEMIC AGRONOMIC

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Abstract

Methodology for evaluating the efficiency and objective-based routing of the educational process, within the disciplines of education, working for several years, a uniform system of verification, assessment and screening of students (SUVAD), which contains requirements and tests control, aiming at the participation and activity in the lessons, progress on key indicators of traction, the athletic training, participation in competitions etc. In this study, we aimed comparative and evolutionary fitness level of students over two semesters.

Key words: *assessment, grading, physical training, physical education, promotion.*

INTRODUCTION

Objective basis to evaluate the efficiency of their activity with groups of students, to stimulate students' interest to participate in organized activities and their level of general and special requirements according to the present stage, checking and assessing students is on the following criteria:
1. weekly participation in lessons;
2. support verification tests of general motility level;
3. specific tests branch of sport;
4. student competitions;
5. basic theoretical knowledge, the issue of physical education and sport activities (discipline practiced) [3,4].

Marks obtained by students in this discipline, is that important segment of the student's personality and sports aimed at physical ability, health and physical and mental vigour, their concerns in this respect, elements without which it could exploit to rate high efficiency, training and all its present and future activity.

Justification for completion of the work, with students assessing the notes is based on solid arguments in as: objective assessment and differential activity of heterogeneous groups of students (the level of training, activity and interest), you can use a scale value of selecting students and on the other hand, increasing interest from students of Veterinary Medicine to participate in organized activities and improvement of their qualifications.

MATERIAL AND METHOD

In development work we tested a sample of 68 students from the Veterinary Medicine Bucharest.

Analysis was done over a period of one academic year, 2007-2008.

The first phase was the development of research protocol and establishes the sample of students tested.

We established evidence and methodology in which students will be tested.

In order to simplify operations by centralizing data, the criterion ratings, notes were divided into four groups as follows: between grade 9 and grade 10 very well, between grade 7 and grade 8 well, between 5th and 6th grade satisfactorily under Note 5 low grade.

Values obtained in the anthropometric measurements of growth and development parameters were compared with those of previous years.

In activity were used to bring relevant evidence on some indices of overall traction. The samples used were those of the unique requirements developed by the MEC.

Were studied: the resistance running on 800 and 1000 m flat (AR), elevation of the vertical trunk of lying dorsal in 30 seconds (ABD), the vertical lifting of the lying ventral trunk in 30 seconds (ES), jump long standing (SLL), traction bar set for students (TR), joint mobility for students (M), dips in the bed arm face (F) [1, 2].

Data were collected, centralized, processed and interpreted in relation to all subjects in the sample overall averages.

Gathering, processing and interpretation of results took place between November 2007 and June 2008.

Statistical and mathematical processing of data collected and using statistical indicators, allowed me a more complex analysis of two test results.

The results obtained in the initial and final testing of the two groups, control group (CG) and experimental group (GE), were introduced into tables and interpreted statistically. Statistical and mathematical procedures that led to the study allowed me ease the process of analysis and interpretation of results, allowing also the establishment of general conclusions on the topic discussed.

Means income, were calculated following statistical parameters: arithmetic mean, standard deviation, coefficient of variation and amplitude.

RESULTS AND DISCUSSIONS

Table 1. The transformation of performance in notes

Measured sport evidence	Note 5		Note 6		Note 7		Note 8		Note 9		Note 10	
	B	G	B	G	B	G	B	G	B	G	B	G
E.R.	4.9	4.9	4.8	4.8	4.7	4.7	4.6	4.6	4.5	4.5	4.4	4.4
ABS	20	18	21	19	22	20	24	22	26	24	28	26
E.S.	22	15	24	17	26	19	28	21	30	23	33	26
S.L.J.	200	150	210	160	220	170	230	177	250	185	255	195
TR	2	-	3	-	4	-	6	-	8	-	10	-
M.	-	S	-	S	-	B	-	B	-	FB	-	FB
P	19	10	21	15	25	20	30	23	35	25	40	27

Table 2. Elevation of the vertical trunk of lying dorsal

Statistical and mathematical indices	Nov 07		June 08	
	Girls	Boys	Girls	Boys
Average	20.76	22.59	23.46	25.95
S	1.72	1.78	1.85	2.11
Cv (%)	8.31	7.89	7.90	8.14
W	5	5	7	8

Comparing and analyzing the performances of the two tests, individual values from the average distribution is best represented when tested in June 2008 when 23.46% and 25.95% of students are performing above average. Following the evolution and comparing test results, translated into notes, we can say that students have achieved grade 7 to grade 8 initial testing and the final one, and students have achieved grade 8 to grade 9 at initial testing and final testing.

Comparing and analyzing the performances of the two tests, individual values from the average distribution is best represented when tested in June 2008 when 23.46% of the students and 25.95% of students are performing above average. Following the evolution and comparing test results, translated into notes, we can say that students have achieved grade 7 to grade 8 initial testing and the final one, and students have achieved grade 8 to grade 9 at initial testing and final testing.

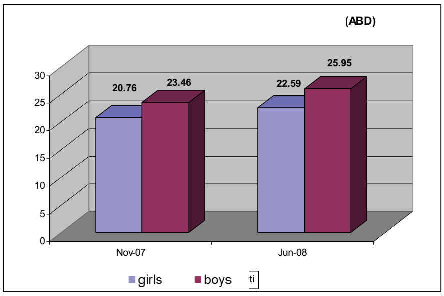

Fig. 1. Elevation of the vertical trunk of lying dorsal

Table 3. Elevation of the vertical trunk of lying ventral

Statistical and mathematical indices	Nov 07		June 08	
	Girls	Boys	Girls	Boys
Average	18.27	24.19	25.21	27.14
S	2.31	1.47	1.70	3.43
Cv (%)	12.68	6.09	6.74	12.64
W	6	4	6	25

After analyzing the test results is an increase of 25.21% percent for female students and 27.14% for students testing in June 2008. Delineating the extremes and making a comparison between the minimum and maximum values recorded for female students were hired between grades 7-10 and for students between grades 6-9.

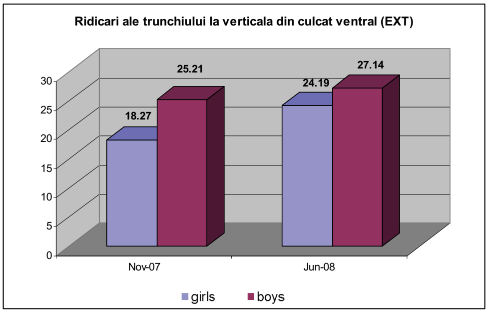

Fig. 2. Elevation of the vertical trunk of lying ventral

Table 4. Standing long jump

Statistical and mathematical indices	Nov 07		June08	
	Girls	Boys	Girls	Boys
Average	1.61	2.21	1.66	2.34
S	0.11	0.15	0.13	0.14
Cv (%)	7.11	7.15	8.15	6.15
W	0.35	0.5	0.51	0.4

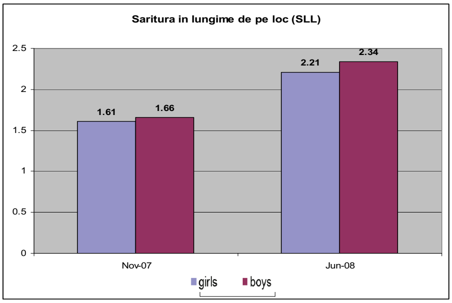

Fig. 3. Standing long jump

The analysis results on testing the standing long jump showed an improvement of 0.05 cm to 0.13 cm respectively students from students. Translated into notes that the average result obtained from the two tests for female students ranged from 7, the smallest and largest is 6 8. At students, media was grade 8, the lowest value in July, and most 9.

Table 5. Pushups in the arms of the bed face

Statistical and mathematical indices	Nov 07		June 08	
	Girls	Boys	Girls	Boys
Average	14.70	21.70	25.21	33.82
S	2.50	1.90	1.98	4.06
Cv (%)	17.01	8.78	7.88	12.02
W	7	5	8	15

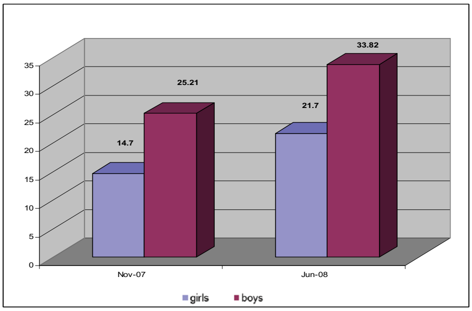

Fig. 4. Pushups in the arms of the bed face

Following data interpretation is to see an improvement of 10.51 and 12.12 repeats the student reps to students. Following the evolution of each student can define extremes falling between minimum 5 and maximum note 6 after testing in November and a minimum grade 8, grade 9 test up to June for female students. Students about the situation are as follows: to test the November notes varies between 5 and 6 when tested in June minimum is 8 and maximum 10.

Table 6. Traction fixed bar (students) / joint mobility (students)

Statistical and mathematical indices	Nov 07		June 08	
	Girls	Boys	Girls	Boys
Average	2.16	4.93	2.23	7.26
S	0.83	1.74	0.82	2.56
Cv (%)	38.68	35.42	36.93	35.25
W	2	5	2	8

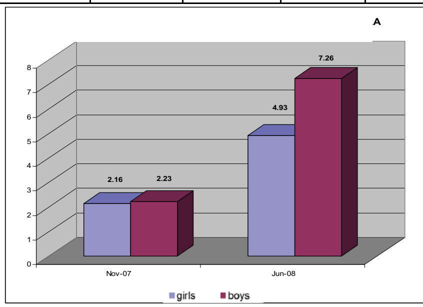

Fig. 5. Traction fixed bar (students) / joint mobility (students)

Best values in the samples were recorded at testing in June 2008, when students have achieved grades between 7 and 9, compared with previous test when the level was quite low, ranging from grades 6-7. The students not recorded any regression. If the driving qualities, progress is minimal, they could not determine the minimum and maximum values.

Table 7. Running resistance

Statistical and mathematical indices	**Nov 07**		**June 08**	
	Girls	Boys	Girls	Boys
Average	4.98	4.26	4.59	4.20
S	0.30	0.18	0.18	0.16
Cv (%)	6.10	4.30	4.01	4.01
W	3.3	0.5	0.5	0.8

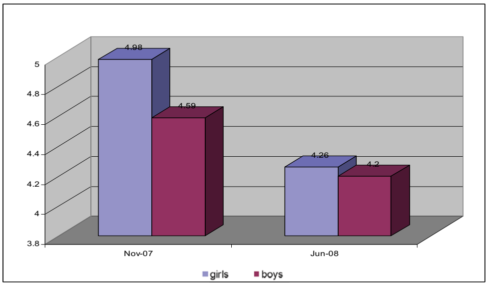

Fig. 6. Running resistance

Comparing the results of two tests, we find that progress in the running resistance of the sample is not remarkable, but for female students considering motric luggage when entering college, we can say that any progress is important, especially in the samples which consistent with their high ideals majority. In this respect, analysis and implementation results show an improvement in grades of 0.39 sec., 0.06 seconds. Converted to notes, the results are the following: for students to test in November 2007 notes ranged between 5-6, as the end of testing in June 2008 to range from 7-8 in most cases, few of them to have grade 10. Notaries about the students there were no values below 8, comprising most of the scale for grade 9 and 10.

CONCLUSIONS

Interpretative data revealed that some of the samples are an increasing level of driving quality indices (resistance, strength, skill, mobility). Reporting the results of studies in guidance rules for assessing the level of physical training of students on MEC was observed that most performance stands at a rate of 33.5% between grades 5-6 and grades 7-8 from 30.5% to students and for students, the proportion is between 29.9% and 32.4%. Making a comparison with previous years, the percentages were 40% in students with grades between 9.10 and 60% with grades ranging from 5-8, I can say that the driving performance of students improved agronomic and interest constant practice of exercise and favourite sports was greatly increased.

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MORFO FUNCTIONAL STUDY ON PROFILE AND DRIVING CURRENT STUDENTS OF USAMV BUCHAREST

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Abstract

This paper is intended as a study into the development and evolution of the dynamic potential of students' biomotric agronomists. Going on the grounds that once known needs and expectations of the university students, successful capture interest about physical education would be big enough, that we can remove or graduated care of her anymore on the accumulation of credits. Thus, the student will become aware and will have the satisfaction of achieving personal goals, and hope in the future application of knowledge gained. For this study, we tested a total of 258 female and male students, aged between 19 and 23, of the Veterinary Medicine Bucharest. Data were analyzed and compared.

Key words: *physical training, morfo-functional, motric, performance.*

INTRODUCTION

Physical education is an important part of general education is a means of emancipation with educational content, aimed at harmonious physical development, physical strengthening, and character education traits of individuals [4].
The age at which students attend full-time in years I and II in higher education is dynamic and powerful that involves a number of vital functions and thus changes the basic driving qualities. Therefore, the content of physical education and sports activities, to some extent, influence favourable evolution of this young age [1].
Each student has a unique set of skills, interests, temperament, attitudes and motivations that define personality. Students may lean towards a certain type of activity, according to psychological characteristics. Preferences can be directed to activities in the form of intense competition, high volume activities but with lower intensity exercise, others prefer team work or on the contrary want a degree of autonomy. Importantly, work assignments or practice in physical education classes, to occur under the direct and continuous teacher [4].
Preferably is such as physical education students to be accepted with pleasure and to be a necessity and not as an obligation.
Both rhythm and practice of the habit of creating practical exercise are requirements for physical education objectives. The beneficiaries are students, for short term gain a better mood and health and increased work efficiency and prevent long-term deficiencies caused by stress, improper diet, sedentary or exposure factors "pollutants" of society present. Realizing the benefits of exercise practice, with pleasure, consistently, one would expect that the positive effects are soon to follow. I mean the growth rate, decreasing the number of debtors and not least the shortage of medical excuse.

MATERIAL AND METHOD

In developing this paper we used a sample of 258 students, aged between 19 and 23 years in Veterinary Medicine Bucharest. Period analysis study was conducted between 2005 and 2006. At first we started by developing a research protocol and to establish the sample of students tested. We established evidence and methodology in which students will be tested. Making measurements of anthropometric parameters on growth, development and body harmony caught in regular testing activity, a longitudinal sample of students without their prior selection using classical tests of value indices of motor and physiological indicators. Samples were subjected students to be studied were: 50 m running speed on flat running resistance on the 800 and 1000 m flat, standing long jump, vertical lifting of the trunk to the rear bed.

Data were collected, centralized, processed and interpreted in relation to all subjects in the sample overall averages, or the comparison from year to year and a dynamic stage to another.

Following centralization, processing and interpretation of results obtained from tests performed on samples of students, initiated research took place during November 2005-May 2006.

