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FACULTY OF AGRICULTURE

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CONTENTS

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FUNCTIONAL - GENETIC PROFILES, CONCEPTUAL CONSIDERATIONS

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Keywords: *pedogenesis, pedogenetic profiles, functional-genetic profiles*

Abstract

In the development of the morpho functionality concept of the soil it is presented the idea about functional-genetic profile which can be defined as integrated produce of the interaction between pedogenetic regimes. The last one has the most decisive importance in migration – accumulation and substances differentiation in pedogenesis.

INTRODUCTION

According to current conceptions, pedogenesis consists of several particular processes which are more or less interrelated and supposed to be special profiles of substances differentiation. Within these profiles, the horizons of substances distribution not always coincide with genetic horizons.

The main factors that determine forming of soil profiles, in the meaning of differentiation of parent material into genetic horizons are, primarily, the vertical currents of substance and energy (descendent or ascendant - depending of the type of pedogenesis and the seasonal, annual or multiannual dynamic) and, secondly, the vertical distribution of vivid substance (root system of plants, the microorganisms, the soil fauna).

The structure of soil profile, or the character and consecutiveness of genetic horizons, are specific for every soil type. In the genetic profiles, the genetic horizons are in interaction, and therefore interrelated. This involves the idea of intern pedogenetic ambiance, being materialized into functional - genetic profiles.

MATERIAL AND METHODS

Conceptual - methodological framework is based on the concept about structural - functional hierarchy of the soil and on the hierarchy of pedogenetic process [1].

The soil, in terms of functional-genetic concept, appears as system of genetic horizons and functional-genetic profiles. Furthermore, within the profile there is distinguished two contours:

a) external materialized in vertical differentiation of substances and is represented by succession of genetic horizons;
b) internal materialized in vertical differentiation of pedogenetic ambiance.

Functional-genetic profiles denote the trend of evolution of pedogenetic process and the share\quantum of some elementary processes during the profile.

Functional-genetic profiles involve one pedogenetic ambiance with different ranks and degrees of activity and mobility of soil substances (organic, organic – mineral, and mineral), but in the same time different forms of soil substances organization.

In terms of structural – functional concept of hierarchy of every hierarchical level it define one functional – genetic type of profile (look in the next table).

Hierarchical level	Functional – genetic profile
Ionic – molecular	Profile of salts Profile of carbonates
Elementary particle	Profile of granulometry
Aggregate	profile of pedoaggregates
Horizont	Profile of settlement indices: a) lacunar b) of density

Within the functional-genetic profiles there are distinguished functional-genetic horizons which are defined as particular junctions of geochemical barriers.

Profile of carbonates is integrated result of eluviation, migration - accumulation and illuviation of carbonates. Therefore within it are distinguished three horizons: carbonates - eluvial, carbonates- migrational and carbonates - illuvial. According to the relations between this horizons, it distinguishes several types of carbonate profiles:

1. Batieluvial - carbonates are leachate from pedogenetic active layer. Within this carbonate profiles the balance of alkaline and alkaline - terros cations in the upper segment is negative and this balance implies low decalcification of soil adsorbtion complex. In the same time the decalcification is followed by eluviation processes of nonsilicate forms of Fe and Al, as well as of the argil.
2. Eluvial - carbonates are accumulated below the lower limit of humus horizon. Within it, the balance of alkaline and alkaline – terros cations is lightly unbalanced. The debasification processes of adsorbtion complex, and the mobilization – eluviation processes of colloids are in early stages.
3. Mezoeluvial - carbonates are eluviated from humus- accumulative horizon (A), but they are detected in the humus – cambic horizon (B). The balance of alkaline and alkaline - terros cations is well- balanced. Here are not found some signs which talk about the beginning of texture differentiation.

4. Normal - carbonates are eluviated from humus- accumulative horizon (A) and are detected in humus – transitive.
5. Incipient - eluvial, here the carbonates are detected in humus – accumulative horizon (A). Their dynamics is determined by hydrothermal conditions. At the pedological scale of the time, the balance of carbonates is easily negative.

The batieluvial and eluvial profiles has unidirectional character on carbonates eluviation, and on textural differentiation of the profile. The eluvial - moderate profile implies partial restoration of carbonates balance, and stability of humus layer. The normal and incipient - eluvial profiles favors one progressive accumulation of the humus in the upper layer.

The soils with batieluvial/eluvial profiles of carbonates, are characterized with extended humus layer (izohumic soils). The soils with normal and incipient - eluvial profiles are characterized with moderate-thick humus layer.

Pedogenesis, unlike geogenesis, implies the humus accumulation, so the organic profile appears as integrated index of pedogenesis at the elementary level particle. The term of organic profile started to be important in pedologic researches in the second half of last century [1, 2] and involves broader categories than the term of the humus profile. In this respect, this term refers to all humus substances of the soil including all mineral components of humic substances. Therefore the organic profile can be defined as conexial succession of some homogeneous areas (sections) of soil. Each of this areas are characterized with specific intensity of flux and reflux processes and transmission (mineralization and humification) of organic substances in pedogenesis [3, 4, 5, 6]. Дерчачева М.И. divided the organic profile of chernozems in two zones:

1) Superior (about 20 cm) within it predominates humification processes.
2) Inferior, during the general process of humification predominates migration of its products.

In functioning of the soil - plant system, the superior zone (here are done the transformation-humification processes) has a decisive role. This zone has accumulative potential increased and practically ensure whole the soil profile with humic substances. According to this, the physical and energy potential of this zone is going to be maintained in permanence compared to inferior zone. Therefore, the presence in permanence of fresh organic material in the soil, is the most important condition of normal activity of the ecosystem both in natural regime as well as agricultural regime.

Not less important is the transport function of superior zone of organic profile. Mobile humic substances, represented by fulva acids, ensure descendant migration of nitrogen, calcium, and other chemical elements, formed in the result of mineralization of organic residue.

In the inferior segment of the organic profile, the biophyl elements are transformed in available forms and are assigned in new biogeochemical circuits (through the descending currents of water or the root system).
Referring to carbonatic profile and organic profile, within genetic profile of chernozem, the horizons of humus accumulation and carbonatic accumulation (even if both are accumulative) are forming in different segments of the profile. But instead, the horizon of humus accumulation overlap with the horizon eluvial – carbonatic. With small deviations, the thickness of humus accumulation horizon and eluvial - carbonatic horizon is almost identical, this allow as to say that both horizons develops synchronous. The interesting point of this is that humus - accumulative horizon, by biogeochemical aspect, represent the accumulation layer of organic carbonat, while the eluvial - carbonativ represent the layer from where is leaching the mineral carbon.

The structural aggregate composition of the soil is one distinctive feature of pedogenesis, result of dynamic of the pedogenetic processes. Specially by structure the soil differs by other bioroutinist systems.

The forming of solid organic - mineral substances, approached by concept of hierarchy of pedogenetic process, constituted the beginning of the processes of substances differentiation and the limit of pedogenesis and soil-formation [8]. Ped formation has two phases:

a) aggregation
b) structuring

The aggregation implies multiple processes of soil substances coupling like agglutination, coagulation etc.

The structuring implies multiple processes determine by expansion - contraction and colloidal condensation, this gives for aggregates special features.

In this context, the pedoaggregat profile consist in ascending differentiation of structural aggregate processes, materialized in different features and functions of the peds (the form, size, density, porosity, specific area, capacity for water, etc.).

Indispensable of pedoagregatic profile is related the profile of settlement indices with decisive role in the ecosystem functionality (and materialized in different types of pedogenetic profiles).

CONCLUSIONS

1. The functional-genetic profiles represent the intern pedofunctional framework of development, evolution and functionality of soil. It provides one conceptual-applicative support of controlling the functional processes of the soil in anthropic regime.

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CHERNOZEMS STAGNIC FROM MOLDOVA - RESULT OF COMBINATION BETWEEN LITOGENESIS AND SOLIFICATION PROCESSES OF PLIOCEN AND QUATERNARY SOIL FORMATION

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Keywords: *chernozems, stagnic process, Pliocene, relict*

Abstract

It was shown up that stagnic chernozems' genesis is conditioned by the clayey compound of Pliocene's sedimentary rock where they were formed. The profile of humus of the soils came into being as a result of a combination of contemporary and relict processes of soil formation.

INTRODUCTION

The soil research at the 1:10000 scale, conducted by the "Nicolae Dimo" Institute of Pedology, Agrochemistry and Soil Protection in the years 1996-2005 showed on the interfluvial plain, at the absolute altitude 200-290 m in auto morph conditions of pedogenesis, the original soil (endemic), gley in the bottom of the profile, called chernozems stagnic [5]. In the previous system of Moldova's soils classification [2] and large-scale soil maps, these soils are not shown. The name "chernozems stagnic" are the names of analogous soils from the systems FAO UNESCO soil classification [4] and the World Reference Base for soil resources 2006 [7]. The main purpose of the research was to study the conditions of stagnic chernozems soil formation, genesis, area of distribution, characteristics, classification at lower level, soil rating, and recommendation system for sustainable use.

MATERIAL AND METHODS

The information on distribution, genesis and characteristics the deep gley chernozems stagnic was obtained based on data from field research carried out in field, laboratory and office. In the field there were studied the profiles of chernozems stagnic and parallel of the area of nearby zonal soils to compare values and determine the characteristics of their potential agricultural production. Research was conducted on key polygons representing a virtual square with sides of 50 m. In the polygon 5 soil profiles were placed, the main one in the center and four on a virtual square tops. Soil samples and laboratory work were performed according to the classic methods. The office phase research results have been collected, processed statistically and presented as tables, diagrams, maps. To determine the level of productivity of the soils on micro- polygons located near the soil profiles was made relying harvest crops sheaves method - evidence.

RESULTS AND DISCUSSION

In Moldova, special research to assess genesis, nomenclature and classification of soils with deep gley horizons has not been performed. These soils are not placed in the existing classification system and soil rating, their genetic and production features are studied. On soil maps developed by the Institute for Land Management, the areas within chernozems stagnic were included in zonal soil areas. There is no evidence this soil taxon in the Romanian system of soil taxonomy [6].

The gley properties of chernozems, formed as a result of the stagnation nature of wetting, are used as diagnostic indices into the FAO UNESCO soil classification [4] and the World Reference Base for soil resources 2006 [7]. These properties concerns at the soil material continuously or periodically, are saturated with water and show signs rain account of the reduction and segregation of iron and have a specific color of gley stagnation – marble of structural aggregates surface.

Pedogenesis of chernozems stagnic is largely determined by the texture of the rock parental clay [5]. According to the geological research at the end of Pliocene, territory of central and southern Moldova continental climate regime is established; the alluvial plain is formed of sedimentary rocks that consist largely of altered clay deposits of lakes and marshes with low water.

In late Pliocene and early Pleistocene gradual lifting of the territory is noted, either the river dividing the two major classes. The Pleistocene tectonic movements are amplified, they form the Central Moldavian Plateau, incurred the hydrographic contemporary [1]. As a result, alluvial deposits - the Pliocene lake are preserved today only on the highest areas of relief to absolute altitude 200-290 m [3].

These rocks are compact clay, have composition chlorito-montmorillonito-hydromicaceous and are situated directly on Sarmatia deposits, formed of limestone material altered. Properties of soils investigated stagnic condition is correlated with soil water saturation in one or more layers (horizons) in the first 200 cm of land area. Saturation zone consists of water suspended from a relatively impermeable layer of clay Pliocene and present events gley processes.

In the field, in most cases, chernozems areas are adjacent to areas stagnate clay chernozems may coarse textured area - clay or clay-sand, located at higher altitudes than the elements of relief as banks. This data the origin of alluvial-lake deposits that formed this land.

Physical characteristics. The most common profile type of chernozems stagnic is characterized by Ahp-Ah-ABh-Bhkg-Gk-Cgk-CRgk. The average data on the soil texture investigated are shown in Table 1.

Table 1

Physical characteristics of chernozems stagnic on arable polygon

Horizon and depth, cm	Fractions		Hygroscopicity coefficient	Density	Bulk density	Total porosity
	<0.001 mm	<0.01 mm	% g/g	g/cm^3		%v/v
Ahp 0-10	51.9	77.3	11.9	2.63	1.14	56.7
Ahp 10-30	51.9	77.3	11.9	2.63	1.28	51.3
Ahk 30-52	51.9	79.1	12.1	2.66	1.36	48.6
ABh 52-74	52.9	80.1	11.3	2.68	1.47	45.2
Bhkg 74-96	53.8	80.7	10.4	2.71	1.53	43.6
Gk 96-106	55.9	81.7	9.8	2.72	1.61	41.0
Ckg 106-180	56.8	79.0	10.1	2.73	1.54	43.6
CRkg180-200	20.6	30.8	4.3	2.74	1.42	48.2

The data confirms that the natural clay content in soils investigated range from 77% to 82% and clay - from 52% to 56%. The parent material with such high percentage of clay can be formed only if its underwater alteration in the climate warm.

The granulometric composition of parent material confirms its origin alluvial-lake in late Pliocene. It is necessary to attribute warned clay observed in field in the cutting of profiles. The boulders of clay removed from the wet land area, the drying under the action of sunlight is covered with cracks and crumbles into small aggregates.

Acquiring parental material to auto crumb contrasting temperature conditions and wetting ensure spring glomerular structure with small aggregates and a fluffy state of arable layer of chernozems stalled.

Literature [3, 4] often indicates that soils with high clay soils are compact. Case studies show that not all processes can be assessed by compaction high clay content in soil. According to Table 1 chernozems stagnic, as clay, is characterized by high levels of hygroscopic coefficient within 10-12%. So, in the soil, water reserves are largely inaccessible for plants.

The density of the soil material varies from 2.63-2.68 g/cm³ in humus horizons to 2.71-2.73 g/cm³ in deep gley clay stratum. Low density compared surface horizons of these soils is due to high humus content.

An integrated index of soil physical quality condition is bulk density. The values of this indicator for soil profiles investigated early spring ranges from 1.00-1.15 g/cm³ in 0-10 cm layer of arable chernozems stagnic to 1.50-1.55 g/cm³ gley parental rock. Total porosity, while, in early spring is very high for arable layer of these soils and underlying small gley layers. The arable layer of chernozems stagnic is characterized by favorable natural features and horizon gley underlying – with adverse physical features. In early spring, this soil layer can be found as too awful and so, after a seed is necessary to roller the soil requires easy.

Chemical characteristics. Data on chemical characteristics of soils are presented in Table 2. The soils studied are characterized by neutral reaction from the surface horizons (pH 7.1-7.3) and underlying horizons weak alkali (pH 7.8 to 8.3). In gley horizons there is a trend towards a slightly more alkaline reaction than in adjacent horizons.

Table 2

Chemical characteristics of chernozems stagnic on arable polygon

Horizon and depth, cm	**pH**	**$CaCO_3$**	**Humus**	**N total**	**C:N**	**P_2O_5**	**K_2O**
		%				g/100 g soil	
Ahp 0-30	7.0	0	4.56	0.265	10.0	2.0	38
Ahk 30-52	7.5	4.7	3.78	0.202	10.8	0.9	22
ABh 52-74	7.8	7.6	2.94	-	-	-	-
Bhgk 74-96	8.0	13.5	1.67	-	-	-	-
Gk 96-106	8.2	22.0	0.76	-	-	-	-
Cg k 106-180	8.0	7.4	0.33	-	-	-	-
CRkg 180-200	7.8	32.2	0.07	-	-	-	-

Horizons of the area are stagnate chernozems non carbonate or weak carbonate. The maximum contents of carbon gley characteristic horizons of altered rocks and rolling limestone, clay outlined below. The investigated soils are rich in mobile potassium (30-60 mg/100 g soil) and total phosphorus poor (0.09-0.11% in the arable layer and the rock parental 0.05-0.06%) and mobile forms (0.9 to 2.0 mg/100 g soil). The content of humus in chernozems stagnic is equal to 4-5% in Ahp, 3-4% in Ah non arable, 2-3% in Bh1 and 1-2% in Bh2.

Profile humus ends rather abruptly, but in practice the horizon below non humus meets black humus "languages", formats the result of mechanical flow of humus material on cracks in horizons above. Humus horizons aggregates are characterized by a characteristic gloss anthracite coal. Report C:N in the humus layer is 10-11 for arable and 12-14 for the middle of the humus profile. Increase value ratio C:N shows the carbonization of humus in the middle of humus profiles, which is probably underwater ancient origin.

Generally chernozems stall is characterized by chemical features favorable for plant growth.

The formation of excess moisture in the bottom of the profile chernozems stagnic, as mentioned, is subject to their texture. The cold period of the year rose loamy soil moisture profile gradually approaches or reaches its full capacity of water. In hot water by the evaporative loss in clay soils are not high.

Following low speed of movement of water to the surface profile fine-textured soils, evaporation leads to loss of water only from their upper (0-50 cm). Drying clay leads to the emergence of large cracks (3-7 cm). Fissures have a great importance in the genesis and fluid regime of chernozems stalled. In summer, during heavy rains, water flows through cracks in the surface, which favors maintaining permanent excess water at the bottom of their profile. Also the cracks (especially in dry years, the fissures s are wide and deep) at the bottom of soil profile penetrates (stream) humus material at the top, leading to the formation of a transitional horizon glossaries tongue humus mass parent gley material. So, but in recent precipitation and temperature conditions of Moldova's heavy clay soils permeable, located on the flat and slopes, is characterized by a stagnant fluid system at the bottom of the profile.

CONCLUSIONS

1. Pedogenesis chernozems stagnic is determined by texture chernozems clay alluvial deposits-lake formed in the late Pliocene, which were currently stored only on the highest areas altitude relief (200-290 m).
2. Diagnostic horizons in profile of chernozems stagnogleic is formed in the bio accumulative layer in an environment where the soil conditions much of the year are saturated and stagnant water accumulated from precipitation.
3. Stagnogleic horizon is pronounced and is characterized by a massive accumulation of carbonates as bieloglasca, greenish-yellow in the Pliocene clay horizon is weaker gley and situated on limestone rocks eluvia compact.
4. In the analysis of the morph-metric indices and profiles investigated was established that humus horizon thickness of these soils vary within very large 40-60 cm to 90-150 cm and differ by a characteristic bright black anthracite given faces aggregates.
5. Chernozems have a fertility potential, but not always give adequate results due to faulty aero-hydro regime in years because of rainfall or problem with their work in autumn dry years (arable layer structure in blocks). Tillage is recommended to chernozems stagnic out only to soil moisture adequate physical maturity.

6. In years when these soils are dry in spring, as a result of high water field capacity, is drought tolerant, but if drought is prolonged in summer, as well spring crop harvest may be lost.
7. In terms of risk, chernozems stagnic are suitable: first, the perennial herbs, apple and plum orchards if gley horizon is located deeper than 70-80cm, secondly - for winter cereals, in the third-hoeing crops.
8. In years when the harvest regime hydro-technical normal crops on such land at least is different from the soil zone and is only 10-15 per cent or less.
9. Note average creditworthiness of chernozems stagnate, their level of productivity as determined by the method sheaves-sample is about 85 points.

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HUMUS AND TRACE ELEMENTS AS AN INDICATORS OF MATERIAL ERODED FROM CARBONATIC CHERNOZEMS SURFACE

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Keywords: *Cobalt, Copper, Nickel, Zinc*

Abstract

A study was conducted to investigate the content of humus and trace elements (Cu, Zn, Co, Ni) in soil of catena with Calcareous (Carbonatic) Chernozems. The data obtained use as materials eroded from soils surface indicators of losses. The humus losses in eroded Chernozems are 52%, the losses of trace elements are 33-35%.

INTRODUCTION

The Calcareous (Carbonatics) Chernozems in The Republic of Moldova are about 44% from total soil surfaces (1). On the catenae with Calcareous Chernozems there is soil pollution by erosion, by excess or deficiency of plant nutrients, by compaction. These soils are most vulnerable to erosion processes. The losses of humus, macro and microelements in agricultural soils on the slope are very considerable and become an ecological problem for agricultural production. The investigation on this research field was the development to verify the content of trace microelements accessible for agricultural plants and to determine the total forms in biogeochemical aims. This article presents the data that confirm soil pollution by erosion, the losses of humus, carbonates and the total and mobile forms of Cu, Zn, Co and Ni in the Calcareous Chernozems on the catena.

MATERIAL AND METHODS

The soil investigations are Calcareous Chernozems on the catena with all types of erosion: non eroded, weakly eroded, moderately and strongly eroded and deluvial (accumulative) soil. The catenaries' soils are presented by the sequence of soils with an approximate age, formed on the same parental material in similar climatic conditions, but having different characteristics depending on the relief variety. The present paper shows the most representative soils: Chernozems non eroded (on the slope top - inter stream), strongly eroded (on the slope bottom) and deluvial soils in depression. The soil samples were collected from all the genetic horizons. The trace elements in soil samples were determined by an atomic absorption spectrophotometer - AAS1. The total forms of microelements were determined by classic methods of desegregation with hydrofluoric acid in combination with sulfuric acid. The mobile and accessible forms were determined in CH_3COONH_4 solution - pH=4.8.

RESULTS AND DISCUSSION

The microelements accumulation in humus horizons is the result of different factors influence. However, in the first, their concentration in these horizons is the result of bioaccumulation and actual anthropogenic pressing. The content of humus in eroded soils was in direct dependence on the soil erosion degree. In the non eroded soil, the humus content in the layer of 0-10 cm of soil has 3.84%, in the strongly eroded soil this content was 1.85% (Figure 1).

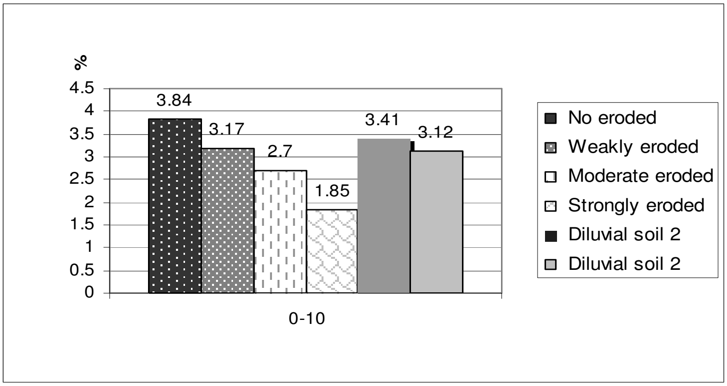

Fig. 1. Humus content in the Chernozems of catena, 0-10 cm

The loss of organic substances by erosion was 52%. In the deluvial soils, the content of humus had the stratification character of accumulation in superficial stratum, which depended on erosion manifestation. The content of humus was washed from the slope and deposited in the valley down. In the deluvial soil, the content of organic mater was the same as in non eroded soils - about 3%. In the Chernozems from the slope, the content of carbonates was changed considerably. In non eroded soils, its content was about 1% in the arable stratum (0-30 cm), but in the strongly eroded Chernozems - 7%, with a large values in depth - 11%.

Copper The total forms of trace elements included all the chemical forms from soils, including: accessible for plants, actual inaccessible for plants. The distribution of Cu in soils was conditioned by the following factors: parental rocks (material), soil genesis and erosion process. The accumulation of Cu in the humus horizons depends on the intensity of bioaccumulation and anthropogenesis (3). The total forms of Cu in the humus layer of Chernozems without eroded was less under average level for Chernozems of Moldova *(34.6 mg/kg)* - 22.7 mg/kg, in strongly eroded Chernozems - 14.7 mg/kg. The losses of total forms Cu in eroded soil were 35% (Table 1).

Table 1

Content of total and mobile forms of trace elements in Chernozems on the catena, ***mg/kg /% from total forms***

Horizon and depth, cm	Cu		Zn		Co		Ni	
	total	mobile	total	mobile	total	mobile	total	mobile
Calcareous Chernozem - non eroded								
Ap 0-20	**22.7**	0.65 2.9	**76.4**	2.4 3.1	**21,0**	0.18 0.9	**48.9**	3.0 6.1
Ah 20-40	**18.4**	0.90 4.9	**55.5**	2.5 4.5	**17,5**	0.15 0.9	**50.0**	3.0 6.0
Bh 40-110	**14.1**	1.10 7.8	**27.8**	4.0 14.4	**15,0**	0.40 2.7	**54.1**	6.8 12.6
BC 110-140	**16.2**	1.50 9.3	**39.3**	2.2 5.6	**15,0**	0.40 2.7	**56.0**	6.0 10.7
C 140-200	**17.0**	1.10 6.4	**48.1**	2.6 5.4	**19,5**	0.44 2.3	**56.7**	5.3 9.3
Calcareous Chernozem strongly eroded								
Bp 0-20	**14.7**	1.0 6.8	**52.7**	1.3 2.5	**17.3**	0.35 2.0	**83.5**	3.0 3.6
Bh 20-40	**14.8**	1.0 6.8	**48.8**	1.3 2.7	**16.9**	0.40 2.4	**72.6**	4.0 5.5
BC 40-60	**13.7**	1.0 7.3	**47.9**	1.3 2.7	**14.6**	0.50 3.4	**75.0**	3.5 4.7
C1 60-110	**12.6**	1.0 7.9	**67.7**	1.3 1.9	**14.3**	0.44 3.1	**69.6**	4.6 6.6
C2 110-160	**11.6**	1.0 8.6	**42.2**	1.3 3.1	**11.7**	0.51 4.4	**90.6**	3.0 3.3
Deluvial Calcareous Soil								
I 0-7	**13.5**	1.0 7.4	**31.3**	4.0 12.8	**19.7**	0.40 2.0	**41.0**	5.0 12.2
II 7-19	**16.2**	1.0 6.2	**51.5**	3.5 6.8	**13.2**	0.40 3.0	**49.5**	3.5 7.1
III 19-30	**18.6**	1.0 5.4	**44.0**	5.0 11.4	**10.9**	0.40 3.7	**54.3**	2.0 3.7

IV 30-45	**14.5**	1.0 6.9	**49.0**	5.0 10.2	**10.2**	0.40 3.9	**53.3**	3.5 6.6
V 45-56	**16.3**	1.0 6.1	**36.3**	5.0 13.8	**10.7**	0.50 4.7	**46.2**	3.5 7.6
VI 56-69	**19.1**	1.0 5.2	**41.2**	2.3 5.6	**10.5**	0.50 3.8	**45.4**	3.5 7.7
A 69-100	**20.6**	1.0 4.9	**43.7**	4.0 9.2	**19.9**	0.51 2.6	**42.9**	5.5 12.8
AB 100-130	**20.4**	1.0 4.9	**49.7**	2.3 4.6	**11.0**	0.50 4.5	**47.7**	5.0 10.5
B1 130-160	**19.3**	1.0 5.2	**49.6**	2.3 4.6	**11.0**	0.40 3.6	**48.8**	3.5 7.2
B2 160-220	**20.2**	1.0 5.0	**32.6**	4.2 12.9	**11.7**	0.45 3.8	**47.9**	5.3 11.1
B3 220-250	**18.1**	1.0 5.5	**42.6**	3.7 8.7	**12.0**	0.35 2.9	**54.0**	4.0 7.4
BCk 250-280	**17.4**	1.0 5.7	**41.3**	3.8 9.2	**11.5**	0.40 3.5	**44.5**	4.0 9.0
Ck 280-430	**13.7**	1.0 7.3	**38.2**	4.1 10.7	**11.3**	0.41 3.6	**45.2**	3.8 8.4

The content of Cu depended on the value of humus, the Cu was accumulated in organic matter. In the strongly eroded soil, the content of Cu in surface horizon (0-20 cm) was 14.7 mg/kg. In the deluvial soil, the accumulation of total Cu was less obvious. In I-VI stratums, the content of Cu was 13.5-19.1 mg/kg. In the covering soil, the content of total Cu was kept at the non eroded level - 20 mg/kg. Total Cu did not have accumulation varieties in depth of horizons B, BC, C of eroded soil.

The concentration of mobile and accessible forms of Cu was in limits 3-9% from total forms. In non eroded soil, these forms had less size in humus horizon – 0.65 mg/kg (2.9%). In depth the concentration increased to 9.3% in horizon BC. In the strongly eroded soil this dependence was not present, the mobile forms were 7-8% from total Cu. In the deluvial soil, the distribution of mobile forms of Cu was in I-VI stratums of soil 7.4-5.2%; in covering soil 4.9-7.3% from total Cu.

Zinc In comparison with copper, Zn had another distribution in the soil profile. In the non eroded soil, the total Zn decreased from surface (0-20 cm) - 76.4 mg/kg to 27.8 mg/kg.

The content of total Zn was higher in the strongly eroded soil, than in the non eroded. The high concentration of Zn was accumulated on the geochemical barrier, when the concentration of carbonates was higher. The losses of total Zn in 0-20 cm stratum of soil were 33%.

The mobile forms of Zn in the non eroded soil consisted in 0-40 cm layer of soil 3.1-4.5% from total forms. The high accumulation of mobile Zn took place in Bh, which were the barrier of transit of parental rock - 14.4%. In other horizons (BC, Ck) the mobile forms are about 5%. In the soil with strong erosion, the concentration of mobile forms had values about 3% in the whole horizon. In the deluvial soil, the accessible forms of Zn had bigger limits (5-13%) than in eroded soils. The higher concentrations were accumulated in humus (9.2%) and carbonate horizons (12.9%).

Cobalt. The reserves of total Co in investigation soils were under the average level (20 mg/kg) for Chernozems. The arable horizons had the higher degree of Co content, than their inferior layers. The losses of total Co were 5% in stratum of eroded soil 0-20. The carbonates horizon of the non eroded soil had about 20 mg/kg Co. This quantity of Co did not retain in eroded soil, it consisted of 12 mg/kg and another quantity migrated after 200 cm of soil (2).

The content of total Co in accumulative soil from the valley had stratification character in distribution in depending on the different texture and humus degree. The deluvial soil content in 0-7 cm - 19.7 mg/kg Co, with a little degree in depth - to 10 mg/kg. This distribution showed that Co leached in the inferior stratums (B, Ck - 11-12 mg/kg) and accumulated in the covering humus horizon (20 mg/kg Co).

The mobile and accessible forms of Co varied from 0.86% to 4.36% from total forms. These forms had the proportional correlation with global forms (Table). The Co ions could be easy sedimented by sulfides, carbonates and hydroxides. As a result, the Co became a weakly mobile element in soils. The concentration of plant accessible forms of Co remainded relatively high in 0-20 cm of soil stratum: 0.18 mg/kg in the non eroded soil, 0.35 mg/kg - in the eroded soil. There are emphasizing the covering horizons of the deluvial soil - Ah, Bh, keeping a good correlation with total forms. The mobile forms of Co in the deluvial soil were 4.3% from global Co. According to the investigation, the methods of the sufficient limits of Co supply for agricultural soil were 0.5 mg/kg. The examined soil has under the supply limits with Co for plants.

Nickel. The carbonatics no eroded Chernozem had in 0-20 cm stratum about 50 mg/kg of Ni. As a result of the erosion processes, the content of Ni increased to 84 mg/kg or 68%. In depth of profile, the total Ni has increased in both soils, but in the eroded one increase was significant, to 90 mg/kg in 140-200 cm. The mobile and accessible forms of Ni were 3-8% from global forms.

The research of the chemical forms of Ni in eroded and deluvial soil is necessary to determine the factors which influence their behaviour and are also an ecological factor in these soils (2, 4). The deluvial soils from this area incorporate the soils which formed in result of accumulation of pedolit deposits deluvial provenience very fast temp as a result of the erosion intensification on the slopes with carbonatic Chernozems.

The inaccessible forms of trace elements are presented by insoluble or heavy soluble salts, organically and organic-mineral compounds, primary and secondary minerals and consists in this soils about 70-80%. Part of them can be successive in time accessible for plants through physical-chemical and biochemical processes of mobilization from insoluble to easy soluble and ionic status. These forms constitute the mobilized potential reserves of trace elements in soils. But in practically insoluble salts and in minerals there are remains another part of the elements which are immobilized for plants.

The regular distribution of the chemical forms content of trace elements in carbonatic Chernozems eroded and non eroded are coordinated by the eroded degree, content of soil carbonates, oxides and clay minerals and have a good correlation with them.

The mobile chemical forms of trace elements in carbonatic Chernozems are partial or total submissive transformations, in this case under erosion processes. In time, these forms can pass from one form to another, to maintain the dynamics equilibrium, but sometimes the accessible forms are immobile. The study of chemical forms transformation of different trace elements in soils complete the information about their provenience.

Between the chemical forms of microelements in soils there does not exist precise separation elements, but there are transitions, gradual passing. At the separation of chemical forms, it is necessary to select the adequate methods of determination and stabilization of the equilibrium between them for each type and subtype of soil. The other ecological problem is the study of the factors which influence the mobility of elements in soil and their anthropogenesis. Using humus and chemical forms of trace element we can diagnose the level of erosion and sometimes the level of pollution by erosion.

CONCLUSIONS

1. The Calcareous Chernozems non eroded and eroded contain the trace elements under the average level, and are tolerated by plants. The losses of trace elements through erosion are: Cu - 35%, Zn - 33%; Co - 5%. The humus losses in eroded soils are 52%.
2. The distribution of elements in profiles depends on organic bioaccumulation, quantity of carbonates. The agricultural soil from the slope is necessary in the fertilization with organic fertilizers. These measures will conduct to increase the content of humus and accumulation of trace elements in mobile and accessible forms for plants.

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SOIL QUALITY MONITORING IN ALBA COUNTY

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Keywords: *monitoring, agricultural, Alba County*

Abstract

The land an agriculture monitoring system in Alba County includes 17 sites. The first determination was in 1994 and the second was realised in 2005. Every site was characterised from a morphological, physical and chemical *point of view. Also, the content of heavy metals and total DDT and total HCH were determined. Research showed that the most af the sites belong to the slightly acid class on the 0-20 cm depth and neutral class on the 0-50 cm depth. The average content of organic matter, total nitrogen, and mobile potassium is moderate. The mobile phosphorus average content is low. The average contents of Cu, Zn, Ni and total HCH are higher than normal contents accepted by legislation. The other heavy metals belong to the normal class.*

INTRODUCTION

Soil is one of the most important parts of the natural environment and it is largely non-renewable. Worldwide, all economies depend on the goods and services provided by the natural environment. Soil, as a natural resource, performs a number of key environmental, social and economic functions [1].

Soil monitoring is esential for the early detection of change in soil quality. Such early detection enables the design and implementation of policy measures to protect and maintain the sustainable use of soil so that it continues to deliver ecosystem goods and services [6]. This paper presents the research results of soil monitoring from Alba County - second determination.

MATERIAL AND METHODS

Methodology. The achievement and maintenance of soil-land monitoring systems at level I (16x16 km) was done under the order no 223/2002 for enforcement 444/2002 law and methodology of soil survey elaboration. In Alba County there are 17 agricultural monitoring sites. The second determination of agricultural land monitoring in Alba County was in 2005. The physical analyses comprised six parameters (particle analysis with ten fraction, density, total porosity, penetration resistance, hydraulic conductivity, structural instability index). Chemical analysis comprised nine parametres (pH_{H2O}, $V_{pH8,3}$, total nitrogen, organic matter, mobile forms of phosphorus and potassium). Also heavy metals - total forms - (Cu, Pb, Cd, Zn, Ni, Co, Mn), total DDT, total HCH and sulphur were analysed.