The first test in November 2005, initially aimed at establishment level of driving ability in students of first year university early. The results can guide teachers in how the educational process to counteract those deficiencies manifested in most of the team. The second test in May 2006 aimed at setting the driving capacity I to mark the end of the efficiency of physical education and sport at the same time, the results were a comparison within the first and third test. Testing the third of November 2006 has provided data on driving capacity values in the first year of organized practice of physical education.

In parallel, dynamic data are used to assessing driving ability compared with baseline in November 2005. Study driving ability level of students was based on measurements from control samples included in the unitary system of verification and evaluation 2005. Data collected were processed using statistical and mathematical those indicators that allow more complex analysis and comparison of both the results of the three tests together, and comparing their performances at last testing (2005-2006).

The results obtained in the initial and final testing of the two groups, control group (CG) and experimental group (GE), were introduced into tables and interpreted statistically. From the descriptive statistics were calculated following statistical parameters: mean, amplitude, median, standard deviation, standard error of the mean and coefficient of variation. Statistical processing of experimental results obtained by those samples was performed using SPSS.

RESULTS AND DISCUSSIONS

Table 1. Running speed girl 50 m flat

	RS girls			RS boys		
Calculated parameters	Nov-05	May-06	Nov-06	Nov-05	May-06	Nov-06
Sample size	115	113	112	143	138	136
Average	9.16	9.05	9.14	7.06	7.04	7.1
Amplitude	6.3	4.8	6	3	3.2	3.2
Average deviation	0.66	0.7	0.58	0.32	0.32	0.37
Standard deviation	0.85	0.96	0.74	0.43	0.44	0.48
Variation quotient	9.37	10.64	8.13	6.16	6.28	6.85
Homogeneity	high	medium	high	high	high	high

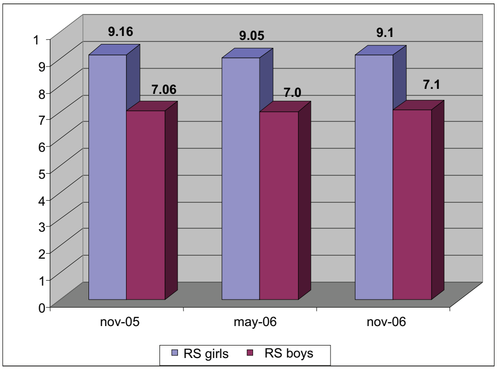

Fig. 1. Graphical representation of results obtained from running the speed test girls 50 m

Best performances were obtained for testing in May 2006 when the average was 9.05, the worst results occurring in first test when the average was 9.16 because this is the first test coincided with the time of admission in the academic environment and could not find the driving qualities of high school graduates.

Coefficient of variation shows high homogeneity in the two tests in November 2005 and November 2006 to May 2006 while testing the homogeneity is average.

For boys in the study average of the three tests are similar amplitude value is an average difference of 3.1 seconds. The results were an average, close to the value; worse performance was obtained in November 2006. Greater homogeneity was in all three tests.

Table 2. Endurance running the 800 meters flat - girls and 1,000 m flat - boys

	ER girls			ER boys		
Parameters calculated	Nov-05	May-06	Nov-06	Nov-05	May-06	Nov-06
Sample size	115	113	112	143	138	136
Success, %	92.38	91.79	93.8	95.66	94.69	94.64
Abandonment, %	7.62	8.21	6.2	4.34	5.31	5.36

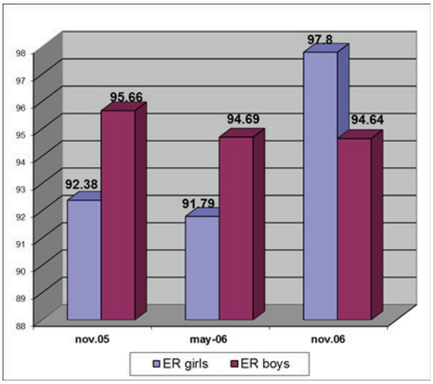

Fig. 2. Graphical representation of run proven success rate of resistance

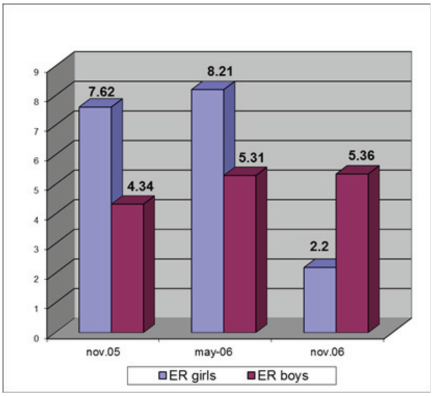

Fig. 3. Graphical representation of the test run dropout rate of resistance

Students ran continuously 12 minutes in noting individual abandonment rate. The first test was 143 enrolled boys they managed to finish the test in percentage 95.66% 4.34% noting the retirements, also 115 girls took part managed to finish this test at the rate of 92.38%. When testing a second sample from 2006 to 138 boys, the percentage of successes being abandoned and the rest 94.69% 91.79% in girls from a total of 113 participants. In the third test 136 boys participated, there were 5.36% and finished sample waivers 94.64%. The girls of 112 participants registered 6.2% abandoned.

In conclusion in girls drop out rate was accept parameters. Significant differences are recorded in boys where the dropout rate was lower in November 2005 and higher in November 2006 this is due to lack of movement in the week.

Table 3. Standing long jump

	SLJ girls			SLJ boys		
Parameters calculated	Nov-05	May-06	Nov-06	Nov-05	May-06	Nov-06
Sample size	115	113	112	143	138	136
Average	1.69	1.68	1.65	2.26	2.29	2.27
Amplitude	1.1	1	1.1	1.3	1.15	1.3
Average deviation	0.12	0.13	0.14	0.14	0.15	0.17
Standard deviation	0.16	0.16	0.18	0.18	0.19	0.21
Variation quotient	9.5	9.82	10.98	8.27	8.47	9.42
Homogeneity	high	high	medium	high	high	high

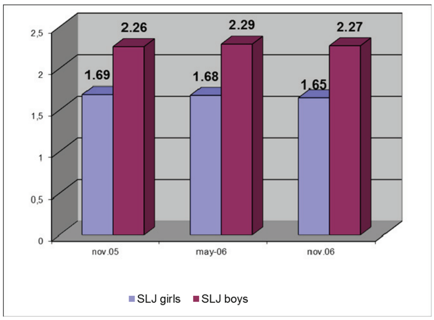

Fig. 4. Graphical representation of the test results on the place long jump

To test the long jump in place best performance were obtained from the first and second test are minimal differences, achieving good performance for girls recorded lower results to the test equipment in November 2006. Following the coefficient of variation found a high homogeneity tests in November 2005 and May 2006 and November 2006 average. If the boys in long jump test immediately all three average value is grouped in 3 cm, the mean of three swings. Amplitude is contained in the three tests between 1.30 and 1.15 m, coefficient of variation for all three tests indicate high homogeneity.

Table 4. Elevation of the vertical trunk of lying dorsal

	ABS girls			ABS boys		
Parameters calculated	Nov-05	May-06	Nov-06	Nov-05	May-06	Nov-06
Sample size	115	113	112	143	138	136
Average	17.9	17.53	18.03	21.46	21.3	21.59
Amplitude	26	22	20	20	18	19
Average deviation	2.95	2.27	2.61	3.02	2.77	2.81
Standard deviation	3.84	2.86	3.32	3.71	3.3	3.45
Variation quotient	not norm	norm	norm	17.32	15.92	15.99
Homogeneity	Homo-geneity absence	med	med	med	med	med

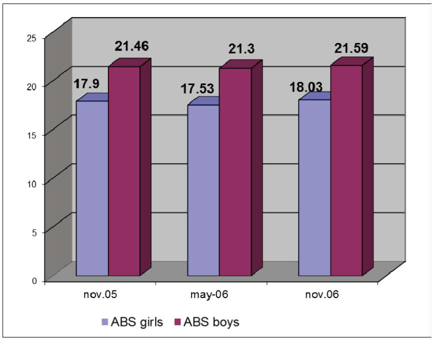

Fig. 5. Graphical representation of test results from the vertical elevation of the trunk of lying dorsal

If proof of the vertical lift of the trunk of lying dorsal best performance to meet the test of November 2006, averaging 18 executions following the testing of November 2005 and then in May 2006 when the average was 17.9 and 17.5 respectively executions. Highest amplitude one records at testing the following in order of value November 2005 testing in May 2006 and then in November. In 2006, one found an average homogeneity tests in May and November 2006 and a lack of uniformity in testing in November 2005.

For boys in this sample environments have the same value in the three tests. Amplitude varies from 18 to 20 performances a great think. If following the coefficient of variability found an average of three tests homogeneity.

CONCLUSIONS

Interpretation of data obtained revealed the dynamic aspect of driving ability level of students. Keeping this theme in our focus will allow the future build a database and information on the dynamics and driving ability of students. SUVA current remains valid still it remains the only way to assess the driving ability.

I recommend every student to engage in conducting a regular program of aerobic exercise 2-3 times per week with a duration of 30-60 min.

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EVOLUTION OF ROMANIAN AGRICULTURE IN THE LAST TWO DECADES AND THE NECESSITY OF COOPERATION

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Abstract

It is well known that the Romanian rural economy is dominated by agriculture whose main feature is the significant percentage of subsistence and semi-subsistence farms that produce for own consumption, occasionally selling these products obtained to the market [2]. This paper refers to the evolution of Romanian agriculture in the last two decades and it will show that rural economy remains very weak integrated in market economy, and that the social measures in agriculture have made this important sector of national economy not competitive and will underlined the necessity of cooperation. In order to characterize the evolution of agricultural sector in Romania a number of indicators have been taken into account such as cultivated areas, total vegetal and animal production, livestock and prices, for the last two decades. The 20 years analysed show the oscillations for indicators used, due to the climate, economical and politically conditions. The EU agriculture was well organized and supported with a huge progress compared to the situation in Romania, where agriculture is still in the early evolution to a business efficiency and performance. The best solution to make the agricultural sector to achieve his potential both in economically and socially are cooperatives.

Key words: *rural economy, evolution, agricultural sector, necessity of cooperation.*

INTRODUCTION

Agriculture is important for all humans and animals around the world because has the primordial task to feed the increasing population of the globe. Agricultural sector is an important branch of rural economy in many countries and it has many problems mainly where small farms are the basic producing units.

It is well known that the agriculture is an important branch with a long tradition in our country.

After 1989, the Romanian agricultural sector has suffered important modification due to the dissolution of the state enterprises and the old APC (Agricultural Production Cooperatives) which did not comply with democratic principles of the European cooperatives.

Agriculture provided a rather feeble support in terms of economic growth over the past 10 years compared with its share in GDP, mainly due to high dependence on weather conditions and low level of equipment with technical means of agricultural holding [8].

For Romania, the chance to overcome the economic crisis is provided by radical changes in zoning of agriculture crops, crop structure, crop rotation, technologies and more environmentally friendly, stable production and prices competitive on the European single market [5].

It indicates that all will be applicable only through farmers' cooperation, supported by the Romanian state and EU with concrete measures and funds for development of cadastre, in order to improve the efficiency of the irrigation system and obtaining loans at interest comparable to other European countries.

In this context, the paper presents an analysis of the evolution of agricultural production from Romania in order to put into evidence the evolution of the cultivated areas, total vegetal and animal production, livestock and prices in the period 1989-2010.

MATERIAL AND METHOD

In order to characterize the evolution of agricultural sector in Romania, a number of indicators have been taken into account such as cultivated areas, total vegetal and animal production, livestock and prices, for two decades.

The period analyzed in this study was 1989-2010.

The data, collected from National Institute for Statistics and Ministry of Agriculture and Rural Development have been statistically processed and interpreted, building the trend line and setting up the forecast based on simulation models for the next period.

RESULTS AND DISCUSSIONS

The arable surface of Romania decreased in 2010 with 53.3 thousand hectares and in 2000 with 23.9 thousand hectares compared to 1989. Area covered with pastures and hayfields in 2000 increased by 243,600 ha to 1989, respectively 113,200 ha in 2010. The area planted with vineyards, orchards and nurseries dropped significantly with 124,800 ha by 2000 and with 183,500 ha by the year 2010 compared to 1989 [7].

Irrigable area in Romania is about 7% of arable land, while the irrigated area is less than 2%. Irrigation by flooding, which requires a high consumption of water, is predominant in Romania (57% of total) [8].

The cultivated area has continuously decreased from 1989 reaching in 2010 a surface of 91.66% for wheat, 67.17% for barley and two-row barley, 76.76% for maize, 12.47% for soybean, 83.58% for potatoes, 62.26% for orchards and nurseries and 82.89% for bearing vineyards. But there were also some increases of the cultivated areas in 2010 compared to 1989: for sunflower the surface increased with 182.33%, for rape with 271.36% and for vegetables with 103.87% [7] (Table 1).

This was the result of the dissolution for the state enterprises and the old APC (Agricultural Production Cooperatives) and due to market demands.

Table 1. Evolution of the cultivated area during the period 1989-2010 (thousand hectares)

Specification	1989	1995	2000	2005	2010	2010/ 1989 %
Wheat	2,359	2,005.4	1,954.3	2,476	2,162.3	91.66
Barley and two-row barley	767.8	342.4	411.9	484.6	515.8	67.17
Maize	2,733.4	2,828.9	3,049.4	2,628.5	2,098.3	76.76
Sunflower	433.7	534.3	876.8	971	790.8	182.33
Rape	19.8	-	68.4	87.8	537.3	271.36
Soybean	512.2	12.8	117	143.1	63.9	12.47
Potatoes	288.7	203.9	282.7	284.9	241.3	83.58
Vegetables	252.8	189.6	234	266.7	262.6	103.87
Orchards and nurseries	318	277.6	206	181	198	62.26
Bearing vineyards	213.4	188.4	247.5	190.6	176.9	82.89

Total production decreased in the analyzed period for wheat from 7,935.2 thousand tonnes in the year 1989 to 5,811.8 thousand tonnes in the year 2010, for barley and two-row barley from 3,436.3 thousand tonnes to 1,311 thousand tonnes, for soybean from 303.9 thousand tonnes to 149.9 thousand tonnes, for potatoes from 3,892.1 thousand tonnes to 3,283.3 thousand tonnes, for orchards and nurseries from 1,580.2 thousand tonnes to 1,419.6 thousand tonnes and for bearing vineyards from 914.5 thousand tonnes to 740.1 thousand tonnes.

Therefore, there were some increases for total production of maize from 6,761.8 thousand tonnes in 1989 at 9,042 thousand tonnes in 2010, for sunflower an important increase from 655.8 thousand tonnes at 1,262.9 thousand tonnes, for rape also from 18 thousand tonnes at 943 thousand tonnes and also for vegetables with a small variation from 3,726.6 thousand tonnes to 3,863.6 thousand tonnes [7] (Table 2).

Table 2. Evolution of total production during the period 1989-2010 (thousand tonnes)

Specification	1989	1995	2000	2005	2010	2010/ 1989 %
Wheat	7,935.2	5,929.8	4456.2	7,340.7	5,811.8	73.24
Barley and two-row barley	3,436.3	961.9	867	1,079.1	1,311	38.15
Maize	6,761.8	9,195.7	4,897.6	10,388.5	9,042	133.72
Sunflower	655.8	675.8	720.9	1,340.9	1,262.9	192.57
Rape	18	-	76.1	147.6	943	523.88
Soybean	303.9	11.9	76.1	312.8	149.9	49.32
Potatoes	3,892.1	2,567.3	3,469.8	3,738.6	3,283,8	84.37
Vegetables	3,726.6	2,559.8	2,527.8	3,624.6	3,863.6	103.67
Orchards and nurseries	1,580.2	670.8	1,301	1,647	1,419.6	89.83
Bearing vineyards	914.5	951.2	1,295.3	505.8	740.1	80.92

Although acreage and productions have ranged during the analyzed period, the prices had a normal significant increase. The price for wheat grown with 178.78% until 2010 from 2001, for barley with 216%, for maize with 225.8%, for sunflower with 253.19%, for soybean with 212%, and for potatoes with 680% [6] (Table 3).

Table 3. Evolution of prices for cultivated crops during the period 2001-2010 (ron/kg)

Specifica-tion	2001	2003	2005	2007	2010	2010/ 2001 %
Wheat	0.33	0.51	0.36	0.61	0.59	178.78
Barley and two-row barley	0.25	0.48	0.36	0.59	0.54	216
Maize	0.31	0.46	0.31	0.55	0.7	225.80
Sunflower	0.47	0.6	0.72	0.78	1.19	253.19
Soyabean	0.58	0.71	0.63	0.78	1.23	212
Potatoes	0.2	0.49	0.84	1.04	1.36	680

The number of livestock has deeply decreased in the analyzed period, arriving in 2010 at 31.18% of the cattle from 1989, at 47.09% for cows, buffalo cows and heifers, at 37.82% of pigs, 55.86% of sheep and goats, 63.37% of poultry, 84.94% of the hen eggs and 89.94% for families of bees [7] (Table 4).

Therefore, in 2010 we had only 46.69% of the beef meat, 53.95% of the pigs meat, 46.06% of the mutton and goats and 92.14% of the poultry meat [7] (Table 5).

Table 4. Evolution of livestock during the period 1989-2010 (thousand heads)

Specifi-cation	1989	1995	2000	2005	2010	2010/ 1989 %
Cattle, of wich:	6,416	3,481	3,051	2,862	2,001	31.18
Cows, buffalo cows and heiters	2,758	1,963	1,769	1,812	1,299	47.09
Pigs	14,351	7,758	5,848	6,622	5,428	37.82
Sheep and goats	17,288	11,642	8,679	8,298	9,658	55.86
Poultry, of wich:	127,561	70,157	69,143	86,552	80,844	63.37
Hen eggs	52,498	36,233	38,497	40,725	44,503	84.77
Families of bees	1,418	747	614	886	1,274	89.84

Table 5. Evolution of the animal production during the period 1989-2010 (thousand tonnes live weight)

Specifica-tion	1989	1995	2000	2005	2010	2010/ 1989 %
Meat, of which:						
Beef	439	392	330	383	205	46.69
Pork	1,023	882	670	605	552	53.95
Mutton and goats	216	152	116	114	99,5	46.06
Poultry	484	355	324	401	446	92.14

Prices have evolved from 2001 until 2010 at meat of which: beef from 2.14 Ron at 4.85 Ron, pork from 2.99 Ron to 4.93 Ron, mutton and goat from 3.6 Ron to 5.38 Ron, poultry from 0.33 Ron to 0.54 Ron. At extracted honey prices went to 8.79 Ron from 2.9 Ron in 2001, at bovine milk from 0.39 Ron to 0.94 Ron and at eggs progressed from 0.15 Ron in 2001 at 0.46 Ron in 2010 [6] (Table 6).

Table 6. Evolution of prices for animal production during the period 2001-2010 (Ron/kg)

Specifica-tion	2001	2003	2005	2007	2010	2010/ 2001 %
Meat, of which:						
Beef	2.14	2.39	3.3	2.98	4.85	226.6
Pork	2.99	3.3	4.69	3.55	4.93	164.8
Mutton and goats	3.6	4.74	3.31	3.52	5.38	149.4
Poultry	0.33	0.51	0.36	0.61	0.52	157.5
Extracted honey	2.9	7.48	4.1	4.55	8.79	303.1
Bovine milk(ron/l)	0.39	0.56	0.64	0.75	0.94	241
Eggs (ron / piece)	0.15	0.17	0.22	0.24	0.46	306.6

We have such results due to the low level of mechanization combined with outdated irrigation systems, more than 71% of the total area used is worked at low intensity, spending more than 125 Euros/ha, as opposed to France which spends 336 Euros/ha for fertilizers and pesticides [8].

National Bank chief economist proposed three directions required by 2014 to have an agriculture that would ensure domestic consumption and to strengthen its position in country's GDP:

✓ Emergency Consolidation of farms by re-establishing life annuities, the tax penalties for agricultural land uncultivated and stimulation by all means of the farmers association.

✓ Investment in human capital in rural areas by establishing a program called "sons of villages".

✓ Investment in physical infrastructure from rural areas [4].

Commissioner for Agriculture has completed the directions to be followed by the transparent operation of agricultural markets addressed by the fiscal intelligent so that farmers are not only constraints but also feel the benefits [3].

For doing what is necessary for Romanian agricultural sector, producers need to be united, correct one to each other, and also to have access to reasonable funding.

Financing agriculture can be supported by setting up the credit cooperatives for financing agriculture and rural development [1].

CONCLUSIONS

✓ Area cultivated with wheat, barley, corn, soybeans, potatoes, orchards, nurseries and vineyards bearing fruit decreased during the period analyzed. But there were some small increases in area cultivated with vegetables and raises significant acreage of sunflower and rapeseed due to increased demand of biodiesel.

✓ Even if currently we cultivate only 76% of surface cultivated area with corn then in 1989, we managed to increase production by 33%.

✓ Livestock has been drastically reduced, exception the poultry sector where we have about 80% from what we had.

✓ The necessary measures to be taken will be applicable only through farmers' cooperation, supported by the Romanian state and EU with concrete measures and funds for achievement of cadastre, in order to improve the efficiency of the irrigation system and obtaining loans at interest comparable to other European countries.

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DIVERSITY OF *XIPHINEMA* SPECIES (NEMATODA: DORYLAIMIDA) ASSOCIATED WITH DIFFERENT CROPS IN ROMANIA

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Abstract

Nematodes of the genus Xiphinema (family Longidoridae) are economically important plant pests, some of them known as vectors of nepo-viruses [13]. Accurate identification of Xiphinema spp. is important in regard to their virus transmission capability. Nine species of the genus Xiphinema are reported so far from Romania. New information on the morphology and distribution of several Xiphinema species recovered from different crops and regions of Romania is provided. Soil samples were collected at a depth of 20-40 cm in the rhizosphere of various plants: grapevine, peach, apricot, alfalfa, strawberry. Based on the morphological and morphometrical characters the following species were identified: Xiphinema italiae Meyl, 1953, X. vuittenezi Luc, Lima, Weischer et Flegg, 1964, X. pachtaicum (Tulaganov, 1938) Kirjanova, 1951, X. simile Lamberti, Choleva et Agostinelli, 1983, X. taylori Lamberti, Ciancio, Agostinelli et Coiro, 1992 and X. parasimile Barsi et Lamberti, 2004. Xiphinema parasimile represents a new geographical record.

Key words: *Longidoridae, morphology, new record, diversity.*

INTRODUCTION

Hitherto, nine species of the genus *Xiphinema* have been recorded from Romania [4, 5]: *X. americanum* Cobb, 1913, *X. italiae, X. index* Thorne et Allen*,* 1950, *X. rotundatum* Schuurmans Stekhoven et Teunissen, 1938, and *X. vuittenezi* from grapevine in different regions of the country [7, 8, 9]; *X. brevicolle* Lordello et Da Costa, 1961, was found in association with grape, peach, currant [10] and *X. diversicaudatum* (Micoletzky, 1927), Thorne, 1939 was recorded also from the rhizosphere of strawberry, cherry and plum trees [11], *X. pachtaicum* (Tulaganov, 1938) Kirjanova, and *X. simile* Lamberti, Choleva et Agostinelli, 1983 were found in association with grapevine. According to Romanenko, *X. taylori* occurred in Romania and was erroneously reported as *X. brevicolle* [6]. Three *Xiphinema* species are known as vector of nepo-viruses: *X. index* and *X. italiae* are vectors of Grapevine funleaf virus and *X. diversicaudatum* transmits Arabis mosaic virus [3].

MATERIAL AND METHOD

Soil samples were collected from the rhizosphere of various plants (grapevine, peach, apricot, alfalfa) at a depth of 20-40 cm, from different regions of country: Odobeşti (Vrancea county), Ostrov (Călăraşi county), Adam Clisi, Murfatlar (Constanţa county), Nicoreşti (Galaţi county), Huşi, Bîrlad (Vaslui county), Băneasa (Ilfov county).
Nematodes were extracted from 200 cm^3 soil by a sieving and decanting technique. Nematodes were heat killed at 60°C for two minute and fixed in a 4% formaldehyde solution. The specimens were processed to anhydrous glycerol and mounted on permanent microscopic glass slides [12].
The morphological and morphometrical observations were made using Leica DMLB microscope fitted with Leica FDC 295 camera, Olympus BX41 and Olympus BX51 compound microscopes with DIC.

RESULTS AND DISCUSSIONS

During our investigations the following species were identified: *X. pachtaicum, X. simile*, *X. parasimile*, *X. taylori, X. italiae* and *X. vuittenezi*, from different crops and regions of Romania (Table 1, Fig. 1 and 2).

Table 1. *Xiphinema* species occurring in Romania

Species name	locality	crop	Reference/present study
X. pachtaicum (Tulaganov, 1938) Kirjanova, 1951,	Braila	Fruit trees	Peneva V., Lazarova S., Groza M., 2006
	Nicoreşti	*Vitis vinifera*	Present study
	Murfatlar	*Vitis vinifera*	Peneva V., Lazarova S., Groza M., 2006/ Present study
	Adam Clisi	*Vitis vinifera*	Present study
	Ostrov	*Vitis vinifera*	Present study
X. simile Lamberti, Choleva et Agostinelli, 1983	Valea Călugărească	*Medicago sativa*	Peneva V., Lazarova S., Groza M., 2006
	Huşi	*Vitis vinifera*	Present study
	Băneasa	*Prunus persica*	Present study
X. taylori Lamberti, Ciancio, Agostinelli et Coiro, 1992	Mărăcineni	Fruit trees	Peneva V., Lazarova S., Groza M., 2006
	Satu Mare	strawbery	Present study
Xiphinema italiae Meyl, 1953	Basarabi,	*Vitis vinifera*	Peneva V., Lazarova S., Groza M., 2006
	Murfatlar	*Vitis vinifera*	Peneva V., Lazarova S., Groza M., 2006
	Braila	Fruit trees	Peneva V., Lazarova S., Groza M., 2006
	Bîrlad	*Vitis vinifera*	Present study
	Adam Clisi	*Vitis vinifera*	Present study
X. vuittenezi Luc, Lima, Weischer et Flegg, 1964	Ostrov	*Vitis vinifera*	Present study
	Murfatlar	*Vitis vinifera*	Romaşcu & Zinca ,1977/ Present study
X parasimile Barsi et Lamberti, 2004	Odobeşti	*Vitis vinifera*	
	Băneasa	*Prunus armeniaca*	Present study

Xiphinema pachtaicum was the most widespread and abundant (35 nematodes/ 200 cm^3soil) species found in four localities followed by *Xiphinema simile* (26 nematodes/200 cm^3 soil) found in two localities).

Description. Females: Body slender, C shaped. Labial region 3.5-4 µm high, set-off from the rest of body. Pharyngeal bulb 60-71 µm long and 12-13 µm wide. Reproductive system amphidelphic, symbiotic bacteria present in the ovaries; uteri short (anterior 26-36 µm, posterior uterus 27-31 long, respectively; ovejector weekly developed, 22-23 µm). No sperm cells detected in the uteri or oviduct. Tail conical, dorsally convex, ventrally almost straight, terminus pointed.

Based on morphological and morphometrical characters *Xiphinema parasimile* Barsi et Lamberti, 2004 was identified in soil sample from Odobeşti (*Vitis vinifera*) and Băneasa (*Prunus armeniaca*) (Table 2).

Table 2. Measurements of. *Xiphinema parasimile* (all in micrometres except body length)

Locality Host plant	Odobeşti *Vitis vinifera*	Băneasa *Prunus armeniaca*
n	5	5
L(mm)	1.87±0.07 1.82-1.99	1.78±0.06 1.68-1.9
a	68.0±2.0 65.4-69.9	67.02±6.1 55.8-76.8
b	7.4±0.9 5.9-8.0	6.6±0.42 6.2-7.4
c	66.7±4.7 59.6-71.0	61.5±8.2 54.2-79.1
c'	1.8±0.2 1.6-2.1	1.94±0.1 1.8-2.1
V%	54.1±1.2 52.1-55.4	57.0±1.1 55.5-57.8
Odontostyle	67.8±2.3 64-70	70.4±1.69 67-72
Odontophore	40.8±1.4 39-42	43.2±1.67 40-45
Anterior to guide ring	61.5±2.5 58-64	62.4±1.8 59-64
Tail length	28.2±3.0 26-33	30±1.5 27-32
h	6.8±0.9; 5.5-8	6.4±0.4; 6-7
Width at lip region	8.8±0.2 8.5-9	8.2±0.36 8-9
Width at guide ring	20.4±2.4 19-24	19.8±0.3 19-20
Width at pharyngeal base	23.6±0.6 23-25	23±1.0 22-25
Width at mid-body	27.5±0.6 27-28	25.6±0.9 24-26
Width at anus	15.9±0.4 15-16	15.4±0.4 15-16

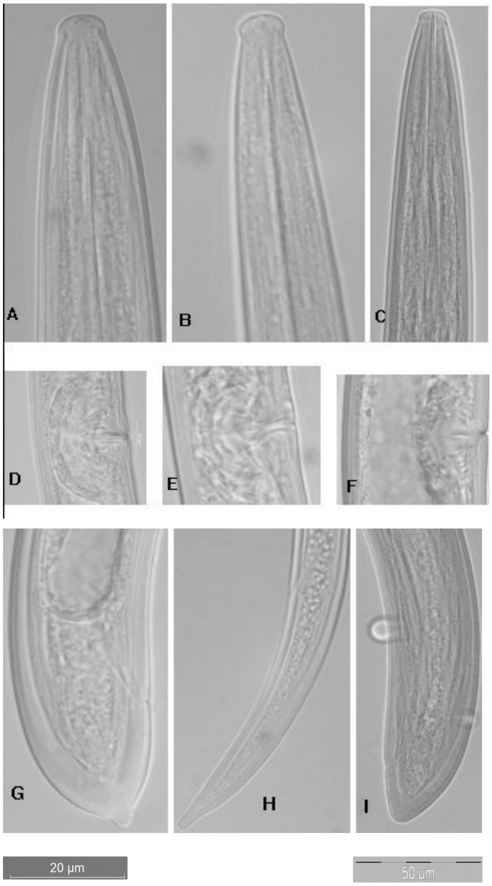

Fig. 1. Anterior end of female: A) *X. vuittenezi*, B) *X. italiae*, C) *X. taylori*; Vaginal region of: D) *X. vuittenez*i, E) *X. italiae*, F) *X. taylori*; Posterior end of female: G) *X. vuittenezi*, H) *X. italiae*, I) *X. taylori.* Scale bar: 20 µm, 50 µm

Remarks. *Xiphinema parasimile* was described from a forest habitat in Serbia and later was found in vineyards in Bulgaria [1, 2]. Morphometrics of Romanian specimens is within the ranges reported for the species in the original description and subsequent record. This is the first finding of this species in Romania.