RESULTS AND DISCUSSION

Soil cover in Alba County. The interaction of the pedological factors led to the existence of a large number of soil types. In Alba County there were identified a total of 12 classes of soil with 23 types and 91 subtypes of soils. Regosols (10.43%), Aluviosols (10.88%), Preluvosols (19.4%), Luvosols (10.98%), Erodated soil phases (11.66 %), Cernozems (6.43 %), Eutric Cambisols (4.96%) and Dystric Cambisols (6.52%) [3].

The processes affecting the quality status of agricultural land in Alba County are:

- *pollution from excavation to date with waste and inorganic waste* is excessive (76-100% crop loss) on 3,946 ha;

- *pollution drift substances* (Zlatna area, Alba Iulia, Ocna Mures), affecting 5500 ha, of which 3,500 ha are very strong, due to ferrous metallurgy Zlatna area;

- *pollution and waste organic residues, agricultural and slurry*, totaling 11.5 ha;

- *pollution by erosion and landslides* in different degrees affect 166,080 ha of agricultural land in the county, reducing yields and causing considerable damage to the sealing and destruction of buildings and facilities;

- *acidic soils* affects strongly 35,937 ha;

- *scarcity of nutrients* and *organic matter* affected from moderate to strong 151,300 ha;

- *soil compaction* on 40,000 ha.

Land quality in Alba County, after the evaluation note, is dominated by the high percentage of land from III and V classes for arable, vineyards and orchards. The prevailing quality of pasture and meadow belongs to IV and V classes [3].

Representativeness of system monitoring. Classes of soil most common are well represented, but not proportionately. Depending on the type of use, there are relatively well represented arable land, pasture and hay fields, and are not represented at all the vineyards and orchards, which occupies 1.53% of total land.

Taxonomic characteristics. Soil types and subtypes of I level monitoring network are: Regosols - 17.4%, Fluvisols - 5.9%, Haplic and Vertic chernozems -17.7, Vertic luvisols - 5.9%, Eutric cambisols and Dystric Cambisols - 41.2%, Pellic vertisols 5.9%, Anthrosols - 5.9%.

Physical characteristics. Table 1 shows the main physical characteristics of agricultural soils in the I level monitoring gride in Alba County. In the A horizon, the prevailing texture is fine (58.8%), followed by medium (35.3%) and in one case (5.9%) the texture is light.

Saturated hydraulic conductivity (K sat, mm.h^{-1}), in the first layers (0-25 cm and 25 cm), varies from moderate to very high and the average is very high. On the 35-50 cm layer, K sat varies from extremly low to very high.

Resistance to penetration (RP, kg.f.cm^{-2}) varies from very low to moderate and the average is low in all layers.

The degree of compaction (GT). The minimum and average values belong to non-compacted classes. The maximum value varies from slightly compacted in the first layer to strongly compacted on the 35-50 cm layer. Average values are in non-compacted class.

Structural instability index (IIS), in all layers, varies from very low to very high. The average is low in the 0-25 cm and 25-35 cm layers and moderate in the 35-50 layer.

Edaphic volume (VE) presents a large range of values, from small to very large, and the average is high.

Table 1

Statistical parameters of physical characteristics

Statistical parameters	Ksat, mm.h-1			RP, kgf.cm-^{2}			IIS			VE
	0-25	25-35	35-50	0-25	25-35	35-50	0-25	25-35	35-50	
n	17	17	16	17	17	16	17	17	16	17
X_{min}	4.12	2.32	0.2	3.0	2.0	3.0	0.04	0.03	0.05	0.03
X_{max}	167.1	113.3	111.8	32	34	42	1.40	1.23	1.63	1.40
X_{med}	77.1	56.2	47	14.2	16.2	20.0	0.34	0.39	0.45	0.77
±σ	46.32	36.1	38.3	9.0	10.4	12.4	0.31	0.28	0.38	0.40
cv,%	60.1	64.1	81.5	63.5	64.5	62.2	91.2	71.8	84.4	51.9

n-total number of samples; X_{min}-minimum value; X_{max}-maximum value; Xmed-mean value; σ-standard deviation; cv,%-coeficient of variation

Chemical characteristics. Table 2 shows the main chemical characteristics of soils in I Level monitoring gride in Alba County.

Soil reaction (pH_{H2O}) in agrochemical layer (0-20 cm) varies from very strong acid to weak alkaline, and the maximum value, in the layer 0-50 cm, range from moderately strong acid to alkaline. Most of the sites belong to the slightly acid class in the 0-20 cm and neutral on the 0-50 cm thickness.

The degree of saturation in the base ($_{pH8\cdot3}$) ranges in oligobazic-saturated in bases field and the average is eubasic in the both layers.

Organic matter content (Ht, %) varies from very low to high in the both layers and the average is moderate.

The content of total nitrogen (Nt, %) is in close correlation with the organic matter ranging in the low-high field in topsoil and in very low-high in 0-50 cm layer, and average is moderate in the both layers.

The content of mobile phosphorus (Pm) is extremly low-very high in both layers and average is low.

The content of mobile potassium (Km) ranges from very low to very high in both layers and the average is moderate in the both layers.

Compare with the first determination, there were found some changes of chemical properties. The soil reaction was slightly decreased and also the average of total nitrogen content, the mobile phosphorus and potassium content were lower at the second measurement.

Table 2

Statistical parameters of physical characteristics

Statistical parameters	**pH**		**Ht, %**		**Nt, %**		**Pm, mg/kg**		**Km, mg/kg**		**$V_{pH8.3}$ %**	
	20 cm	50 cm	20 cm	50 cm	20 cm	50 cm	20 cm	50 cm	20 cm	50 cm	20 cm	50 cm
n	17	17	17	17	17	17	17	17	17	17	17	17
Xmin	4.3	4.7	0.67	0.56	0.105	0.053	3.9	3.6	41	44	30	31
Xmax	8.1	8.5	9.50	9.68	0.423	0.314	120	99	508	361	99	100
Xmed	6.2	6.9	4.74	3.55	0.240	0.190	18	14	188	154	80	81
$\pm\sigma$	1.3	1.3	2.36	2.04	0.078	0.067	29	23	124	100	24	25
cv, %	20.9	19.3	50	57.5	32.5	35.3	163	170	66	65	30	31

Table 3 shows the statistical parameters of potentially polluting substances contents.

The content of total Cu varies from 8.4 to 138 mg/kg and average is 35 mg/kg. The average is higher than the average content (23.3 mg/kg) of copper from I level monitoring greed [4] and typical values (20-30 mg/kg) for our country [2].

The content of total Pb varies from 2.6 to 22.7 and the average content is 12 mg/kg. This average is under the average content (29.3 mg/kg) typical of agricultural I level monitoring greed [4].

The content of total Zn varies from 33 to 255 mg/kg and average is around 109 mg/kg. This average is higher than specific values of our country [2, 4].

The total Cd content is very low (0.1-0.3 mg/kg). The average content is lower than average content (0.9 mg/kg) of agricultural I level monitoring greed (Dumitru, 2000) and average value (1.11 mg/kg) reported by Lăcătuşu, 1997 [5].

Table 3

Statistical parameters of potentially polluting substances (mg/kg)

Statistical parameters	Cu	Pb	Zn	Cd	Ni	Mn	$S\text{-}SO_4^{2-}$	DDT	HCH
n	17	17	17	17	17	17	17	17	17
Xmin	8.4	2,6	33	0.14	7.1	92	78.8	0.004	0.009
Xmax	138	22.7	255	0.32	54.7	1015	222.3	0.114	0.033
Xmed	35	11.8	109	0.23	36.5	460	134.7	0.020	0.020
$\pm\sigma$	10.6	5.7	50	0.07	12.6	193	44.4	0.030	0.010
cv, %	38.4	48.5	46	30.4	34.5	42	33.0	150	50

Content of total Mn varies from 92 to 1015 mg/kg and the average is around 460 mg/kg. These values are closed to the reported values by Bajescu&Chiriac, 1984 [2].

The content of soluble sulfur ($S\text{-}SO_4$, $mg.kg^{-1}$) varies in the field 79-222 mg/kg. The maximum values are located in field of low load without reaching the alert threshold of sensitive use [7].

Although DDT and HCH had been banned over 20 years, they were found in soil. The values of total DDT content are in the normal field and the values of total HCH content are over normal values according to Order no 756/1997 [7], but below the alert threshold of sensitive use.

Compared with the first determination, the contents of potentially polluting substances were lower.

CONCLUSIONS

1. Research has shown that the most af the sites belong to the slightly acid class on the 0-20 cm depth and neutral class on the 0-50 cm depth.
2. The average contents of organic matter, total nitrogen, and mobile potassium are moderate. The mobile phosphorus average content belongs to low class.
3. The average of total nitrogen content, the mobile phosphorus and potassium content were lower at the second measurement.
4. The average contents of Cu, Zn, Ni and total HCH are higher than the normal contents accepted by legislation. The other heavy metals belong to the normal class.

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PEDOGEOGRAPHICAL OBSERVATIONS IN THE PLAIN BETWEEN THE JIU AND THE DANUBE

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Keywords: *western Oltenia Plain, soils, vulnerability, drought*

Abstract

The plain territory between the Jiu and the Danube correspond, under geomorphologic report, to the two big subdivisions of the Oltenia Plain: Blahnitei Plain (Mehedintiului) and Calafat-Bailesti Plain. Between the Jiu and the Danube the soils are characterized by a pedoclimatic locality, this being determined mostly by the relief flooridge.

On the sands formed in some massives disposed on more alignments developed a large scope of soils containing from eutric arenosols up to lamellar red preluvosols, and the presence of water at low depth helped the release of some Hydrisols or even salsodisols.

In the Jiu Danube Plain territory dominant are cernisoils represented by chernozems, haplic chernozems, luvic chernozems, to which are added some luvisols meaning tipic preluvosols or red preluvosols, as some eutricambosols. Hydrisols and salsodisols are not absent, and in the lower areas there are fluvisols represented by entic fluvisols and eutric fluvisols. Locally, in the Blahnitei Plain you can find Histosols represented by turbosols.

INTRODUCTION

The fact that in Romania there is drought is not an accident, it is a normal situation with certain periodicity. Usually, the drought seasons have a higher frequency in the southern areas of the country, wth a higher accent in the plain between the Jiu and the Danube. In this part of the contry the phenomena seems to amplify as a following of light textural soils, sands and sandysoils presence, with physic and hydrophysic characteristics less favorable of which surfaces exceeds 100,000 ha.

On amplifying or reducing the meteorological drought effects, an important factor is the chemical composition of the soil. For example, the low content of humus and other soil nutrients increases the strength of the drought.

Reportedly, the direct influence of drought in the areas most affected by these phenomena takes place through the aridization of the soil humidity regime; referring to the degradation of the quantity of water entered and kept in the soil in troughs.

At the same time, the main physical, biological and biochemical processes in the soil whose deployment is conditioned by the presence of water slows down or ceases altogether.

MATERIAL AND METHODS

The risk to drought is related to the ability of soil to retain and provide needed water to plants. A ranking of soils in this regard requires specific data processing. Therefore the grouping of soils and land vulnerability report was based on other criteria. We had to view hot-dry climate (average annual temperature is between 10.5-11.5 ^{0}C, the amount that go over 10 °C temperatures of 1500-1800 °C, the warmest month temperatures frequently exceed 23 °C, and the absolute maximum reaches up to 42 °C, mean annual precipitation below 500 mm and the vegetation period not exceeding 300 mm), soil type and texture (medium and coarse textured chernozems and arenosols), fragmentation of relief, groundwater depth (mid-large, predominantly from 5 m) and salted soil.

RESULTS AND DISCUSSION

The plain territory between the Jiu and the Danube correspond under geomorphologic report to the two big subdivisions of the Oltenia Plain: Blahnitei Plain (Mehedintiului) and Calafat-Bailesti Plain.

In the limits of this territory there are a high plain known as the Salcuta-Segarcea Plain, a glacis surface called Caraula-Desnatui and the terraced plain of the Danube.

The relatively good global drainage in the southern half becomes imperfect, as we ease up the Danube and that happens because the parental material of the sandy loessoid soil becomes, going north, a little delicate, with clay content. The water table is at depths of over 10 m.

The climate data analysis over a long period (1896-1985) situates the whole Plain territory between the Jiu and the Danube in a hot-droughtly climate, characterized through high values of the termic resources, the modest water resources, on large extensions of terrain with soil accessible humidity resources and stress termic stress and water important parameters.

The annual medium temperature is between 10.5 and 11^{0}C. The sum of temperatures higher than 0 °C (global) is situated between 4200-4300 ^{0}C, and of the ones over 10 ^{0}C (real) between 1500-1800 ^{0}C. The temperatures of the hottest month (July) can exceed 23 ^{0}C (22.5-23.5 ^{0}C), the absolute maximum goes up to 42 ^{0}C, and the minimum frequently goes up to - 29.2 ^{0}C.

In the climatic and morphologic conditions of the territory, the water table is situated at different depths. It can be found at over 20 m in the north of the region and at depths (0-5 m), from which influences the soil in a bigger or smaller manner, in the south (Figure 1).

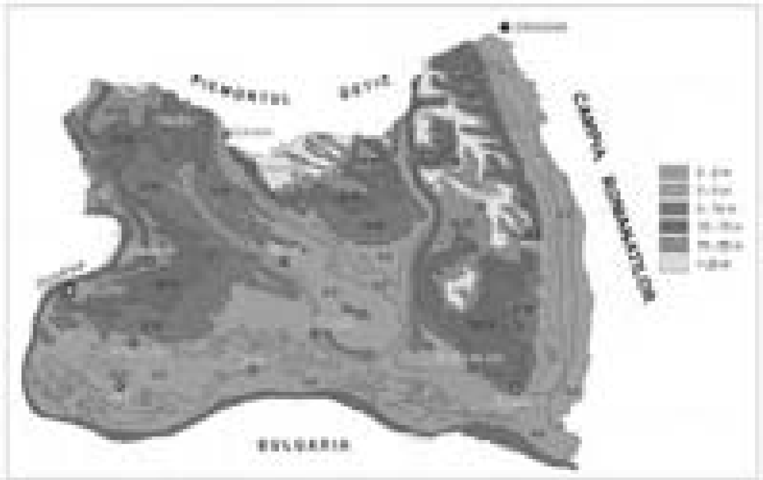

Fig. 1. The Plain between the Jiu and the Danube – water table depth map, sc. 1: 500.000

The mineralization degree of the water table is on most of the surface relatively low (0.5-1.0 residuum sec, g/l), except the slight depresionary areas or with a water table level at low depth.

The season oscillations of the water table generally have relatively big amplitudes (1-2 m). The can be observed easier in the waved relief.

Between the Jiu and the Danube the soils are characterized through a pedoclimatic locality, this being determined mostly by the relief flooridge. On a distance of about 30-35 km from the Danube to the north in which the absolute altitude of the relief goes up to 125 m is the change from calcic chernozem (formed on loessic sediments and loess) from the lower terrace of the Danube to haplic chernozem, luvic chernozem and red preluvosols (Figure 2).

On the sands formed in some massives disposed on more alignments developed a large scope of soils containing from eutric arenosols up to lamellar red preluvosols, and the presence of water at low depth helped the release of some hidrisols or even salsodisols.

As resulted from the soils map in the Jiu-Danube Plain territory, dominant are cernisoils represented through chernozems, haplic chernozems, luvic chernozems, to which are added some luvisols meaning tipic preluvosols or red preluvosols, as some eutricambosols. Hidrisols and salsodisols are not missing, and in the lower areas there are fluvisols represented by entic fluvisols and eutric fluvisols. Locally, in the Blahnitei Plain you can find histosols represented through turbosols.

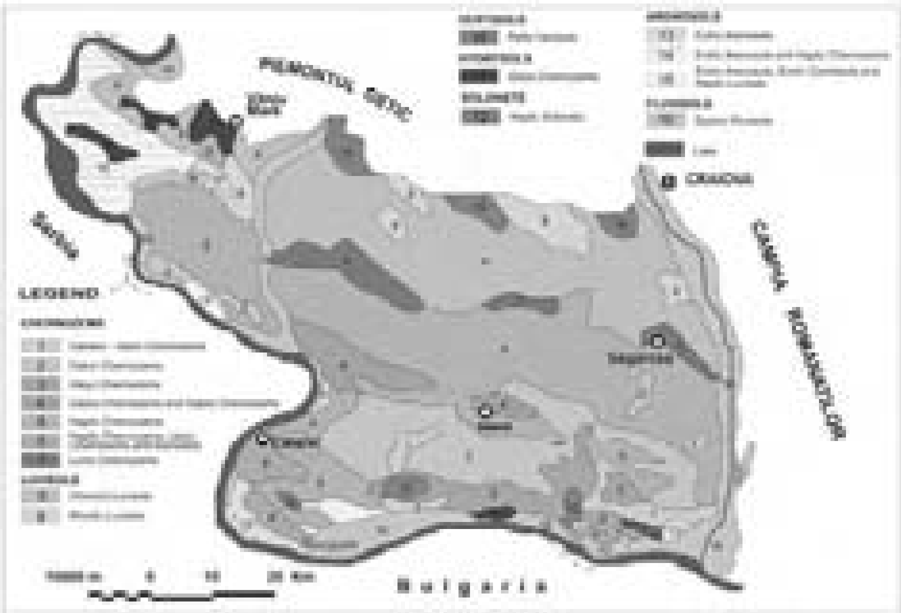

Fig. 2. The Plain between the Jiu and the Danube - soil map

Vulnerability (from 0% to 100%) results from the latency of a phenomena to produce damage. In case of soil drought there is risk concerning the capacity of the soil to retain and give the plants the necessary water. Considering more criteria (climatic area, soil type and texture, relief fragmentation and slope, water table depth, erosion and salting) in Jiu-Danube Plain we have differenced six units united in three soil drought vulnerability groups. All are situated in the limits of the hot-dry climatic area (Figure 3).

The first two groups refer to hard and moderate vulnerable soils, and the third group contains the soils vulnerable only to long droughts.

A. Lands with highly vulnerable soils (130,960 ha; 26%)

Lands with sandy sols, on wind waved relief

Such lands appear in Calafat-Bailesti Plain, in the area of the two main cities Calafat-Bailesti between Ciuperceni and Desa, and also on half of Blahnitei Plain.

Arenosols, chernozems and haplic sandy chernozems represent the most drought affected soil category.

Soils (arenosols, chernozems), like the parental material, have a sandy texture on the dune peaks and sandy-clay in the interdunes, low cohesion and weak structure, which makes them irritable to deflation. They contain under 10% clay <0.223 mm, have a low absorption surface and wide lacunar spaces so a high permeability for water and air, but a low capacity to retain water, this leading to the accentuation of the drought phenomena.

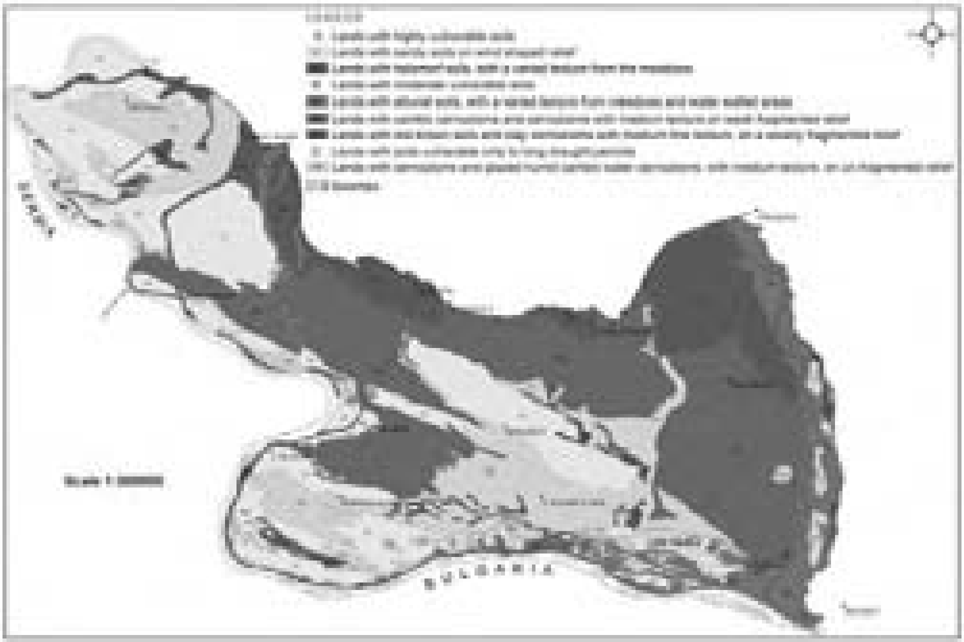

Fig. 3. The Plain between the Jiu and the Danube - the land grouping map considering drought vulnerability

Lands with salsodisols, with a varied texture from the meadows

In this category were included the land surfaces with solonet type soils.

You can find them in the Danube's meadow and in Jiu's and Desnatui's meadows. In this case along the climatic drought we can also talk about physiological drought, the last one being determined by the impossibility of water providing to the plants as the water in the soil is characterized through a high content of salts.

B. Lands with moderate vulnerable soils (281,960 ha; 56%)

Lands with eutric fluvisols, with a varied texture from meadows and water walled spaces

Most parts of this refer to the Danube's and Jiu's meadows.

Apparently uniform, the relief of the two meadows show a series of deserted meadows and small depression areas, from which some are pretty wide and deep (0.3-1.5 m), swamped or even full with water (Lake Nedeia).

The materials from which they are constituted are layered and are characterized through wide texture diversity. On them appear fluvisols (entic fluvisols and eutric fluvisols), and also a series of hidrisols (gleyc chernozems, distric gleiosols) and salsodisols (haplic solonetz).

Land with haplic chernozems and medium texture chernozems, on a weakly fragmented relief

Are represented in Calafat-Bailesti Plain (240,000 ha) and also appear in the south of Blahnitei Plain between Gruia and the confluence of the Danube with Drincea.

In these conditions, the soil cover is dominated by chernozems and cambic chernozems. Erodosols appear on the versants and in the lengthen of some valleys haplic chernozems.

Lands with red preluvosols and middle-fine texture luvic faeozioms, on weakly fragmented relief

Reduced as expansion they appear at the northern extremity of the territory, at the contact with the Getic Piedmont, were the climate maintains hotter and dryer. The medium annual temperature goes up to 11°C (10.5°C), but in the summer months (July-August) it goes over 22°C.

Lands with soils vulnerable only in long drought conditions (91,760 ha; 18%)

This kind of lands correspond to the parts with a low depth water table situated in the dry climate. Two important parts from the Danube's terraces are overlapped, weakly drained (with a water table between 2-5 m).

The soil cover is in this case made out of semicarbonatic chernozems, water table humid and cambic chernozems, also water table humid, soils characterizes through a high fertility level.

CONCLUSIONS

1. In Romania, the drought seasons have a higher frequency in the southern areas of the country.
2. Considering more criteria (climatic area, soil type and texture, relief fragmentation and slope, water table depth, erosion and salting) in Jiu-Danube Plain we have differenced six units united in three soil drought vulnerability groups.
3. The first two groups refer to hard and moderate vulnerable soils, and the third group contains the soils vulnerable only to long droughts.

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PEDOGENETIC SOIL ENFRANCHISEMENT OF THE RELICT GETIC PIEDMONT

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Keywords: *relict Getic Piedmont, evolution, soils*

Abstract

The soil cover of the Relict Getic Piedmont was formed during its evolution process. In the characteristic pedogenetic conditions, a large group of soils was formed gathered in six classes: protisoils, cernisoils, cambisoils, luvisoils, pelisoils and hidrisoils. The luvisoils are dominant, followed by the cambisoils and hidrisoils.

The limiting factors of agricultural production are different for each subunit. The most spread are erosion and stagnant humidity excess, the high acidity of most soils and also a small humus reserve.

The increase of the fertility potential of the soils implies as main requirements the prevention and stopping of the erosion, elimination of the humidity excess through loosening, limestone adding and ameliorative fertilization (radical).

INTRODUCTION

The ground shell of the Getic Piedmont in general and especially the relict Getic Piedmont were formed in the evolutionary process for millennia. Starting in the second part of the Pleistocene environment, the Getic Piedmont development as a form of relief ended. The next stage of carving was preceded by a period in which most of the territory remained a swamp regime.

Gradually the complex pedogenetic factors change particularly those orographic and edaphic. This makes the hydromorph intensity factors to evolve under the influence of external area, climate and vegetation.

In Wurm 3 and the Holocene increase in the intensity of clay process to determine the bioaccumulation of various stages of evolution that explains the current structure and the area of soil.

MATERIAL AND METHODS

The risk to drought is related to the ability of soil to retain and provide needed water to plants. A ranking of soils in this regard requires specific data processing. Therefore the grouping of soils and land vulnerability report was based on other criteria. We had to view hot-dry climate (average annual temperature is between 10.5-11.5 ^{0}C, the amount that go over 10 °C temperatures of 1500-1800 °C, the warmest month temperatures frequently exceed 23 °C, and the absolute maximum reaches up to 42 °C, mean annual precipitation below 500 mm and the vegetation period not exceeding 300 mm), soil type and texture (medium and coarse textured chernozems and arenosols), fragmentation of relief, groundwater depth (mid-large, predominantly from 5 m) and salted soil.

RESULTS AND DISCUSSION

The Getic Piedmont is a relict geomorphological relief unit with significant variations from the flat, low lands fragmented by moderately rough with strong fragmentation. Taking into account all these features were particularly morfogeographic geosystems two main units separated by the Olt in the western relict Getic Piedmont, with the subdivision Motrului Piedmont, Olteţului Piedmont and Bălăciţei High Plain and the eastern relict Getic Piedmont, which belongs to Cotmeana Piedmont and Cândeşti Piedmont (Figure 1).

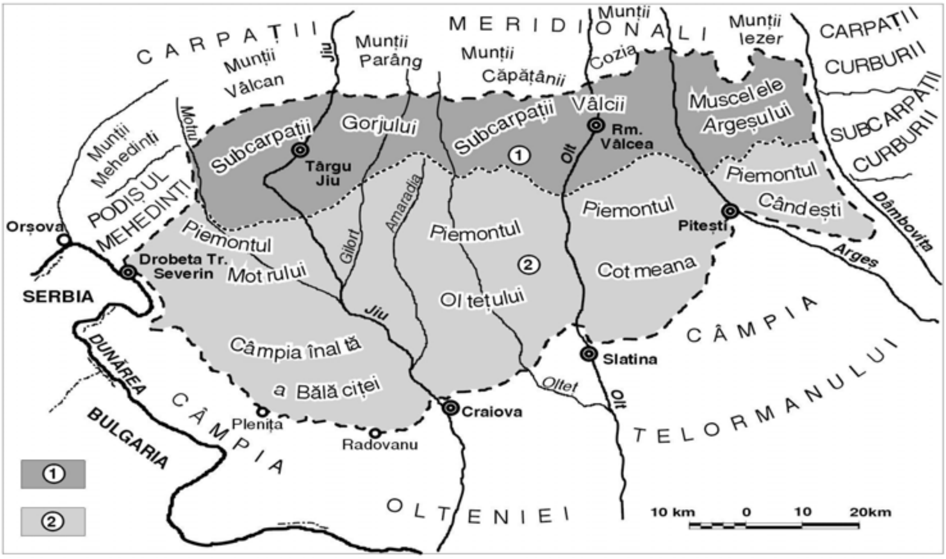

Fig. 1. Subdivision of the Getic Piedmont
1. Getic Piedmont; 2. Relict Getic Piedmont

Geological formations taking part in the composition of Piedmont Getic are phase prequaternary of subsidence and sea-lake and continental semilacuster quaternary phase. The latter, although very short in comparison with the previous phase is more important both for specifying the main stage on the morphogenetic evolution of the Piedmont and in pursuit of becoming the occurrence and geographical components, and particularly as regards training and pedogenetic empowerment of the soil.

During Levantine, the Getic Piedmont was occupied by a lake sedimentation sweetened the relatively quiet was disturbed from time to time the arrival of coarser materials from the mainland, made with a heavy bedding. This phenomenon is increasing, but more towards the end, when you install a fluvial-lacustrine facies, where sand and gravel dominate, which also marks the transition to lower Pleistocene.

In the early Quaternary (Pleistocene lower-villafranchian) levanter lake water continuously regression are clogged with coarse material psamo-psefitic (Cândeşti layer) carried by torrential waters, which came down in stormy Southern Carpathians, affected by movements of lifting the Wallachian phase. The layer thickness of Cândeşti varies between 150-200 m.

Pleistocene begins with a cooling medium increased, announcing production of the alpine glaciation. This climate change area is marked by a slight rain phase, characterized by relatively abundant rainfall. As a result of altered crust materials deluvial and soil-eluvial orogen zone formed by the end of lower Pleistocene are subject denudation and transported to the south by torrential bodies and covers such a thickness of 3-6 m slayers of Cândeşti exceeding Piedmont limits even.

In all probability, during the deposit of sediment clay, worked as the swamp area of the corresponding Getic Piedmont and the Danube River and much of Plain Teleorman, with a relatively rich hydrophilic vegetation. After the amount of organic matter in soil left it appears that this phase did not last too long. S-type soils formed little lakes (Figure 2).

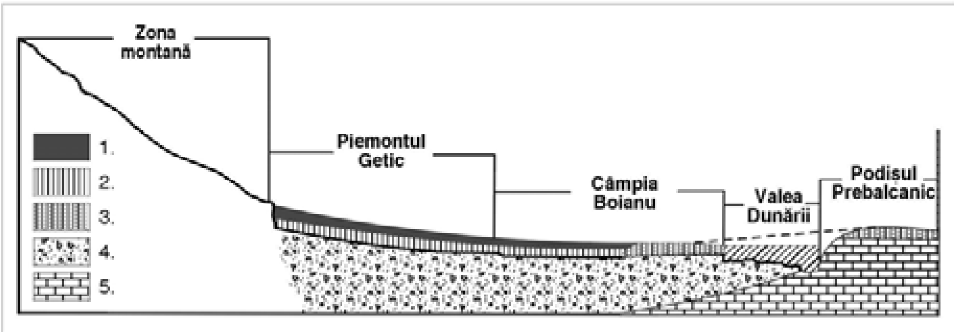

Fig. 2. Genesis and evolution periods of the Getic Piedmont and the soil cover

1. Cernic gleiosoils (little lakes) that became vertosoils (loamy soils or vertisoils); 2. Proluvial loamy deposits; 3. Loessoid deposits; 4. Layers of Cândeşti and Frăţeşti; 5. Limestone.

The Getic Piedmont deposits yellow clays that form of relief cease development and enter the stage of evolution downward, subject factors action modifiers. In this respect, the most active role was played fluviatile erosion system. River bodies that stage training Piedmont played an important role is also being widened (Mindel II) in their own twin agesters (Jiu, Olt, Argeş) and others (Motru, Gilort, Olteț, Topolog, Bascov, etc.) slipped on their flanks, and attracted the local areas of subsidence. As the mountains rose (Wallachian phase continued into Quaternary) outline progress south Piedmont detrimental to lake water, record a withdrawal continues south and east.

Parallel to the hightening of the region and achieving overall drainage occur important changes in climate and vegetation. The continentalism increases, becoming ever more pronounced, and instead of hydrophilic vegetation and mesophilic forest installs first highway, then the actual quercinee.

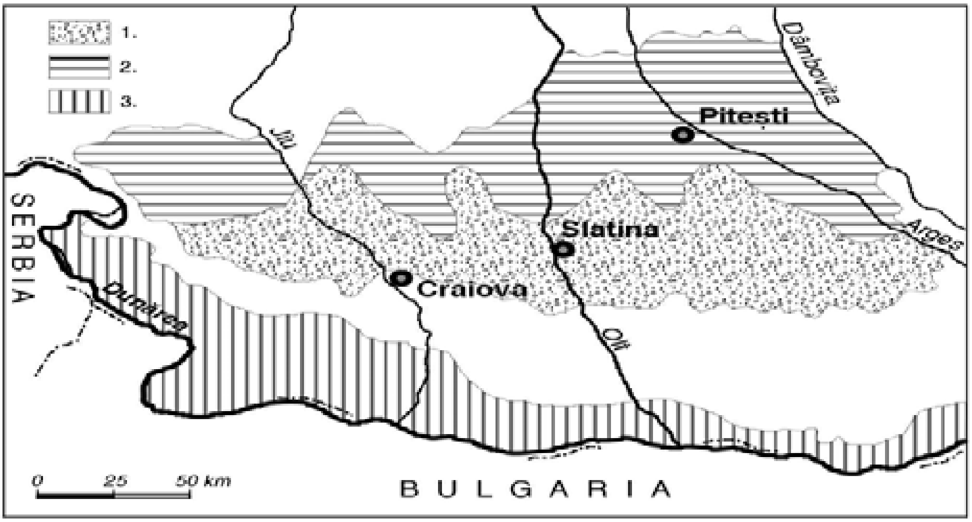

Fig. 3. The spread of vertosols (1) and soils that evolved on them (2); Danubes terraces (3)

The new bioclimatic conditions cernic gleiosoils (little lakes) pass through several stages of pedogenetic emancipation.

Initially, the output from the influence of groundwater, they have evolved largely to vertosoils (smolnas or vertisoils). As a zonal shaping climate and vegetation, much of these soils have entered a new stage of development, the characters retain their legacy only in the area of contact with the field in a space climax, where going north, they have reached the time of luvisoils evolved, namely albic luvosoil (Figure 3).

Because of global defective drainage, locally developed to hidrisoils as stagnosoils. In this respect they have ranging from south to north a dark Bt subhorizon as evidence of trends in vertosoils.

The main physical and chemical features of the two terms from the information are below. Thus, vertosoils have a fine texture, loam (47-51% clay under 0.002 mm), moderate acid reaction in the upper horizon (5.6-5.7), low humus content (2.4-3.2%) and nature mezobazic (V-71%).

Albic stagnant luvosoils, melanie presented strong differentiated textural (Idt-2.6), are strongly acidic (4.4), have a low humus content (2.6%) and fall within oligobazic soil.

Features of the current ground cover relict Getic Piedmont are determined by about 70% of the territory of high loam of parent material and landform diversity consisting of flat, poorly fragmented by moderately rough terrain. It consists, in luvi-soils order of predominance (55%), with soils occurring cambisoils classes (15%), protisoils, pelisoils (14%), hidrisoils (0.8%) and cernisoils (0.2%) (Figure 4).