CONCLUSIONS

Xiphinema parasimile is a new record for Romania.

Six species of *Xiphinema* genus were identified during our investigations.

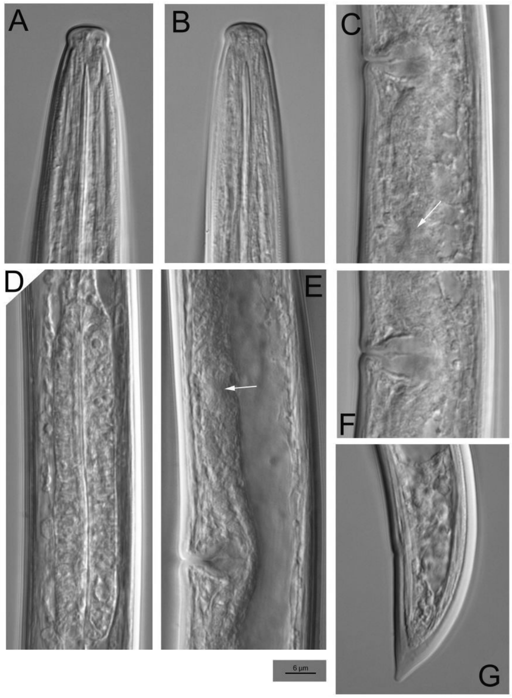

Fig 2**.** *Xiphinema parasimille* Barsi et Lamberti, 2004. Female: A-B, Anterior region; C, Posterior uterus; D, Pharyngeal bulb; E, Part of anterior genital branch, including the uterus, sphincter and *pars dilatata oviductus*; F, Vaginal region; G, Tail; Sphincter marked with arrows. Scale bar: 6 µm

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THE AGRICULTURAL CONSULTANCY SERVICE FROM ROMANIA

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Abstract

The paper is aimed to present the manner in which the agricultural consultancy service has evolved until now and how it operates in Romania. The analyzed material is represented by the legislation in force and the agricultural consultancy services manner of operating. The agricultural consultancy services represent a vital element in the field of agricultural information and technological transfer, providing flows of information which can contribute to the improvement of the living conditions for population from rural area. The consultancy also plays an important part in the transfer of the research results by adapting them to the local agricultural ecological conditions and to the farmers' resources. The reorganization of the agricultural consultancy service occurred following the intention to make it closer to the needs of the farmers and the inclusion, thereof, in the decisional process. The agricultural chambers represent the deliberative body in the promotion of the Romanian and European agricultural policies.

Key words: *agricultural consultancy service, rural area, agriculture, Romania.*

INTRODUCTION

Having a total surface of 238,391 km^2, Romania is the ninth largest state of the European Union from the point of view of its size and the seventh largest state of the European Union considering its population. Of its total area of 23.8 million hectares, the agricultural surface amounts to 14.7 million hectares, i.e. 61.6% of the total surface. The rural population represents 44.9% of the total population, 60.3% of them carrying out agricultural activities, that placing Romania above the average of 5.9% of the EU27 countries. Romania has a great agricultural potential that is given by the favourable climatic and soil conditions, agricultural traditions, but also by the rural population carrying out agricultural activities as well as by the specialists well trained in agriculture.

The village is the starting point of the society and human civilization is the birthplace of culture, where there are stored values and strong traditions which need to be discovered, recovered and preserved.

As shown in many European research projects, in comparison to other EU countries, Romania ranks last or penultimate place at many indicators considering living conditions for the population and rural unfavourable hangs heavy balance in the case of our country (Alber, Jens, Tony, Fahey "Perception of Living Condition in an Enlarged Europe, the Foundation for the Improvement of Living and Working Conditions, Luxembourg, 2004).

However, after 1990, it has been observed the migration of active population from industry and urban to agricultural and rural areas.

In 2009, Romania counted 320 towns, 2860 communes and approximately 12960 villages.

In rural areas, 50.3% of the total employed population works in households, cultivating land or raising animals [4].

The discrepancy between urban and rural areas manifests itself strongly in school instruction and access to vocational training during secondary and higher education period. About 67% of the people living in the villages complete secondary education [5].

The counties with the highest degree of ruralization (excluding the Ilfov County, which surround Bucharest, the capital of Romania) are Dâmboviţa, with 69.96% of the population living in rural areas, followed by Giurgiu, with 69.15%, Teleorman (66.73%), Suceava (66.38%), Bistrita Nasaud (63.88%), etc. On the other side, highly urbanized counties are found: Hunedoara with only 23.04% population living in rural areas, Brasov (25.45%), Constanta

(29.10%), Sibiu (33.46%), Cluj (33.80%), Braila (34.68%), Timis (39.27%), etc.

At national level, the average value of UAA (agricultural used area) in a farm is 3.45 ha. Agricultural holdings without legal personality have an average of 1.95 ha and the holdings with legal personality have 190.84 ha [6].

MATERIAL AND METHOD

The analyzed material is represented by the legislation in force, the agricultural consultancy services manner of operating and system evolution over time. Statistical data to highlight the situation of Romanian agriculture were also analyzed.

RESULTS AND DISCUSSIONS

Why Was Agricultural Consultancy Needed?

After its accession to the European Union, Romania received support for decreasing the differences between the economies of the Member States. In order to absorb and use more wisely the funds granted by the EU, a complex system was developed for allocating financial resources based on European projects for accessing the available funds. Accessing these funds requires the recipient's commitment to follow specific steps and duties in a given period of time, which requires the setting of a goal, an objective analysis of the project, the establishment of the activities within the project, the financial calculations, the predicttion of project results.

The agricultural consultancy service helped farmers by providing support for drawing up projects and the accessing such funds. By Government Resolution no. 676/1998 the set-up, organization and operation of the National Agency for Agricultural Consultancy (ANCA) was decided as well as by law no. 283/2010 the set-up, organization and operation of the chambers for agriculture, forestry and rural development was decided.

The emergence of an agricultural consultancy service was determined by the following farmers' needs: to be aware of the changes in the agricultural field; to acquire the necessary knowledge for performing modern technologies; to ensure the profitability of the activities that they usually carrying out, by actions of training, qualification, and improvement; to have access to the latest technical, technological, economic and legal information, to the information regarding the development of template projects, the drawing up of the documentation related to the implementation and monitoring of the structural funds accessing projects and other domestic and international financing programs; for the transfer of the results from the research field to the farmers and vice versa. Farmers need the agricultural consultancy service in order to obtain information and correct their actions, in order to make progress and to bring new elements in the work that they perform. The consultancy service is necessary for improving the decision-making skills of the farmers and to improve the promotion policy by marketing activities so that production can be exploited efficiently.

Professional training is an essential component of adult education. People are different one from each other, the differences consisting in the knowledge, the skills and abilities they have, and in the relationship between what they say and what they do. For adults, learning is not an issue of knowledge accumulation or supplementation but of reorganization, restructuring or unlearning [1]. Consultancy service contributes to farmers training and knowledge reorganization with courses it organizes and the materials it distributes.

Who Are the Beneficiaries of the Agricultural Consultancy Service?

The beneficiaries of the agricultural consultancy service are: farmers, the rural population engaged in various income-generating rural activities, the foreign investors and the agricultural consultants in training.

The objectives of the agricultural consultancy services are:

- the transition from the subsistence farming stage to the family farm stage with commercial character and the set up of associations, the development of the exploitation, the adaptation and diversification of production in order to increase profit, the accessing of structural funds and other internal and external instruments of financing means;

- the sustainable development by updating marketing and improvement for agricultural and fish products;
- the promotion of organic farming and traditional products;
- the setting up of national and international partnerships by attracting investors in order to identify the investment possibilities and opportunities in the rural area and especially in the agro-food production.

The professional training and continuous improvement of knowledge is an important step in the implementation of the measures established by the Romanian Government in the National Rural Development Program 2007-2013.

Who Provides Agricultural Consultancy Services?

In Romania agricultural consultancy service providers are represented by the Agricultural Chambers, the public service of Ministry of Agriculture and Rural Development (MADR), the scientific research units of the agricultural field, the higher education institutions, the Zonal University Offices for Agricultural Consultancy, the local agricultural consultancy centers, private consultancy companies, private companies which sell inputs, consultancy foundations, farmers organizations and associations.

Agricultural consultancy methods

Consultancy in agriculture can be transmitted by training, information, improvement courses, the setting up of experimental plots, the organization of symposia, seminars, meetings, roundtables, workshops, fairs, exhibitions, competitions and festivals, the distribution of informational materials, films or audio-visual materials, local radio and TV shows, the development of standard projects, the provision of technical assistance.

The professional training of adults entails the practical exposure in a much higher ratio than the theoretical presentation, as sometimes it is necessary to replace the knowledge accumulated over time with new elements - action which can be hampered by the reluctance of the trainees. The increase of the training level helps to improve the work force quality and the decision-making skills of the farmers.

In 2009, the impact of graduation of qualification courses organized by the National Agricultural Consultancy Agency contributed to the accessing of European funds (out of which 3.5% for measure 121- Modernization of Holdings, 13% for measure 112- Establishment of Young Farmers, 26.9% for measure 141- Supporting Semi-subsistence Farms), as well as to the setting up and modernization of the agricultural undertakings (42.2%).

Generally, the requests regarding the granting of specialized consultancy and technical assistance refer to the specific agro-industrial fields: the correct application of production technologies; the identification, accessing and use of inputs; the correct management of the production processes; products' marketing; the performance of the activities in compliance with the specific legislation, the subsidies and facilities granted by the government, the EU regulations, the land register, the agricultural real estate register, the agricultural life income, the milk quotas, etc.

The Organization of the Agricultural Consultancy Activity (1998-2010)

The National Agricultural Consultancy Agency was a specialized institution of the central public administration, with legal capacity, subordinated to the Ministry of Agriculture and Rural Development, financed from the state budget and from its own incomes. As organization at national level, it had as subordinates: the Agricultural Consultancy County Offices (O.J.C.A.), and at local level the Local Agricultural Consultancy Centers (C.L.C.A.) and the Farmer's Houses.

ANCA activity in 2008-2009

According to annual reports from the period 2008 – 2009, ANCA recorded in 2009, 300 training courses more than in 2008, but the number of participants decreased with 5,547 [2]. In a period of two years a total of 135,961 participants attended training courses. The topics of these courses included subjects as: new technologies in the field, legislation, good agricultural and environmental condition (GAEC), insurance and agricultural credit.

The total number of training courses in 2009 had a rate of only 12.5% (of all training courses that took place in those two years), the number of participants represented 32.8%.

For training the trainers, ANCA received the support of the agricultural universities in the country, universities that participated in MAKIS Program supported by World Bank. These courses have prepared 34 groups of students and 399 consultant specialists graduated.

Between January to December 2009, ANCA contributed to the establishment of 32 agricultural cooperatives, 28 associations and 10 groups of manufacturers under the Government Ordinance no 26/2000 [3].

Generally, the requests about the advice and technical assistance were related to the management of production processes, proper application of technology, facility and grants provided by government and EU regulations.

During the two years there were carried out a number of 2,521 demonstration plots on an area of 6,865.38 ha for various crops, and also 449 lots of livestock demonstration, lots that are aimed at popularizing the breeds and lines of animal performance and technology by growth and exploitation of animals.

Several technical and scientific events were organized: 192 fairs, 196 exhibitions, 217 contests, 95 festivals, 530 symposia, 849 seminars, 13,774 meetings, 2,339 roundtables and 2,505 debates.

In addition to the development and free distribution of informative materials by its own publications or specialized newspapers, consultancy service made the subject of 1,046 broadcasts to local and national radios, and 539 TV shows.

All the actions pursued: increasing economic dynamism of rural areas, increasing educational levels, training and employment of residents, and increased adaptability to socio-economic changing, growth rate of innovation using and technology transfer to the production processes, increasing agricultural competitiveness, diversification and its orientation towards new markets.

The Reorganization of the Agricultural Consultancy Service – Agricultural Chambers (in the period after 2010)

The Agricultural Chambers were set up under law no. 283/2010 and are public nonprofit institutions, with legal capacity, and setted up in order to represent, promote and protect the interests in agriculture, zootechny and forestry, with all their branches, as well as to contribute by all means to the increase of all agricultural, zootechnical and forestry fields production. The members of the agricultural chambers, comprising representatives of the farmers, are elected by uninominal vote by all citizens who carry out agricultural activities.

The powers of the Agricultural Chambers are:

- administrative, legal and budget related, according to the legal provisions;
- related to the development of regulatory proposals at regional and national level in their respective business field;
- of a consultation institution, as institutional dialogue partner of the Ministry of Agriculture and Rural Development, as well as of the local and central structures subordinated to, coordinated by or under the authority of the Ministry of Agriculture and Rural Development;
- with approval part and consultative character, at the request of local and county's authorities for projects regarding the land set up and rural space management;
- of professional training, in collaboration with specialized public and private institutions, within the country or from abroad, providing specialized professional training for youth and adults;
- of mediation, as a voluntary way of amicable settlement of disputes;
- of representation and promotion for specific professional and local interests, as well as for general interest of the persons who carry out agricultural and related activities;
- the promotion of good agricultural practices and animal welfare rules;
- the implementation of agricultural policies, according to the powers delegated by state institutions;
- of advice and technical assistance to farmers and those who carry out similar activities in products' manufacturing and marketing activities and in the professional organization;
- of professional training sessions organization.

The financing of the operational technical unit is ensured by its own funds and the resources obtained from the state budget.