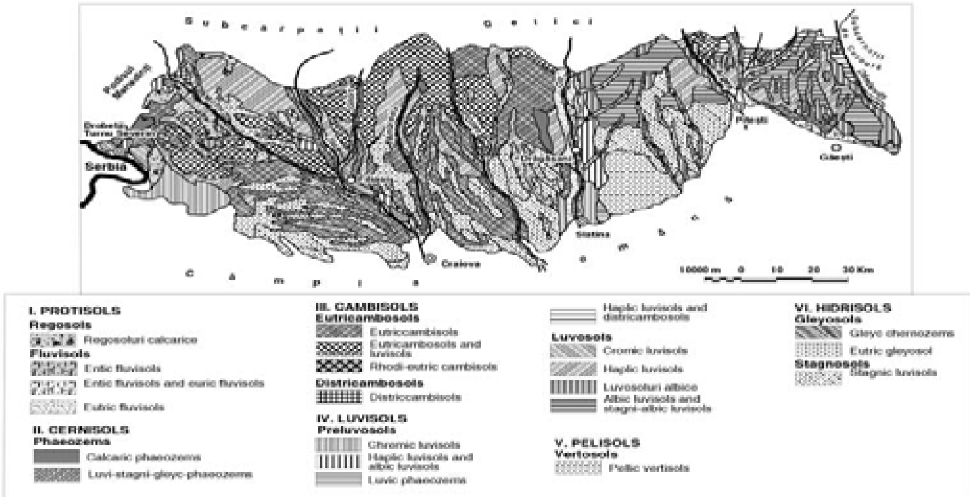

Fig. 4. The relict Getic Piedmont - soil map

The prevailing western relict Getic Piedmont luvisoils (31%) were represented mostly by regosoils (15%) and aluviosoils, as pelisoils type vertosoils (10%). At close range is met red preluvosoils (0.8%) and typical (0.3%), gleiosoils, stagnosoils and even faeozioms class cernisoils.

This section is reported the extent of erosion processes, affecting about 44% of the territory, as excess moisture stagnant.

In the relict eastern Getic Piedmont, covering soil is made up in order of dominance of luvisoils, respectively typical luvosoils, albic luvosoils, including stall (42%), followed by hidrisoils represented by luvic stagnosoils and albic stagnosoils (25%) characteristic of the inter piedmont widely developed. A significant proportion also have the protisoils (19%), with a higher frequency regosoils spread on most slopes. Not missing vertosoils occupying a compact area on the intersaw river.

A significant proportion also have the protisoils (19%), with a higher frequency regosoils spread on most slopes. Not missing vertosoils occupying a compact area on the intersaw river.

Most soils in which we have referred has a fine texture (34-63% clay), sometimes highly differentiated textural, with a medium texture in upper horizons (15-31% clay) and fine-very fine in the lower horizon (48-64% clay), a volume edaphic high (98-100%), moderate degree of compression (5-16%), low-aeration porosity to very low (4-13%), useful water capacity range from very low up to high (70-200 mm/h) and low permeability-too small (0.1-2.2 mm/h).

Humus content of most soils fall between 2-3.5%. Higher values are specific as to cernice gleiosoils as some eutricambosoils evolving under forest vegetation. Over 60% of soils are weak acid-weak alkaline pH 6.1-8.4, lower values of pH (strongly to moderately acid 4.8-5.6) specific luvisoils majority.

The negative impact on processes of soil covering the relict Getic Piedmont, great as erosion, pollution and excess moisture stagnant.

CONCLUSIONS

1. The development of Getic Piedmont had two main phases were distinguished: prequaternary subsidence phase or sea-lake phase (senonian-Pliocene) and quaternary phase semi-lacuster and mainland. Piedmont was formed progressively from north to south in the time elapsed since the end of the Pleistocene Levantine to medium (Mindel).
2. The set of physical and geographical factors have determined ultimately forming the territory of Piedmont Getic a ground cover that has evolved from little lakes by vertisoils to luvisoils.
3. Most of these soils have a fine texture and even a strong textural differentiation, a low humus content, reaction moderately acidic pH to slightly alkaline and degree of saturation in the database varied.

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PEDOLOGICAL IMPLICATIONS OF STRONG WINDS IN SOUTH DOBROGEA

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Keywords: *Dobrogea, strong winds, pedological, ecopedology*

Abstract

Winds are strong atmospheric phenomena, with a great impact on South of Dobrogea land. In meteorology, atmospheric phenomena are defined as characterized by air currents speed ≥ 15 m/s (calculated for a period of 2s). The synoptic activity, the average wind speed ≥ 10m/s (calculated for a period of 10 s) is included under „warning message", its hazardous weather phenomena. The winds in gusts (which for 1 s-20 s, have a speed ≥ 5 m/s compared with the average value in the range set), „warning messages" are transmitted when the speed is ≥ 12 m/s.

These atmospheric phenomena associated with strong turbulent motions, which involve essential changes in hydrothermal and gas regime of ecosystems and in areas where have a high, creating the characteristic morphological adaptations of plants and animals. Ecopedologia areas affected by strong winds in southern Dobrogea, are of concern from several points of view, because the repercussions of this phenomenon is felt in the state of soil fertility, and hence the stability of harvests. The phenomenon of strong wind, in Dobrogea, is extremely influential, sometimes decisive, in determining the extent and intensity of many processes of soil degradation and related to it, to establish agricultural technologies applied, with consequences for crops and production stability achieved.

INTRODUCTION

The ecopedology of surfaces affected by strong winds in Dobrogea deals with various aspects because of the consequences this phenomenon has on soil fertility and crop stability. The knowledge of strong winds climatology is important for their precise forecast and also, for the elaboration of more efficient protection methods against their harmful effects.

In meteorology, strong winds are defined as atmospheric phenomena characterized by air currents with a speed of ≥ 15 m/s (calculated for a time interval of 2'). In the synoptic activity, the average wind speed of ≥ 10 m/s (calculated for a time interval of 10') is included in the category of "warning messages", characteristic to the dangerous meteorological phenomena. For the blasts of wind (considered those that sustain a speed of ≥ 5 m/s for 1'-20', compared to the average value recorded for the given interval), the "warning messages" are transmitted when the speed is ≥ 12 m/s.

MATERIAL AND METHODS

The analysis of strong winds in Dobrogea is based on the data obtained from the observations accomplished in six meteorological stations between 1965 and 2005 (Figure 1). Its purpose is the climatic characterization of the regime, of the occurrence probability (in the representative landscape points, with relatively complete recordings) and of its territorial distribution.

Fig. 1. Distribution of weather stations in southern Dobrogea

RESULTS AND DISCUSSION

The frequency of strong winds ≥10 m/s decreases inside south Dobrogea as the distance from the sea increases. Considering this aspect, there is a tendency of wind intensification in the high, hilly and plateau zones in the south-west, or on the Danube bank (in Harsova), taking into account the fact that the air currents are channeled along the fluvial valley, where the frequency of strong winds ≥10 m/s is close to the one recorded on the Black Sea shore. On the sea surface, the frequency of strong winds ≥10 m/s increases.

The regime of directions characteristic to strong winds ≥10 m/s and ≥15 m/s was presented on seasons in Constanta and also in comparison for January and July in Valu lui Traian, Medgidia and Harsova. Thus is emphasized the way in which these winds are manifested in the eastern and western extremity of south Dobrogea.

The association of north and north-eastern directions with strong-predominant winds can be observed from the Black Sea littoral to the western extremity of Dobrogea, especially in winter. Their frequency is high in the points where the landscape configuration orients wind on these directions, for example on the Black Sea shore (in Constanta) or on the Danube bank (in Harsova). At the meteological stations located in the relatively high landscape, there is an increase in the frequency of western strong winds, for example, in Medgidia in January. In these points, the western strong winds or those oriented by landscape from the western sector of the horizon can become dominant in summer. This phenomenon can be observed in July in Medgidia and Valu lui Traian.

In the daily evolution, there is an accentuation of strong winds at night and in the morning. Their frequency, of the total of these cases, did not drop under 70% in winter and under 50% in the other seasons – at intensities of ≥15 m/s and under 50% in winter and autumn and under 40% in spring and summer – at intensities of ≥10 m/s. The diurnal interval is when the strong northern and north-eastern winds weaken, especially in summer.

As a whole, the annual frequency of strong winds (north and north-east) in Constanta exceeded 70% of the total cases ≥10 m/s and 90% of the total cases ≥15 m/s. Generally, on the Black Sea shore and the bank of littoral lakes, the annual frequency of strong winds ≥10 m/s oscillates between 3% and 4.5% (10-16 days). The most part of the high plateau area of South Dobrogea is included in this frequency register.

Winter is the season with the highest frequency of strong winds. On the sea shore and the bank of littoral lakes, the frequency of strong winds ≥10 m/s oscillates between 5% and 9% (4-8 days), while in the plateau zone, they oscillate between 3% and 6% (3-6 days). At the meteorological stations located in the aerodynamic shelter zones, the frequency of these winds is reduced below 3% (1-2 days).

In spring, the frequency of strong winds decreases, oscillating between 2% and 4% on the littoral and most of south Dobrogea – at intensities of ≥10 m/s and up to 1% - at intensities of ≥15 m/s. A high frequency of strong winds ≥10 m/s is recorded in the marine space (approx. 15% - 2 weeks) and in those areas of orographic intensification of the air currents (almost 14% - 16 days).

Summer is the season with the most reduced frequency of strong winds ≥10 m/s, which reaches 8% (one week) in Constanta and 5% (approx. 5 days) in Medgidia and Adamclisi. In the rest of south Dobrogea, the seasonal frequency oscillates between 0.5% and 1.5%, reaching 0.1% in the sheltered zones.

In autumn, the frequency of strong winds ≥10 m/s intensifies again exceeding 14% (almost 2 weeks) in Constanta and 11% (approx. one decade) in Medgidia. The frequency of these winds oscillates between 3% and 4% at the Black Sea shore and on the bank of the great littoral lakes, while in the most part of south Dobrogea it oscillates between 1%, except the sheltered zones, where it drops under 1%.

The annual variation of strong winds ≥10 m/s is characterized by the reduction of the frequency from winter to summer. Also, there is a tendency of shift of the maximum frequency in winter towards December and January in the marine space and towards February in the southern sector of the littoral, inside the land of Dobrogea.

The maximum frequency was also noticed in December, at some weather stations with short observation period (e.g. Cernavoda). In these cases, the curves of strong wind frequency appear generally disparate and fragmented due to the short period of observation needed for an actual image of the characteristics of the climatologic regime of these phenomena.

Pedological implications of strong winds in South Dobrogea

The ecopedology of surfaces affected by strong winds in Dobrogea deals with various aspects because of the consequences this phenomenon has on soil fertility and crop stability. Like other regions, similar in terms of the geographical makeup (limestone and green schists), the morphological subunits that make up the agroecosystem - the plateaus of Istria, Casimcea, Negru-Voda and Carasu are completely organized for irrigations and many of the analyzed aspects involve this element.

The soil covering, developed on such a structural and lithologic support could only concur with the pedogenetical factors, to which vegetation and the climatic conditions contributed in particular. But, if the former are considered passive factors in the production of soil, the vegetal blanket and the climate had a particular dynamics, their influence being felt in the distribution area, and especially in the soil quality and preservation state.

The predominant soils are: chernozems (CZ), cambic chernozems (CC), yellowish soils (SB) and redzina soils (RZ), all part of the mollisol soils, lithosols (LS), regosols (RS) and coluvisols (CO), all belonging to the non-evolved, cut or sloppy soil class.

The problem of research, in the context of the themes proposed, targeted the following aspects:

- the destruction of the structural aggregates and degradation of texture state, caused by strong winds;
- erosion (surface and depth), as a result of the deflation process;
- the filling of the river bed with sediments fallen from the slopes and brought by the wind;
- the salinization-alkalization phenomenon as a result of transport by means of wind of the particles resulted from marine evaporation and deposited together with the loess layer;
- irrigation and the process of excess humidity, temporarily stagnant, caused by wind intensity and direction;

It is well known that south Dobrogea represents a transition region for the Romanian ecopedological area, from steppe soils generated by the extreme climate, dry and strongly xerophytic of the Black Sea basin, to the forest-steppe soils, characteristic to the Danube basin. A specificity of the landscape is given by the loess deposits, with variable thickness (from tens of cm to tens of meters) which deposited on a pre-existing landscape with hard stratigraphical organization. The loess also constitutes the parental material on which all the soils that belong to the mollic class (and not only) were formed.

The fact that these phenomena exist even in regions located at over 100 km from the shore (Esichioi, Dumbrăveni etc) and irrigations were not used at the research date (to emphasize a secondary salinization) support without a doubt these statements. Moreover, recent researches accomplished by Irina Pozdneakova all over south Ukraine confirm the presence of sodium in the soil's absorptive complex (1996). Wind was the agent that spread by air the saline powders resulted from the marine evaporation over the entire basin of the Black Sea and deposited with the loess in the last part of Pleistocene.

CONCLUSIONS

1. The wind factor is responsible for the degradation of the layer of fertile soil (Table 1).

Table 1

Size and structure of disaster areas during 1980-2009 strong winds

Aria	**Disasters per year average surface**	**Affected by strong winds which**	
		ha	% of the affected area
Albeşti	629	252	40.1
Ciocârlia	630	271	43.0
M. Kogălniceanu	1694	89	5.1
Nazarcea	393	82	20.9
Negru Vodă	1741	561	32.2
Dorobanțu	1204	300	24.9
N. Bălcescu	1164	44	3.8
Poarta Albă	591	30	5.1
Săcele	832	172	20.7
Târguşor	1912	15	0.8
Independența	176	176	100.0
Peştera	868	300	34.0
Vultur	619	619	100.0
Adamclisi	209	209	100.0
Ostrov	2324	8	0.3
Total South Dobrogea	28066	3128	11.1

2. Limestone, green schists and detritus resulted from their alteration was uncovered where the wind forces reached considerable intensities and the

lithologic substrate was made up of consolidated material. A characteristic of the action of strong winds in Dobrogea on soil genesis is represednted by the occurrence of the salinization and alkalization process. The research done on a large ecological area, exceeding the territory of south Dobrogea, demonstrates the presence of sodium in the loess deposits and at considerable depth (0.80 - 1.50 m). This has only one explanation: the sedimentation of saline powder with the Pleistocene loess dust.

3. The strong winds in Dobrogea have an extreme influence, sometimes decisive, on the establishment of the degree and intensity of many soil degradation processes, on the establishment of the used agricultural technologies with consequences on the crop stability and productions obtained.

ACKNOWLEDGEMENTS

We wish to thank the Regional Meteorological Centre provided valuable data Dobrogea well as local municipalities gave us information about areas affected by strong winds.

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RESTRUCTURING LAND USE AND AGRICULTURAL CROPS DEPENDING ON THE CURRENT STATE OF CLIMATE AND SOIL RESOURCE OF ROMANIA

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Keywords: *agricultural land use, aridization, EUV (edaphic useful volumes), climate risk, psamo-soils*

Abstract

The evolution of the current climate has caused many changes in terms of environmental components, including the soil. Aridization process led to the depreciation of its fertility traits for example: de-structuring of aggregates, compaction, consequently decrease of the amount of humus reserve, soil water constant changes. This led to restructuring of land use, replacement of other crops, energy, land improvement systems in rethinking and rehabilitation.

This paper having personal support of some researches in several agro-ecosystems of Romania aims to bring the current concerns regarding the current status of the land, soil support and conservation status of soil and not least the current cultures and future crops.

INTRODUCTION

The research of agrarian space presents, from our point of view, several components, the most important being: geo-topographic location, pedological resource, all hydro climatic conditions and land use. The last three decades are characterized as the climate issue, both through extensive changes in the global and national territory.

The temperate zone, in which we are situated, has suffered for the period to which we relate many perturbations of temperature, precipitations, changes in the status of vulnerable land and deepened continuously.

If we have to take into consideration the proposed scenarios for the next 20 - 50 years, following the increase in value of temperature, 0.8 ^{0}C, as is currently the Central and Eastern Europe will have a similar thermal regime of northern African continent. Also finds that in many countries of the Mediterranean and the Balkans or Black Sea basin. The year 2003 was the warmest of the latest century, with incalculable losses to agriculture, and unfortunately many human lives.

The weather is expected according to the calculations to have an average annual warming of 0.5-1.5 ^{0}C until the year 2030.

Continued global warming will result in +3 ^{0}C melting of polar glaciers and raise sea levels by 1 ma planet. At 4 ^{0}C in addition, Scandinavia will become Europe Mediterranean and northern Canada the most fertile agricultural area of the world.

For the year 2035 are expected in the current rate of warming, melting glaciers and the total since the current five degrees above average temperature, thermal shock will be that mankind will not last.

Our natural question is: who will be the answer to the impact of soil future thermal shock? It will degrade the fertile layer? How and in what rate? How will react to its physical and chemical components to stop the phenomenon and what measures are necessary for improvement?

Therefore, for the present situation we intend to point such phenomena, in various locations in our country and having a specific pedology support.

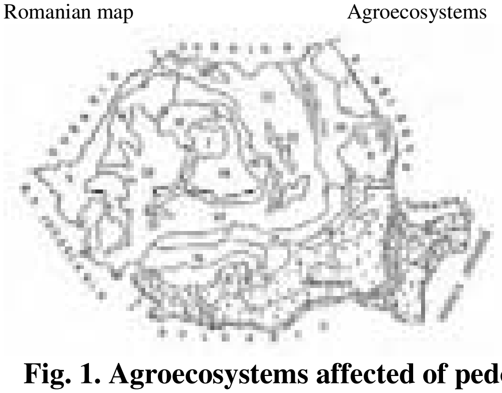
The pragmatic side means the restructuring of land use, accompanied by their subsequent replacement to other species than the traditional ones. At the same time, it takes into account the translating of the culture of grain, with more energy as alternatives to time.

THE PURPOSE AND METHODS OF RESEARCH

What has followed? First of all, the crops evolution of current land use status according to the pedology resource. Research has the high-impact of aridization process where soil vulnerability is evident.

We have focused on certain soil types, namely: psamo-soils in southern Oltenia, kastanoziom in Dobrogea and chernozems in limestone in the south of Moldova. Sites are in correlation with the forecast sketch (with additions) of moisture regions in Romania (USD Soil Conservation, 1994).

Romanian map   Agroecosystems   Legend



1. Romanian plain and Dobrogea tableland
2. Flood plaine and Danube Delta
3. Dobrogea tableland
4. Romanian plain
5. Oltenia plaine with Dune

Fig. 1. Agroecosystems affected of pedological aridization with degradation sustenability from land crop

Table 1

Analytical data

Sandy salonetzic soil - Flood Danube plain; Potelu, Corabia											
Horizon	Depth (cm)	Clay %	Fine sand %	Humus %	Nitrogen %	Sodium m.c.	pH	$CaCO_3$	Hidraulic conductivity mm/h	Aeration porosity %	Resistance to penetration Kgf/cm²
Ao	0-15	6.2	74.5	0.88	0.021	0.43	8.5	8.60	105.2	32.3	10
A/C	23-32	4.1	66.8	0.30	0.010	0.43	8.8	9.70	121.4	34.6	7
C	35-45	3.3	73.4	0.17	-	0.43	8.8	5.83	137.9	36.4	7
	70-80	6.3	87.7	-	-	0.59	9.0	7.58	134.9	34.9	6
	90-100	5.1	89.5	-	-	0.59	9.0	13.35	-	-	-

Chestnut steppe soil - Dobrogea; Casimcea zone					
Horizon	Depth (cm)	Clay (%)	Fine sand (%)	Humus (%)	Nitrogen (%)
Ap	0-13	24.6	6.9	2.1	0.13
Am	18-33	24.0	8.6	1.7	0.13
A/C_{ka}	35-50	24.4	10.1	1.5	0.11
C_{ka}	75-90	23.3	16.1	0.9	0.05
C	100-120	22.7	15.7	-	0.04

Lithosol - Central Dobrogea									
Horizon	Depth (cm)	Grading		Chemical			Physical		
		Clay (%)	Fine sand + coarse sand (%)	Humus (%)	pH	Nitrogen (%)	Total porosity (%)	Aeration porosity (%)	Hydraulic conductivity mm/h
A/R	0-17 (rock)	20.6	54.5	5.70	7.8	0.31	59.9	24.9	134.7

Rogosoil - South Moldova - Corvului plain									
Horizon	Depth (cm)	Grading (%)			Chimice		Fizice		
		Clay	Silt	Fine sand + coarse sand	pH	$CaCO_3$ (%)	Hydraulic conductivity mm/h	Aeration porosity (%)	Resistance to penetration Kgf/km^2
Ao	0-20	14.6	29.3	56.1	8.3	12.7	1.5	49.6	24
A/C_k	22-33	12.8	30.5	56.7	8.4	14.6	10.4	54.3	20
C	35-45	9.7	27.5	62.8	8.6	16.2	-	-	-
	50-75	9.5	21.1	69.4	8.5	13.2	24.2	56.9	17
	80-100	10.6	30.8	57.8	8.7	11.9	-	-	-

In the last 25-30 years, the area (agro ecosystems) we refer to, belonged to a climate of xeric type.
Our methods of investigation were based on specific mapping, such as substantiation to draft L.I. (land improvement) (DES-DRE, CES, OT, etc.) and A scale covered were determined according to load and complexity of land.
Soil analyses were those of current laboratory practice, following in the dynamic modification of physical and mechanical attributes (DA, RP, K, PT, PA and others) for fertilization (humus and Rh, macro and micro elements) or soil chemistry (pH, V, carbon content, salts etc.).
The data are based on soil evaluation and land classification in soil fertility class. It was intended also to compare the present situation with the previous evaluation of soil notes, all related to land use and culture.

The available production data helped us to understand the real situation of vulnerability of land for agrarian economy.

THE CONTENT OF RESEARCH AND RESULTS

In Oltenia, the area investigated was the Danube meadow between localities: Dunareni-Bechet-Potelu-Corabia. Dominant soils are psamosoils (sandy soils) and some subtypes of alluvial sandy soil.

Their characteristics are low content of clay (<12%) and humus (subunit percent). Over time, in the process of farming these soils have been improved (irrigation, fertilizers, incorporation of clay, etc. Fertilizers were predominantly organic fertilizer and green manures. The effect was not the desired one, because of the strong mineralization of the incorporated material and the leaching of these on soil profile. Applied, for example, from the first decade of March to the end of spring, in May, they were completely mineralized and no trace or effect of their incorporation into the soil was identified. Humus still remained <1% and the reserve calculated on the first 50 cm 30t/ha - extremely small.

The values of soil surface temperatures in the South of Oltenia are often between 50 ^{0}C- 60 ^{0}C and it is continued throughout high value on control sections. Lack of water in the soil resulted in the most of plantation from the Danube to the root system atrophy, in some cases, even to necrosis. The effect: dry partially or totally hearths entire perimeter planted.

The transition from one regime type to one weak arid xeric, lithology means an extension of periods of dryness, from 4 months consecutively in a period of several months of dryness effective control of entire sections of land.

Here, in Oltenia, Mehedinti county territory, at Gogosul and other territories like Burila Mare, with sandy soils, specialists have taken measures replacing maize crop in 2009, with sorghum and triticale plants better adapted to new climatic conditions. It is expected, that in a short time, in southeastern Oltenia to introduce also in culture citrus and fig trees.

<u>On the fields of Dobrogea</u> with pedology component of kastanozioms, in majority, and with other types or subtypes lithic (conditioned by VEU), vulnerability is extremely high, the report Penmann (P/ETP) being the most critical in Romania (<0.75).

In the Casimcea plateau land, the arable land restrains use, the place being taken by xerophytes pastures, pastoral worthless. Erosion as a process characteristic of vulnerability, removed only in the last two decades more than 5,000 hectares of set-aside.

Drought, as the defining phenomenon of aridization, between 1999 and 2003 led only to partial or total disaster of crops: wheat, barley, maize, sunflower and rape. The value of loss production was then tens of millions of ROL in Castelu, Medgidia, Poarta Alba, Basarabia, Valul lui Traian. Only for the wheat, for example, were losses of 9.3 billion of ROL, from Medgidia and 43.7 billion of ROL to Castelu.

In the sunflower crop in Castelu, in the same year (2003), the losses amounted to 36.5 billion of ROL same cause of vulnerability soil due to the impact of the phenomenon of aridization.

Following soil indicators, the most affected were: humus and reserve humus, carbon content, hydro-physical and physic-mechanical constants. The indirect factors are found slope land and groundwater regime. Penalties included by these indicators for soil evaluation notes, go to 20% -70% (subunit coefficients of 0.8-0.3).

Where we located the use of pasture land, especially on the slopes of the valley Casimcea, listed indicators are useful add edaphic volume (VEU) - appearance of hard rock (limestone or green schist).

<u>In the south of Moldova</u>, Covurlui plateau area, investigating the climate impact on soil resource was noted by: intensive mineralization of humus horizon with dehumificatin softness, destructuring of the physical and the particular process area, sufossion in loess.

Land is now slightly arid climate, compared to the previous xeric, evidence of its extension northward.

The pedology shell is dominated by limestone chernozems (CZka), the plates and regosoils (RS) on the slopes. Degradation of the physical is obvious, both to the chemical. The recognized natural causes, joined and human action, through interventions such as deforestation, destruction or abandonment hydro ameliorative and ESC systems, pollution, etc. Emanation of dust from the factory steel plant in Galati, leading to contamination of thousands of hectares of farmland and abandoned works to the highest of the IRI system (Terrace Covurlui-170,000 ha) have influenced land degradation in accelerated.

The reducing fertile led horizons by erosion and deforestation (especially in points of connection interfluve slope-shelf) to change land use (from arable land to grassland or even in the future in non-productive land).

Another cause, the man-to-ground impact of the current climate, with repercussions on land use changes remains the new cadastral configuration. This led to fragmentation of the land, there are currently four million parcels cave regarding Romanian level. Changes in the geo-topographical drawing of boundaries of plots could not keep account of old hydro schemes and other works of land improvement, ameliorative recommendations from pedology methods.

Natural causes overlapping human interventions have reduced fertility potential of the soil, reaching the abandonment of approx. 1 million ha, with changes of use or other destinations. Approximate of the 7 million hectares are used for only 50% - 60% of the area (3.5 million hectares remaining, currently cultivated).

If the trend of global transformation will continue, Romania will have to draw up new agricultural areas and ecological pedology climate areas where crops in rotation to meet the resources of soil.

Restructuring will also replacing traditional crops such as wheat and maize, with several technical plants adaptable to new thermal conditions (e.g. sunflower, rapeseed), but also the introduction of specific types Mediterranean climate, e.g. sorghum, millet, triticale, future planning of olive groves, kiwi and fig trees. Some of them are already cultivated, occasionally the surfaces (the Ostrov area), and especially olive Mediterranean species and will be put into future concerns of specialists.

A new entrant in culture aside is artichoke, herbs and not only, as we shall see, and planted on former swamp alluvial soil of Ialomita, the SC Agrofarm Fetesti. Cultivation was done in 1000 ha in 2009, in order to test its energy value. Artichokes proved better adapted to new climate conditions on and support the underlying pedology of increasingly low in humus and nutritional substances.

On the cultivated area has achieved a production of about 20,000 t, which can then be used to manufacture "blade"-small solid bio-fuels. The equivalent in classical-diesel fuel is 2 kg pallets for gas oil 1l. Being a perennial, artichokes, exploit weak soils and potential environmental pedology and the profit rate can reach 700 euro / ha, compared with wheat which does not exceed 50 euro a ha.

The whole experiment of meadow reclaimed from the sea to the Danube, from Fetesti is not singular for Europe, because it is part of a general partnership called "Green Energy", with agricultural universities in the Balkans and beyond. The next phase will invest 3 million euro for building factory pallets and gradual transition to the use of bio-fuels, partly or wholly for agriculture.

CONCLUSIONS

1. Global warming is actually an undeniable phenomenon that, for agriculture in general and soil distinction in particular, will mean gradual but continuous degradation of everything that's sustainable land as a human food resource.
2. Vulnerability of agricultural land in Romania was identified after 1990, all studies of specialized international bodies (ONU-FAO, PNUD, UNISDR-United Nations International Strategy for Disaster Reduction) and materialized on the "Map of forecast moisture regimes soils" (1994).
3. For Romania, the impact is more obvious in the agro-ecosystems of South and East (Oltenia, Baragan, Dobrogea and South of Moldova), with such resources as soils: psamosoils, kastanozioms, chernozems limestone, lithic or regosoils types and subtypes.
4. The change in the soil moisture regime resulted in poor arid climate zones extending to the detriment of xeric.
5. Vulnerability of soils meant obvious changes in terms of physical, chemical and biological component, the most important being the mineralization of humus-acid huminic providing dark blackish organic matter, with repercussions on the state of fertility.
6. Some properties such as: acidity, degree of saturation in bases, total and active calcium content, this salt, etc. will undergo changes that will lead, predictably, to remove from arable land, save currently is replacing or changing assortment of cultural usage.
7. Agro-pedology restoration will mean adapting to rapid and extensive measures such as reconsideration of IRI and CSE systems, fertilization mainly organic radical; structured rotation with perennial plants and dominant; move limits by replacing traditional crops with plants easily adaptable to new climate conditions.

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RESEARCH CONCERNING THE EVOLUTION OF PHYSICAL AND CHEMICAL PROPERTIES OF REDDISH PRELUVOSOIL FROM MOARA DOMNEASCA

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Keywords: *reddish preluvosoil, chemical properties, technologies*

Abstract

The research conducted in the experimental field from Moara Domneasca showed changes in the physical and chemical characteristics of reddish preluvosoils. The measurements of chemical characteristics (reaction, base saturation degree, hydrolytic acidity, nitrogen, phosphorus and potassium content) showed a change in the application of agricultural technologies, while there were negative changes regarding the main physical properties (bulk density, total porosity, soil permeability, penetration resistance).

INTRODUCTION

The research conducted in the experimental field from Moara Domneasca showed that the following technologies are applied to a significant downward trend from 6.2 in soil reaction 15 years ago in 2009 to 5.1-5.4, while the humus content is low to very low and N, P, K content is also medium to small. Reddish preluvosoil has a clay-loam textures that influence the bulk density, soil permeability and soil penetration resistance. To follow the changes, comparisons were made between the main soil properties determined in tests conducted in 1995 and 2009 in the fruit trees plantation and the Agrotehnics experimental field.

MATERIAL AND METHODS

The research was conducted in 2009 in the Moara Domneasca experimental field on reddish preluvosoil, and soil samples were collected in disturbed and undisturbed state the depth of 0-20 cm, 20-40 cm and 40-60 cm to determine the main chemical and physical properties of soil: soil reaction, content of humus, N, P, K, base saturation degree, hydrolytic acidity, soil texture, bulk density, soil porosity, penetration resistance and soil permeability. Soil samples were collected from the fruit trees plantation, where works were carried raising up to 40 cm and from the Agrotehnics experimental field of plowing 20 cm. Soil samples were analyzed and interpreted according with the methodology ICPA, 1987. To follow the changes in the evolution of chemical and physical properties of the reddish preluvosoil from Moara Domneasca, the physical-chemical characteristics of the control determinations were measured in 1995 by the specialization of Pedology.

RESULTS AND DISCUSSION

The climatic conditions recorded at the Moara Domneasca area in 2009 are characterized by deviations from the characteristic average multiannual values of the area.

In 2009, rainfall was well above the normal (566.4 mm) and an average annual temperature of 12.2^{0}C (Figure 1). During the vegetation season, the amount of rainfalls was 357.6 mm, exceeding the average multiannual values of 118.6 mm, and an average temperature of 20.9^{0}C, compared to 19.2^{0}C as it is normal for the respective area, i.e. an increase by 1.7^{0}C.

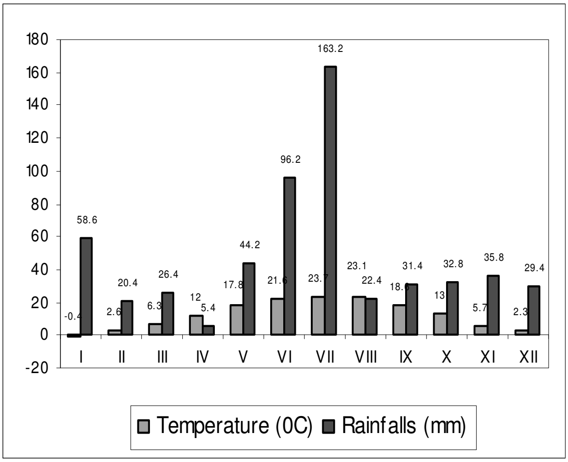

Fig. 1. Temperature and rainfalls values

at the Moara Domneasca area in 2009

The analyses conducted to determine soil reaction showed a significant pH decrease of reddish preluvosoil, generally in the first 0-20 cm from 6.8 (slightly acid reaction) respectively at 5.4 and 5.2 (moderately acidic reaction). This is generally caused by mineral fertilizers with acid reaction that have long applied in the experimental field from Moara Domneasca. The closely related reddish preluvosoil pH values recorded a decrease of base saturation degree from 71.33% to 65.25 and 60.1% respectively (Figure 2).

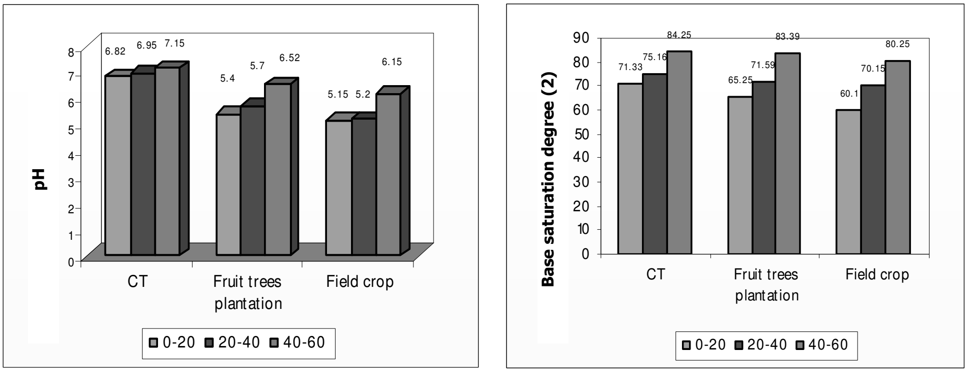

Fig. 2. Evolution of soil reaction and base saturation degree from Moara Domneasca experimental field

The decreasing base saturation degree increased the soil hydrolytic acidity from medium to high in the first 0-20 cm of soil (Figure 4). We consider that, to neutralize the acidity of reddish preluvosoil should, the apply to limestone amendments, a dose of 10-15 t/ha.

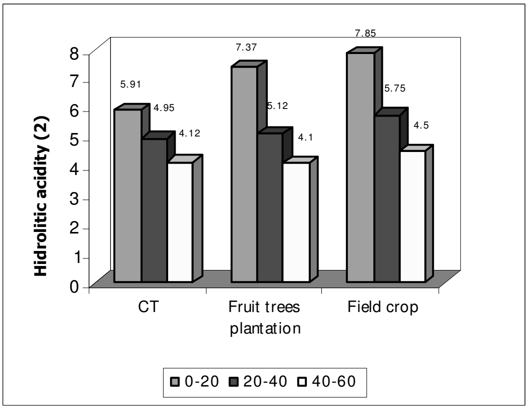

Fig. 4. The hydrolytic acidity value of reddish preluvosoil from Moara Domneasca experimental field

The organic matter content in the reddish preluvosoil is low in the first 0-20 cm and very low at 20-40 cm depth. Soil nitrogen supply is low during the first 20 cm, total nitrogen recorded low to very low at depths greater than 20 cm (Figures 5).