Agricultural consultancy provided by other public bodies

There are other public institutions that besides current activities in agriculture give consulting services. Among these there are: universities, research centers, the Agency for Payments and Intervention in Agriculture (APIA), the Paying Agency for Rural Development and Fishing (APDRP), Regional Development Agency (RDA), Local Action Groups (GAL), Agricultural Unites of Rural Development (DARD), ONG (represented by associations, federations and unions of producers). All these institutions contribute to the improvement of the farmers' knowledge informing them, implementing and disseminating the various changes occurring in agriculture and represented farmers' rights in relation with different institutions. The services offered by public institutions are transmitted indiscriminately to the target group.

Private Agricultural consultancy in Romania

Besides public agricultural consulting services farmers can benefit by private agricultural consulting services. Most of them give advice in many areas not just in agriculture. Their number has registered significant growth in recent years as a result of accessing EU programs. Generally companies that ask private consultancy service are large companies that pay a tax for services rendered, but the advantage of buying these services is that private companies deal exclusively with their application and the time for request resolution may be lower. Besides private companies that offer only consulting services, there are private companies such as those that sell inputs, which in addition to marketed products and give information about how to use them. The latter provides these services and only occasionally in order to increase sales without additional charge for technical information.

CONCLUSIONS

Agriculture has a great potential in Romania, determined by its favourable natural resources. Romanian rural economy is dominated by agriculture, and the progress of the rural area leads to the welfare of the inhabitants of both rural and urban area, as well as of farmers.

The agricultural consultancy services contribute to the educational training of the adults from the rural areas by a series of actions such as qualification and improvement courses, the popularization of the European agricultural practices, the dissemination of the Romanian legal provisions, etc.

Agricultural consultancy is an important component of the agricultural policy in Romania, contributing to the modernization and sustainnable development of the rural area.

The role of the agricultural consultancy is to guide and train farmers so that they can take the right decisions and improve their marketing activity in order to have a better capitalization of their production, which will contribute to the increase of their income and the improvement of their living standards.

The main task of the consultant agent is to detect the need for change and to identify ways to achieve it. Change refers to the change of mentality and actual activities of the farmers who must be able to identify the problem they are faced with and find a solution with the support of the consultant.

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SPIKES OF AZURE BLOOM: LAVENDER – HISTORY... AND STORIES

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Abstract

Lavender has often drawn considerable attention both scientifically and artistically. The Mediterranean aromatic plant was known and used since ancient times, as mentioned by Theophrastus, Dioscorides and Pliny the Elder, without making any difference between the species. Later on, Hildegarde von Bingen dedicated an entire chapter to lavender in her work "Materia Medica", distinguishing between Lavandula vera and Lavandula spica for the first time in history. Scientific interest was manifest further on over the centuries until our modern times, as proven by the numerous botany treatises which provide detailed descriptions of the strongly scented plant, highly appreciated in the industry of perfumes, cosmetics and aromatherapy, particularly for its relaxing effect. The numerous varieties are also pleasant to the eye, and their presence in the garden creates full harmony with its delicate beauty, connecting human essence with natural landscape. The pale purple flowers are equally well represented in literature. From William Shakespeare and Stephane Mallarmé to the Romanians Ion Minulescu and Tudor Arghezi, the old metaphor of strong affections and subtle seductiveness blends the magic of nature with simple facts of life. The emotional atmosphere of the meditative stories forges a deep philosophy aiming to recover the self's authenticity and commonsense.

Key words: *aromatic plant, Lavandula angustifolia, perfume, purple, symbol.*

INTRODUCTION

The area of origin for the *Lavandula* species is southern Europe, most specifically the western Mediterranean basin, extending from East to the Dalmatian Coast and Greece (E. Păun, 1985) [17].

Photo 1. *Lavandula angustifolia* Mill. - Distribution in Europe
(Source:http://luirig.altervista.org/flora/taxa/index1.php?scientific-name=lavandula+angustifolia)

In countries like France, Italy, Spain, Greece, North Africa, lavender can be cultivated in fields and gardens, but it also grows spontaneously at altitudes between 700 and 1800m (*Lavandula angustifolia* Mill.). In the same area, *Lavandula latifolia* Vill. can be found at lower altitudes (400-700m) and lavande (*Lavandula hybrida* Reverchon) at altitudes of 600-800m (E. Coiciu and G. Racz, 1962) [4, 17].

The Romans are considered the first to spread this species to the North, to England, a country where lavender has now become a very important plant in any garden [26].

The largest lavender-cultivated areas are found in such countries as France, Bulgaria, Spain and the countries of former Yugoslavia [16].

The numerous varieties are pleasant to the senses, their presence in the natural or human-touched landscape appealing to the eye, touch and smell simultaneously. The feelings of tenderness and sophistication created by the pale purple flowers and their mysterious scent are often remembered in literature, particularly in poetry, as will be seen later from some of the finest examples of universal verse.

MATERIAL AND METHOD

The present paper is primarily based on data collected from scientific literature (among which the invaluable treatises on aromatic and medicinal plants authored by Evdochia Coiciu and Gabriel Rácz, Florentin Crăciun, Ovidiu Bojor and Mircea Alexan, Aurel Ardelean and Gheorghe Mohan and the excellent studies on lavender by Tessa Evelegh, Helen Farmer-Knowles and Maria Lis-Balchin), completed with the excellent studies by the anthropologist Kate Fox, botanist, zoologist and physiologist Ruth Binney, and literary critic Terry Gifford, as well as several representative extracts from poetical writings of internationally renowned persons of letters (William Shakespeare and Stephane Mallarmé), contemporary British poets (Myra Schneider and Isobel Dixon), and prominent Romanian artists (Ion Minulescu and Tudor Arghezi).

Our research approach is mainly descriptive in its scientific section and interpretive in the literary one, aiming to bring solid evidence and argue in favour of the undeniable botanic and aesthetic qualities of the herbaceous plant.

RESULTS AND DISCUSSIONS

History

The name of the genus *Lavandula* L. comes from the Latin word *lavare – to wash,* as the Romans used the plant to perfume their bath water and also for theraupeutic purposes (I. Grinţescu, 1961) [16,17].

The earliest writings mentioning lavender belong to the Greek scholar Theophrastus (370-285 BC), Tim Upson [14]. The plant became an important medicinal species around 77 AD [26] when the Greek physician, pharmacologist and botanist Pedanius Dioscorides (40-90 AD) noted its presence in the Stoechades islands on the Gallic coast. Dioscorides described the laxative and refreshing characteristics of lavender (S. Festing, 1989) [13].

The Roman physician, surgeon and philosopher Galen (129-199 AD) listed lavender among the antidotes used against poisoning and insect bites [13].

Pliny the Elder (23-79 AD) made the distinction between *Lavandula stoechas* and *Lavandula vera* (today known as *Lavandula angustifolia*). In his writings, the Roman naturalist and philosopher advocated the use of lavender to treat sadness and other illnesses [12].

The Arab physician Avicenna (980-1037) showed that “lavender essence acts as a strong narcotic: used sensibly, it decreases sensitiviy, slows reflexes and removes pain”, E. Favre, 2005 [9].

The first reference of the species *Lavandula angustifolia* belongs to the German polymath Hildegarde von Bingen (1098-1179). In her “Materia Medica”, she dedicated an entire chapter to this species, “On *Lavandula*”, in which she rendered the differences between *Lavandula (vera) angustifolia* and *L. spica*. (Fluckiger and Hanbury, 1885, Throop, 1994) quoted by Jo Castle and Maria Lis-Balchin [13], E. Păun, 1988 [17].

Hildegarde wrote that the Romans used lavender oil to remove lice; the method was still in use in Provence in 1874 [7].

In 1837, at the court of Charles VI, the King of France, pillows were filled with lavender, both for fragrance and in the hope of removing insects [12].

Lavender oil was obtained for the first time in the 16th century (H.P. Dörfler şi G. Roselt, 1984) [16].

In the 16th and 17th centuries, lavender became widely known as a medicinal species, being used to treat various illnesses and diseases.

In the 19th century, lavender was included in the “London Pharmacopeia” as an ingredient used for various treatments [7].

E. Păun, 1988, wrote that lavender began to be cultivated after World War I; before that time, countries such as France, Italy, Spain used spontaneously grown lavender for the extraction of volatile oil [17].

The plant has been mentioned as a melliferous species since the 1950s. Thus, Gluhov, 1955, placed lavender among the species that provide very fine honey while Radoev, 1955, showed that the honey production obtained from a hectare of lavender could vary between 116 and 128 kg [4].

The results of the research carried out by E.C. Barbier, 1956, indicated that the lavender plants visited by bees produced a higher amount of volatile oil than the isolated plants [4].

Systematics and description

Lundmark wrote the first monograph of the genus *Lavandula* in 1780. "De Lavandula" mentioned the existence of five species and eight varieties. Later on, in 1826, François de Gingins, Baron of Sarraz, published a second monograph of the genus, in which he described 12 species in terms of morphology, geographic distribution, characteristics and uses. "A Taxonomic Study of the Genus *Lavandula*" (1936) was the third monograph dedicated to the genus by D.A. Chaytor. The book described 28 species and numerous varieties belonging to five sections [13].

In the subsequent years, several researchers displayed interest in the genus. Thus, in 1949 A. Rozeira revised the section *Stoechas*; in 1985, A.G. Miller noted the presence of the species *Lavandula* in Arabia and northeastern Africa; in 1986 and 1989, M. Suarez-Cervera and J.A. Seoane-Camba described five new species within the Iberian Peninsula [13].

The genus *Lavandula* L. includes species of long-lived subshrubs and perennial plants with full or pinnate fidate leaves. The flowers are grouped into spike-shaped inflorescences. The flower consists in: a cylindrical calyx tube with five lobes, the upper lobe presenting a broad apendicle; a bilabiate corolla, blue or violet in colour, which includes the stamens; the ovary whose base presents a nectar disk with four lobes opposing the four ovoid nucules. The stigma lobes are flat, the receptacle is convex in shapes, and the seeds lack an endosperm [20].

Nowadays over 30 lavender species are known, including very many subspecies and varieties. Over the time, the genus *Lavandula* was divided into three sections: *Spica, Stoechas* and *Pterostoechas*. However, the genus has been recently classified into six sections: *Lavandula* (*Spica*), *Dentatae Stoechas*, *Pterostoechas*, *Subnudae şi Chaetostachys* (Table 1) [13].

The most important species are: *Lavandula angustifolia* Mill., *Lavandula hybrida* Reverchon, *Lavandula latifolia* (L. F.) Medik. All belong to the section *Lavandula* and are known as True Lavender, Lavandin and Spike Lavander, respectively.

Table 1. Classification of sections

Section *Lavandula*
1 – *L. angustifolia* Mill.
2 – *L. lanata* Boiss.
3 – *L. latifolia* Medik.
Section *Dentatae*
4 – *L. dentate* L.
Section *Stoechas*
5 – *L. stoechas* Ging.
6 – *L. viridis* L'Hér.
Section *Pterostoechas*
7 – *L. multifida* L.
8 – *L. canariensis* Mill.
9 – *L. pinnata* L.f.
10 – *L. buchii* Webb. and Berthel
11 – *L. minutolii* Bolle
12 – *L. rotundifolia* Benth.
13 – *L. tenuisecta* Coss. ex. Ball
14 – *L. marocanna* Murb.
15 – *L. mairei* Humbert.
16 – *L. antineae* Maire
17 – *L. coronopifolia* Poir.
18 – *L. pubescens* Decne.
19 – *L. citriodora* A. G. Miller
Section *Subnudae*
20 – *L. subnuda* Benth.
21 – *L. macra* Baker
22 – *L. dhofarensis* A. G. Miller
23 – *L. setifera* T. Anderson
24 – *L. nimmoi* Benth.
25 – *L. galgalloensis* A. G. Miller
26 – *L. aristibracteata* A. G. Miller
27 – *L. somaliensis* Chaytor
Section *Chaetostachys*
28 – *L. gibsonii* Grah.
29 – *L. bipinnata* (Roth) Kuntze
Unclassified taxa
30 – *L. basikensis* A. G. Miller
31 – *L. atriplicifolia* Benth.
32 – *L. erythreae* (Chiov.) Cufud.

In Romania, the following species can be found: *Lavandula angustifolia* Mill., *Lavandula hybrida* Reverchon [17].

Lavandula angustifolia Mill. = *Lavandula officinalis* Chaix et. Vill. = *Lavandula vera* D.C. – lavender, French lavender with several varieties, among which the most important are var. *delphinensis* ('petite' or 'fine lavande') and var. *fragrans* ('moyenne lavande'). This species produces high quality oil but requires better climate and soil conditions [16].

Commonly termed 'levănţica', the species also bears other popular names: 'aspic', 'levand', 'livant', 'spichinel'.

The genus *Lavandula* L. includes species of long-lived subshrubs and perennial plants (up to 20-30 years) shaped into globular bushes. The grey-green bushes can reach 30-70 and even up to 100 cm in height [5].

The root system is lignified and can reach 2 m in length.

The young stem is quadrangular and beset with very fine hairs; with age, it becomes lignified, the highly branched structures turn brown and bark exfoliates.
The oppositely disposed leaves are full or pinnate, linear, sharp-pointed, sessile, 2-5 cm in length and 3-5 mm in width (photo 2). The grey colour of the lower leaves results from the ramified hairs present on both sides; the upper leaves are grey-green in colour [5].

Photo 2. *Lavandula angustifolia* Mill. (a–calyx, b–corolla) (Source: Flora of the Popular Republic of Romania, 1961)

The flowers are grouped into spike-shaped inflorescences with 3-8 false verticils and 3-7 labiate, almost sessile, flowers.
The flower consists in: a cylindrical calyx tube with five lobes, the upper lobe presenting a broad apendicle; a bilabiate corolla, blue or violet in colour, which includes the stamens (photo 3 and photo 4); the ovary whose base presents a nectar disk with four lobes opposing the four ovoid nucules [5].
As verticiles are disposed at the base, the inflorescence looks like a long spike (3-7 cm). The flowers have brown membraneous oval bracts; the calyx is cylindrical, hairy and glandular; and the bilabiated membraneous corolla has fine hairs.


Photo 3. *Lavandula angustifolia* Mill. - Flower before the petals emerge (Original)

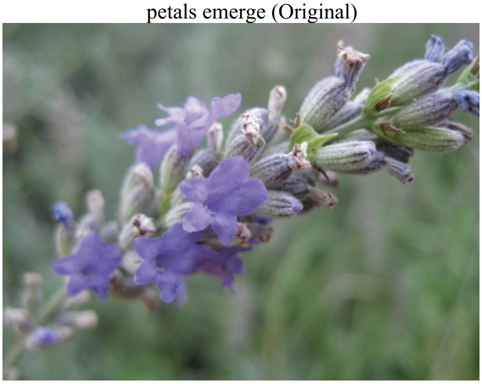
Photo 4. *Lavandula angustifolia* Mill. - Calyx and corolla (Original)

The species generally flowers from June to August. Lavender has a fresh, floral scent as a top note and base note of green grass with a slightly bitter taste.
Lavender produces groups of four ovoid glossy brown nucules as fruit [5].
The flowers harvested from this species (*Lavandulae flos, Lavandulae angustifoliae flos, Flores spicae*) can be used both fresh and dried whereas the lavandin flowers can be used only fresh (*Lavandulae hibridae flos*) [16].
The content in volatile oil can vary between 0.7 and 1.4% in the fresh flowers, and can reach 11.3% in the dried ones [16].
Linalool (either free or esterified) is the main component of the volatile oil extracted from the lavender flowers. However, lavender oil

includes other alcohols (geraniol, nerol, lavandulol, borneol, citronellol, terpinen), free acids, phenols, aldehydes and ketones [16].

Lavender or Lavandin was brought from Bulgaria and was originally used only as ornamental and aromatic species in the gardens around Bucharest [16, 19].

Between 1949 and 1955 the first experiments were initiated in the species (1949 – Evdochia Coiciu tested plant material brought from Bulgaria and grown at Măgurele; 1950 – the first industrial lavender culture was established at Feldioara, 50 hectares of land being cultivated with plant material brought from the U.S.S.R.). After 1955, Tatiana Săveanu initiated research studies on the lavender population variability aiming at creating a local variety at Moara Domnească [4, 17].

In the 1970s and 1980s, industrial growth of lavender expanded. Thus, 420 ha were grown in the 1980s and the outlook for the Nineties included an increase of up to 3,000 ha.

In 1988, E. Păun indicated that lavender culture should be extended especially in southern and southeastern Romania [17].

Since lavender is not extremely demanding for special soil conditions, but requires good light and temperature, it can be used for erosion control and sand fixation purposes [17].

However, in the 1990s, Romanian agriculture underwent a period of fragmentation and reorganization. Consequently, the limitation of the grown areas and the decrease in the crop assortment affected the cultivation of medicinal and aromatic plants.

At present, lavender is grown in southern and southwestern Romania [16].

In Romania, the range of varieties included a Bulgarian variety (Karlovo) for a long period of time; between 1973 and 2006, it added a population known as "Of Moara Domnească" (in Romanian: "De Moara Domnească"). In 1992, researchers also homologated the Codreanca variety; certified as early, frost resistant and rich in volatile oil (1.40-1.48% in fresh flowers), this variety is still present in the Romanian Official Catalogue. The list was recently completed with two new varieties: Emilia (2010) and Hof 90 (2011) [25].

Apart from the scientific aspect, there are other elements that define the importance of lavender: medicinal, for its carminative action in digestive disorders, its slightly antispasmodic effects or as local antiseptic; culinary, in various cake and biscuit recipes and for sugar flavouring; cosmetic, as perfume, soap and bath scent; aromatic, in various potpourri mixtures and scented sachets; decorative, in parks and gardens.

Last but not least, the cultural dimension of the herbaceous plant should not be overlooked for lavender has captured the imagination of many peoples all over the world.

Some stories

The scented flowers, said to have acquired their specific fragrance when the Virgin Mary spread the clothes of the infant Jesus on the bushes to dry, are equally well represented in literature.

Paradoxically, the typically Mediterranean herb has exerted particular fascination to England – a rural country *par excellence*, famous for its traditional lifestyle practices that preserve a 'green' sense of pleasure deriving from the natural world. No wonder that *Lavandula angustifolia* is also known as 'English' or 'true' lavender owing to its top qualities that recommend it as the most valuable of all lavender species.

Highly appreciated for its healing and spiritual value in the times of Queen Elizabeth I, the purple-flowered plant was used to soothe various ailments and protect against evil. Therefore, William Shakespeare could not overlook their distinctive perfume which he praised in 'The Winter's Tale' (1623) [22].

In Act IV, Scene 4, gracious Perdita offers her father's guests strongly perfumed flowers gathered together in what she believed an irresistible alchemy destined to pleasure the senses. Lavender interweaves its charm with other strongly-perfumed herbs, arising like an insignia of innocent femininity appealing to middle-aged men:

"… Here's flowers for you;
Hot lavender, mints, savoury, marjoram;
The marigold, that goes to bed wi' the sun…"
(Shakespeare 1120)

The maiden's homage to the flowers 'of middle summer' creates an atmosphere of ingenuity and affluence that alludes to a utopian landscape. The garden turns into the intimate space of tender closeness where the self could find refuge and protection from distress and regain its true essence – therefore, the invitation is direct and unequivocal: ‘Come, take your flowers’ (Shakespeare 1120).

The invitation is echoed indirectly in the traditional song of the gypsy sellers of lavender on the streets of London [27]. Their unmistakable cry is essentially addressed to the senses, proposing a vision of subtle sophistication – a revised version of sensuality captured in alternating lines consisting of eight and nine syllables:

“*Won’t you buy my sweet blooming lavender,*
Sixteen branches one penny,
Ladies fair make no delay,
I have your lavender fresh today…” (1-4)

The incantation is destined exclusively to a female audience seems to forge a semantic of unrepressed energy: the only reaction response would be a submission to the senses and to promote a hedonistic philosophy of life enjoyment. The metric variations seem to encode different strategies of seduction and continuity, dominated by a basic capitalist doublet: otium/negotium, insidiously involving the negotiated relationship in which eventually one has to give in, for

“Buy it once, you’ll buy it twice,
It makes your clothes smell sweet and nice.
It will scent your pocket handkerchiefs,
Sixteen branches for one penny…” (5-8)

There is a slightly dual symbolism of the flowers: innocent beauty, purity and spiritual devotion and seductive feminine beauty, passion and sexual power. Paradoxically, the ‘sweet and nice’ lavender seems even more attractive in the combinations of decency and sin, virtue and impurity, simplicity and refinement.

Perhaps that is what prompted the French poet Stéphane Mallarmé to detect a malevolent significance in the delicate flowers [14]. To the symbolist poet, the bouquet of wild flowers turns into a devilish gift of deceived affections, quite similar to the as declared in ‘The Seller of Scented Herbs’ (not coincidentally published as one of his ‘Cheap Songs’):

“Your strawy lavender so blue,
never believe that with those bold
eyelashes it may be sold
to me…” (Mallarmé 1-4)

The music of the metric patterns (hepta- and octosyllables), doubled by the mirror symmetry of the arch-rhyme alternating with cross-rhyme, points unequivocally to a blunt strategy of seduction, unrestricted by any sense of guilt or shame. As the explicit image of the ‘bold eyelashes’ alludes to a promise of erotic entertainment, the protagonist meditates on the dual power of the perfumed flowers, commonly related to order, cleanliness and restraint, consistent with the norms and laws of tradition:

“…as to a hypocrite who
would use it as a tapestry
in places most convenient
so that the mocking bowels may be
reborn to true blue sentiment” (Mallarmé 4-8)

Ironically, the mentioning of the ‘mocking bowels’ suspends the conservatism suggested by the ‘true blue sentiment’, liberating the wild streak of human nature. And thus the virtuous becomes vicious, guided by self-indulgence to a world of certainties rather than possibilities:

“Better to set it among these
masses of overwhelming hair
and let the clean wisp perfume there…” (Mallarmé 9-11)

Mallarmé’s sanguine song of illicit passion appears unique in the creative imagination of the world’s poets for the general public perception of *Lavandula Angustifolia* is positive, as proven by the lavender sellers’ subtle song which was further refined by Caryl James Battersby [28].

Towards the end of the 19th century, the lyricist proposed a more elaborated version of the nomadic lines, developed by the English musician Edward German into a popular tune known as ‘Who’ll buy my lavender?’. The direct address to the ‘ladies fair’ remains but the reference to the herbaceous plant occasion yet another doublet: individual/collective, as the personal turns into an ode to national pride:

“Ladies fair, I bring to you
Lavender with spikes of blue;
Sweeter plant was never found
Growing in our English ground.
Who’ll buy my lavender?” (1-5)

The generosity of the flowers renowned for their refreshing effect prompts the desire to extend personal borders to the outside and participate in the collective history of the nation. It is, at the same time, an appeal to transcend personal drives and commit oneself to high ideals of communion, for the seclusion of the domestic space seems to be enlivened by a glimpse of nature brought behind the walls:

"*Lavender shall turn your rooms*
Into gardens full of blooms;
You shall almost hear the bees
Humming drowsy melodies.
Who'll buy? Who'll buy? Who'll buy?
Who'll buy my lavender sweet?
Who'll buy?" (6-12)

The obsessive refrain attempts to create and manipulate an invisible, and yet perceivable, audience: the specific female subjectivity, naturally characterised by tender and protective care-taking. The atmosphere of peaceful home is captured in domestic rituals in which lavender plays its well-established part which dissolves into a tinge of humour:

"Velvet gown and dainty fur
Should be laid in lavender,
For its sweetness drives away
Fretting moths of silver grey.
Who'll buy my lavender?" (13-17)

Escaping desacralization by the curt reference to trivial things that compose ordinary existence, lavender stays true to its destiny and contributes to creating a living space of balance, harmony and comfort – the place that the English anthropologist Kate Fox noted to highlight 'the quiet, unrestrained aspects of Englishness', among which the typical 'predilection for moderation, for domesticity, for the comfortingly tame and familiar' (K. Fox, 2004) [10].

The conclusion arises naturally: the sweet-scented plant is a challenge to permanence. The silent flowers seem to transfer their delicateness and subtleness to their human counterpart, both united in their struggle to escape the implacable passing of time:

"*Ladies fair, I pray that ye*
Like the lavender may be,
And your fame when you are gone,
Still in sweetness linger on.
Who'll buy? Who'll buy? Who'll buy?
Who'll buy my lavender, my sweet lavender?" (18-23)

William Shenstone explored the same attempt to capture a glimpse of eternity in his 1748 poem, 'The School-Mistress' whose lines describe the simplicity and purity of a Shakespeare-resembling collection of aromatic plants [23].

The teacher appears not only as the genuine holder of knowledge and wisdom, but also as the creator of a fantasy green land, in a desire to achieve harmony between the self and the natural surroundings. The private space articulates a story of consensus between the material, the actual botanical characteristics of the garden plants, and the spiritual, their reflection in the character traits of the private person.

For, in the tenderly cared-for garden, 'tufted Basil', 'pun-provoking Tyme', 'Marygold of cheerful hue, 'the lowly Gill, that never dares to climb', 'pungent Radish', 'Marjoram sweet' and 'trim Rosmarine' compete in creating a feeling of commonsense and tranquility that gives the measure of the pure insular self. And *Lavandula*'s bluish spikes arise between all these to complete the image of the personal 'sacred shelter', 'the dantiest garden of the proudest peer':

"Shall be, ere-while, in arid bundles bound
To lurk admist the labours of her loom,
And crown her kerchiefs with mickle rare perfume" (Shenstone 105-108)

The simple presence of the lavender flowers is sufficient to recapture the essence and power of home, the individual place of concrete attachment to time and space. With numerous contemporary women poets, the dwelling place is the mythical place where the self regains its strength and from where affections spring, the place whose quietude and familiarity always secure comfort and plenitude. And lavender is summoned to bring its contribution to self-relocation within a mundane universe.

Myra Schneider provides such an example in *Writing My Way Through Cancer* (2003), an account of her traumatic experience of mastectomy, from diagnosis and surgery to chemotherapy and radiotherapy and, finally, to the early stages of recovery [21]. Each phase of illness becomes the source of profound spiritual transformation as the impaired corporeality gains an almost divinely comforting resonance

through the agency of the lavender scent sprinkled in the bath water:
"*The water was warm, softening my back…, all the tension in my muscles melting like a miracle, the sense of cleansing, the lavender of the bath essence filling my nostrils, an overwhelming sense of release, a blessing – surely a poem there? […] Money couldn't buy such a gift*" (Schneider 32).
The delicate suggestion of typically British rural life makes the direct connection with the life-giving earth and its secrets of divine creation. Individual reintegration into the natural life cycle unchains creativity and the self becomes able to achieve the state of simplicity so as to get in touch with long-ignored elementary feelings, as the anticipated poem turns to form:
"… this pool of bliss can no more
be explained than the song that pours
from a lark as it disappears into
stitchless blue, the seed circles
that cram a sunflower calyx,
day splashing crimsons
and apricot golds across the sky
before it sleeps into the silence
of night, the way love fountains" (Schneider 58:22-30)
Vulnerability is slowly overcome as the self strives to regain vitality from the force of the comforting flowers that confront the bodily desert with a pledge of good health, which helps the self resolve its intimate drama superbly by similitude with the empowering metaphor of the Amazon – the brave one-breasted female exulting in profusion and stamina.
The same attempt of the anguished spirit to recapture its quintessence amidst natural world, thus regaining concordance with both the outside and the inside, is displayed by another contemporary English poet, Isobel Dixon [6]. In 'After Grief', her fictionalized self makes use of the fragrant lavender flowers to relieve the mental gloom generated by her father's death:
"Three drops of lavender in this water
is not balm enough. (Dixon 1-2)
[…]
But I shall have it, scent and life.
I will not bathe in only salt and blood" (Dixon 5-6)
Although the ritual recollecting the Gerardian 'swimming of the braine' (R. Binney, 2006) [3] is acknowledged as insufficient for the instantaneous alleviation of grief, there is still comfort at the thought of temporary suspension, accomplished with the help of the natural agent – a profound and individual way of entering the world and gaining strength from it. A union between the subject and the world seems to be achieved, and this union is shown in an intensely empathetic language.
Romanian poetry also includes the rich imagery of *Lavandula Angustifolia* to create comforting images of delicate affections and plenary emotions. In 'Randuri pentru Mi-Tzu-Ko' ('Lines for Mi-Tzu-Ko'), the symbolist poet Ion Minulescu assigns a new meaning to the strongly fragrant herb which subtly turns into an aphrodisiac: its velvety flowers and sweet perfume propose an exercise in imagination by mentally substituting the exotic female body [15]. The tiny space of personal intimacy appears blessed by the joy of a mutually-shared first love:
"In my room – happy
White
Small
Room
Bearing a lavender scent –
We bend our arms
Like four sunrays..." (Minulescu 3-9)
The tranquility of the individual area identified by the familiar perfume nurtures an impossible leave-taking. The present annuls the attempted rupture in favour of rapture as ecstatic delight is reiterated by the recurrent reference to the enclosed space where the two identities merge with each other in instantaneous disidentification and reidentification:
"Mi-Tzu-Ko, can you not guess
That in my small room
Bearing a lavender scent
What you were yesterday
No longer you are today?" (Minulescu 26-30)
The repeated reference to the sunny room sounds like an incantation that creates a balanced communion in which the self become the perfect complement to the other. Even if transient, happiness is impossible to measure, either materially or mentally, as it belongs to

natural, incomprehensible laws, accentuated by the two lovers' unrestricted communion:

"Can you not see that God
Has sent us a rainbow
So that our new being –
Divided until yesterday –
Can become one in the sun (Minulescu 31-35)
[...]
As though my happy
White
Small
Room
Bearing a lavender scent –
Would be still your room as well?" (Minulescu 40-45)

A few decades later, Tudor Arghezi voices the same intense abandonment in 'Morgenstimmung' [2]. Touched by the flamboyance and ardour of a song whose imagination assigns fatal passion, the poet celebrates love arising from high appreciation and reverential wonder:

"You slipped your song into myself
One afternoon, when
The safely locked-up window of my soul
Was opened in the wind
And I was unaware that I heard your song" (Arghezi 1-5)

The mysterious song allows oblique confessions of the self that simultaneously discovers itself by externalizing to the other:

"*Your song was filling the whole building,*
The drawers, boxes, and the carpets, too,
As sonorous lavender. Look,
All my bolts had broken loose
And my monastery was left unlocked" (Arghezi 6-10)

The harmonious tune dissolves the entire system of the fortuitous listener who turns into a dramatic recipient of a great change translated as present incompleteness. At the same time, it is a challenge to fill in the empty space by restoring the balance of his personal microcosm by raising metaphysical questions and dilemmas destined to find the concealed meaning of an apparently ordinary occurrence:

"*Why did you play? Why did I hear you? (Arghezi 21)*
[...]
I was coming from above, you were coming from below.
You were coming from the living, I was coming from the dead" (Arghezi 24-25)

As seen from above, in the realm of literature, particularly in poetry, lavender generates highly personal sensual and sensuous responses. The extent of the ultimately subjective reactions depend upon the dimension and nature of the individual character, ranging from refined sensorial perception activating a special form of intellectualism to sheer sexuality following the normal course of instincts.