The state nutrient supply mobile and mobile potassium P indicates a good supply of reddish preluvosoil the first 20 cm, potassium and phosphorus content in soil is high (Figures 6).

The phosphorus and potassium content in soil has increased compared with 1995 due to mineral fertilizers applied lately to plants and fruit trees plantation.

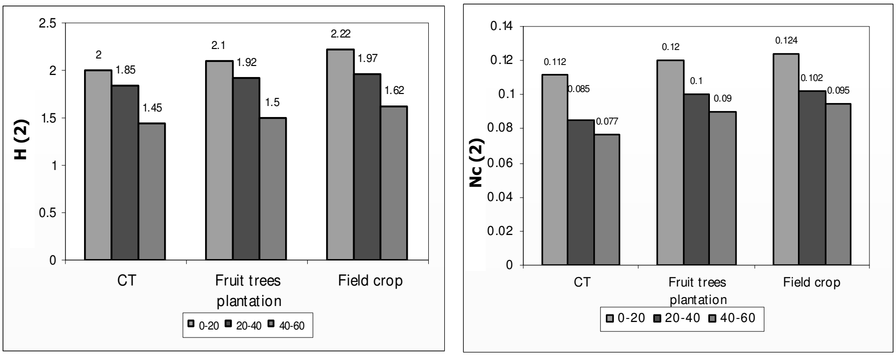

Fig. 5. The organic matter and nitrogen content of reddish preluvosoil from Moara Domneasca experimental field

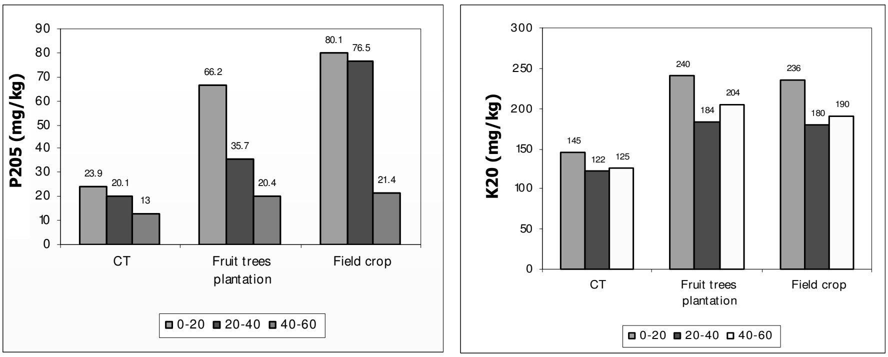

Fig. 6. The phosphorus and potassium content of reddish preluvosoil from Moara Domneasca experimental field

The physical characteristics of reddish preluvosoil are influenced generally by clay-loam texture with a clay content about 32% in the first 0-20 cm and to around 40% clay to 60 cm.

The results obtained up to 60 cm depth on the distribution of particle size fractions of sand, dust and clay showed that texture in the upper horizon (0-20 cm) is clay dust and clay on clay 20-40 cm and 40-60 cm which depth is increasing the resistance to penetration, the bulk density and total porosity decrease with increasing clay content in soil profiles (Figure 7).

The bulk density values in the fruit trees plantation indicates that the soil is non compacted the first 0-40 cm due to work performed before the fruit growing plantation establishment and in the field crops soil is non compacted in the first 0-20 cm, slight compacted between 20-40 cm and moderate compacted over the 40 cm depth.

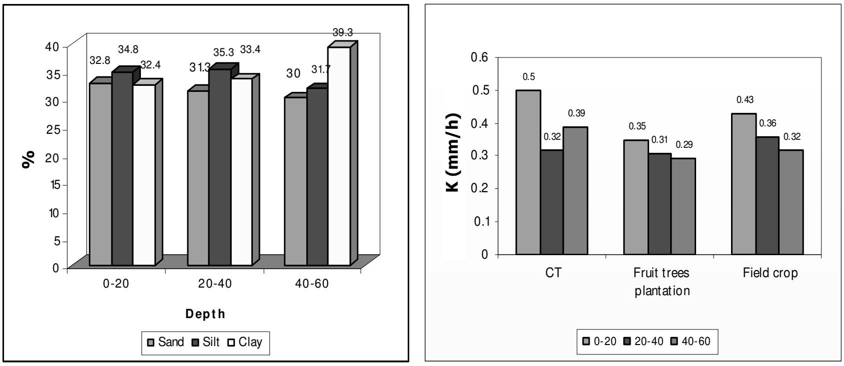

Fig. 7. The particle size distribution and soil water permeability of the reddish preluvosoil located at Moara Domneasca

The total porosity of reddish preluvosoil have higher values in growing trees and small to medium values of field crops which were recorded and higher values of bulk density (Figure 8).

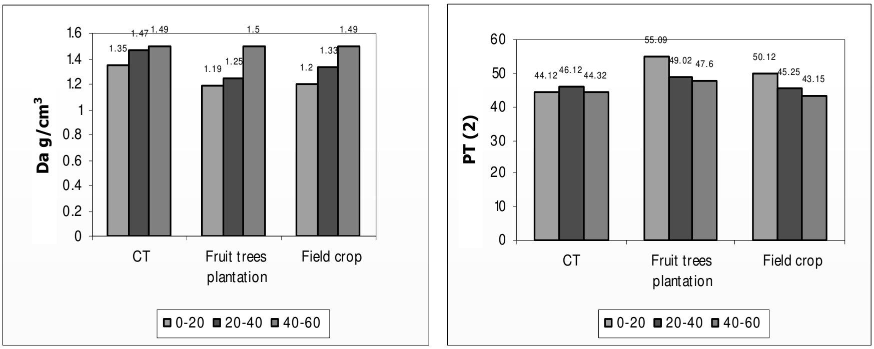

Fig. 8. The bulk density and total porosity of the reddish preluvosoil from Moara Domneasca experimental field

Soil penetration resistance has small amounts of fruit trees plantation and higher values in the experimental field due to higher values of bulk density and lower of total porosity. The penetration resistance values are affected by increasing clay content and the soil moisture profile. The value obtained 0.8-1 MPa, not adversely affect plant root system development (Figure 9). Under the pronounced decrease in soil moisture below 10% penetration resistance of reddish preluvosoil can touch around 2 MPa to 30-40 cm depth, which is a limiting factor for the development of plant root system.

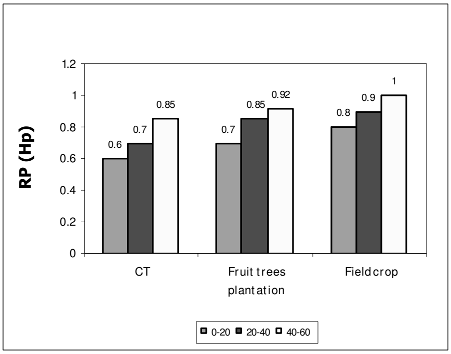

Fig. 9. Soil penetration resistance for management systems (July 2009)

CONCLUSIONS

1. The Reddish Preluvosol from the Moara Domneasca experimental field has a low humus content between 2.1-2.2% the first 20 cm.
2. Lately, reddish preluvosoil reaction underwent significant changes in the application of agricultural technology with values between 5.2-5.4, moderate acid reaction.
3. The decreased reaction and increase the hydrolytic acidity requires the application of limestone amendments.
4. The clay-loamy texture of soil determine a reduced of soil permeability which favors rain water stagnation on soil surface. To increase the soil permeability and disposal of soil compactation should apply organic fertilizers and agricultural work done during the optimum moisture.
5. Soil penetration resistance was reduced less than 1 MPa because there was an additional moisture during May-June when the tests were conducted.

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STUDIES ON THE MODIFICATIONS OF PHYSICO-CHEMICAL ATTRIBUTES OF ARABLE LANDS FROM THE WATER CATCHMENT AREA VALEA HARBOCA, LOCATED ON THE LEFT SLOPE OF SLANICUL DE BUZAU, COMPARED WITH THE STANDARD PROFILE

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Keywords: *erosion, hydrographic basin, improvements*

Abstract

The soil study conducted in the water catchment area of Valea Harboca aimed the identification, characterization and evolution of soil coating under anthropogenic influence. In this regard, a control profile was opened (under natural regime) in order to trace, with its help, the evolution of the physico-chemical properties of the cultivated soils.

The soil types identified after analyzing eight main profiles are: chernozem, erodosol and antrosol, under the current system of soil classification.

The project presents a comparative study of the physico-chemical attributes of the arable soils from the studied perimeter, with the ones of the standard profile. Among them were selected: granulometric composition, Da, PT, pH and the humus content, on two depths 0-20 and 20-40 cm.

MATERIAL AND METHODS

For soil characterization, three alignments were set in the top, middle and lower region of the water catchment area, on which 10 main profiles were opened, whose description permitted the identification of the soil types existing in the region: chernozem, erodosol and antrosol. In this project, three representative profiles are presented for the studied area and a standard profile of the regional soil (chernozem). From the soil attributes, determined by laboratory tests conducted on samples harvested from the main profiles, the following were selected for presentation: granulometric composition, bulk density, total porosity, pH and the content in humus.

RESULTS AND DISCUSSION

Erodosol-cambic-calcaric (ph1) is situated in the upper third of the right slope strongly inclined; with live farm use (it was arable). The soil formed on loess deposits, has uniform medium texture on profile and is excessively eroded. The soil formula and name below ground level is:
ER-ca-ka/k1d3e15-SL-l-Vn; *Erodosol cambic, carbonatic, semi-profound, excessively eroded by water, loess, medium clay, live.*

Morphological description of the profile

Aok	**Aok horizon (0-17 cm)**: clay, 10YR3/2 color in wet condition and 10YR4/4 in dry condition, poorly developed granular structure, friable in wet condition, moderately cohesive in dry condition, slightly plastic and adhesive, moderately compact, strong effervescence
Cn1k	**Cn1k horizon (17-65 cm)**: clay, 10YR5/4 color in wet condition and 10YR6/5 in dry condition, unstructured, friable in wet condition, moderately cohesive in dry condition, slightly plastic and adhesive, moderately compact, strong effervescence, straight net crossing;
Cn2k	**Cn2k horizon (over 65 cm)**: clay, 10YR6/6 color in wet condition and 10YR7/6 in dry condition, unstructured, friable in wet condition, moderately cohesive in dry condition, slightly plastic and adhesive, moderately compact, strong effervescence, presents shell fragments

Gleic-Chernozem (ph2) is located at the base of the left slope, arable agricultural use. The soil was formed on loess deposits, it had uniform medium texture and presented gleic horizon of oxidation-reduction (Go) from 63 cm in the profile. The soil formula and name below ground level is:
Cz-cb-gl/G3d6-SL-l/t-A; *Gleic chernozem, strong depth, loess and loess deposits, medium clay/medium loamy clay, arable*.

Morphological description of the profile

Am	**Am horizon (0-26 cm)**: clay, colored in shades of 10YR2/1 in wet condition and 10YR2/3 in dry condition, wet, glomerular structure disturbed by cultivation, friable in wet condition, poor cohesive in dry condition, slightly plastic and adhesive, light, frequent cervotocine, cornevine and larvae places, gradual right passing.
Bv	**Bv horizon (26-63 cm)**: loamy clay, colored in shades of 10YR2/3 in wet condition and 10YR3/4 in dry condition, wet, well developed angular polyhedral structure, friable in wet condition, moderately cohesive in dry condition, moderately plastic, adhesive and compact, rare cervotocine and cornevine, gradual right passing.
Cn1	**Cn1Go horizon (63-125 cm)**: clay, colored in shades of 10YR5/3 in wet condition and 10YR6/4 in dry condition, mottled appearance, it shows frequent 10YR3/1 color stains in wet condition, wet, unstructured, friable in wet condition, moderately cohesive in dry condition, moderately plastic, adhesive and compact, gradual right passing.
Cn2Gr	

Antrosolul – hortic (h4) is located in the lower third of the right slope, arable agricultural use. By the leveling executed in the area, on the surface of the soil was deposited a humus material with a 60 cm thickness. The soil formula and name below ground level is:
At-ho/d5c63-SL-l/t-At; *Antrosol hortic, very profound, highly covered anthropic, loess and loess deposits, medium clay / medium loamy clay, arable.*

Morphological description of the profile

Aho	**Deposited material (0-60 cm)**: clay, the color is not uniform and it's dark and its dominant shade is 10YR2/2 in wet condition, wet, unstructured (with glomerular fragments), friable in wet condition, moderately cohesive in dry condition, slightly plastic and adhesive, moderately compact, rare medium cracks, gradual right passing. **C1 (Am) horizon (60-80 cm)**: loamy clay, 10YR3/2 color in wet condition and 10YR3/3 in dry condition, wet, poorly developed granular structure, friable in wet condition, moderately plastic, cohesive and compact, traces of roots, gradual right passing.
C1(Am)	C2 (Bv) horizon (over 84 cm): loamy clay, 10YR4/4 in wet condition and 10YR5/4 in dry condition, wet, moderately developed angular polyhedral structure, friable in wet condition, moderately plastic, cohesive and compact.
C2(Bv)	

Chernozem (ph6) is the standard profile, located at the base of the right slope, in an area without anthropogenic intervention, it is used as pasture. The soil was formed on loess and presented Cca horizon at the depth of 45 cm on profile. The soil formula and name below ground level is:
CZ-ca/k3d4-SL-l/s-Ps; *semi-calcareous* c*hernozem, moderately deep, loess and loess deposits, medium clay / sandy clay, pasture.*

Morphological description of the profile

Am	**Am horizon (0-26 cm)**: clay, 10YR2/1 color in wet condition and 10YR2/3 color in dry condition, wet, partially disturbed glomerular structure, friable in wet condition, moderately compact in dry condition, slightly plastic and adhesive, light, frequent thin roots;
Bv	**Bv horizon (36-45 cm)**: clay, 10YR3/1 color in wet condition and 10YR3/3 color in dry condition, wet, partially disturbed polyhedral structure, friable in wet condition, moderately cohesive in dry condition, slightly plastic and adhesive, moderately compact, rare thin roots; **Cca horizon (45-68 cm)**: clay, 10YR5/4 color in wet condition and
Cca	10YR6/5 in dry condition, wet, unstructured, friable in wet condition, moderately cohesive in dry condition, moderately plastic; **Cn horizon (over 68 cm)**: clay, 10YR5/5 color in wet condition and 10YR7/6 in dry condition, wet, unstructured, friable in wet condition,
C	moderately cohesive in dry condition, moderately plastic, adhesive and compact, strong effervescence, frequent $CaCO_3$ stains, it presents sand insertions.

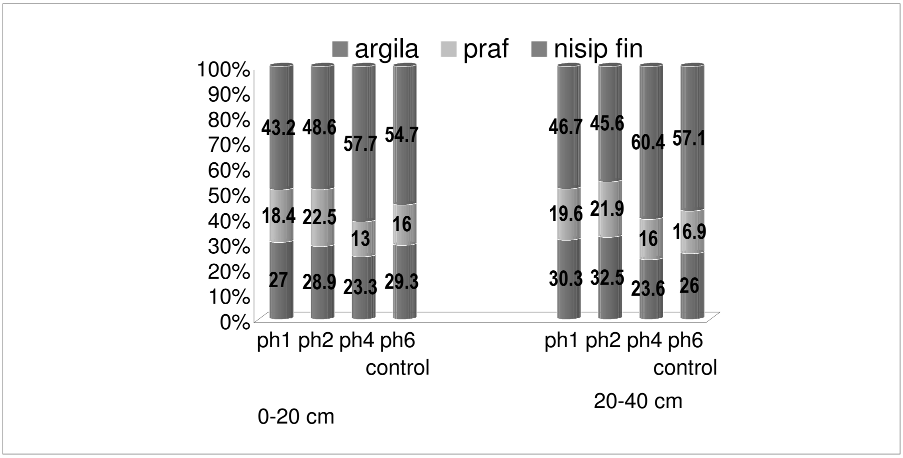

Fig. 1. Granulometric composition, at the 0-20 cm and 20-40 cm depths, it the analyzed profiles

In comparison with the clay content of the standard profile, it was observed: in the first 20 cm, the values diminish, compared with the control profile, by 0.4% at the gleic chernozem, by 2.3% at the erodosol cambic and by 6% at the antrosol hortic; in the next 20 cm, the clay content diminishes only at the antrosol hortic, by 2.4%, at the gleic chernozem and at erodosol cambic increases by 6.5%, respectively by 4.3%.

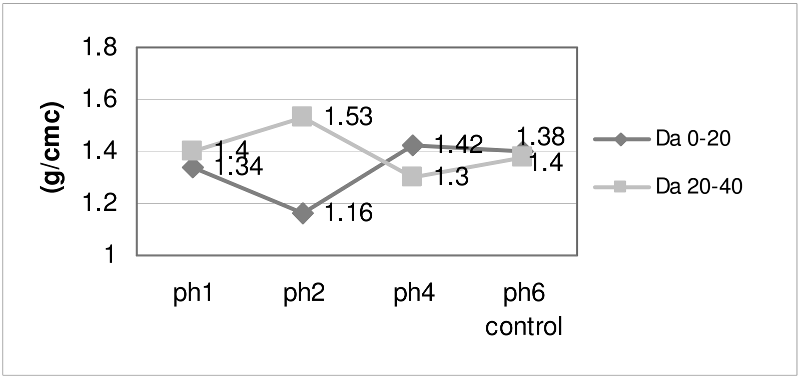

Fig. 2. Bulk density values, at the 0-20 cm and 20-40 cm depths, at the analyzed profiles

Bulk density values (Da) (Figure 2), in the first 40 cm, are close only at the standard profile and at erodosol. The largest amplitude of these values is registered at the gleic chernozem, whose pressing starts at 40 cm. The close values of the apparent density at antrosol show a uniformity of the material deposited on the soil surface by smoothing.

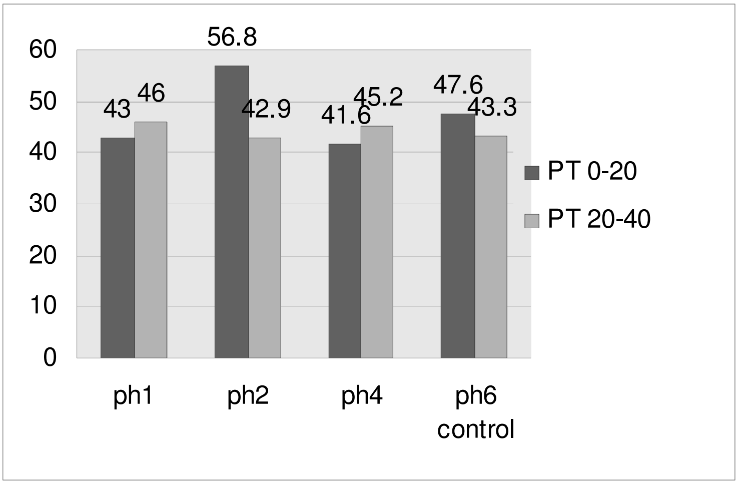

Fig. 3. Total porosity values on the 0-20 cm and 20-40 cm depths, at the analyzed profiles

In comparison with the standard profile, the gleic chernozem has the highest value of total porosity (PT) (Figure 3) in the first 20 cm. At erodosol and at antosol, the values are lower in the first 20 cm in comparison with the next 20 cm, due to agricultural usage.

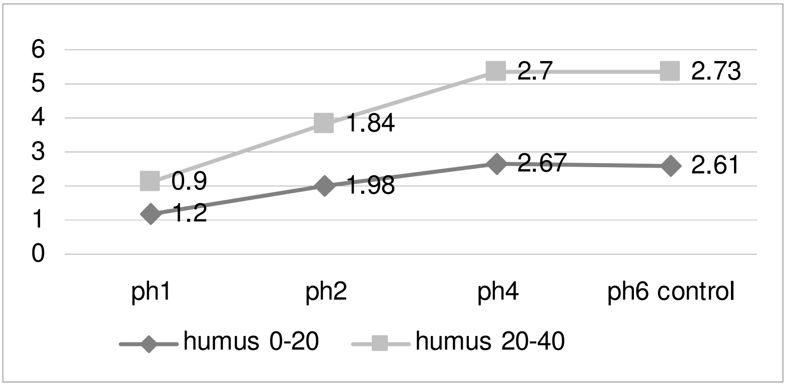

Fig. 4. Values of the humus content, on the 0-20 cm and 20-40 cm depths, at the analyzed profiles

The humus content (Figure 4) has the lowest value (0.9%) in the first 20 cm of the erodosol, in comparison with the value registered in the control profile, on the same depth (2.73%). Values close to those recorded in the standard profile pertain to antrosol, which justifies its classification in the hortic subtype.

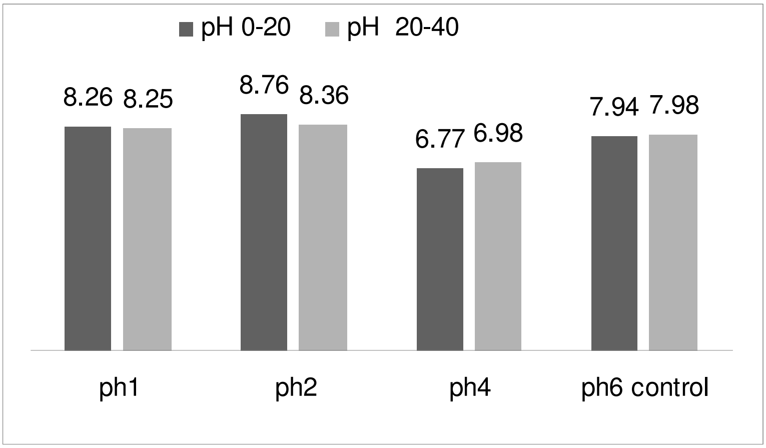

Fig. 5. pH values, on the 0-20 cm and 20-40 cm depths, at the analyzed profiles

From analyzing the data presented in Figure 5, it results that the values of the pH are relatively uniform in the first 40 cm at the studied profiles. The lowest pH values pertain to antrosol, and the highest to gleic cambic chernozem.

CONCLUSIONS

1. The bulk density values (Da) (Figure 2), in the first 40 cm, are close only at the standard profile and at the erodosol.
2. The clay content has different dynamics on the two depths that were studied, in the first 20 cm the trend is ascending, and in the next 20 cm is descending.
3. At erodosol, and at antosol, the values of total porosity are lower in the first 20 cm than in the next 20 cm, due to agricultural usage.
4. The erodosol has the lowest humus content in the first 20 cm of the profile.
5. The pH values are relatively uniform in the first 40 cm at all studied profiles.

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PHYTOTOXIC EFFECTS OF CADMIUM ON SOYBEAN PLANTS GROWN IN GREENHOUSE CONDITIONS

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Keywords: *cadmium, soybean, phytotoxicity*

Abstract

This paper is focused on the cadmium accumulation by soybean (Glycine max) plants grown on Eutric Fluvisols material with different Cd contamination. The cadmium contents in soil material increased by 3, 5, 10, 15, 20 and 30 mg/kg Cd using cadmium acetate. The results of tests carried out to determine the content of cadmium in soil and soybean plants (roots, stalks, leaves and seeds) showed that the cadmium uptake in soybean plants increased with increasing total cadmium content in soil. An increase over 14 times of total cadmium content in the soil increased the cadmium content in different parts of the soybean plants (55 times in roots of 8 times in stalks and leaves and 24 times in seeds). The high cadmium content in soil does not induce highly significant reductions in seeds or biomass production of soybean plants.

INTRODUCTION

Cadmium, a non-essential metallic element for the life cycle of living organisms, is known as one of the most dangerous pollutants in the environment. The continuous inputs of this element in biosphere, as a result of various industrial activities, may pose a risk to the health of ecosystems and people. Cadmium has high mobility, is poorly retained by the soil and is readily uptaken by plants [1].

Vegetal species, such as soybean represent a health risk if are grown on soils contaminated with cadmium, because these plants are able to accumulate large amounts of cadmium in their edible part. Although metal toxicity in plants is manifested only on heavily polluted soils, their accumulation in plant tissues, even at a lower level than phytotoxic level, is a concern. Serious diseases have been reported to be related with ingestion of food and/or water contaminated with Cd even if the cadmium concentration in food is still considered low [2].

This paper is focused on the cadmium accumulation by soybean (*Glycine max*) plants grown on Eutric Fluvisols material with different Cd contamination.

MATERIAL AND METHODS

This experiment was conducted in the Greenhouse of INCDPAPM-ICPA Bucharest. For pot experiments soil material was used collected from the upper horizon of Eutric Fluvisol from bottomland of the Dâmbovița River. The soil was air dried, crushed and passed through a 2-mm sieve prior to analysis and filling the pots. This soil material was artificially spiked with cadmium acetate to make its final total concentration as 3, 5, 10, 15, 20 and 30 mg/kg Cd.

The total content of cadmium was measured with a flame atomic absorption spectrometer in hydrochloric solution resulted by digestion of soil samples in acid mixture. The concentrations of mobile Cd in soil were determined following Na_2EDTA extraction method.

Plants were harvested at maturity. Plants material divided in to roots, stalks, leaves and seeds was washed in distilled water and dried at 65°C until constant mass. Dried plant material was mineralized using nitric-perchloric acids mixture and the content of Cd determined by atomic absorbtion spectrometry.

The experimental design was entirely randomized with 3 replications. The effects of the treatments were studied by analysis of variance and average test (Tukey).

RESULTS AND DISCUSSION

The controlled increases of total cadmium content in soil changed some soil chemical characteristics and soybean plants.

It is noted that, for 9 of the 12 studied characteristics, changes were statistically assured. Extremely statistically significant changes were established for five of the studied characteristics: the total content of cadmium in soil, potential mobile cadmium content in soil (Na_2EDTA-extractable form) and cadmium contents in soybean plant. Very significant values of Fisher test were determined for two characteristics: total biomass of above-ground part of soybean plants and total nitrogen content in soil material (Table 1).

The treatments involving the addition of cadmium acetate produced statistically significant increases of total cadmium content in soil material used for pot experiment (Figure 1).

Also, using a cadmium salt with high solubility in order to increase the total cadmium content resulted in an increase of mobile form of cadmium in soil (Na_2EDTA extractable form). For the soil treatment with maximum amount of cadmium acetate, the cadmium content in soil in soluble form has come to represent 90% of the total cadmium content. Similar results were obtained by [3] who found that mobile cadmium content in soil represent 70-80% of the total cadmium content if metal pollution was induced artificially by incorporating a soluble salt of cadmium.

Table 1

Fisher test significances established by analysis of variance to reveal the changes produced by increasing of cadmium content in soil on some characteristics of soil material and soybean plant

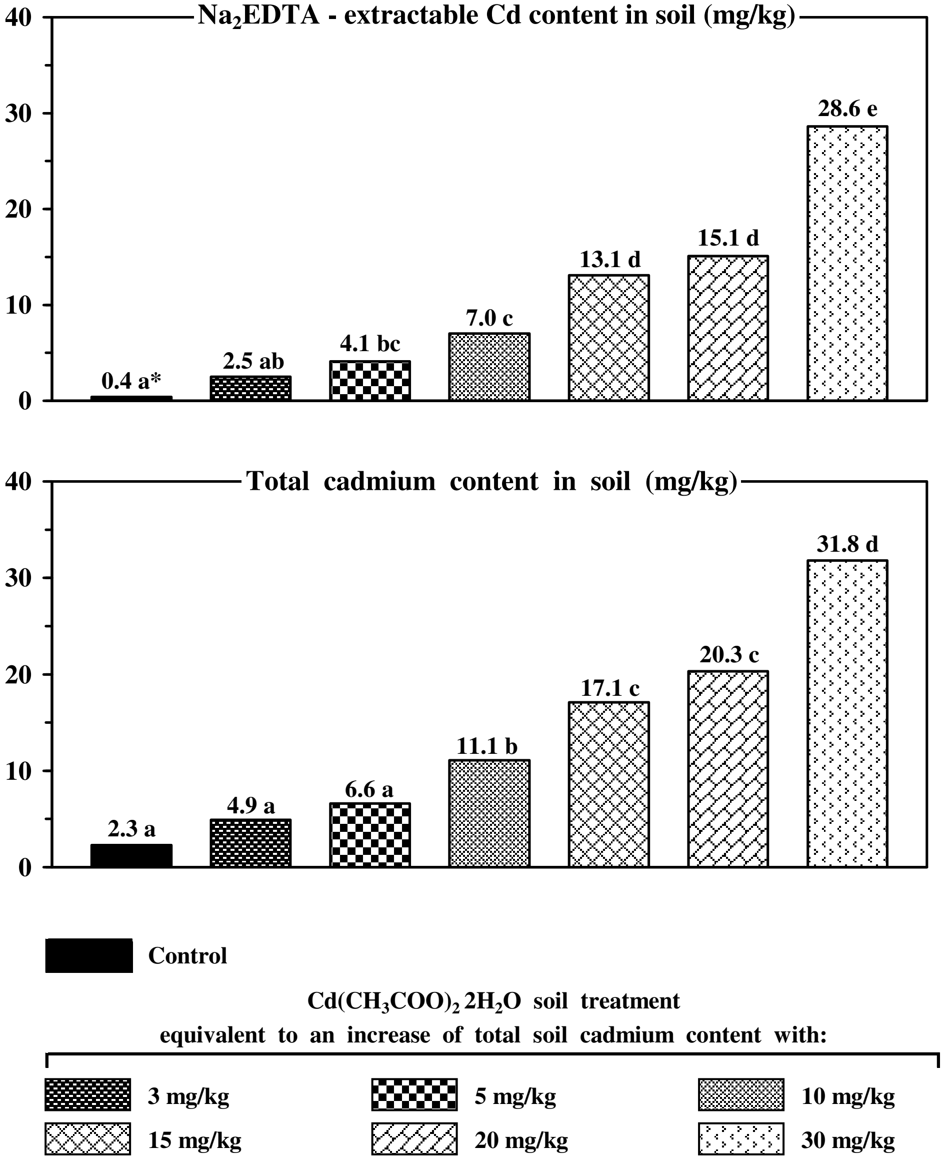
Soybean plant characteristic / Soil material characteristic	**Fisher Test significances**
Total biomass of above-ground part of soybean plant	**
Soybean stalks and leaves weight	NS
Soybean pods weight	*
Soybean seeds weight	*
pH of soil material	NS
Organic carbon content in soil material	NS
Total nitrogen content in soil material	**
Total cadmium content in soil material	***
Na_2EDTA-extractable cadmium content in soil material	***
Cadmium content in soybean roots	***
Cadmium content in soybean stalks and leaves	***
Cadmium content in soybean seeds	***

NS - Not Significant ($p > 0.05$)
*Significant ($0.01 < p \leq 0.05$)
**Very significant ($0.001 < p \leq 0.01$)
***Highly significant ($p \leq 0.001$)

The augmentation of total cadmium content by incorporating equivalent amounts of cadmium salt (cadmium acetate), favoured maintaining of significant metal amounts in soil solution, with direct effects on the cadmium content of plants.

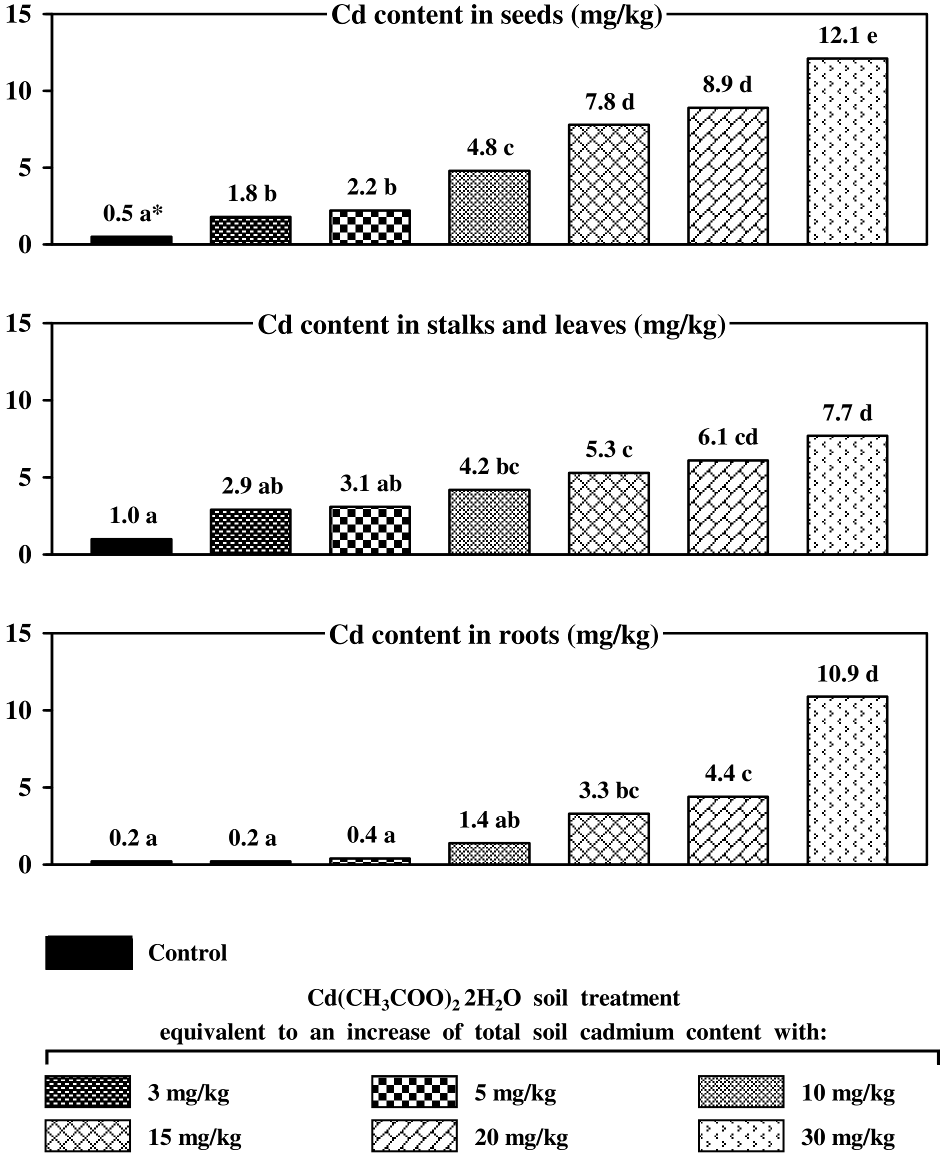
The higher bioavailability of cadmium in soil enables the soybean plants to uptake and to accumulate higher metal concentration in their tissues.

For the plants grown on cadmium polluted Eutric Fluvisols, the cadmium content determined in roots ranged from 0.2 mg/kg (control) to 10.9 mg/kg (maximum polluted soil). The values of cadmium content in roots were statistically significant as compared to the control starting with the treatment appropriate to an increase with 15 mg/kg of total cadmium content in soil (Figure 2).



* Values followed by the same letter (a, b, ...) did not differ at the 0.05 significance level using Tukey's honestly significant difference procedure.

Fig. 1. Effects of $Cd(CH_3COO)_2\ 2H_2O$ soil treatment on cadmium content (total and Na_2EDTA-extractable) of soil material used in pot experiment



* Values followed by the same letter (a, b, ...) did not differ at the 0.05 significance level using Tukey's honestly significant difference procedure.

Fig. 2. Effects of $Cd(CH_3COO)_2\,2H_2O$ soil treatment on cadmium content in soybean plants grown on soil materials from upper horizon of an Eutric Fluvisols

The values of cadmium content in stalks and leaves of soybean plants grown on polluted soil material ranged from 1 mg/kg in control to 7.7 mg/kg for plant grown on soil treated with the maximum amount of cadmium acetate (Figure 2).

The cadmium content in soybean seeds increased from 0.5 mg/kg (control) to 12.1 mg/kg (treatment with highest amount of cadmium acetate). The results showed, that if the average content of cadmium in soil was 31.8 mg/kg, the cadmium content of grains was about 24 times higher than that determined in the seeds of control plants.

CONCLUSIONS

1. Eutric Fluvisols have the capacity to limit the uptake of cadmium in plants mainly due to the weak alkaline reaction so that the high cadmium content in soil does not induce highly significant reductions in seeds or biomass production of soybean plants or other obvious symptoms of phytotoxicity.
2. Regarding the distribution of cadmium in different parts of studied plants, it is noted that soybean allows rapid transfer of the pollutants in stalk and leaves, leading to the accumulation of significant quantities of cadmium in the seeds.

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SELENIUM IN WHEAT PLANT AND SOIL FROM SOUTH-EASTERN PART OF ROMANIA

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Keywords: *selenium, health, wheat*

Abstract

Selenium is an essential microelement for animal and human nutrition, being involved in many metabolic processes, especially antioxidants, owing to its presence in composition of the glutathion peroxidase enzyme, seems to be the most important. Selenium occurs in thyroidian hormones homeostasis, in the imunity and fertility processes, besides the antioxidant role. Selenium can be present in soil such as selenates, elemental selenium, pyritic selenium and organic compounds of selenium whose composition is unknown. The organic compounds of selenium and selenates are the most available for uptake by plants. Its presence in soil over a certain level (seleniferous soil) can lead to increase of selenium content in plants who grows on respective soil, and in conclusion if we are consume these plants, it can appears toxicological phenomenons – acute or chronic at human body and animals (selenosis).

This paper is focused on the South-Eastern part of the Romanian Plain, Central and South Dobrogea, where a study was done regarding low level of selenium in soil and plant, these areas being characterized by a natural handicap, selenium deficitary. For this purpose, data regarding selenium total content in soil and plant (wheat), as well as mobile content selenium from soil, contents determined through investigations chemical methods and analytic techniques, are presented.

INTRODUCTION

Selenium is an essential micronutrient for humas and animals. As a trace element, selenium belongs to the trophic chain circuit plant-animal-human, playing a important role as well as the other micro-elements present in human nutrition [2, 7, 14, 16, 17, 21]. Plants growned on soils deficient in selenium leads through consumption at deficiency of this trace and those growned on selenifereous soil and introduced in food goes to selenosis, with consequences on human health.

Generally, the selenium content is 0.1-0.3 mg kg^{-1} for the diets of various animals, but a selenium content of 3-15 mg kg^{-1} can be considered an excess causing toxicity [14, 19]. The uptake of Se by plant roots depends on some soil propesties such as: oxidation state, pH, chemical and mineralogic composition, and the concentration of Se and competing anions such as sulfate and phosphate in solution

[3]. In soil, selenium is found in various forms, namely: selenides (-2), elemental selenium (0), selenites (4) and selenates (6) in the inorganic selenium and -2 valence in the organic selenium. Between them, selenate is the most soluble Se species and can be taken up by plants and leached through the soil profile [4,5]. Distribution of selenite and selenate between the solid and solution phases within soil is a function of pH and mineral species present.

The purpose of this paper is to survey the data regarding selenium level from soil and plant in the south-eastern part of Romania, Central and South Dobrogea, its uptake by plant transfer.

MATERIAL AND METHODS

Location of plant and soil points covers the south-eastern part of the Romanian Plain, central and south Dobrogea. Plant samples were collected from the same points with soil samples. Soil samples were collected on the 0-20 cm depth. To the plant samples it were collected aerian parts with the waist of 20-30 cm, and wheat grains were collected when they reached maturity. Map location of soil and plants samples points is shown in Figure 1.

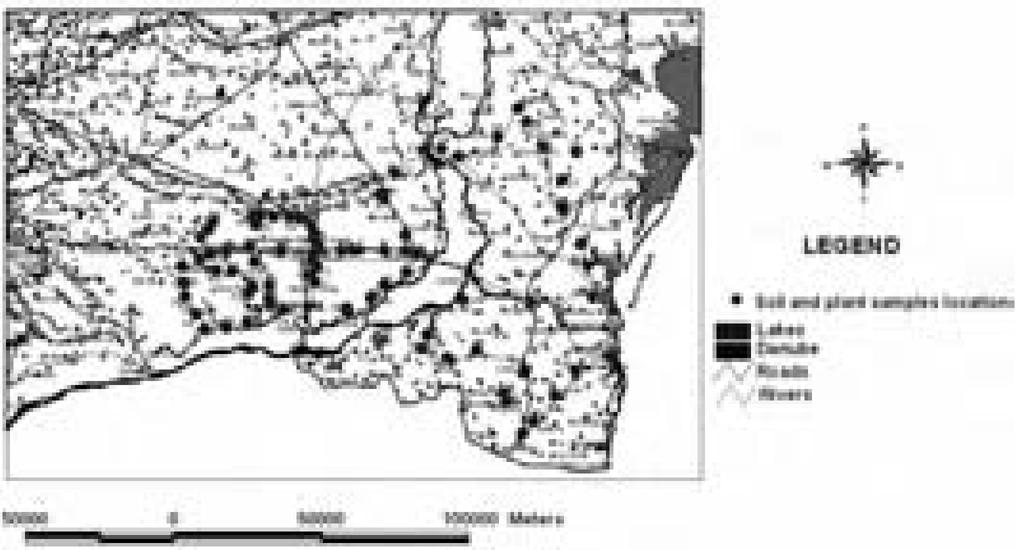

Fig. 1. Soil and plant location (n = 83)

Selenium total and mobile content from soil samples, as well as selenium content in wheat green plants were determined in our laboratory.

A mixture of minerals acid (nitric acid and chlorhydric acid) and perhydrol was used for the digestion of soil samples to determine total selenium. During the digestion, selenium was passed through selenite (SeO_4^{2-}), then it was reduced with sodium borohydrure ($NaBH_4$), when it is resulted selenium hydrure (H_2Se), wich was dosed through flame atomic absorption spectrometry coupled with hydride generator. Mobile content of selenium in the soil was determined by extraction using a common extractant (ethylene diaminetetraacetic and ammonium acetate solution at pH 7, after Lăcătuşu and al., 1987 [12]).

Plant samples were calcined at a temperature of 450ºC and the ash obtained was dissolved into a hydrochloride solution, in wich selenium total was dosed using the method used to determine selenium total and mobile in soil [8, 13, 15, 22].

Total content, selenium mobile from soil and selenium content of wheat plants were determined on a total of 83 soil and plant samples from central and south Dobrogea, and south-eastern of Romania.

RESULTS AND DISCUSSION

The data regarding the selenium content in the Romanian soils was found in several papers, that had shown the level of selenium in mountainous soil and alluvial deposits from the northern area of Oriental Carpathians [1,10], but also in soils of Dobrogea [6,9,11,18,20]. Recently, research was performed refering at selenium content in soils of the south-east Romanian Plain, central and south-eastern Dobrogea (Lăcătuşu and al., 2008, 2009). Arithmetic averages of total and mobile content selenium values in soil, as well as plant content for the studied samples are presented in Table 1.

Table 1

Arithmetic average of total content, mobile soil selenium values ($mg \cdot kg^{-1}$) and content of plant for soils which were growned wheat in agricol years 2007/2008 and 2008/2009

Arithmetic mean of total content x1, mobile content x2 in soil, wheat plant content x3 samples number=83	South-east of Romanian Plain 1 (2007-2008)	Central and south Dobrogea (2007-2008)	South-east of Romanian Plain 2 (2008-2009)	South-east of Romanian Plain total
x_1	0.189	0.143	0.270	0.237
x_2	0.006	0.004	0.020	0.014
x_3	0.023	0.022	0.050	0.039

1 Slobozia – Călăraşi – Feteşti – Ţăndărei area
2 Slobozia – Orezu – Lehliu – Mănăstirea – Călăraşi area

The average contents of total selenium from the soil samples collected from the upper horizon (0-20 cm) of Romanian Plain soils are 0.189 mg/kg for the soils from the Slobozia - Călăraşi - Feteşti - Ţăndărei perimeter and 0.270 mg/kg for the soil samples from the perimeter bordered by Slobozia - Orezu - Lehliu - Mănăstirea - Călăraşi, the average of these areas from south-east Romanian Plain being 0.237 mg/kg.

For central and south area of Dobrogea, the average content of total selenium from soil collected samples is 0.143 mg/kg.

The average content of mobile selenium in the soil collected samples from same depth of the south-east Romanian Plain soils is 0.006 mg/kg for soils in the perimeter bordered by Slobozia – Călăraşi – Feteşti – Țăndărei area (1) and 0.020 mg/kg for soils of Slobozia – Orezu – Lehliu – Mănăstirea – Călăraşi area (2). Central and south Dobrogea soils presents an average content of mobile selenium at 0.004 mg/kg, lower than the average content of mobile selenium which is 0.014 mg/kg for these two perimeters (1, 2) from the south-eastern part of Romanian Plain.

It were determined average values of selenium content of 0.023 mg/kg for Slobozia – Călăraşi – Feteşti – Țăndărei area (1) and 0.050 mg/kg for Slobozia – Orezu – Lehliu – Mănăstirea – Călăraşi area (2) in wheat green plants collected from same points with soil samples.

For central and south Dobrogea area, wheat plants presents an average content of selenium of 0.022 mg/kg, while the value of 0.039 mg/kg is representative for plant samples of these two perimeters from south-east Romanian Plain (1, 2).

CONCLUSIONS

1. The averages contents of selenium total and mobile in soil, but those content of green wheat plant from south-east Romanian Plain are higher than those similareous from Dobrogea**,** observing a discordance between these researched areas.
2. A deficit level of selenium is showed in wheat plants grown on central and south Dobrogea soils.

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EVOLUTION OF HEAVY METALS POLLUTION FROM COPSA MICA

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Keywords: *heavy metals, soil pollution, Copşa Mică, evolution*

Abstract

This paper presents a synthetic study on the dynamics of the phenomenon of heavy metals pollution, which took place over 25 years in the Copşa Mică. The main results of research in the pollution of soil, vegetation, animals and the main effects recorded have been reviewed. The first investigations carried out (Răuţă et al., 1987, Vădineanu et al., 1991, Toti et al., 1993) outlined an area affected by pollution about 180,750 ha, of which a highly polluted area of 21.875 hectares, in which the least one or two main pollutants exceeding the maximum admissible limits. After two decades, research conducted by Vrinceanu in the year 2005 and published in 2009, outlined a polluted area of 22,565 hectares, in which at least one heavy metal was at a higher content of the alert threshold for a sensitive land use. Therefore, it can be said that there was a slight tendency to increase the areas with polluted soil. Moreover, the latest data published by Damian et al. (2008) on the levels of heavy metals in soils near the emission source Copşa Mică SC Sometra SA show the heavy metals concentration values higher than those reported previously by other authors. However, we can speak about a reduction in the levels of heavy metals in the soils outside the area of pollution itself, the content of heavy metals are below the maximum admissible limits, but are higher than those normally recorded in unpolluted soils. The reduction may be due to a "self-purification" of the soil by the absorption of chemical elements by plants and by leaching. Moreover, reducing industrial production at SC Sometra SA (source of emissions) and increasing plant performance in the purifying emissions sent into the atmosphere contributed to reduce the amplitude of the pollution phenomenon.

INTRODUCTION

The Copşa Mică area and its surrounding became worldwide known because of the pollution phenomenon generated by emissions from two industrial units that are produce mainly carbon black and metallic chemical elements. The pollution intensity was so great that it was known, in the years that passed, as the most polluted town in Europe.

Industrialization of this area started in the 1930's, when the facilities for the manufacture of carbon black (1935) and zinc production (1939) were built, due to the presence of methane gas, water, and relatively cheap labour. Over the coming years, industrial activity developed separately in two units, first with chemical profile, and other with non-ferrous metallurgy profile. Between the sixth and eigth decades of the last century, production activity recorded maximum intensity without consider, seriously considering environment protection.

In the late 90's, the two industrial units from Copşa Mică renamed SC CARBOSIN SA and SC SOMETRA SA, after the year 1990 currently producing 10 chemical and 15 metallurgical products. Among them, carbon black, methyl methacrylate and methyl polymethacrylate, zinc, lead, gold-silver alloys and others.

Because of the inadequate production to environmental protection, there were sent into the atmosphere and surface water network large quantities of: carbon black, carbon oxides, sulphur oxides, particulates loaded with heavy metals. Pollutants released into the atmosphere, returned to the ground, polluting vegetation, soil and surface water. Oxides of sulphur, carbon and even nitrogen resulting from the combustion processes, and released into atmosphere were subjected to oxidation, hydration, then return to the ground as acid precipitation, causing burns to the vegetation, emphasizing the acid reaction of soils and hence triggering a chain of soil degradation, with serious depreciation of organic matter, alteration of mineral part, the loss of nutrients, surface and deep erosion, and others.

Black carbon released into the atmosphere and then returned to the soil created "sinister landscapes" throughout the area. Initially, black smoke was the trigger factor of attention on the pollution phenomenon at Copşa Mică. It could be “seen”, unlike the heavy metals that getting into the soil, plants, animals, and human bodies, and, because they couldn’t be "seen", had no warnings in the early stages. Only when animals and people started to get sick, heavy metals came to the attention of specialists in environmental and related disciplines.

The major sources of pollution recorded in the early 90's were black carbon plants, agglomeration plants and sulphuric acid installations [9].

In 1993, the closing of carbon black factory solved the problems of pollution by this chemical. Over time, the atmosphere and houses were clean. It should be noted that, for soil, carbon black was not a real source of pollution, knowing that, normally, carbon is an important element in soil composition.

In 1998, a Greek company, "Mytilines Holdings”, acquired plant SOMETRA SA, and made some improvements to facilities for the remediation of gaseous and liquid emissions, significantly reducing production in order to lower pollution intensity from the previous period of 1990. However, there were many periods of time when they reported excedents of the maximum admissible limits for the pollutants constituents of air (sulphur oxides, heavy metals). As a result, the company decided to build a new sulphuric acid plant, with modern technology and a very small pollutant impact on soil. In fact, since February 1, 2009, plant production was temporarily stopped.

If other components of the environment (air, water) have their own dynamic of "self-purification" capacity, soil is the only component that accumulates pollutants, not having the degradation capacity of inorganic pollutants, and, moreover, being a transfer factor of pollutants in plants, water, animal and human bodies. If no special measures are taken, heavy metals can remain in soil for a long time such as decades or centuries [5]. This paper represents a synthesis of the most important research on soil pollution in the Copşa Mică area.

MATERIAL AND METHODS

To achieve this synthesis work, we studied the most significant papers published over the years concerning soil pollution in the area under the influence of the SC SOMETRA SA. Major elements were outlined that helped to present the evolution of the pollution phenomenon. It was interpreted from new points of view, how air pollution has manifested, at Copşa Mică lately, and its effects on vegetation and the soil.

RESULTS AND DISCUSSION

The first data concerning heavy metals and sulphur soil pollution at Copşa Mică were published by Rauță et al. [7], and were related to forest soils.

The first measurements of areas polluted with heavy metals, performed in the 1990s and reported by Vadineanu et al. [9], Toti et al. [8] showed that the entire area of land affected by pollution was 180,750 ha, of which 149,465 ha of agricultural land and 31,285 of forest land. The polluted territory covers an area eastward to Dumbrăveni and even more, in the south up to Şeica Mare, in the west to Blaj, and in the north up to Cetatea de Baltă. Toti et al. [8] states that the highly polluted area, where at least one from entire heavy metals had content above the maximum admissible limit (MAL) was 21,875 ha, of which 18,630 ha of agricultural land and 3,245 ha of forest land (Figure 1).

In a paper published in 2005, Dumitru [1] presented data determined in three different years (1990, 1993 and 1995) regarding the total content of heavy metals in A horizon (0-20 cm) of arable soils from the Copşa Mică area. The author noted an obvious decrease in the total content of cadmium and copper, mainly, at the maximum and average values. Compared to 1990, in 1993 and 1995 content values have decreased by 13 and 50% for cadmium and by 32, and 51%, respectively for copper (Table 1). For lead and zinc, in 1993 compared to 1990, increases in contents, by 7% and 10% respectively, were recorded. But, in 1995 compared to 1990, decreases in contents, by 28% and 12% respectively, were observed. These changes in the content of heavy metals, especially decreases, must be attributed to the agricultural operations, especially deep ploughing, which allowed the dillution of polluted upper horizon, in a greater mass of soil.

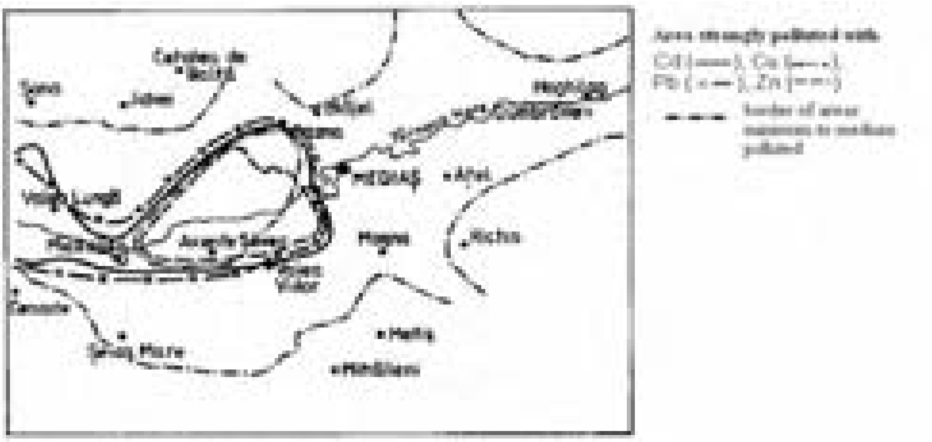

Fig. 1. Distribution of heavy metals polluted areas from the Copşa Mică territory in the year 1985 (adapted from Rauţă et al., 1987, Toti et al., 1993)

Table 1

Dynamics of heavy metals content (mg·kg^{-1}) in arable horizon (0-20 cm) from Copşa Mică strongly polluted area (after Dumitru, 2005)

Element	1990			1993			1995		
	min.	max.	med.	min.	max.	med.	min.	max.	med.
Cd	1.5	31.5	8.7	2.5	28.0	7.7	1.8	15.1	4.3
Cu	20	370	75	30	110	51	25	92	37
Pb	25	805	228	85	735	243	35	584	165
Zn	110	765	465	190	1640	514	134	1350	407

If we make a comparative analysis of the heavy metal content ranges, especially the mean values of the upper soil horizon, the result, for forest soils, is an increase of the content in these elements, by 1.1 times for cadmium and lead, 3 times for copper and 2 times for zinc, in 1993 compared to 1987 (Table 2). It should, however, be noted that, in fact, the reported values were significant for earlier periods, when samples were collected. For agricultural soils, in the same period, Toti [8] reported values close to those of forest soils (Table 2). Lăcătuşu et al. [3] calculated close mean values, also for soils from pasture, although, except for zinc, content ranges were narrower than in agricultural soils (Table 2). In all cases, the heavy metal content decreased with soil depth profile, so that at depths varying from 20 to 60 cm, the heavy metal content reached normal values, characteristic to the pedogeochemical fund.

Table 2

Intervals and average values of total heavy metals in the A horizon of soils from Copşa Mica area, according to land use

Chemical element	Statistical parameter	Forest soils Răuţă et. al. (1987)	Forest soils Toti et al. (1993)	Agricultural soils Toti et al. (1993)	Soils from pastures Lăcătuşu et al. (1995)
Cd	X_{min}	0.8	1.0	0.5	4.4
	X_{max}	22.6	26.0	31.5	11.9
	X_{med}	5.4	6.2	6.0	6.9
Cu	X_{min}	6.0	20.0	10.0	15.0
	X_{max}	77.3	174.0	370.0	127.0
	X_{med}	22.2	67.0	59.0	39.0
Pb	X_{min}	20.0	22.0	25.0	37.0
	X_{max}	552.0	335.0	835.0	476.0
	X_{med}	116.0	124.0	195.0	171.0
Zn	X_{min}	51.1	91.0	50.0	178.0
	X_{max}	791.0	1,646.0	675.0	1819.0
	X_{med}	219.0	442.0	349.0	539.0

If we consider measurements of Vrinceanu [10], we find that, in the year 2005, the total polluted area, where at least one heavy metal concentration exceeded the alert threshold for a sensitive use, was 22,565 ha, characteristic of lead pollution in the horizon 0-20 cm.

Other polluted surfaces, characteristic to cadmium (10,320 ha), zinc (7,040 ha) and copper pollution (1,600 ha), overlaped in the area outlined by lead pollution, proportionally to the size of each of the areas, as suggested in Figure 2.

The above data lead us to conclude that reducing the amount of land affected by pollution occurred only when the levels of heavy metals were below the maximum admissible limits. Specifically, if we compare the size of areas contaminated with content levels above the maximum admissible limit or above the alert threshold value, we find that the amount reported in 1991 and 1993 (21,875 ha) by Vadineanu et al., and, respectively Toti et al., was close to that reported by Vrinceanu in 2009 (22,565 ha) for year 2005. This finding shows that, after 1993, the rate of pollution has become lower and lower.

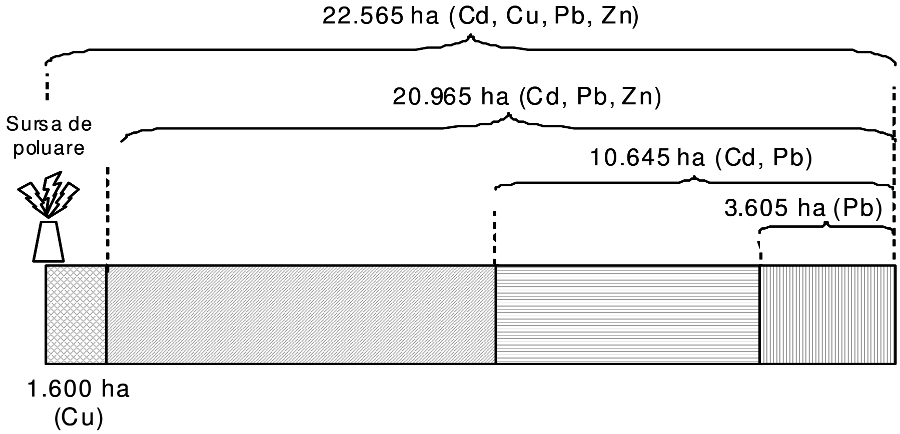

Fig. 2. Areas of land polluted by a single chemical element (lead), two (cadmium, lead), three (cadmium, lead, zinc), four (lead, cadmium, zinc and copper)

Otherwise, if the pollution intensity of SC Sometra SA did not decrease, the polluted area would have increased much more. In support of this assertion, the data obtained by Ozunu et al. [6], which, by modelling the dispersion powders containing heavy metals emitted into the atmosphere by industrial activity of SC Sometra SA and deposited on the soil, showed a significant reduction in deposits and consequently on their heavy metal content. Thus, over 9 years, from 1999 to 2008, the maximum annual deposits decreased in intensity, and their heavy metals content (g/m^2) also decreased from 315.02 to 5.90 for zinc, from 191, 56 to 3.69 for lead, and from 2.79 to 0.008 for cadmium. Furthermore, the above named authors calculated the time required for these deposits to achieve the levels of alert and intervention thresholds for sensitive land use if, hypothetically, would not naturally contain such chemical elements. The results showed that the periods of time would be from 250 to 1,000 years for zinc, from 42 to 333 years for lead and from 25 to 167 years for cadmium, depending on the land type (arable or natural, forest cover or pasture) and the nature of the threshold (alert or intervention). Since the last time, the amounts of heavy metals that were deposited on the ground were quite low, allowed the polluted land area not to increase exponentially, and the overall content of heavy metals from soil to maintain, as magnitude order, around levels determined in the years 1991-1993.

Therefore, once again, laboratory experiments [4] verified and confirmed the earlier assertion that soil is an accumulator of pollutants, mostly inorganic, and, by natural means, the disappearance rate of heavy metals in soil is carried on in historical times, of tens, hundreds, thousands of years.

While surface soils contaminated with heavy metals has increased slightly, the area covered with forest vegetation, destroyed due to air pollution has decreased dramatically over the past 22 years (Figure 3). Satellite images published by Ianculescu et al. [2] highlighted the polluted area restriction in 2001 to only 20% of that found in 1986. The surface of contaminated vegetation decreased continuously over the coming years, so that, degraded forest area in 2008 represented only 2% of the original degraded area.

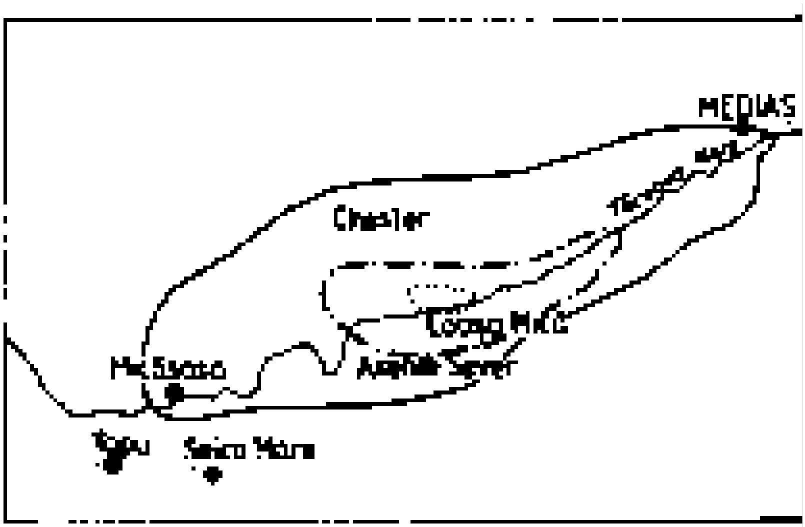

Fig. 3. Degradation of forest vegetation dynamics in the years: 1986 (____), 2001 (_ . _ . _) şi 2008 (..............) (according to Ianculescu et al. 2009, using satellite images)

Therefore, the forest has responded very well to reducing air pollution by SC Sometra SA, following the improving of environmental protection facilities and production reducing. However, the authors showed an increased concentration of pollutants in soil, especially cadmium and lead.

CONCLUSIONS

1. As a result of the environmental pollution exerted by the two industrial units over the decades, the area of polluted land, assessed in the 1990s, was 180,750 ha, of which 31,285 ha forest fund and 149,465 ha of agricultural land. The heavily polluted area, where at least one or two of the main pollutants exceeded the maximum admissible limits, was 21,875 ha, of which 3245 ha forest fund and 18,630 ha of agricultural land.
2. The polluted land area, assessed during 1991-1993, to 21,875 ha, was very close to that reported for 2005, equal to 22,565 ha. The difference of only 690 ha, showed a slight increase in the polluted area in the time since the

year 1991 to 2005, which demonstrates a systematic reduction in the pollution intensity over time. Otherwise, the polluted area expanded greatly.

3. The dynamics of forest vegetation pollution in 22 years (1986-2008) showed a very significant reduction, while the surface covered with contaminated soil remained almost constant, with even a slight increasing trend.

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SOIL POLLUTION WITH CRUDE OIL - A CASE STUDY IN BRAILA COUNTY

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Keywords: *soil pollution, crude oil, Braila County, total petroleum hydrocarbon*

Abstract

Soil pollution with crude oil has become an important problem of our days. Crude oil introduction into soil environment can occur from pipeline blow-out. When released on soil surface, petroleum hydrocarbons adsorb on the organic mineral matter of the soil. This paper presents the data obtained during a case study achieved in Perisoru-Ianca, Braila County. The pollutant is crude oil, and the main parameter followed is total petroleum hydrocarbons.

INTRODUCTION

Pollution is the process of atmosphere contamination (particles, gases and vapors produced artificially), the natural surface or underground water (domestic waste water, industrial, nitrates from fertilizer) or soil (with fertilizers, pesticides, radioactive wastes, etc.) [5, 7].

Currently, about 80% of lands are contaminated/polluted by products of petroleum origin (hydrocarbons, solvents etc.) used as an energy source in the oil industry, as well as chemicals. There is a variety of pollutants affecting soil and subsoil, such as fuel and oil products, hydrocarbon residues, crude oil, other products resulting from the operation (saturated and unsaturated aliphatic hydrocarbons, and the monocyclic and polycyclic aromatic).

These types of products (mainly hydrocarbons) have a harmful risk, affecting the quality of groundwater, which becomes unfit for use for a long time (drinking water, irrigation and different industrial uses). It also poses risks to human health, biological environment and vegetation, aromatic compounds having a strong feature of mutagenic and carcinogenic and, not least, affect the environment security, presenting risks of explosion and fire, when the floating oil reach the groundwater in the basement of various buildings [3].

Accidental oil pollution has become nowadays a common phenomenon that can cause environmental and social disasters [1, 2]. Potential sources of direct pollution of soil and subsoil can be covered by tanks, separators old from wastewater treatment plants, settling basins, slurries and waste pits of tar, ramp CF loading and unloading, underground pipelines, sewerage networks etc.

Solid residues, unstored corresponding, which can pollute the soil, come from: solid impurities involved in crude oil, sewage sludge from wastewater treatment plants and raw water treatment, solid waste from the maintenance and cleaning of incinerator ash sludge, powder catalyst [4].

Most oil pollution sources are anthropogenic, but there are also some natural sources. There is evidenced that some organisms, such as high-class plants are able to synthesize hydrocarbons and can penetrate the soil [6].

MATERIAL AND METHODS

The case study achieved was necessary to establish the degree of pollution of the contaminated/polluted area with crude oil. Braila County is known for its historical pollution with petroleum hydrocarbons.

Perisoru City, Braila County is located on the map at 45°7' North 27°29' East.

Fig. 1. Location of case study - area of Perisoru, Ianca, Brăila County (source Google Earth)

RESULTS AND DISCUSSION

The crude oil provided by transport pipelines led to soil cover with a film, which stayed on its surface and formed a crust. At soil surface, there remained asphaltenes forming crust, and the other hydrocarbons with a lower molecular weight penetrated and completely obstruct the soil pores causing air traffic stop. The lack of oxygen involves stopping the process of biodegradation of petroleum hydrocarbons. This phenomenon, comparable to animal bodies hypoxia (lack of oxygen to cells), led to the installation of an anaerobic system in soil, leading to faster or slower death forced aerobic microorganisms and cells root, with the consequent inability of roots to retrieve sap and support plant metabolism.

Fig. 2. Image with the profile achieved in Perişoru-Ianca, Brăila County

Figure 2 presents the profile achieved in Perisoru-Ianca, Brăila County.

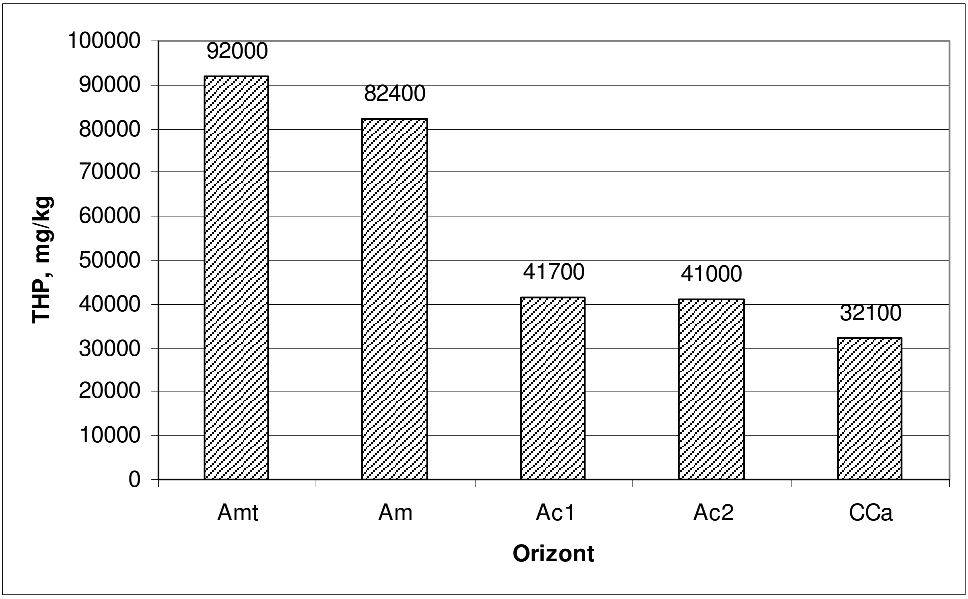

Fig. 3. Evolution of total petroleum hydrocarbon content with horizon in the profile achieved at Perişoru, Ianca, Brăila County

In the profile achieved in Perisoru area, Ianca, Braila County a very strong pollution was registered with petroleum hydrocarbons, a descending pollution. In the Amt horizon, 0-20 cm was registered a concentration of total petroleum hydrocarbons by 92000 mg kg^{-1}, in the Am horizon at 20-40 cm depth, the concentration has a value of 82400 mg kg^{-1}. The Ac1 horizon located at a depth of 55-75 cm there is a halving of residual oil content in determining the value of 41700 mg kg^{-1}, almost identical to that of AC2 horizon located at 75-95 cm depth, with a value of 41000 mg kg^{-1}. At 100-120 cm depth there was identified the last horizon of the profile and value of total petroleum content in continued to decrease reaching the value 32100 mg kg^{-1}, which maintains the level of excessive pollution. The evolution of total petroleum hydrocarbon content with horizon in the profile achieved at Perişoru, Ianca, Brăila County is shown in Figure 3.