CONCLUSIONS

Whenever someone says the word 'lavender', their thoughts certainly fly towards fields varying from blue to purple – always a gratifying encounter since the colour and scent of the narrow-leaved aromatic herb stimulate the sense of beauty and measure springing from both its curative and spiritual qualities.

An old metaphor of strong affections and subtle seductiveness, *Lavandula Angustifolia* blends the magic of nature with simple facts of life in an ambiguous fusion of strength and fragility, sensuality and ingenuity, sophistication and simplicity. As medicine, perfume or cosmetics, the healing and aesthetic qualities of the lavender types promote the need to return to an unspoiled natural identity connected with, and committed to, the environment and thus to re-create a utopian Golden Age governed by 'peace, decency and order' (T. Gifford, 1995) [11].

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CHANGES IN THE STRUCTURE OF *PLATANUS* SP. AND *TILIA* SP. SPECIES INDUCED BY POLLUTION

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Abstract

Motor vehicles produce carbon monoxide (CO), hydrocarbons (unburned, partially burned, cracked), nitrogen oxides and sulfur compounds. The largest amount of CO is produced by motor vehicles. Due to the addition of tetraethyl lead in gasoline, the lead is eliminated with the exhaust gases, which are deposited on plants and soil (pollution). Although the organism's behaviour to pollution depends on many factors such as health, sex, etc. [4], we have proposed in this paper to highlight a small part of the structural transformation in Platanus sp. and Tilia sp. petioles and leaves induced by pollution caused by motor vehicles. Thus, we have discovered a tissue reduction in the organs harvested from the polluted area compared with those collected from the unpolluted area.

Key words: *leaves, petioles, pollution.*

INTRODUCTION

Following human activity, in the atmosphere is eliminated over 200 chemical compounds, including SO_2, NO, NO_2, CO, acid vapors, phenols, particles of ash, dust, soot, oxides containing toxic heavy metals etc.

The problem of environmental protection requires a deep study of the influence of different types of pollution on living organisms. By biochemical reactions, plants incorporate, metabolize and partially detoxify pollutants, thereby helping to reduce the risk posed by environmental pollution.

They appropriately respond to adverse actions, and physiological and biochemical processes are perfectly coordinated with the ambient factors.

In the vegetable organism pollutants generate stress, which consists in modifying of growth and development, photosynthesis, respiration, hormonal activity and other processes regulated at the molecular level [4].

The existence of living organisms in adverse environmental conditions is determined by the capacity for adaptation and resistance [4].

MATERIAL AND METHOD

For the anatomical study we used fresh material (leaf, petiole) from *Platanus hispanica* Miller ex Muench. [2] and *Tilia platyphyllos* Scop. (bigleaf linden) [2] harvested from two areas: a polluted (Crângaşi district) and other less polluted (Youth Park, district Youth, Bucharest).

Numerous cross sections [1] were made through leaves and petioles collected from both the less polluted and polluted area.

Numerous micrometer measurements [1] were made to leaves and petioles tissue with a microscope ML-4M IOR found in the laboratory of Botany, USAMV Bucharest.

The photos were taken with the digital camera Panasonic Lumix DMC - LS60 (6MPX, 3X optical zoom).

RESULTS AND DISCUSSIONS

Results of the anatomical structure of petioles and leaves of the species *Platanus hispanica* Miller ex Muench. [2], harvested from the less polluted area (Youth Park, district Youth, Bucharest) and the polluted area (Crângași district)

In the polluted area, *Platanus hispanica* species, during May-June 2011, do not present leaves on all branches, being observed spots, burns etc., possibly due to heavy traffic of motor vehicles.

The dimensions of the tissues from petioles structure harvested from the less polluted area (Youth Park, district Youth, Bucharest) and the polluted area (Crângași district) are shown in Fig. 1.

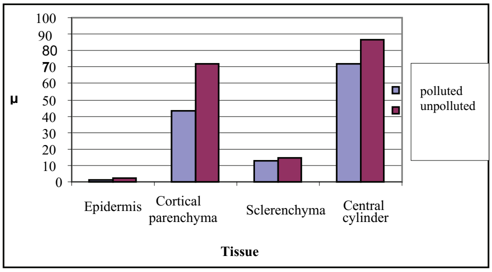

Fig. 1. Dimensions of the various tissues from the petioles structure in the two areas studied

All the tissues measurements (Fig. 2) belonging harvested petioles from the polluted area recorded slower growth, especially epidermis and cortical parenchyma, followed by the central cylinder [3].

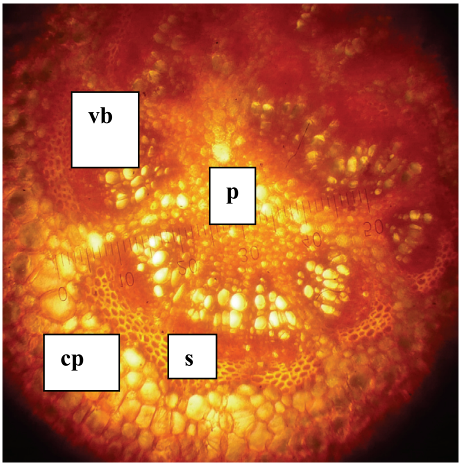

Fig. 2. Cross section through the petiole:
cp - cortical parenchyma, s - sclerenchyma,
vb – vascular bundles, p - pith.

The measurements of tissues (Fig. 3) belonging to leaves harvested from the polluted area showed reductions in their size.

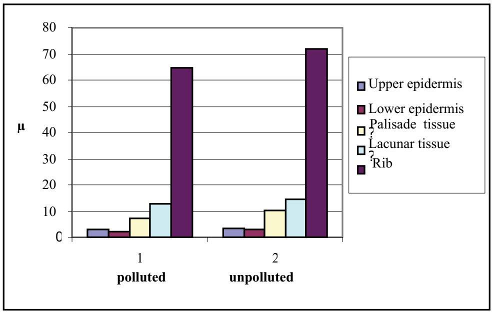

Fig. 3. Dimensions of various tissues from the leaf structure in the two areas studied

The lacunar tissue [3] of the leaves taken from polluted area has fewer cell layers compared with the same type of tissue examined in the leaves collected from less polluted area (Fig. 4).

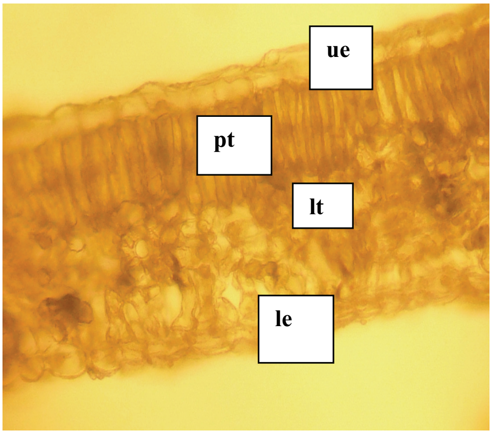

Fig. 4. Cross section through the leaf:
ue – upper epidermis, pt – palisade tissue,
lt – lacunar tissue, le – lower epidermis.

Significant differences were found mainly in palisade tissues and ribs [3].

Results of the anatomical structure of petioles and leaves of the species *Tilia platyphyllos* Scop. (bigleaf linden) [2], harvested from the less polluted area (Youth Park, district Youth, Bucharest) and the polluted area (Crângași district)

In the polluted area *Tilia platyphyllos* species, during May-June 2011, do not present leaves on all branches, being observed spots, burns, etc., possibly due to heavy traffic of motor vehicles.

The dimensions of the tissues from petioles structure harvested from the less polluted area (Youth Park, district Youth, Bucharest) and the polluted area (Crângaşi district) are shown in Fig. 5.

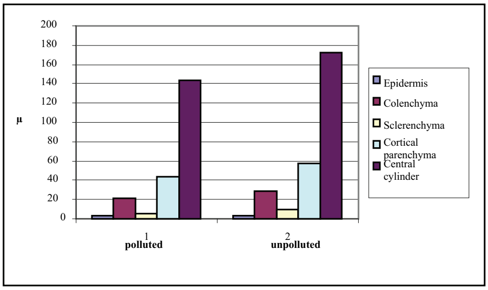

Fig. 5. Dimensions of various tissues from the petioles structure in the two areas studied

All the tissues measurements (Fig. 6) belonging harvested petioles from the polluted area recorded slower growth, especially colenchyma and the central cylinder [3].

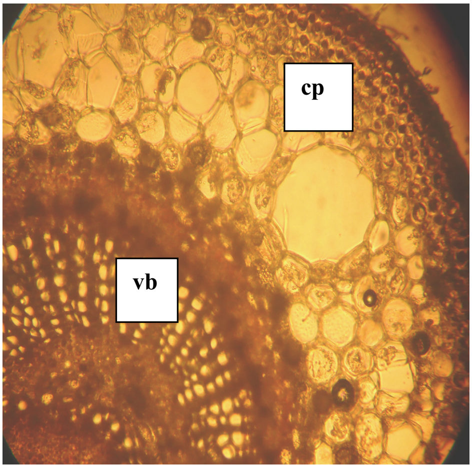

Fig. 6. Cross section through the petiole:
cp - cortical parenchyma,
vb – vascular bundles.

The measurements of tissues (Fig. 7) belonging to leaves harvested from the polluted area recorded reductions in their size.

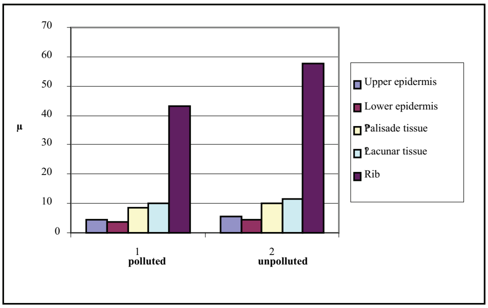

Fig. 7. Dimensions of various tissues from the leaf structure in the two areas studied

The lacunar tissue [3] of the leaves taken from polluted area has fewer cell layers compared with the same type of tissue examined in the leaves collected from less polluted area (Fig. 8).

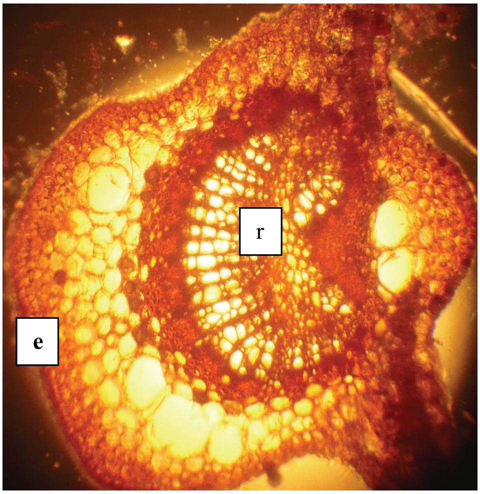

Fig. 8. Cross section through the leaf:
e – epidermis; r – rib.

Significant differences were found mainly in palisade tissue and ribs [3].

CONCLUSIONS

All the tissues measurements from the petiole structure belonging to *Platanus hispanica* species - the polluted area, recorded slower growth compared with the petiole tissues harvested from less polluted area.
Significant differences were found in cortical parenchyma, central cylinder and epidermis.
Leaves harvested from the polluted area present less developed tissue; lacunar tissue is being

formed from a smaller number of cell layers compared with the same type of tissue analyzed in the leaves collected from less polluted area.

Significant differences were also found in the structure of petioles belonging to *Tilia platyphyllos* species (especially in the central cylinder) but also in the leaves.

Colenchyma and central cylinder from the petiole structure recorded large differences.

Palisade tissue (assimilation) and ribs recorded slower growth to the leaves harvested from polluted area.

Carbon monoxide and not only being deposited on plants lead to changes in their structure, and consequently affecting the physiological processes.

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MODEL AND SUPPORT SYSTEM PROTOTYPE FOR SCHEDULING THE BEEHIVE EMPLACEMENT TO AGRICULTURAL AND FOREST MELLIFEROUS RESOURCES

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Abstract

The paper presents a model and a support system prototype for scheduling in time and space the beehive emplacement to different melliferous crops and different melliferous tree species. A general model specifies the data structures (inputs / outputs), the data processing for obtaining the beehive movement schedules, and different melliferous balances at territorial levels, based on the melliferous capability of the commune crops and forest bodies and the number of the existing beehives at commune level. The algorithm of the beehive movement schedules aims at the minimisation of the movement distances taking into consideration a large territory of the country. A reduced version of the scheduling model was implemented into a computerised support system prototype, "PaSPas-1.1". It refers to rapeseed crops and to robinia trees, and provides beehive movement schedules at commune level and forest body level, respectively, localised within eight districts ("judets") of South Romania.

Key words: *agricultural melliferous resources, forest melliferous resources, pastoral beekeeping planning, pastoral beekeeping planning model, planning support system.*

INTRODUCTION

In order to be sustainable and competitive, the beekeeping has to be “pastoral”. That means that the beekeepers move their beehives, beginning with the spring start and till the summer end, to different places of melliferous resources, correspondingly to their flowering, in order to have a continuous honey gathering at the maximum intensity.
This activity could be carried out only by an appropriate planning, based on the data regarding the melliferous resource locations, access resource distances, resource melliferous capacities (potential), resource flowering period, as well as based on the honey gathering needs for beehives in conditions of profitableness [3].
This paper presents a general model for scheduling in time and space the beehive emplacement to different melliferous crops and different melliferous tree species, and a prototype of a computerised planning support system (“PaSPas-1.1”), which implements a reduced version of the scheduling model (rapeseed and robinia tree resources from eight districts of South Romania). The prototype has however the main necessary functions.
Such a system is useful to the beekeepers’ associations for planning the efficient common use of the available melliferous resources within a large territory (one or more regions of the country).