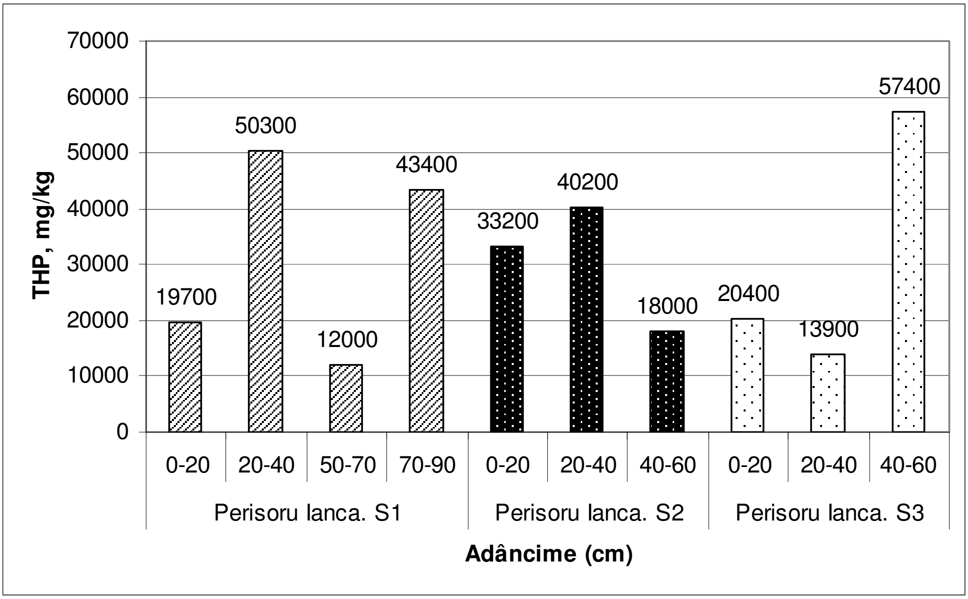

Fig. 4. Evolution of total petroleum hydrocarbon (TPH) content with depth in the 3 soundings achieved in Perişoru, Ianca, Brăila County

In the sounding 1 (S1) made on 4 depths was registered the highest concentration of total petroleum hydrocarbons with a value by 50300 mg kg^{-1} on 20-40 cm depth, followed by 43400 mg kg^{-1} on 70-90 cm depth, 19700 mg kg^{-1} at surface (0-20 cm) and 12000 mg kg^{-1} on 50-70 cm depth. Sounding 2 (S2) have been realized on 3 depths, being registered a decrease in total petroleum hydrocarbons content with depth. Thus, there was a surface concentration of total petroleum hydrocarbons by 33200 mg kg^{-1}, 40200 mg kg^{-1} on 20-40 cm depth, and 18000 mg kg^{-1} on 40-60 cm depth. The concentration of total petroleum hydrocarbons in sounding 3 (S3) presents in the first horizons a descending pollution from 20400 mg kg^{-1} at the surface drops to 13900 mg kg^{-1} at a depth of 20-40 cm and then a strong ascending pollution concentration reaching the value of 57400 mg kg^{-1}. The evolution of total petroleum hydrocarbon (TPH) content with depth in the 3 soundings achieved in Perişoru, Ianca, Brăila County is presented in Figure 4.

CONCLUSIONS

1. The case study was achieved in an area known for the history of petroleum hydrocarbons pollution.
2. The pollution degree of the studied area is excessive in the majority of the soil samples.

3. In the profile achieved in Perişoru area, Ianca, Brăila County a very strong pollution was registered with petroleum hydrocarbons, a descending pollution.
4. In the sounding 1 (S1) made on 4 depths the highest concentration of total petroleum hydrocarbons was registered on 20-40 cm depth and on 70-90 cm depth.
5. Sounding 2 (S2) was realized on 3 depths, being registered a decrease in total petroleum hydrocarbons content with depth.
6. The concentration of total petroleum hydrocarbons in sounding 3 (S3) presented a descending pollution in the first horizons and then a strong ascending pollution concentration.

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ECOLOGICAL CLOSURE OF THE SLIME DEPOSITION AT S.C. OȚEL INOX S.A. TÂRGOVIȘTE

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Keywords: *slime deposition, ecological closure*

Abstract

Slime deposition resulting from technological process of pickling steel bands is located in the unit S.C. OȚEL INOX S.A. Slime is a metal waste which cannot be recuperated and its storage in the deposition is final.

Because storage slime on deposition no. 3 approached to the final rate, the unit commanded a study necessary for the ecological closure of the slime deposition. By construction, slime is stored in a concrete pit which is a barrier for soluble salts and heavy metals to infiltration into the soil and underground water

To determine the chemical composition of slime deposition, there were collected several surface samples and a profile, uniformly distributed on the sides of deposition and on the ridge deposition.

From the surface, samples obtained an average sample used for the levigation test and the first eluate of the percolation test.

The analytical values determined for all the elements are within the range given by the Order 95/2005 and is not a danger of water pollution with chemical elements.

As a result, slime deposition no. 3 stored in the S.C. OȚEL INOX S.A. area containing pickling process slime can be subject to ecological closure, in accordance with the environmental legislation.

INTRODUCTION

The slime resulted of the technological process of pickling steel bands and all afferent operations that happen in S.C. OȚEL INOX S.A. Târgovişte (main activity - cold rolling) is stored in depositions located inside the company. The unit is located in an industrial area of the town Târgovişte, in the south-west of the town, besides the road no.16 to Găeşti.

The purpose of this study is the deposition no. 3 with a storage capacity by approximate 4750.2 m^3. Slime is a metal waste which can not be recuperated and its storage in the deposition is final. Slime deposition resulting from the technological process of pickling steel bands is located in the west of the unit S.C. OȚEL INOX S.A.

Slime deposition is protected by construction for the soil and subsoil pollution because it is stored in a concrete pit. Both floor and walls are constructed of reinforced concrete. The floor is provided with a grid to collect the liquid phase. Around the floor there is a sewer to collect rainwater and waters which derive from the slime.

Before storage, the slime on the pit a layer of lime was disposed in clods (with a thickness of about 20 cm) in order to produce a neutralization reaction with the stored slime.

Since storage slime on deposition no. 3 approached the final rate, unit S.C. OȚEL INOX S.A. Târgovişte commanded a study necessary for the ecological closure of the slime deposition, realized by I.C.P.A. Bucharest [1].

MATERIAL AND METHODS

To determine the chemical composition of the slime deposition no. 3, there were collected several samples of 7 points: 6 points (P1, P2, P3, P5, P6 and P7) were uniformly distributed on the sides of deposition and 1 point (point P4) was placed on the ridge deposition. Samples of the points P1, P2, P3, P4 and P7 were taken on 0-20 cm depth, the P6 point on 0-5 cm depth and a profile was made at the point P5 on 200 cm depth (4 samples).

From the surface, samples was obtained an average sample used for the levigation test L/S = 10 l/kg, and the first eluate of the percolation test C (0) L/S = 0.1 l/kg.

The analytical methods used for slime samples were: reaction, nitrates, total soluble salts content, soluble salts, heavy metals - total content and mobile forms, soluble and the total fluoride [3].

RESULTS AND DISCUSSION

The physical and chemical property of the slime

The freshly taken samples had gray to dark-gray colors. In the storage, slime is a semisolid material, predominantly yellow-rusty colors with black, rusty brown, reddish, orange, black to white spots or areas, due to the presence of the calcium hydroxide mixed with slime.

From the chemical point of view, slime is a mixture of oxides and hydroxides of heavy metals, emanated from chemical composition of metal bands. The chemical composition of slime include salts such as sulfates, chlorides, fluoride, resulted in the process of pickling neutralization technology.

The reaction of the slime samples was moderately alkaline in samples collected at the point P6 (pH = 8.90) and strongly alkaline in the point P1 (pH = 9.78). For the other slime samples reaction was extremely alkaline with values within pH range = 10.36-11.20 (Table 1).

Slime high alkalinity is due to the calcium hydroxide solution (10%) used in the precipitation processes of the heavy metals, and to a mixture of salts containing sodium hydroxide (62.2%) used in the thermochemical pickling process. The slime reaction over pH=10 indicates that in the neutralization process was used an excess of the hydroxide calcium.

The lower amount of moisture to the surface samples was 50% (P6, 0-5 cm) and the highest was 85% (P2, representing the newly deposited material) (Table 1). For profile samples (P5), slime humidity ranged between 74% and 79%.

The total content of the soluble salts have similar values in the surface horizons and the profile slime, being in the range 1301-2082 mg/100g (mean values = 1661 mg/100g) and corresponds to a strong salinization compared with the limits concerning the soils salinization degree.

The salinization was mainly sulphatic, and anionic and cationic composition of the soluble salts showed that the dominant salts are: calcium sulfate and calcium nitrate, then sodium nitrate and calcium chloride. Small quantities of calcium bicarbonate, magnesium nitrate and potassium nitrate occur.

The sulfates were formed in the pH correction process of the wastewater to a value of 2-2.5 pH units with sulfuric acid (neutralization station). Chlorides were formed along the entire process. Nitrates were resulted from chemical and electrochemical pickling with nitric acid.

The calcium and sodium salts were formed in the precipitation processes of heavy metals with calcium hydroxide solution (10%). In the thermochemical pickling process was used a salt mixture containing 62.2% sodium hydroxide, 25% sodium nitrate and 12.5% sodium chloride (neutralization station).

Soluble fluorine values were between 36 and 47 mg/kg with a mean of 42 mg/kg. The total fluorine content varied between 1.6% and 2.6%, with the mean of 2.1% (Table 1).

The total and mobile content of heavy metals presented approaching values in the surface horizons and the profile.

Because the chemical elements determined in slime samples had generally similar values in the, surface horizons and the profile, show that slime have a similar composition, even if the collection was made on the surface or in depth deposition.

The levigation test and first eluate of the percolation test

The concentrations of the chemical elements in P1 - the levigation test L/S = 10 l/kg and P2 - C (0) - first eluate of the percolation test L/S = 0.1 l/kg) were presented in Table 2.

The P1 reaction is moderately alkaline (pH = 9.03) and it is given by the presence of the sodium carbonate. The P2 reaction is slightly alkaline (pH = 8.22) and is due to the calcium bicarbonate.

Table 1

Chemical analysis of surface samples from slime deposition no.3

Indicator	Unit	Values					
		P1	P2	P3	P4	P6	P7
pH	pH units	9.78	10.85	10.77	11.20	8.90	10.36
Water extract, ratio 1:5							
HCO_3^-	mg/100g	35	44	49	43	32	44
Cl^-	mg/100g	75	41	24	53	60	76
SO_4^{2-}	mg/100g	499	356	24	309	24	380
NO_3^-	mg/100g	632	760	970	530	1462	1005
Ca^{2+}	mg/100g	415	322	243	269	457	434
Mg^{2+}	mg/100g	2.2	0.8	0.7	0.5	7	1.5
Na^+	mg/100g	61	115	48	93	38	102
K^+	mg/100g	4	4	3	4	3	4
Total soluble salt content	mg/100g	1723	1643	1362	1301	2082	2047
F, total	%	2.1	1.6	2.5	2.0	2.6	2.1
F, soluble	mg/kg s.u.	39	42	36	39	41	47
Heavy metals, total forms							
Zn	ppm	39.6	35.2	39.6	36.0	41.9	31.7
Cu	ppm	127	133	127	122	197	122
Fe	ppm	90041	108936	114493	108936	110418	97451
Mn	ppm	992	1258	1487	1293	1275	1134
Pb	ppm	34.9	42.1	56.7	34.9	42.1	71.2
Ni	ppm	7111	6595	8069	8290	9469	7995
Cr	ppm	13157	15493	35031	18891	16130	17617
Co	ppm	184	186	215	211	239	192
Cd	ppm	*	*	*	0.15	*	*
Heavy metals, mobile forms							
Zn	ppm	0.66	1.75	1.63	1.34	1.50	1.31
Cu	ppm	19.0	67.1	43.5	40.2	32.7	42.6
Fe	ppm	9.29	5.71	3.93	3.57	10.0	3.93
Mn	ppm	80.8	87.3	74.3	87.3	77.0	61.3
Pb	ppm	4.22	8.58	6.40	4.22	3.49	4.22
Ni	ppm	624	353	611	641	1054	731
Cr	ppm	349	327	667	520	789	496
Co	ppm	7	6	8	10	16	12
Cd	ppm	*	*	*	*	*	*

* values under detection limit

Calcium salts predominated, followed by sodium salts pursuant to the precipitation processes of heavy metals with calcium hydroxide 10% and the usage of a mixture of sodium salts in the thermochemical pickling process.

The content of heavy metals in the levigation sample P1 is low. The analytical values determined for all the elements are within the range given by the *Order 95/2005* [2] and there is no danger of water pollution with those chemical elements.

By construction, slime is stored in a concrete pit which is a barrier for soluble salts and heavy metals to infiltration into the soil and underground water. During storage of the slime deposition up to fill is continuously monitors storage activity.

As a result, slime deposition must be subject to the process of ecological closure. The ecological closure of slime deposition will run according to specific projects.

Table 2

Concentrations of chemical elements in P1 - levigation test L/S = 10l/kg and P2 - C (0) - first eluate of percolation test L/S = 0.1 l/kg)

Indicator	Values obtained		Values maximum allowed Order 95/2005	
	P1 - L/S = 10 l/kg mg/kg s.u	P2- C(0), mg/l	L/S = 10 l/kg mg/kg s.u	C(0) mg/l
pH	9.03	8.22		
HCO_3^{2-}	60	-		
HCO_3^-	1100	64		
Cl^-	1880	113	25000	15000
SO_4^{2-}	18050	1045	50000	17000
NO_3^-**	11070	487		
Ca^{2+}	12000	700		
Mg^{2+}	68.8	5.7		
Na^+	2260	162		
K^+	410	29		
F^-	7.3	0.5	500	120
Cu	0.42	0.02	100	60
Ni	2.0	0.15	40	12
Zn	2.3	0.14	200	60
Cd	0.16	0.003	5	1.7
Cr, total	42.5	1.92	70	15
Mn	0.45	0.03	-	-
Pb	1.7	0.10	50	15
Co	2.5	0.22		
Fe	13.7	0.8		

CONCLUSIONS

1. Slime resulted of the technological process of pickling steel bands in S.C. OȚEL INOX S.A. Târgovişte was stored in depositions located inside the company. Slime is a metal waste which cannot be recuperated, and its storage in the deposition is final.
2. From the chemical point of view, slime is a mixture of oxides and hydroxides of heavy metals. The reaction of the slime samples were moderately alkaline, strongly alkaline and extremely alkaline.
3. The slime presented a strong salinization, mainly sulphatic and the dominant salts are calcium sulfate, calcium nitrate, sodium nitrate and calcium chloride.
4. Because of the chemical elements determined in slime samples had generally similar values in the surface horizons and the profile, show that slime have a similar composition.
5. In the levigation test and first eluate of the percolation test calcium salts predominate, followed by sodium salts and the content of heavy metals in the levigation sample is low. The P1 reaction is moderately alkaline and P2 reaction is slightly alkaline.
6. The analytical values determined for all the elements are within the range given by the *Order 95/2005* and there is no danger of water pollution with those chemical elements.
7. Slime is stored in a concrete pit which is a barrier for soluble salts and heavy metals to infiltration into the soil and underground water.
8. Slime deposition no. 3 stored in the S.C. OȚEL INOX S.A. area containing pickling process slime can be subject to ecological closure, in accordance with the environmental legislation.

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ISSUES REGARDING THE ECOLOGICAL RESTORATION OF LAND COVERED WITH SLUDGE PIT AT TOMEŞTI-IAŞI

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Keywords: *sludge, ecological restoration, soil, plant*

Abstract

Sludge from the water treatment station Iasi, one of the largest in the country, was stored for ten years, between 1995 and early 2006, on an area of 18.920 m^2.

The wet sludge has a negative impact on environment by: anaerobic fermentation gas emissions, the presence of heavy metals, soluble salts and pathogens; it was necessary to close the deposit.

The variant of land ecological restoration through phytoremediation is plausible as long as the water regime from the deposit is check up. First, it is necessary to accelerate the drainage, in order to install vegetation throughout the area.

In this paper there were analyzed and presented some aspects regarding the phytoremediation as the least costly method, with a high probability of land ecological restoration affected by wet sludge deposits.

For this purpose three sludge samples were collected and analyzed. First is a reddish sludge due of trivalent iron oxides and hydroxides under water excess conditions. The second sample, the darker, is a transient state sludge oxidation and the third sample was collected from an area with reeds where begins the humification process. Also, plant samples were collected from seven species: Atriplex sp., Rumex acetosela, Phragmites australis, Chenopodium album, Aster panonicum, Solanum nigrum, Galinsoga parviflora. Plants were separated for analysis in organs: root, stem and leaves.

INTRODUCTION

The sludge deposit was built by removing the layer of soil over an area of 9.1 hectares with planning surrounding and partitions dams. The deposit was divided into 11 compartments of different sizes. Between the compartments there are lapses of movement of water and mud. The total deposit volume is 225,000 m^3 with a total active area of 15 hectares. The deposit is located in the major bed of Bahlui River, on its right side the distance in straight line until water treatment station Iasi is approximately 2000 m [2].

MATERIAL AND METHODS

To investigate the sludge three samples were collected and analyzed. First was a reddish sludge due of trivalent iron oxides and hydroxides under water excess conditions. The second sample, the darker, was a transient state sludge oxidation and the third sample was collected from an area with reeds where begins the humification process. Sampling depth of sludge was between 20 and 30 cm. Sludge samples were dried at room temperature and then were minced.

Plant samples were collected from seven species: *Atriplex* sp., *Rumex acetosela, Phragmites australis, Chenopodium album, Aster panonicum, Solanum nigrum, Galinsoga parviflora.* Plants were separated in organs: root, stem and leaves.

The main chemical properties determined on sludge samples were: sludge reaction (pH determined potentiometrically in aqueous suspension), organic matter content (Walkley and Black method), C/N ratio, contents of total nitrogen (Kjeldahl method), and content in mobile forms of phosphorus and potassium in acetate-soluble solution of ammonium lactate at pH 3.7 (Egner-Riehm-Domingo method). Also, were determinate the total contents of heavy metals (measured with flame atomic absorption spectrometer in hydrochloric solution resulted by digestion of soil samples in $HClO_4$-HNO_3 mixture). Those parameters were determined according to the ICPA methodology.

Plant samples were dried in the oven for several hours, at a temperature of 70^{o}C, after which they were crushed. Total nitrogen was determined by Kjeldahl method, macro elements (P, K, Ca, Mg) and microelements (heavy metals) were determined hydrochloride solution obtained after solubilisation plant ash produced by burning plants, several hours, at 450^{o}C. Measurements were made by spectrometry in the visible (P), flame photometry (K, Ca) and atomic absorption spectrometry for Mg, Cd, Co, Cr, Fe, Mn, Ni, Pb and Zn.

RESULTS AND DISCUSSION

The chemical composition of sludge

The reaction values (pH), determined in aqueous suspension at a ratio dry sludge: water of 1:5, indicated a weak alkaline reaction in reddish sludge and a weakly acid reaction in the other two samples. The reaction was slightly alkaline due to the presence of hydroxides and carbonates (Table 1).

The organic matter content was 3.06% in the reddish sludge and 27.1% in sludge sample collected near the dam. A high content of organic matter was found in the sludge with reed vegetation. Reed vegetation helped to reduce the amount of water and influenced favorable the humification process. The ratios C/N value of 11.5 showed a good evolution of the mineralization process. In sample 1, organic matter content and total nitrogen content was low. Although, the C/N is 13, mineralization had a very low intensity. Sludge sample taken near the dam, had a high nitrogen content which significantly reduced the value of the ratio C/N.

Table 1

Reaction and content of macro elements sludge samples collected from the Tomeşti deposit

Sample number	Identification	pH	Organic matter	N_t	$C_{org.}$	C/N	P_{AL}	K_{AL}
		H_2O	%				ppm	
1	Reddish sludge	7.91	3.06	0.158	1.8	13.1	1233	1526
2	Sludge dam area	6.75	27.1	4.633	15.7	4.0	504	558
3	Sludge with reed vegetation	6.78	22.4	1.321	13.0	11.5	600	549

The total nitrogen content of sludge samples, compared to the limits of interpretation of content classes in soil, showed different levels namely: very low (reddish sludge sample), small (sludge sample with reed vegetation) and very high (sludge sample collected from dam are). The content of mobile forms of P and K was high.

The total heavy metal content (Table 2) showed a significant loading of heavy metals. If the analytical data are compared with Clark values, in the three samples of sludge, heavy metal content, with the exception of two chemical elements (Co and Mn) were larger than Clark. Zinc values were 125 times, 54 times, respectively 85 times higher than the Clark. Also, cadmium levels in the three samples were 54 times, 23 times, respectively 38 times higher than Clark. Pb had a major accumulations between 6 and 11 times the value of Clark. Other elements analyzed (Cr, Ni), in some cases exceeded three times Clark values.

Table 2

Total heavy metal content (mg/kg) of sludge samples Tomeşti, compared with Clark values (C), with normal values in soil (NV) and with the alert threshold values (PA) and intervention threshold values (PI) for a less sensitive land use

Identification	Cd	Co	Cr	Cu	Fe	Mn	Ni	Pb	Zn
Reddish sludge	7	14	106	141	34525	542	65	186	10409
Sludge dam area	3	10	52	144	26632	486	39	95	4473
Sludge with reed vegetation	5	14	107	130	22653	427	134	141	7088
Clark values C[1]	0.13	18	83	47		1000	58	16	83
normal values NV[2]	0.30	5	30	20		500	20	15	50
alert threshold values PA[3]	5	100	300	250		2000	200	250	700
intervention threshold values PI[4]	10	250	600	500		4000	500	1000	1500

[1]Fiedler and Rösler (1988); [2]Lăcătuşu and Ghelase (1992) [3, 4]Order 756/1997 of MAPPM (1997)

Comparing the data analysis of heavy metals content in sludge with the alert thresholds and intervention thresholds for a less sensitive land use showed that most heavy metal content are lower than these thresholds. This variant of comparison was chosen because it is not recommended to cultivate this land with plants used in human or animal nutrition, after ecological restoration.

If we consider the pH sludge samples range variation, from a slightly acid reaction to a slightly alkaline, with predominance of neutral reaction, we observe that the mobility of heavy metals is lower than in moderately acid or strongly acid pH range of variation.

Absorption of chemical elements by plants from spontaneous flora installed on sludge at Tomeşti

The analytical data on the content of primary (N, P, K) and secondary (Ca and Mg) macro elements showed that plants have received sufficient amounts of these nutrients. This was demonstrated by the levels of these chemicals in the sludge substrate, founded in various physical and chemical stages of maturation (Table 1) and by the concentrations of these nutrients in leaves, stems and roots of seven types of plants from ruderal flora, which were analyzed (Table 3).

Table 3

Macro elements content of plant organs collected from Tomeşti

Nr.	Species		N	P	K	Ca	Mg
			%				
1		leaves	3,75	0,339	2,75	2,16	0,598
2	*Atriplex sp.*	stems	0,91	0,097	1,25	0,31	0,055
3		roots	0,92	0,149	1,92	0,27	0,180
4		leaves	3,11	0,237	2,92	5,23	0,569
5	*Rumex acetosela*	stems	1,18	0,064	2,62	1,00	0,097
6		roots	1,77	0,365	1,25	1,72	0,273
7		leaves	3,40	0,231	3,10	0,60	0,140
8	*Phragmites australis*	stems	1,07	0,088	1,42	0,18	0,050
9		roots	2,77	0,331	2,09	0,73	0,180
10		leaves	3,22	0,292	5,39	1,99	1,070
11	*Chenopodium album*	stems	0,70	0,070	2,13	0,44	0,085
12		roots	0,71	0,168	1,21	0,40	0,171
13		leaves	3,46	0,257	1,51	2,91	0,503
14	*Aster panonicum*	stems	1,65	0,105	1,95	1,50	0,116
15		roots	0,80	0,148	1,92	0,57	0,100
16		leaves	6,00	0,462	4,92	3,22	0,344
17	*Solanum nigrum*	stems	2,03	0,278	4,25	1,26	0,204
18		roots	1,31	0,218	2,27	0,97	0,152
19		leaves	5,61	0,857	4,86	4,23	1,554
20	*Galinsoga parviflora*	stems	3,22	0,220	4,39	1,10	0,213
21		roots	2,51	0,379	7,07	5,07	0,311

The nitrogen concentration was close to 3.5% in leaves of *Atriplex* spp., *Rumex acetosela, Phragmites australis, Chenopodium album, Aster panonicum* and high with values of 6.0% and 5.6% in leaves of *Solanum nigrum* and *Galinsoga parviflora.* Nitrogen absorption in these species leaves is a typical characteristic of these plants [3]. The nitrogen contents of stems and roots analyzed between 0.7% and 2.77% are normal. Higher values, in stems and roots of *Solanum nigrum* and *Galinsoga parviflora*, between 1.31% and 3.22% are specific to these species.

The absorption of larger quantities of nitrogen in these two species was accompanied by a proportional uptake of other macro (P, K, Ca and Mg), particularly in leaves.

The accumulation of P, K, Ca and Mg in stems and roots of species analyzed was produced in accordance with the requirements of a chemical element of each species. Thus, in terms of macro elements nutrition of analyzed plants, there are no morphological or biochemical signs which may indicate aspects of deficiency or excess.

Accumulation of heavy metals (microelements)

Unlike macro elements, heavy metals have accumulated in large quantities, some quite large in comparison with plants needed for a balanced nutrition (Table 4).

Analyzing the obtained data, it is noted that some heavy metals were at a high level of content, others at a medium level and some at normal levels. Thus, Zn content was 37 times higher than the normal limit (60 ppm) in leaves of *Rumex acetosela.* Similarly, high levels of zinc were recorded in leaves of *Aster panonicum* and *Galinsoga parviflora* (19 times then the value of 60 ppm).

Table 4

Microelements (heavy metals) content of plant organs collected from Tomeşti

Nr.	Species		Zn	Cu	Fe	Mn	Pb	Cr	Ni	Co	Cd
			mg/kg								
1		leaves	664	10	269	242	10	sld	1,60	1,36	3,10
2	*Atriplex sp.*	stems	147	4	75	20	7	sld	sld	1,46	2,36
3		roots	309	7	135	21	10	sld	sld	1,27	3,05
4		leaves	2246	9	349	676	10	sld	0,81	1,45	3,53
5	*Rumex acetosela*	stems	351	3	98	54	9	sld	sld	1,59	2,56
6		roots	1391	35	121	128	21	15,72	11,32	3,41	3,94
7		leaves	158	5	191	150	11	sld	1,10	1,61	2,81
8	*Phragmites australis*	stems	140	4	88	40	10	sld	sld	1,61	2,63
9		roots	685	13	1043	108	13	2,18	1,38	2,37	3,10
10		leaves	899	9	291	268	13	sld	sld	1,72	2,71
11	*Chenopodium album*	stems	192	4	61	30	13	0,73	sld	1,56	4,36
12		roots	372	7	388	23	13	1,08	sld	2,27	2,96
13		leaves	1151	12	685	517	14	1,57	sld	2,81	3,20
14	*Aster panonicum*	stems	220	3	69	54	14	0,81	sld	2,15	2,89
15		roots	460	9	1136	43	14	2,49	0,81	2,88	2,93
16		leaves	608	38	121	505	14	1,46	1,15	2,33	3,67
17	*Solanum nigrum*	stems	527	7	98	118	13	1,15	sld	2,27	3,24
18		roots	901	17	1670	63	17	6,42	2,49	3,10	3,28
19		leaves	1171	28	481	252	16	2,91	0,87	3,82	3,54
20	*Galinsoga parviflora*	stems	225	5	98	14	14	2,69	sld	2,55	4,13
21		roots	1671	15	1920	50	19	5,90	2,57	2,42	3,49
Levels of normal content*			20-60	5-30	20-600	50-200	5-10	0,02-0,2	0,1-2,0	0,1-0,5	0,01-0,1

*from Pendias, 2001

The average zinc content of the seven plants analyzed was approximately 11 times higher than the right limit of the range of content. Also, the content of Cd in all plants analyzed is 32 times higher than normal content.

From the second category, in which chemical elements were in the medium levels of content were: Fe, Mn, Pb, Cr and Ni. Thus, the Fe content was high in roots of *Phragmites australus*, *Aster panonicum, Solanum nigrum, Galinsoga parviflora*. Larger amounts of Fe were accumulated in the leaves of *Aster panonicum* and *Galinsoga parviflora.* In the third category, of normal contents, was Cu and Co.

Of all the chemical elements analyzed zinc content of plant organs was very high. In descending order of concentration were the iron and then the rest of heavy metals.

The variant of land ecological restoration through phytoremediation is plausible as long as the water regime from the deposit is check up. First, it is necessary to accelerate the drainage, in order to install vegetation throughout the area [3]. *Phragmites* plants are an early solution to remedy this field. These, together with other species, help to reduce the amount of water and of chemicals in excess by absorption. The yields obtained for several years can significantly reduce both excess of moisture and chemical elements.

CONCLUSIONS

1. The sludge samples had a slightly acid reaction to slightly alkaline, a significant content of organic matter and total nitrogen and high concentrations of mobile forms of phosphorus and potassium. In some areas the mineralization of organic matter and the humification process began.
2. Sludge contained excessive amounts of zinc, well above the intervention threshold value and larger amounts of Cd. Other heavy metals (Cr, Cu, Ni, Pb) have levels content nearly the normal contents.
3. In the plants from spontaneous flora, increased on the sludge from Tomeşti the accumulation of macro elements were done in the normal level of content, depending on the nature of species.
4. The variant of land ecological restoration through phytoremediation is plausible as long as the water regime from the deposit is check up.
5. *Phragmites* plants, together with other species, help to reduce the amount of water and of chemicals in excess by absorption. The yields obtained several years can significantly reduce both excess of moisture and chemical elements; at least a few years after the installation of solification process, the land will not be used for growing plants for animal or human feed.

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

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Keywords: *sulphur pollution, soil, Thermal Power Plant (TPP)*

Abstract

Some of the most complex polluters of the environment are the Thermal Power Plants that use 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 the Sub-Carpathian hills, on the Ialomița Valley, is a major source of environmental pollution with sulfur, since 1952 when was built.

Geographically, the studied territory can be included into the Sub-Carpathians Curvature, more specifically in the Prahova Sub-Carpathian subunit. Pedogenetic factors: rock, topography and parent material, have led to 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.

INTRODUCTION

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

Sulphur from the burning gases reaches on soils and vegetation under the form of aerosols or acid rain. Up to date, expeditionary field research, performed in the areas of the main power stations could not show significant changes in the soil reaction caused by emissions from coal thermal power plants. This fact is due to the large height of exhaust chimney 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. Generally, the sulphur content in the form of SO_4^{-2} is less than 450 mg·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 sulphur 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 chimney 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 METHODS

In preparing this study, field research was required for observation on materials that make up the slopes and terraces around Doiceşti Thermal Power Plant and soil sampling. Soil sampling was done on the depth of 0-20 cm and the sampling points were placed on the map. 23 soil samples were collected, which are subject to the following set of tests: SO_4^{2-} content, total sulphur content and organic sulphur content.

The total sulphur content was determined by gravimetric method as barium sulphates. The principle of the method: ion sulphates precipitated with barium ion in acidic solutions, forming a white precipitate, insoluble crystalline barium sulphate in hydrochloric and nitric acid. Solubility in water at normal temperature is $1x10^{-5}$g/l. The precipitate is separated by filtration, cremated and then weighed.

Organic and mobile sulphur content was determined by the method of Bardsley and Lancester (1960-1965). In this method, organic sulphur is oxidized into sulphates by incineration of soil mixed with sodium bicarbonate. Sulphates are extracted from the soil cremated with a phosphate solution of acetic acid, and then are dosed through turbidity or colorimetric. The method requires a prior procedure of decomposition of sulphide, and easily soluble sulphates removal from the soil.

RESULTS AND DISCUSSION

The study of soil pollution in the area of the Thermal Power Plant Doiceşti requires an extensive analysis of soil properties that make up soil covering of great complexity, determined by the diversity of relief, groundwater, rock and parental materials.

In the area influenced by emissions of the Thermal Power Plant (TPP) Doiceşti, soil samples were taken from 23 soil profiles, mostly located on both sides of the Ialomiţa River, between localities Pucioasa and Târgovişte and western side of the Dâmboviţa River between localities Izvoarele and Drăgăeşti-Ungureni.

The location of soil profiles from the Doiceşti TPP, is the following: on Ialomita Valley to 0.8-9.5 km N from 0.8 to 6.7 km E, at 1.7 to 6.3 km S-SSE; on the left side of Dambovita to Târgovişte, at 1,6-9 km S-SW-V away from TPP, and 6.9-9.1 km away from TPP, respectively.

About 50% of soil profiles are located in meadow, on Entisols (majority Eutric Fluvisols, Haplic, Skeletic and Gleyc). The remaining soils are: 17.65% Cambisols (Eutric Cambisols, Lepti-Eutric Cambisols, and Stagnic-Eutric Cambisols), 17.65 % Luvisols (Haplic Luvisols and Stagnic Luvisols) 8.82% Regosol, 2.94% Mollisols (Rendzic Leptosols) and 2.94% Vertisols (Pellic Vertisols) [2].

In the following the analysis of each pollutant, is presented separately.

A feature of soils from Doiceşti area is low-medium supplying with humus; however, coal dust, rich in organic carbon, has a direct influence on its content in soils located in the area of influence of emissions. Although, to characterize the state of organic matter soil supply, generally used humus content, we considered inappropriate to use as a means of comparison, this parameter. This feature is imposed by the processes of bioaccumulation which, for various reasons, did not allow accumulation of large amounts of humus. Climatic conditions and natural vegetation are the main reasons which prevent the accumulation on the soil surface and the profile of large amounts of plant debris. Many of the soils studied are affected by erosion processes that have the effect of transport of material from the upper soil profile. All these soils can have up to 1.8-3.0% humus under natural conditions. In the investigated soil profiles organic carbon content varied widely, from 0.89 to 4.78% (Figure 1).

The behavior of any chemical element is influenced by soil reaction. There is a relationship of proportionality between the acidity of the soil and the mobility of sulphur. In the area investigated, the analysis revealed a variation of pH values from 6.09 to 8.17, respectively, a variation of soil reaction from slightly acid to slightly alkaline (Figure 2).