MATERIAL AND METHOD

A first level analysis of the pastoral beekeeping activity (problem) was carried out and the type of the planning (scheduling) model and its requirements for functioning and computer implementation were established. A more detailed analysis of the information and objectives implied in the pastoral beekeeping planning led to the elaboration of the planning model (algorithms).

The main part of the model was implemented in a computerised planning support system (computer program), which was tested with real data concerning the existing bee-families, rapeseed crops and forest bodies of robinia trees located within the region of S-SE Muntenia (South of Romania), comprising eight districts: Calarasi (CL), Ialomita (IL), Ilfov (IF), Giurgiu (GR), Teleorman (TR), Olt (OT), Dolj (DJ), and Valcea (VL).

RESULTS AND DISCUSSIONS

1. On the problem of pastoral beekeeping planning

The pastoral beekeeping planning aims at scheduling the emplacement of a number of beehives corresponding to the melliferous potential of each melliferous resource (agricultural crop or tree species), having different objectives: all beehives to have enough melliferous resources for both their own food and for maximum possible trading honey, not to remain unutilized melliferous resources, minimizing the beehive transport costs, that is minimizing the moving distances and others [3].

Many characteristics of the problem of pastoral beekeeping planning [1, 2, 3, 6, 7] determine it to be considered a *"poorly-structured" problem* [4, 5]:

- *Data uncertainty:* fuzzy nature of spatial /geographical delineation of melliferous resources areas, fuzzy nature of biologic processes concerning the melliferous resources and beekeeping, qualitative /statistical nature of the parameters on melliferous resources and beekeeping, human errors in the data collecting, communication and storing, incomplete and unavailable data, data of different qualities and structures (obtained with different methodologies/definitions) etc.;
- *Knowledge uncertainty:* incomplete knowledge about the processes of land - plant - atmosphere - bee relation, uncertainty in establishing the right representative indicators for factors; qualitative knowledge; approximate methods/models for evaluation and decision (qualitative, statistical, heuristic, or deterministic with uncertain parameters and approximate submodels), etc.;
- *Uncertainty related to the management process:* decision-maker's subjectivism, uncertainty in establishing the evaluation criteria, errors in choosing and applying the models, delays in data availability, errors/delays in applying the decisions, etc.;
- *Problem complexity:* multi-criteria character of decisions, the great number and complexity of processes, state variables and inter-relations implied in the land - plant – atmosphere - bee system (e.g. factors/processes determining the flowering period of crops and trees, meteorological factor influence on nectar gathering etc.), risky/unknown phenomena, spatial variability of the melliferous resources characteristics, local knowledge necessity etc.

The problem analysis, including the above considerations, led to establishing some general requirements for a pastoral beekeeping planning system:

(i) In order that the system to be easily used by users, there are necessary:

- reduced requirements regarding input data to be provided by the user to the system, that is the input data to be available and easily to be obtained;
- reduced requirements on user knowledge needed to system use;
- simple user-system interface.

(ii) As a result of the "poorly-structured" character of the problem, the approach of the computerised implementation of a pastoral beekeeping planning system is necessary to be that of a "decision support system" type, respectively based on a strong interactivity with the user, which has to be included within the decision process. It is not advisable to have a completely automatic system that accomplishes the entire decision-making process [4, 5].

Consequently, the system has to be implemented as an open system, ensuring easiness in its development during its life, that is the system development has to be adaptive-evolving ("prototype" method):

- The prototype is a first variant of the requested system, which has its essential characteristics, at least in an incipient way. It is more rapidly and economically built, but in such a way to be easily modified.
- Then, step by step, the prototype is extended with new functions and improved during its utilization, as it is evaluated by users in real conditions.

The method is useful because of initial uncertainty on system detailed requirements. During its development, the system is adapted and personalised.

2. General model for pastoral beekeeping planning

Main input data

(i) *Production and gathering indices for each melliferous source type* (crop /tree-species):

- Honey Production Index (PI): the potentially gatherable honey quantity during a crop/tree-species flowering season (kg/ha);
- Honey Gathering Index (GI): the total honey quantity gathered by a bee-family (BF) during a crop/tree-species flowering season (kg/BF);
- Own Food Honey Gathering Index (OGI): the honey quantity gathered by a bee-family, that is used for its own food, during a crop/tree-species flowering season (kg/BF);
- Swarm Food Honey Gathering Index (SGI): the honey quantity gathered by a bee-family, that is used for its swarm food, during a crop/tree-species flowering season (kg/BF);
- Trading Honey Gathering Index (TGI): the honey quantity gathered by a bee-family during a crop/tree-species flowering season, that is collected for trading (kg/BF); TGI = GI - OGI - SGI.

(ii) *Input data for each "commune"* (basic administrative unit: commune /town /city): name, district ("judet"), absolute geographic coordinates X and Y of the commune centre/median, number of the existing bee-families, areas of the main melliferous crops (yearly updated).

(iii) *Input data for each forest-body*: name, district, forest direction, forest district, forest production unit, absolute geographic coordinates X and Y of the forest-body centre/median, number of the existing bee-families, areas of the main melliferous tree-species.

Data processing

(i) *Need and Availability of Melliferous Resources:*

- Trading and Total Honey quantities needed to be gathered, from each melliferous resource (crops/communes, tree-species/forest-bodies), for the existing bee-families at different levels (commune /district /country region); They are calculated based on honey gathering indices and the number of existing bee-families;
- Areas of each melliferous resource (crops/communes, tree-species/forest-bodies) needed for the existing bee-families at different levels (commune /district /country region); They are calculated based on honey production indices and the number of existing bee-families; It is considered that the bees gather 75% of the total potentially gatherable honey quantity during a crop/tree flowering season;
- Potentially gatherable Trading and Total Honey quantities from the existing melliferous resources (crops/communes, tree-species/forest-bodies) at different levels (commune /district /country region); They are calculated based on honey production indices and the areas of existing melliferous resources; It is considered that the bees gather 75% of the total potentially gatherable honey quantity during a crop/tree flowering season;
- Number of bee-families for which the necessary melliferous resources of each type (crops, tree-species) exist at different levels (commune /district /country region); They are calculated based on honey gathering indices and the total potentially gatherable honey quantities from the existing melliferous resources (crops/communes, tree-species/forest-bodies);

(ii) *Beehive emplacement scheduling to a given melliferous source type* (crop /tree-species):

- Location of the bee-families at the commune or forest-body level before their moving to the melliferous resources of the given type; For each commune and each forest-body, the number of bee-families from each home-commune, that are located within them, is specified; The locations result from the preceding emplacement, and for the first season they result from commune's input data (bee-family home-communes); The user may update the locations, according to the actual emplacement (in the case of the modifications of the schedules);
- Movement of the bee-families to the melliferous resources of the given type; For each commune and each forest-body, it is determined the number of bee-families from each home-commune, that are located within them, planned to be moved, if necessary, to an appropriate destination commune/forest-body having available resource; The moving distance is calculated, too; The melliferous resource are allocated in the increasing order of the sum of two distances: (1) the distance between the current location of the bee-families of a home-commune and the destination location, and (2) the distance between the destination location and the home-commune; In this way, it is aiming at minimising the moving distances without going too far away from the home-commune; The distances used in the scheduling algorithm are approximated by the distances "in air right line" between the centres/medians of the locations (communes /forest-bodies), calculated based on their X / Y coordinates;
- Location of the bee-families at the commune or forest-body level after their moving to the scheduled melliferous resources of the given type; For each commune and each forest-body, the number of bee-families from each home-commune, that are located within them after the movement, is specified;

(iii) *Melliferous parameters and balances at different levels* (commune /district /country region) *on different melliferous source types* (crop /tree-species):

- Surplus/deficit of the potentially gatherable trading and total honey quantities from the existing melliferous resources related to the number of the existing bee-families;
- Surplus/deficit of the number of the existing bee-families related to the potentially gatherable total honey quantities from the existing melliferous resources;
- The number of the existing bee-families scheduled to be moved to different existing melliferous resources;
- The potentially gatherable trading and total honey quantities planned to be obtained by the pastoral beekeeping from the existing bee-families.

(iv) *Other developments of the model:*

- Design and implementation of a GIS (geographical information system) version of the planning support system, containing the spatial layers of communes and forest-bodies, and the calculation of the distances used in the scheduling algorithm by applying the appropriate GIS function on the road layer;
- Design and implementation of a beekeeper database and the aggregation of some necessary data from that database;
- Obtaining different melliferous parameters and balances at the beekeeper level, too.

3 Support system prototype for pastoral beekeeping planning

A support system prototype for pastoral beekeeping planning (PaSPas-1.1) was developed, which implements the planning for rapeseed crops and forest bodies of robinia trees located within the region of S-SE Muntenia.

The system prototype is structured in three subsystems: database, model and data processing subsystem and user interface. The data on 623 communes (communes /towns /cities) and 1494 forest-bodies are loaded in the system prototype database. The commune and forest-body centre/median coordinates were established by using the appropriate function of a commune GIS of Romania and, respectively of a forest resource GIS of South Romania.

The output window with beehive movement schedules to rapeseed crops of the PaSPas 1.1 system is showed in the Fig. 1.

In the left-top table of the window, there are showed the commune input data: district-code_commune-name (Com), commune

coordinates (ComX, ComY), number of the existing bee-families (NFExC) etc.
In the right-top table of the window, there are showed the location of the bee-families before beehive moving: the number of the existing bee-families (FamEx), their home (origin)-commune (OrigCom) etc.;

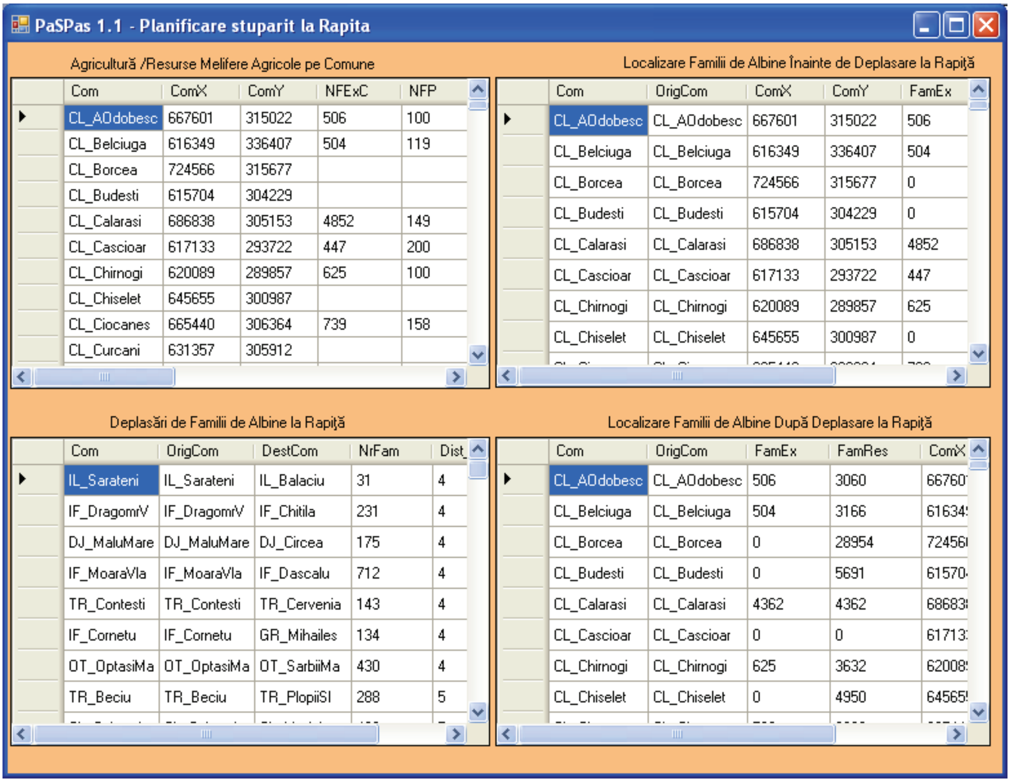

Fig. 1. PaSPas 1.1 – Output window for Rapeseed (Beehive movement Schedules to Rapeseed crops)

The data (bee-family location) may be modified, if necessary; because the rapeseed crop flowering is the first gathering season, “Com” is just “OrigCom”.
In the left-bottom table of the window, there are showed the beehive moving scheduled for the rapeseed crops. For example, in the first table row 31 bee-families (NrFam), originated in Sarateni_Ialomita (OrigCom) are scheduled to be moved four km (Dist) from the present location, Sarateni_Ialomita (Com), to the destination location, Balaciu_Ialomita (DestCom).
In the right-bottom table of the window, there are showed the location of the bee-families after the scheduled beehive moving. For example, within the city of Calarasi, initially having 4852 existing bee-families (FamEx in the right-top table), and after the scheduled beehive moving left 4362 bee-families (FamEx in the right-bottom table), because the rapeseed crop area in Calarasi is enough only for 4362 bee-families (FamRes in the right-bottom table). That bee-family location may be modified according to the field situation (if the beehive did not move according to the schedule) and become the input location for the next season scheduling (e.g. robinia-tree).

CONCLUSIONS

The beekeepers’ associations need a computerised pastoral beekeeping planning support system for scheduling the efficient common use of the available melliferous resources within a large region of country.

The main characteristics of the pastoral beekeeping planning problem (uncertainties concerning the data, knowledge and management, multi-criteria character of decisions, problem overall complexity et al.) determine it to be considered a "poorly-structured" problem.

Consequently, some requirements for a pastoral beekeeping planning system are needed: reduced requirements regarding the input data (available and easily to be obtained) and the user knowledge needed to system use; the system implementation approach is necessary to be that of a "decision support system" type, respectively based on a strong interactivity with the user, which has to be included within the decision process.

The pastoral beekeeping planning model elaborated corresponds to these requirements, ensuring an optimal allocation, in each gathering season, of the necessary melliferous resources for the existing bee-families, in the conditions of minimising the beehive moving distances.

The planning model could be improved primarily by the elaboration of a GIS-based version, comprising the spatial layers of communes and forest-bodies, and the calculation of the distances used in the scheduling algorithm by applying the appropriate GIS function on the road layer.

It is advantageously that a pastoral beekeeping planning support system to be implemented as an open system, by using the "prototype" method (adaptive-evolving development and implementation of the system): the prototype is a first variant of the requested system, which has its essential characteristics, at least in an incipient way; it is more rapidly and economically built, but in such a way to be easily modified; then, step by step, the prototype is extended with new functions and improved during its utilization, as it is evaluated by users in real conditions.

The method is useful because of initial uncertainties on system detailed requirements.

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