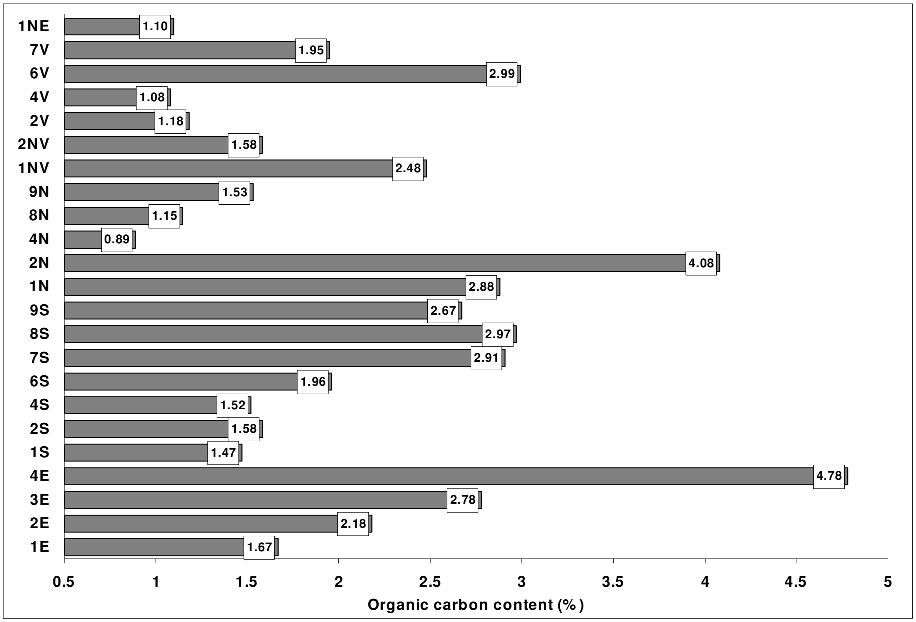

Fig. 1. Amplitude variation of organic carbons content in soil profiles located in the area of the thermo-electric power station Doicesti

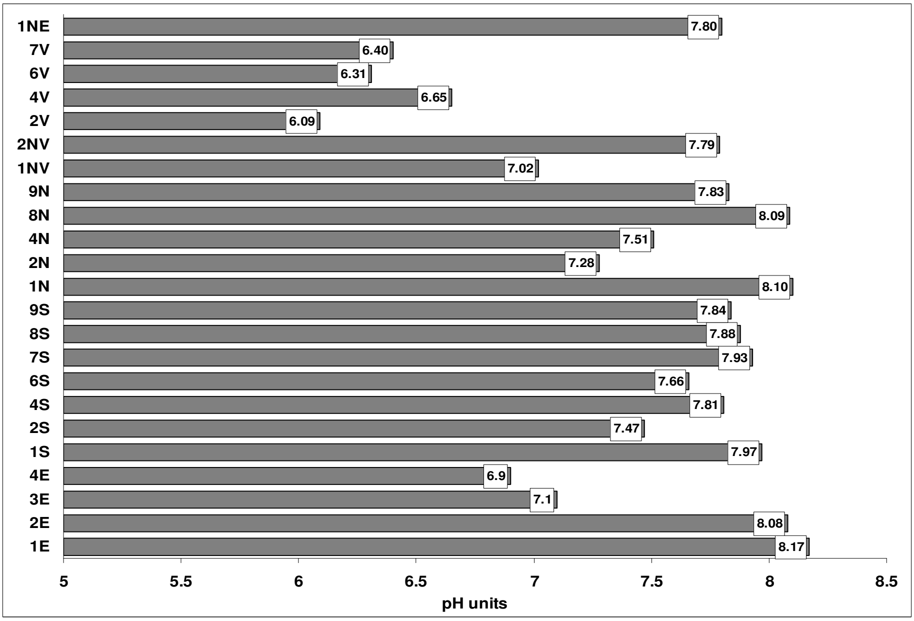

Fig. 2. Amplitude variation of pH values in soil profiles located in the area of the thermo-electric power plant Doicesti

Evaluation of soil degree loading with sulphur derived from the Thermal Power Plant Doiceşti is, however, the subject of this paper. Samples were collected from 23 soil profiles performed on all cardinal directions. Soil samples were analyzed for determination of total sulphur, organic sulfur and mobile sulfur.

Total sulfur content.

Loading degree of soil is low when the total sulphur content is less than 200 mg·kg^{-1}, medium between 201-800 mg·kg^{-1}, and high between 801 and 1600 mg·kg^{-1} (figure 3). In our determination, total sulphur content presented values ranging from 275 mg·kg^{-1} (Profile 2S) and 3350 mg·kg^{-1} (9S profile).

The analysis revealed that in the entire investigated territory, only 5 of 23 soil profiles had values over 801 mg·kg^{-1}, reflecting high total sulphur content. Of these, two profiles showed excessive contents of over 3000 mg·kg^{-1} (Figure 3).

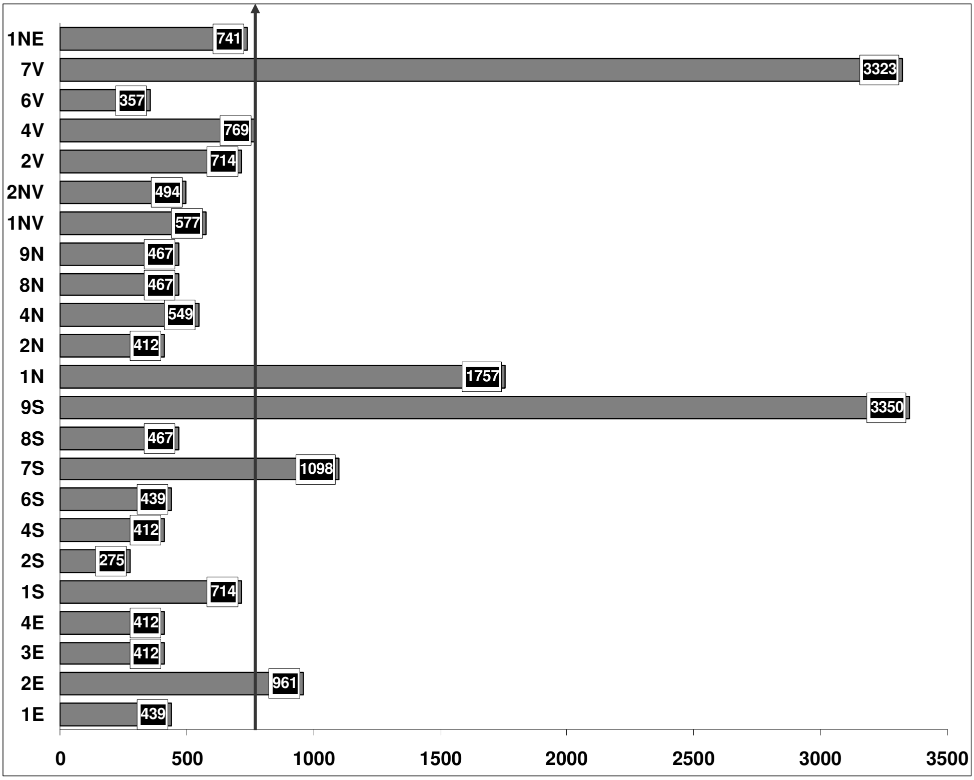

Fig. 3. Total sulphur content in soil profiles located in the area of the thermo-electric power plant Doiceşti (mg·kg^{-1})

On the east direction there were 4 soil profiles with values between 412 mg·kg^{-1} and 961 mg·kg^{-1}. Only profile 2E recorded a high load level, 961 mg·kg^{-1}, due to the small distance from Thermal Power Plant.

In the southern direction there are 7 soil profiles with values between 275 and 3350 mg·kg^{-1}. 7S and 9S profiles have the highest values of the entire studied area, because their location quite close to the Thermal Power Plant Doiceşti.

On the north there were tested 5 soil profiles, profile 1N been quite close to the Thermal Power Plant having the highest value (1757 mg·kg^{-1}). On the western direction there are 4 soil profiles, with values between 357 (6V) and 3323 mg·kg^{-1} (7V). On the direction of NV there are two soil profiles with values between 494 and 577 mg·kg^{-1}, corresponding to the middle class content.

The total sulphur pollution is relatively high in a southern direction in the 7S and 9S profiles, to the north in the profile 1N, and in a western direction in the profile 7V. The remaining profiles have values ranging into the middle class of content (201-800 mg·kg^{-1}).

Organic sulphur content

There are three classes for soil organic sulfur content: low - when the sulphur content is less than 160 mg·kg^{-1}, medium - sulphur content is between 161-320 mg·kg^{-1}, and high - sulphur content is over 320 mg·kg^{-1}.

Organic sulphur content ranged from 134 to 606 mg·kg^{-1} in the investigated area (Figure 4). Eight entire soil profiles had values over 320 mg·kg^{-1}, the limit that marks the high content class.

Only a single profile (4S) had a low organic sulfur content value, about 134 mg·kg^{-1} belongs to the low class content.

The amount of organic sulphur content recorded in 1E, 3E, 4E, 1S, 2S, 4S, 1N, 2N, 4N, 9N, 1 NV, and 1 NE profiles belong to the middle class. Soil profiles 2N, 7V, 8V, and 2 NV had values at the border between medium and high-content classes. Profiles 2E, 7, 8, 9S, and 4V showed very high values of between 426 and 606 mg·kg^{-1}.

The wide variation of organic sulphur content was influenced by a multitude of factors, less the distance from the source. Stable relationships, highly significantly correlated, between organic C, N and S for different groups of soils, have been reported in spite of great variations in climate and parent material by G. Koptsik, C. Alewell [4]. The relatively weak relationship between air emissions of S and S content in soil is due to the fact that most of the SO_2 is emitted by high chimneys which favor emissions rather transport distances than local deposits.

The previous studies from the surroundings of Nikel and Zapolyarnyy did not find any relationship between the distribution of total soil S and atmospheric S load [6, 10]. The results of geochemical mapping of the Central Barents region did not reveal the anthropogenic enrichment of the organic horizon of the podzols with S despite the S input from the Kola smelters [3].

Novák et al. [7] for Central Europe and Novák et al. [8] for a NW-SE European transect reported statistically significant straight-line positive relationships between the atmospheric S input and total the S concentration in the topsoil. A significant correlation was also found between total S content in the soil organic and mineral layers and the input of S from atmosphere in forest ecosystems of the USA [5]. The impact of 40 a of S emissions from a sour gas processing plant in Alberta (Canada) has also lead to the increase in soil S pools caused by accumulation of organic S in the forest floor and accumulation of inorganic SO_4^{2-} in the mineral soil [9].

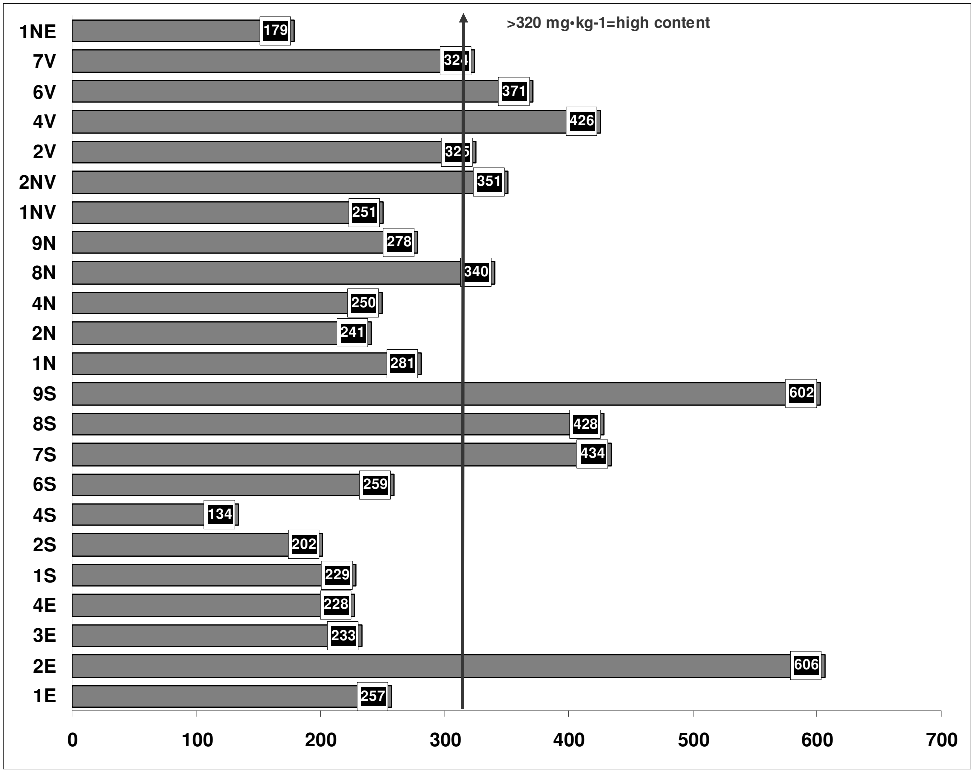

Fig. 4. Organic sulphur content variation in soil profiles located in the area of the thermo-electric power plant Doicesti (mg·kg^{-1})

The research of Mitchell and Lindberg [5] revealed that the sulphur in the O horizons was mainly present as organic S. Organic S, calculated from total S by subtracting inorganic S represented 99% of the median of total S content [5]. Mineral horizons contained significantly lower amounts or organic S. The latter is due to the combined effects of catabolism and chemical precipitation of dissolved organic S in the mineral soil. Nevertheless, the dominant form of S in most mineral soils was also organic [5].

Mobile sulphur content

There are three classes of content for this form of sulphur, namely: low - for values ≤ 5 mg·kg^{-1}, medium for values between 6-15 mg·kg^{-1} and high for values > 16 mg·kg^{-1}. Of the 23 soil profiles investigated, only one profile 4S, recorded a sulphur content value which belongs to the middle class (8.4 mg·kg^{-1}), all other profiles with values well above 16 mg·kg^{-1}, which marks the crossing in high class content (Figure 5).

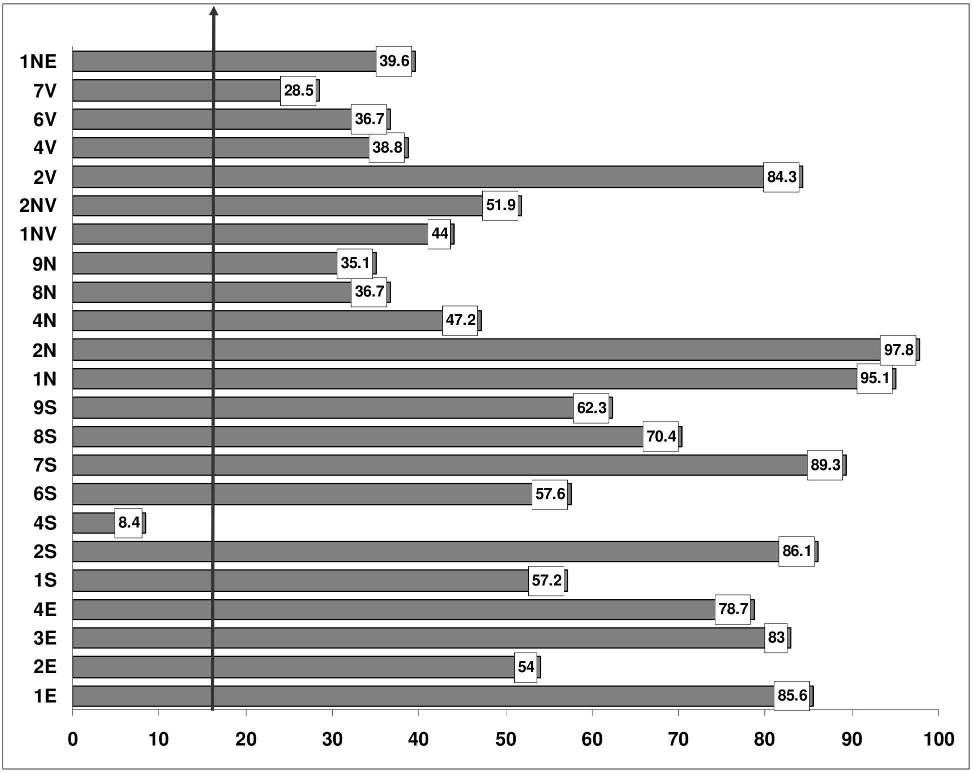

Fig. 5. Mobile sulphur content variation in soil profiles located in the area of the thermo-electric power plant Doicesti (mg·kg^{-1})

Mobile sulfur contents range from 28.5 mg·kg^{-1} to 97.8 mg·kg^{-1}, the highest values, above 95 mg·kg^{-1}, recorded in profiles 1 N and 2 N. Other soil profiles with high mobile sulphur content, over 80 mg·kg^{-1}, were profiles 1E, 3E, 2S, 7S and 2V. Among these soil profiles with high mobile sulphur content, only profiles 1N and 7S had, also, high content of total sulphur. So, a feature of the investigated area is that although total sulphur contents do not always reach levels that could generate pollution problems, mobile forms of sulphur, soluble, highly chemical and biochemical reactive, reaches alarming levels in the soil.

CONCLUSIONS

1. Total sulphur pollution is relatively high in the southern direction in the 7S and 9S profiles, to the north in the profile 1N, and in the western direction in the profile 7V. The remaining profiles have values ranging in the middle class of content (201-800 $mg \cdot kg^{-1}$).
2. The organic sulphur content recorded a large variation from 134 to 606 $mg \cdot kg^{-1}$ in the investigated area. Eight of the entire soil profiles had values over the limit that marks the high content class. The wide variation of organic sulphur content was influenced by a multitude of factors, less the distance from the source.
3. Of the 23 soil profiles investigated, only one profile, 4S, recorded mobile sulfur content value which belongs to the middle class, all other profiles recorded values well above limit which marks the crossing in high class content.
4. The concentrations in soil of total, organic and mobile S tended to be higher in profiles located near the thermal power plant; however, no relationship between distance to emissions source and S contents was found.
5. In the area of influence of the Thermal Power Plant pollution by sulphur Doiceşti is caused by emissions from thermal power station. A feature of the investigated area is that, although total sulphur contents do not always reach levels that could generate pollution problems, mobile forms of sulphur, soluble, highly chemical and biochemical reactive, reaches alarming levels in the soil.

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SOIL CHEMICAL AND MICROBIOLOGICAL PROPERTIES VARIATION AS A CONSEQUENCE OF OIL POLLUTED SOILS ELECTRO REMEDIATION

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Keywords: *oil pollution, electro remediation*

Abstract

Electro remediation technologies have been applied on a former Petroleum Park, at Sfinții Voievozi, Dâmbovița County. The evolution of the soil chemical and microbiological properties has been studied, by sampling and laboratory analyses carried out at different time intervals. Organic carbon and nutritional macro elements contents varied in time. An organic carbon depletion tendency has been noticed, implying the oil residues contents depletion, which is the purpose of the experiment. The variations of the plant nutritional elements contents (nitrogen, phosphorus, and potassium) were low, meaning that these elements do not migrate with the oil residues, which is very important for this land's re-cultivation. The soil reaction and the total soluble salts content registered small variations, statistically not ensured. As for the microbiological properties, a modification phenomenon was noticed, of the number, communities' structure, and physiologic activities of the soil micro flora. The obtained results will be used to develop a computing system for petroleum products pollution risk management and to apply electro kinetic and bio-remediation techniques in situ.

INTRODUCTION

The oil contaminated fields problems are getting more important lately, from the practical, scientifical, and political point of view, at a national and international scale, and constitute a major concern of the European Union. The inherited contamination represents, in the last few years, a critical soil pollution category, because of the polutant persitentce in soil an groundwater on one hand, and because is more difficult to manage or to solve than a new pollution on the other hand. The present paper was elaborated in the frame of a project which aims to develop management tools of the health estate of certain areas and assist stategic and tactic decisions taking depending on it.

MATERIAL AND METHODS

The research field is placed near Târgovişte, in the Sfinții Voievozi area, on o former Petroleum Park. A 2 by 2 m lot was delimited and electrodes vere inserted in its corners (catodes, F1-F4) and middle (anode, F5), in ceramic tubes, down to 2 m depth. A potential difference was applied between the electrodes, as part of the remediation technology. The lot was sampled at the electrodes 7 times, at several days intervals.

The soil samples were chemically analysed in the laboratory, by standardized methods [1-5], in order to dermine the reaction, organic carbon, total nitrogen, nitrates, mobile phosphosus and potassium, and soluble salts contents. Microbiological analyses were also performed, as microbiologic activity is very important for the oil polluted soils remediation. All these soil properties' variation in time was studied, in order to develop decontamination technologies, along with a risk assessment system for such terrains.

RESULTS AND DISCUSSION

The evolution in time of organic carbon and nutritional macro elements contents under the influence of remediation electro kinetic treatment

The organic carbon contents around the electrodes have a depleting tendency with the electro remediation time (Figure 1). It is more accented at the cathodes, but not here or at the anode is it statistically ensured.

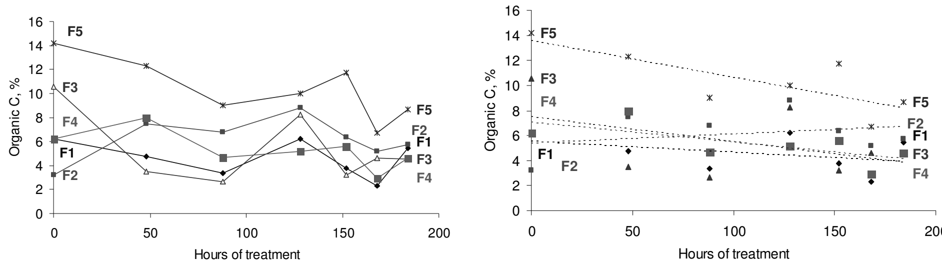

Fig. 1. Evolution in time of organic carbon contents of samples taken from the electrodes in experimental lot; right: linear tendencies

The total nitrogen contents have a depleting tendency (Figure 2) during the remediation process, more stressed for the F3 cathode and almost inexistent at the anode, not statistically ensured.

The carbon:nitrogen ratio tendency is symetrical with that of the total nitrogen content: the latter increasing tendency is reflected by the former depleting tendency (Figure 3). Again simetrically, the most accented depleting tendency is registered at the F3 cathode, and weakest at the anode. These tendencies are not statistically ensured.

The nitrates contents vary irregularly, especially at the F4 cathode (Figure 4). The fact must be considered that nitrates are easily leached into the soil depth due to their high water solubility an the experimenting period was a rainy one. A slight increasing tendency can be noticed though at the F2 cathode and a depleting tendency at the anode, not statistically ensured.

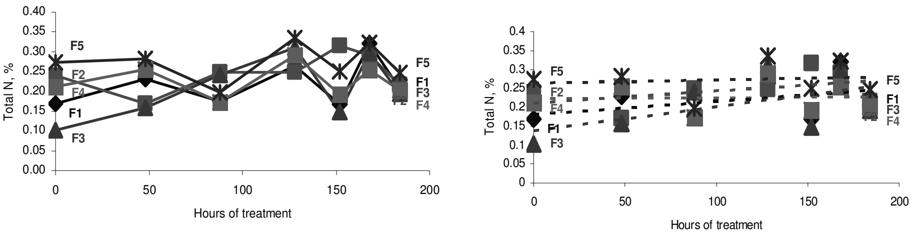

Fig. 2. Evolution in time of total nitrogen contents of samples taken from the electrodes in experimental lot; right: linear tendencies

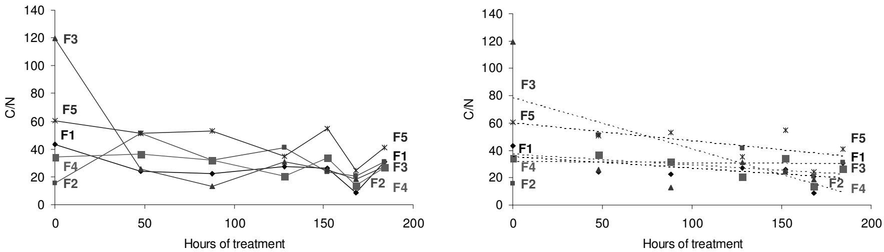

Fig. 3. Evolution in time of C/N ratio of samples taken from the electrodes in the experimental lot; right: linear tendencies

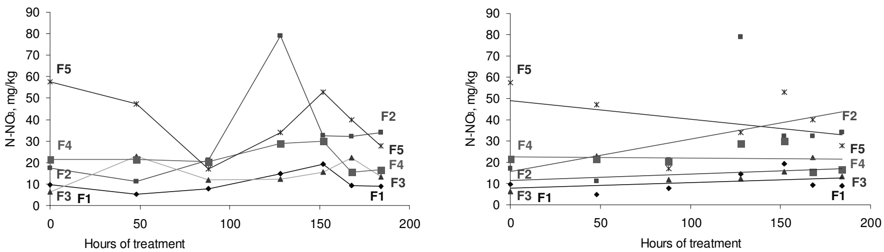

Fig. 4. Evolution in time of nitrogen contents of samples taken from the electrodes in the experimental lot; right: linear tendencies

The mobile phosphorus contents variation is also irregular (Figure 5). The increasing tendendency at the F2 and F3 cathodes and the depleting one at the anode are not statistically ensured.

The mobile potassium contents tend to increase at the F2 cathode and to deplete at the anode (Figure 6) but the tendencies are not statistically ensured. Almost no difference can be noticed at the other cathodes.

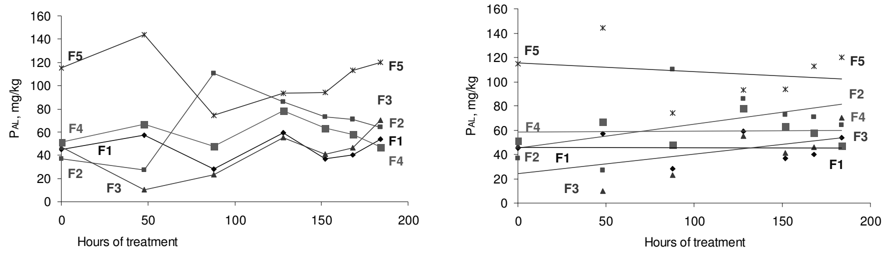

Fig. 5. Evolution in time of mobile phosphorus contents of samples taken from the electrodes in experimental lot; right: linear tendencies

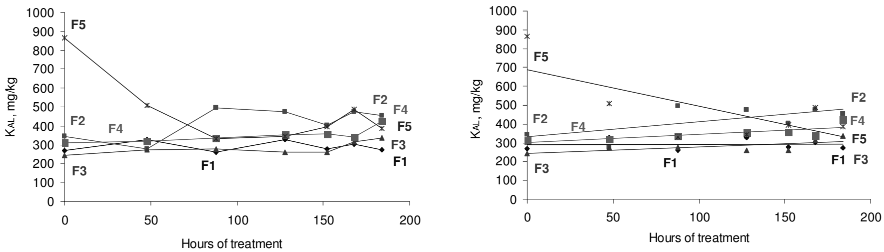

Fig. 6. Evolution in time of mobile potassium contents of samples taken from the electrodes in experimental lot; right: linear tendencies

The variation in time of soil reaction and soluble salts content

The soil reaction is slightly alkaline, with a little higher values at the F1 cathode and lower at the F2 ONE and has a slightly increasing tendency in these points (Figure 7).

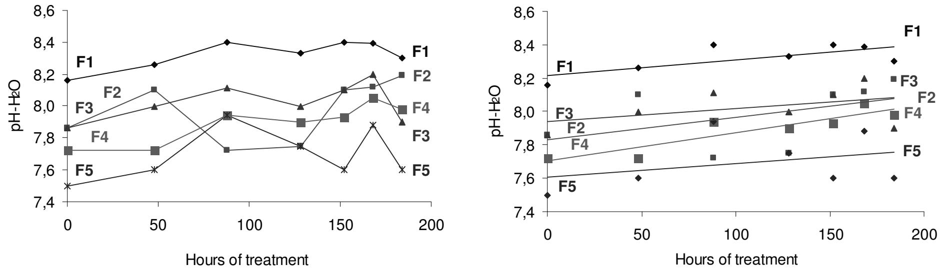

Fig. 7. Evolution in time of reaction of soil samples from the experimental field electrodes; right: linear tendencies

The total soluble salts (determined by conductimetry, Figure 8) dynamics indicate a slight increase at the F3 cathode and a bigger one at the F2 one and a slight diminution at the F1 cathode and bigger at the F4 cathode and the anode.

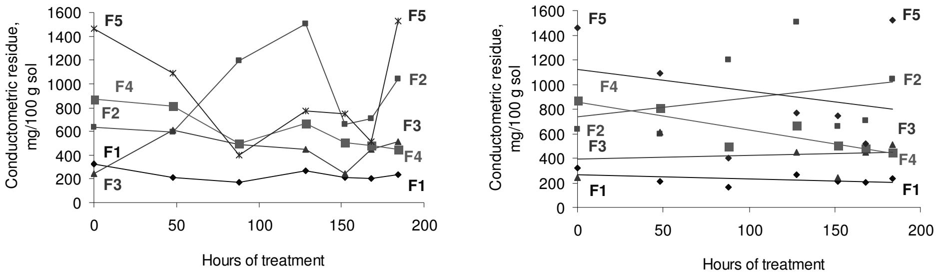

Fig. 8. Evolution in time of total soluble salts contents, determined by conductimetry, in soil samples from the experimental field electrodes

Microbiological soil properties variation along the remediation treatment

A modification phenomenon takes place, under the influence of the remediation treatment, of the communities' numbers and structures and of the physiologic activities of the oil polluted soil micro flora which is very important from the oil polluted soils remediation technologies point of view. As compared to the initial moment, an increasing sinuous tendency is noticed of the bacteria and fungi populations, with maximums at different moments. Very high values were registered at the cathodes in the samples taken after 152 hours and at the anode in the samples taken after 168 hours.

The most important fungi numbers increases as compared to the initial moment, and also as compared to the cathodes, were registered at the anode, after 168 and 184 hours. The general tendency is of microbial population increase in time both for the cathodes and for the anode. The phenomenon is more accented with the bacteria, with up to 3 orders of magnitude, than with the fungi (only 1 order of magnitude).

As regards the microbial community structure, fluorescent *Pseudomonadaceae* settle as dominant bacteria species after 88 hours, both at the cathodes as at the anode, and the *Bacillaceae* share diminishes. For the fungi the potentially pathogenic species belonging to the *Fusarium* genre are dominant regardless of the sampling moment, both at the cathodes and at the anode.

The soil respiration values have an increasing tendency at the cathodes, with different maximums at F1 and F3 after 168 hours, F2 after 152 hours, and F4 after 88 hours. At the anode, where higher values than at the cathodes were registered, a maximum was noticed 88 hours from the initial moment after which the tendency was of diminution.

CONCLUSIONS

1. The organic carbon and macro elements contents in the experimental field vary in time under the influence of the electro kinetic remediation treatment. The organic carbon contents depletion tendency is to be noticed, as it means diminution of hydrocarbons' contents, the very goal of the remediation treatment. The variation of the contents of plant nutrition elements are much too weak meaning that these elements are not exported from the soil along with the hydrocarbons, which is very important for the re-cultivation of the terrain.
2. The soil reaction and total soluble salts contents do not significantly vary. The slight increasing tendency is due to their accumulation at the electrodes under the influence of the potential difference. It is possible that the contents depletes between electrodes, so these spaces should be sampled too.
3. The microbiologic soil properties vary in time, in numbers, in structure, and in physiologic activity, which is very important from the oil polluted soils remediation technologies point of view. The increasing tendencies are sinuous.
4. The experimental time was short so clear tendencies, especially for the organic carbon contents, could not be highlighted. A longer experimenting period and sampling at larger periods could clarify the described tendencies. The weather conditions in the experimenting period must be recorded because rain, fog, drought, for example, significantly influence the elements' contents of soils. The rainy period of the experimentation affected the elements' contents variation in soil.

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EXPERIMENTAL VERIFICATION OF RESULTS REPRODUCTIBILITY AND RESIDUAL EFFECT IN GREENHOUSE ON ARTIFICIALLY POLLUTED SOIL WITH LEAD (I)

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Keywords: *polluted soil, lead, EDTA, residual effect*

Abstract

Phytoextraction is a technique to remove heavy metals from soil by direct absorption into plant tissues. The implemention of phytoextraction involves growing one or more plant species that are contaminants hyperaccumulators. Specific conditions for the application of phytoextraction program for a polluted area reffers to amendments, period of vegetation, pollution degree, etc.

The paper presents experimental research in greenhouse, aimed to check the parameters determining the reproductibility of selected plant (maize) and following the conclusions of the preliminary laboratory test experiments.

Verification consisted in achieving 2 experiments with 2 degrees of artificially soil pollution with Pb: 1000 mg Pb/kg soil and concentration of EDTA with a ratio Ligand/Lead between 0 and 0.5 and 2000 mg Pb / kg soil and ratio Ligand/Lead between 0 and 0.4 and three growing cycles (Cycle 1, Cycle 2 - residual effect, Cycle 3 - residual effect).

INTRODUCTION

Metals are natural constituents of soil. Over 100 years of industrialization have led to huge changes in the overall budget of the critical chemicals in the earth's crust [1].

Soil contamination can destroy the delicate equilibria between physical, chemical and biological processes, which influences soil fertility.

The effects of soil contamination with heavy metals are already found in many zones of the entire world [2-3].

In the recent years the number of research focusing on the study of soil pollution with heavy metals has increased due to various anthropogenic sources [4-5].

Phytoremediation, a relatively new remediation technology, is mainly designed for land contamination or areas with high pollution due to urban and industrial activity. Phytoremediation by phytoextraction is an extraction and accumulation procedure for contaminants/pollutants in plant tissues considered hyperaccumulators-including the roots and aerial part [6].

MATERIAL AND METHODS

In this stage, two experimental series were performed in greenhouse to verify the reproductibility of determined parameters on previously selected plants and the conclusions of the preliminary test experiments.

Preliminary test experiments established:

- Remaining test plant in the experiment - maize;
- Experimental scheme will include two degrees of artificial soil pollution with lead: 1000 mg Pb / kg and 2000 mg/kg;
- Experience 1 contains 7 experimental variants in three repetitions;
- EDTA concentration (expressed as EDTA:Pb ratio) in experiment with soil polluted with 1000 mg Pb / kg will be: 0, 0.1, 0.2, 0.3, 0.4, 0.5;
- Experience 2 contains 6 experimental variants in three repetitions;
- EDTA concentration (expressed as EDTA:Pb ratio) in experiment with soil polluted with 2000 mg Pb / kg will be: 0, 0.1, 0.2, 0.3, 0.4;
- Soil type: the cambic chernozem from Fundulea;
- Physical, chemical and microbiological characteristics of soil are the same in the Preliminary Test Experiments;
- Lead and ligand treatment was applied to soil before sowing.
- Quantity of soil per pot was 8 kg for both experiments in the two series.
- Pots used were MITSCHERLICH type with a capacity by 10 L.
- Pb was applied as $Pb(NO3)_2$ - (1000 mg/kg, 2000 mg/kg) and EDTA (ethylenediaminetetraacetic acid) at the beginning of the experiment, before sowing.
- Was not applied phytosanitary treatments, neither mineral or organic fertilizers.
- Two experimental series lasted 8 weeks each.

Series II and III used the same test plant – maize, has experienced the same pots of Series I seeking residual effect of treatment.

RESULTS AND DISCUSSION

SERIES I, harvest Experience 1 and Experience 2 – Maize crop

The treatment with lead and ligand was applied to soil before sowing (Series 1). For 8 weeks there was followed the evolution of plants starring with seedling, emergence until harvest. Regarding the aspect and appearance of maize leaves was found a high influence of treatment with Pb, with EDTA or Pb + EDTA. After harvesting, maize measurements were made as parameters as plant height and weight of biological material and dosing results lead to the establishment of lead accumulated in plants. After the analysis of variance (Tukey test, Fisher test), the statistical data showed a different evolution of these parameters according to treatment.

Experience 1 - soil treated with the same lead content (1000 mg/kg) and different EDTA content (0, 0.1, 0.2, 0.3, 0.4, 0.5) - Series 1

Table 1 shows the evolution of biomass, plant height of corn and leaves the lead content of soil polluted with 1000 mg Pb/kg with increasing ligand content so that the $\frac{EDTA}{Pb}$ ratio to reach values of 0, 0.1, 0.2 , 0.3, 0.4, 0.5. Leaves biomass decrease distinct significantly from control to experimental variants V4, V5, V6 and V7. The increase of leaves biomass at experimental variant V2 comparatively with control is explained by higher content of nitrogen provided by lead nitrate. Comparativelly with control, the decrease is significant starting with experimental variant V7(EDTA:Pb=0,5). So, it is considered efficient the treatment, in terms of minimum biomass decrease compared with the control, the experimental variants V5 or V6. Comparativelly with the experimental variant V2 $\left[\text{Soil}\left(+1000\,\text{mg Pb/kg}\right)+\text{EDTA}\left(\frac{\text{EDTA}}{\text{Pb}}=0\right)\right]$ leaves biomass has a significant decrease starting with experimental variant V5 $\left[\text{Soil}\left(+1000\,\text{mg Pb/kg}\right)+\text{EDTA}\left(\frac{\text{EDTA}}{\text{Pb}}=0.3\right)\right]$. This means that the ligand effect is distinguished from V5 experimental variant, which means that treatment with high efficiency is the experimental variant V4 $\left[\text{Soil}\left(+1000\,\text{mg Pb/kg}\right)+\text{EDTA}\left(\frac{\text{EDTA}}{\text{Pb}}=0.2\right)\right]$.

Plant height decrease distinct significantly comparativelly with control.

As regards the leaves lead content presented in Table 1 shows a distinct significantly increase in each variant comparativelly with control. Significant increase of more than 58.6 cm (DL 5%) occurs in experimental variants V5, V6 and V7. The evolution of leaves biomass, plant height and leaves Pb content, can be appreciate that until V4 experimental variant $\left[\text{Soil}\left(+1000\,\text{mg Pb/kg}\right)+\text{EDTA}\left(\frac{\text{EDTA}}{\text{Pb}}=0.2\right)\right]$ was not registered a significant decrease in biomass, this ligand does not react in negative terms while the concentration of lead increased significantly. As such, are considered as efficient treatment for phytoextraction in presence of lead concentration 1000 mg Pb/kg soil, the experimental variants V4(EDTA:Pb=0,2) and V5(EDTA:Pb=0.3)

Table 1

Biological material weight at harvest (biomass), plant height and leaves content of lead in a soil polluted with Pb 1000 mg/kg soil and different content of EDTA - Series 1

Treatment	Biomass (g)	Height (cm)	Pb (mg/kg)
V1 Control Cambic chernozem from Fundulea	190.0	57.3	5.0
V2: Soil (+ 1000 mgPb/Kg) + EDTA (EDTA:Pb=0)	215.0	51.7	44.3
V3: Soil (+ 1000 mgPb/Kg) + EDTA (EDTA:Pb=0.1)	195.3	56.7	43.6
V4: Soil (+ 1000 mgPb/Kg) + EDTA (EDTA:Pb=0.2)	171.3	52.0	61.7
V5: Soil (+ 1000 mgPb/Kg) + EDTA (EDTA:Pb=0.3)	140.0	50.3	69.6
V6: Soil (+ 1000 mgPb/Kg) + EDTA (EDTA:Pb=0.4)	132.0	46.3	74.0
V7: Soil (+ 1000 mgPb/Kg) + EDTA (EDTA:Pb=0.5)	104.3	42.7	112.0
DL 5% (Tukey test)	71.3	7.2	58.6
Fisher test	**	**	**

Experience 2 - soil treated with the same lead content (2000 mg/kg) and different EDTA content of (0, 0.1, 0.2, 0.3, 0.4) - Series 1

Table 2 shows the evolution of the three parameters (biomass, height, leaves content of Pb) in a soil polluted with 2000 mg Pb/kg with increasing content of ligand (EDTA) in the $\frac{\text{EDTA}}{\text{Pb}}$ ratio by 0, 0.1, 0.2, 0,3, 0,4.

Plants biomass and height has a distinct significantly decrease with variants and leaves lead content a significantly distinct increase. So, treatment can be efficient in the phytoextraction process in 2000 mg Pb / kg soil by application of EDTA content to produce a ration by EDTA:Pb=0.1.

Table 2

Biological material weight at harvest (biomass), plant height and leaves content of lead in a soil polluted with Pb 2000 mg/kg soil and different content of EDTA - Series 1

Treatment	Biomass (g)	Height (cm)	Pb (mg/kg)
V1 Control Cambic chernozem from Fundulea	190.0	57.3	5.0
V8: Soil (+ 2000 mgPb/Kg) + EDTA (EDTA:Pb=0)	164.3	50.0	80.8
V9: Soil (+ 2000 mgPb/Kg) + EDTA (EDTA:Pb=0.1)	147.3	49.3	85.8
V10: Soil (+ 2000 mgPb/Kg) + EDTA (EDTA:Pb=0.2)	44.3	31.7	211.0
V11: Soil (+ 2000 mgPb/Kg) + EDTA (EDTA:Pb=0.3)	40.0	23.3	439.7
V12: Soil (+ 2000 mgPb/Kg) + EDTA (EDTA:Pb=0.4)	7.3	10.0	1994.1
DL 5% (Tukey test)	47.6	8.4	120.1
Fisher test	**	**	**

Meanwhile, the leaves biomass comparativelly with the control (V1) has a significantly decrease starting with experimental variant V10 $\left[\text{Soil}\left(+2000\,\text{mg Pb/kg}\right)+\text{EDTA}\left(\frac{\text{EDTA}}{\text{Pb}}=0.2\right)\right]$. This means that the efficient treatment is the undecrease of leaves biomass of experimental variant V9 $\left[\text{Soil}\left(+2000\,\text{mg Pb/kg}\right)+\text{EDTA}\left(\frac{\text{EDTA}}{\text{Pb}}=0.1\right)\right]$. This variation correlates very well with leaves lead content that has a significantly increase starting with experimental variant V10.

CONCLUSIONS

1. Following the evolution of the three parameters (biomass, height, Pb leaves content) in the first cycle of vegetation, it can be stated that thetreatment with ligand (EDTA) on a soil polluted with 1000 mg Pb/kg stimulates the

accumulation of lead from soil in maize plants without affecting the evolution of plants and soil characteristics at an EDTA concentration to achieve a EDTA:Pb ratio between 0.2 and 0.3. Lower concentrations of ligand are not specific to the phytoextraction process on favorable conditions, while higher concentrations cause adverse effects to plants and their vegetative evolution is affected in the first cycle of vegetation.

2. Following the evolution of the three parameters (biomass, height, leaves Pb content), it can be said that treatment with ligand (EDTA) on a soil polluted with 2000 mg Pb/kg stimulates the accumulation of lead in soil without harming the maize plants plant evolution and soil characteristics at at an EDTA concentration to achieve a EDTA:Pb ratio by 0.1.
3. The statistical data showed that exists differences statistically assured in terms of biological material weight at harvest (biomass) and plant height, but the biomass lead content in function with applied treatment. 4. At the same soil concentration of lead, leaves lead content increase with the applied EDTA increasing levels, which explains the ligand capability to increase the lead solubility in soil and uptake by plants.
4. Following the preliminary experiments carried out with mustard and maize, maize has met the requirements to be selected as test plant in experiments.

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THE SEWAGE SLUDGE INFLUENCE UPON COPPER CONTENT IN THE LUVOSOIL-PLANTS ECO-SYSTEM

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Keywords: *processed sludge, luvosoil, Cu, field plants*

Abstract

Another heavy metal-copper (Cu), is part of the agricultural environment. The concentration below which it is in the ground depends on several factors. Of these organic matter (OM) expressed by quantity and evolution play a role in the cross-circuit composed of soil-plant system. In order to improve luvosoil OM of domestic sludge anaerobic digestion was used and dried. The contents of soil evolution was observed using doses of sludge as fallows: between 0 and 50 t.ha^{-1} with and without chemical fertilizers. Applying these organic- mineral fertilizers has contributed to increased plant biomass of: maize, wheat and soybeans. With increasing total biomass took place and a more pronounced absorption of Cu ions (Cu^{2+}). Correlations obtained between total biomass and leaf Cu contents show obvious increases, provided statistics on soybeans and wheat in year 4. Grain productions were negatively correlated with Cu, but the uncertain values significant. Such research with finding new methods for improvement of cross-cultural environment is needed for the majority highlight aspects of nutrition of plants in each hand.

INTRODUCTION

The existence of copper (Cu) in nature is strongly related to the contents of soil parent material originally evolved. Heavy metal accumulation in arable horizon is favored both by growing plants and the contribution of organic matter (OM) from different sources. Thus, if lithosphere contains about 100 mg Cu, soils contain between 2 and 100 mg [1, 5]. Recent estimates show content in the soil ranging between 1-37 mg Cu total forms and 3-14 mg Cu mobile ones [7]. However, the levels that are found with plant roots in the area is not the most important factor for absorption and thus to use it in normal physiological processes [15]. Copper is found in soil in the form of ion- Cu^{2+} (highest proportions) as well as neutral insoluble salts, other water soluble components as well as mineral-rich with [2]. The ions are absorbed on clay minerals and in a way related to organic matter. Absorption cross - Cu^{2+} in soil environment occurs depending on a number of factors. The most important are: pH, organic carbon (OC) content, presence of other metal ions, humidity etc. Positive influence on soil acidity Cu^{2+} absorption with the possibility that as the ions increases with pH values to be less active. Cu-MO complexes vary in stability over a variety of cases and are explained by the existence of different links to print the nature of trade between the mineral [17]. In this case, they will be detained for such a complex, sometimes not [13]. Instead the association with-clay has a degree of hydrolysis so that Cu^{2+} on clay is more easily absorbed by plants [6]. In comparison with other metal ions Cu^{2+} reduces Fe and Mn availability and in turn is inhibited by Zn and Mo [7]. Copper is absorbed by plants for normal functioning of normal physiological processes [4, 10]. Any plant that grows normally contains certain concentrations of Cu^{2+}. The control of crop plants show some states between deficiency and excess. Deficiency occurs in concentrations of 3-4 mg Cu in the leaves [1]. The normal values are below 10 mg. From this point of view of literature data shows a relative uncertainty. Toxicity occurs when the concentration of soil and plant exceeds certain limits. An estimate of toxicity shows that, over 20 mg of plant leaves, copper becomes dangerous [1, 12]. On acid soils, toxicity to the exchange takes place over 50 mg. Excessive concentrations of copper can be achieved by applying sewage sludge resulting from urban waste water treatment. Raw sludge obtained by processing and dewatering can be used as organic fertilizer only if the Cu content does not exceed legal standards [18]. Such sludge processed is used in this experiment due to the high content in macro- nutrients and a moderate copper level.

MATERIAL AND METHODS

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 rates of organic- mineral. Thus, these rates 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 the Pitesti Wastewater Treatment Plant. Chemical fertilizers were differentiated on three levels: unfertilized, needs to 1/2 of normal and total rates (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. Sludge rates 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 rates. Each variant had a surface of 100 m^2 each and was rehearsed (replicated) for three times. Leaves samples were taken during flowering period: in maize the leaves located at cob level, in winter wheat the last 3 leaves including the standard leaf and the soybeans the leaves in the central area of the plant but also with bean-pods in formation process. 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: copper leaf and ground forms total - SR ISO 11047-99, 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 (Anova test) and with the help of correlations and regressions.

RESULTS AND DISCUSSION

Cu contents in the cultivation environment (soil). Ground measurements performed revealed heavy metal forms both by total and by mobile forms (Table 1). The data show that copper in soil culture was present in high levels. Thus, the total ranged between 14.1 and 27.6 mg of the limit and between 17.03 and 22.5 mg as annual averages. In comparison with literature data led to experiment with was of sufficient levels of good (great). Course to improve soil contributed to the heavy metal processed and dewatered sewage sludge. Mobile forms of Cu were between 3.0 and 7.4 mg of the limit and between 3.48 and 5.87 mg as the average. Both forms of Cu total and mobile demonstrates ensuring favorable environment for the absorption and translocation of this element, and particularly important in ensuring the growth and development of plants [17]. Sewage sludge increased soil content in copper with 1.11 mg in total forms and 0.37 mg in mobile forms. These concentrations demonstrated that the item was actually a chemical micro- nutrient valuable plant available.

Table 1

Copper concentrations from luvosoil cultivated with field crops

Crop plants	Cu, mg.kg^{-1} d.w., total forms		Cu, mg.kg^{-1} d.w., mobile forms	
	limits	media	limits	media
Maize	19.7 – 27.6	22.95	4.9 – 7.4	5.87
Winter wheat	18.7 – 24.7	20.78	3.0 – 4.0	3.48
Soybeans	15.2 – 18.8	17.03	3.3 – 5.2	4.07
Winter wheat	14.1 – 23.8	19.19	3.7 – 6.7	4.64

Influence of experimental factors on the content of Cu in leaves and grains. Given the favorable conditions in the cultivation soil, field plants absorbed Cu in the vegetative organs. Copper is considered an essential micro- nutrient. The average concentration of plants would be the situation in general between 5 and 20 mg [1]. Between 4 and 5 mg with the leaves is considered a danger zone that begins with deficiency [7]. Given the limits of this deficiency and heavy metal excess, plant analysis highlighted moderate concentrations of copper. In case of the biometric analysis of the three plants (Figure 1) found the existence of positive correlations with levels of copper. Thus, total biomass produced was directly correlated and increased concentrations of Cu accumulated in the leaves during flowering. The slope of the correlation is quite obvious 3 which shows the favorable effect of sewage sludge doses, chemical fertilizers doses and absorbed doses of copper. In statistical terms- the only two correlations of soybeans and of wheat since last year have provided the level of significance. These situations could emphasize the characteristics of the three plant nutrition in relation to Cu. Compared to maize and soybeans, wheat in the year-two ranked lowest on oscillation contents of copper depending on biomass, and in terms of absolute values the soybeans has absorbed more. Of the three, soybeans plants has a deep root system and developed what could explain the absorption Cu at the highest levels. In the final phase- at maturity there was noticed that the plants have deposited Cu in grains. Representing one of the constitutive plants' element, Cu was initially absorbed, transposed through xylem and phloem, and contributed to a better enzymes regime functioning, in the synthesis of chlorophyll and fruition, then Cu deposited into grains. Thus a Cu export phenomenon took place, from the cultivation environment into the grains.

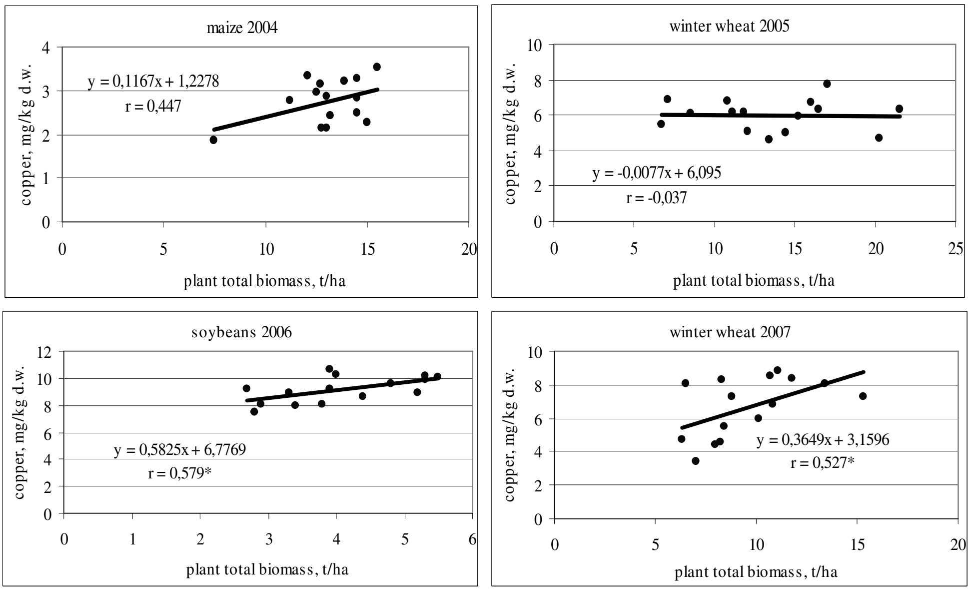

Fig. 1. Correlations between total plant biomass and Cu content from plant leaves

Regressions were thus set between the grains production formed and the Cu concentrations in grains, with slightly trends, with few data fluctuations (Figure 2). This demonstrates on the one side that at maturity plants no longer need Cu, and their value was relatively variable compared with the grains production. With higher values of copper from grain were determined in soybeans, the lowest in maize and winter wheat was intermediate.

Expressing Cu^{2+} concentrations in the cultivation plants. Plants need the field of copper ions. To avoid deficiencies and excesses well as periodically to carry out state supply plant with. Usually companies producing micro- nutrients resorting to estimates, which are a milestone in ensuring the complex feeding of the plants. To some estimates, experimental results have shown different situations (Table 2). By Yara [19], with recent data, young plants need in stages of 4.10 mg Cu. In comparison with these average date obtained showed that for maize were needed in leaves 3 mg Cu, wheat 7 mg and 10 mg soybeans. In the final stage, the mature plants were content with the level of 2 mg Cu in maize grains, 6 mg Cu in wheat grains and 17 mg Cu in soybeans grains. Hence it is clear the different nature and specific absorption and translocation of copper by field plants. An important step is to ensure sources with micro- nutrients, and from these domestic sludge is perfectly adaptable because of its high mineralization capacity.

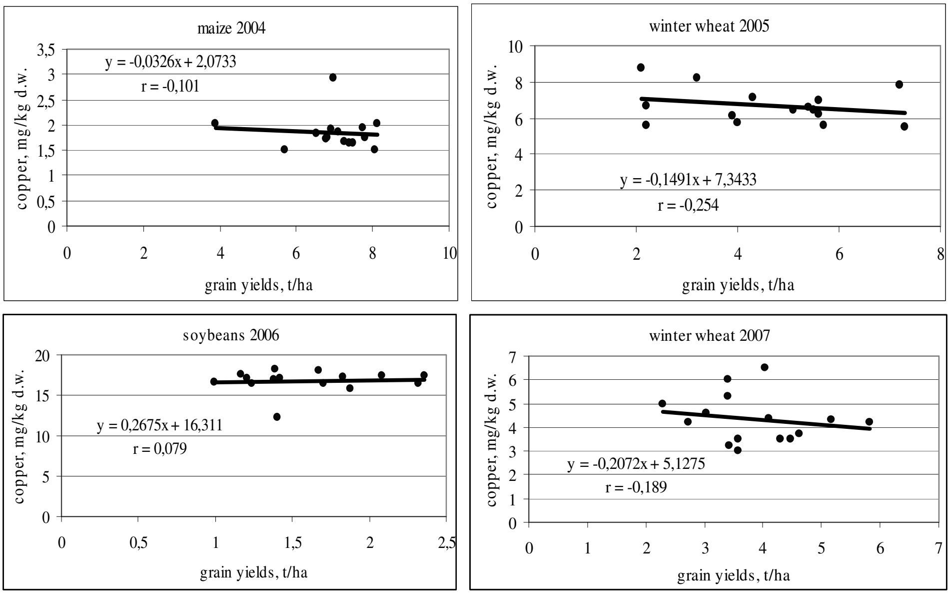

Fig. 2. Correlations between grain yields and Cu content from plant grains

Table 2

Expression of the Cu^{2+} concentration ($mg.kg^{-1}$ d.w.) from field crops

Crop	Necessary amounts for growing period*)	Plant determinations	
		Flowering stage	Maturity stage
Maize	10	3	2
Wheat	5	7	6
Soybeans	4	10	17

*)YARA

CONCLUSIONS

1. Sewage sludge improved the feeding regime of the plant, including copper (Cu), an indispensable micro-nutrient for the plants. Soil Cu total forms increased with 2 $mg.kg^{-1}$ d.w. with the used doses of sludge. Mobile forms increased with 1 $mg.kg^{-1}$ d.w. due to the sludge contribution.
2. Biomass production increased in an evident manner as a result of optimal feeding conditions creation. Correlations between the biomass and the Cu content in leaves demonstrated the Cu absorption and movement in direct relation to its increase.
3. Copper was deposited in the useful production-grains, which stand for an export of this essential micro-nutrient. Regressions between grains production and Cu concentrations showed a relative standstill.
4. Plants needs in terms of Cu ions presented specificity issues, in close relation with both environment factors and the feeding sources ensured. Sewage sludge ensure non- hazardous Cu quantities, having due to the mineralization degree the quality of bio-nutrient.

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PCBs IN SEWAGE SLUDGE FROM WASTEWATER TREATMENT PLANTS

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Keywords: *sewage sludge, PCBs, gas chromatography*

Abstract

Recycling of sludge from wastewater treatment plants by agricultural land, presents a major interest. It is known that municipal sludge contains toxic organic compounds for human health and for environment. Among these, in the list of European Community Council polychlorinated biphenyls (PCBs) are included. Therefore, their determination in sludge is absolutely necessary. The present work shows the results of a study about the content of PCBs in sewage sludge coming from wastewater treatments plants located in Pitesti, Curtea de Arges, Câmpulug and Mioveni. 24 samples of sludge were collected and the PCBs residues were extracted with organic solvents. Determination was performed by gas chromatography after a preliminary purification of the extract. The determined compounds were PCBs with IUPAC numbers: 28, 52, 101, 138, 153, 180 which are mentioned by the actual legislation. The results show that the total content of PCB compounds are ranged between 0.0031 mg/kg and 0.0610 mg/kg, so values which are 10-100 times smaller than the maximum limit (0.8 mg/kg). So, the sludge samples of this study show contents of PCBs which are permitted in agricultural use according to guidelines of our country.

INTRODUCTION

Most wastewater treatment processes produce a sludge which has to be disposed of. Very rarely do urban sewarage systems transport only domestic sewage to treatment plants; industrial effluents and storm-water runoff from roads and other paved areas are frequently discharged into sewers. Thus, sewage sludge will contain, in addition to organic waste material, traces of many pollutants used in our modern society. Some of these substances can be phytotoxic and some toxic to human and/or animals, so it is necessary to control the concentrations in the soil of potentially toxic elements and their rate of application to the soil [3].

The application of sewage sludge to land in member countries of the European Economic Commission is governed by Council of European Communities 1986. This Directive prohibits the sludge from sewage treatment plants from being used in agriculture unless specified requirements are fulfilled, including the testing of the sludge and the soil. Parameters subject to the provisions of the Directive include the following: dry matter, organic matter, pH, nitrogen, phosphorus, heavy metals, polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), dioxines.

PCBs are types of persistant environmental contaminants with enhanced toxicity and carcinogenic and bioaccumulting properties. Research in this field indicates a high stability of heavily chlorinated PCBs in sludge which suggests a more precautions use of sewage on soil surface [1]. In regard to PCBs, human exposure is primarily attributed to background contamination caused by diffuse contamination of these pollutants through the trophic chain. Of the 209 PCB congeners, European legislation, on which our country is affiliated, requires determination of the following compounds: PCB 28, PCB 52, PCB 101, PCB 138, PCB 153, PCB 180.

MATERIAL AND METHODS

The sludge samples were collected from four different wastewater treatment plants located in Piteşti, Curtea de Argeş, Câmpulung and Mioveni. The samples were collected at different moment of time. Thus, from the Piteşti wastewater treatment plants, sludge was collected day by day, total 15 samples. From Curtea de Argeş, Câmpulung and Mioveni the sludge was collected three times a week.

The dried samples are extracted with petroleum ether:acetone = 2:1. The extracts are purified on Florisil column and evaporated to a convenient volume. 1 µl of extract are injected in gaz chromatograf. The separation of the PCB compounds takes place in a cappillary column with a non-polar stationary phase (OV 1) and programmed temperature (from 70°C to 330°C with 20°C/minute). The separated compounds are detected with an ECD (electron capture detector) operated at 300°C. The analythical result is a chromatogram were each compund is represented by a peak and a specific retention time. The concentration of each compound is calculated reffering on the calibration curve.

RESULTS AND DISCUSSION

The analythical results show that the low chlorinated PCBs (28, 52, 101) are undetectable in all samples of sludge. The high chlorinated congeners (138, 153 and 180) contaminate all the samples (Table 1). Similar results are presented in literature, PCBs residues being found in nearly every sample of selected sewage sludges, with the congeners 138 and 153 the most imortant among the others [2].

The PCB 138 concentrations ranged between 0.0006 mg/kg and 0.0145 mg/kg, PCB 153 concentrations have values in the interval 0.0008 mg/kg - 0.0153 mg/kg and PCB 180 concentrations ranged between 0.0013 mg/kg - 0.0610 mg/kg. Regarding the total PCBs content it can be observed that the interval of variation is

0.0031 mg/kg - 0.0225 mg/kg. The higest value of concentration is obtained in sample collected from the wastewater treatment plant located in Mioveni, 0.0610 mg/kg, but even in this case the concentration value is about 10 times smaller than the maximum limit (0.8 mg/kg).

Table 1

Polychlorinated biphenyls in sewage sludge (mg/kg)

Location	Time of sampling	PCB 138	PCB 153	PCB 180	Total PCB
P I T E Ş T I	1	0.0049	0.0076	0.0084	**0.0209**
	2	0.0006	0.0010	0.0015	**0.0031**
	3	0.0030	0.0042	0.0036	**0.0108**
	4	0.0025	0.0041	0.0039	**0.0105**
	5	0.0020	0.0037	0.0029	**0.0086**
	6	0.0024	0.0035	0.0024	**0.0083**
	7	0.0025	0.0041	0.0034	**0.0100**
	8	0.0035	0.0057	0.0044	**0.0136**
	9	0.0016	0.0028	0.0021	**0.0065**
	10	0.0015	0.0022	0.0020	**0.0057**
	11	0.0016	0.0029	0.0022	**0.0067**
	12	0.0024	0.0031	0.0027	**0.0082**
	13	0.0024	0.0037	0.0024	**0.0085**
	14	0.0022	0.0039	0.0030	**0.0091**
	15	0.0012	0.0022	0.0012	**0.0046**
CURTEA DE ARGEŞ	1	0.0020	0.0008	0.0022	**0.0050**
	2	0.0013	0.0045	0.0048	**0.0106**
	3	0.0016	0.0024	0.0025	**0.0065**
CÂMPULUNG	1	0.0014	0.0020	0.0017	**0.0051**
	2	0.0011	0.0016	0.0015	**0.0042**
	3	0.0011	0.0019	0.0013	**0.0043**
M I O V E N I	1	0.0042	0.0095	0.0116	**0.0253**
	2	0.0145	0.0153	0.0179	**0.0477**
	3	0.0068	0.0076	0.0081	**0.0225**
Maximum limit					**0.8**

The variation in time of the total concentrations of PCB compounds in the sludge samples collected from Piteşti indicate that there is no correlation between the two parameters (Figure 1). In Curtea de Argeş and Mioveni, the total concentration of PCBs increase at the second sampling, while in Câmpulung the level of concentration is, practic, unchanged. So, it can not be determined a time value corresponding to a minimum of PCBs concentration value. For this reason, monitoring the concentration of PCBs in sewage sludge coming from wastewater plants is absolutely necessary.

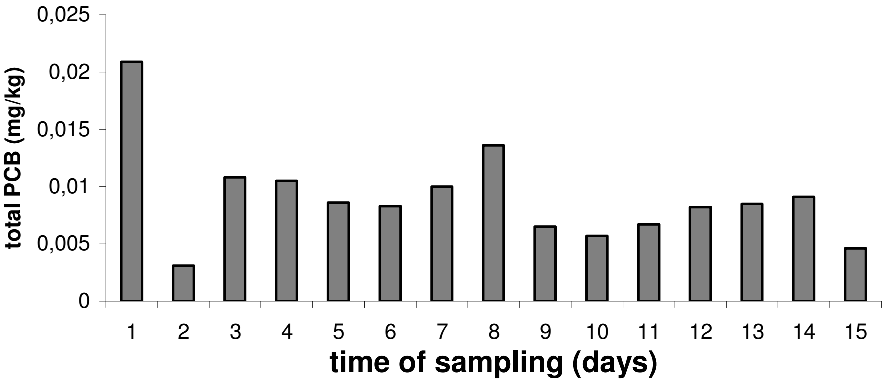

Fig. 1. Variation in time of total PCB content in sewage sludge samples collected from Piteşti

CONCLUSIONS

1. The sludge samples of this study show contents of PCBs which are permitted in agricultural use according to guidelines of our country.
2. It is absolutely neccessary to monitor the content of the polychlorinated biphenyls compounds in sewage sludge.

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STUDIES REGARDING NITROGEN POLLUTANTS IN WELL WATERS FROM ROMANIA

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Keywords: *nitrate, nitrite, water, health, methemoglobinemia*

Abstract

The nitrate contamination of ground water is a serious threat to public health and high nitrate levels can cause. The aim of our research was to evaluate nitrate and nitrite concentrations in well water from Matca (Galați), Săhăteni (Buzău), Brănești (Ilfov) and Clinceni (Ilfov) localities. The lowest nitrate level was recorded in Clinceni. Nitrite levels were generally low, except one water sample from Matca (1.13 mg/l).

INTRODUCTION

Water quality has become an increasing, environmental and social constraint for modern society. Contamination of drinking water by nitrate is usually associated with the pollution resulting from human activities, especially from agriculture. Over time, due to great solubility, nitrates can accumulate in groundwater that may then be used as a drinking water supply.

The nitrate in itself is not very toxic. Inside the human body, nitrates are converted to nitrites, due to the action of specific enzymes and, in the end, converted to nitrosamines that generate cancer. The hazardous effect of nitrite is its ability to react with haemoglobin (oxyHb) to form methaemoglobin (metHb) and nitrate [10], according to reaction: $NO_2^- + \text{oxyHb } (Fe^{2+}) \rightarrow \text{metHb } (Fe^{3+}) + NO_3^-$.

Methemoglobinemy is also known as "blue baby syndrome" because its first manifestation is a bluish colour of the infant's skin. For example, in the counties where the villages from where we collected the samples there were, in 2007, 11 baby blue syndrome cases in Buzău County, 2 in Galați County and 2 in Bucharest.

There are also reported other negative effects produced by large quantities of nitrates, as follows: gastric cancer [8], central nervous system defects and some other cancers [1, 7]. A Danish research group has shown that nitrate can interfere with iodine retention by thyroid, resulting in the hypertrophy of the thyroid [11]. There is a positive association between nitrates in drinking water and non-Hodgkin lymphoma and colorectal cancer [5].

Nowadays, nitrate concentrations in water are close to levels which are unacceptable under current legislation of the European Union such as Nitrate Directive [3] and Drinking Water Directive [2].

Toxicity and physiological effects of excess of nitrates and nitrites in water are well known and have been reported in many publications [4, 6, 9].

The WHO report of 2004 maintains that extensive epidemiological data support limiting the value of nitrate-nitrogen to 10 mg/L or as nitrate to 50 mg/L for human consumption [12].

We chose to analyze the water from a village with intensive agricultural practices (Matca), a viticulture area (Săhăteni), an industrial area (Brăneşti) and a village with no intensive agriculture (Clinceni).

MATERIAL AND METHODS

The well water collected from different sources from Matca, Săhăteni, Brăneşti and Clinceni villages were analyzed. The samples analyzed of well water collected from a depth of 5-60 m. All samples were collected in polyethylene bottles and carried to the laboratory where were stored at 4°C.

The nitrate content in water samples was determined through two analytic methods: spectrophotometric (phenoldisulphonic method) and ionometric, using nitrate-selective electrode. The obtained results using these methods were similar so we used as the final results the media of results obtained by the two methods. All chemicals used were of analytical reagent grade. The calibration curves for nitrate and nitrite were linear for studied concentration ranges. The nitrite levels were determined spectrofotometrically using Griess reagent.

Spectrophotometric measurements were carried out using Metertek SP830 Plus apparatus, meanwhile ionometric measurements were performed with a Metler Tolledo ionometer with a nitrate selective electrode.

RESULTS AND DISCUSSION

For experiments we have selected four villages with different main activities and located in the south - east of the country, namely Clinceni (Ilfov County), Brăneşti (Ilfov County), Săhăteni (Buzău County) and Matca (Galați County).

The localities Clinceni and Brăneşti are situated in the Romanian Plain to one side, and another of the capital Bucharest, Clinceni 16 km west and Brăneşti 18.9 km the east. The localities are situated as folows: Săhăteni at 107.1 km north and Matca on 240.9 km north-east from Bucharest. Matca is located in the Galați County and is famous for the vegetables (especially tomatoes) grown especially in protected area. It is quite sure that farmers use fertilizers and, as consequence, it is important to determine the levels of nitrate and nitrite contaminants in well water that is used by inhabitants for drinking and cooking.

Table 1

Analytic results for analyzed well water samples from Clinceni

No.	pH	Nitrate, ppm (MAL=50 ppm)	Nitrite, ppm
1	7.02	52.08	< LD
2	7.00	50.03	< LD
3	7.15	44.70	< LD
4	7.16	66.58	0.17
5	7.02	45.42	0.13
6	6.90	45.79	0.02
7	7.03	45.06	< LD
8	7.02	48.64	0.17
Average	*7.03*	*49.78*	-

Table 2

Analytic results for analyzed well water samples from Brăneşti

No.	pH	Nitrate, ppm (MAL=50 ppm)	Nitrite, ppm
1	7.92	< LD	0.28
2	7.97	< LD	0.16
3	7.98	< LD	0.20
4	8.32	29	0.11
5	6.98	314	0.01
6	6.97	272	0.03
7	6.92	288	0.16
8	6.79	493	0.01
9	6.92	449	0.03
10	7.30	< LD	0.01

The main activities in the four communes are quite different. Taking into account these activities, we can presume that the smallest pollution with nitrates and nitrites has to be in the two villages nearest Bucharest: Clinceni and Brăneşti. Nevertheless Brăneşti had a non-ferrous industry represented by Neferal enterprise even if this factory is practically not working today.

Water samples were taken from 7-10 wells distributed in every village so that they can cover relatively the entire area. Results are presented in Tables 1-4.

Table 3

Analytic results for analyzed well water samples from Săhăteni

No.	pH	Nitrate, ppm (MAL=50 ppm)	Nitrite, ppm
1	7.44	403.1	<LD
2	7.25	270.4	<LD
3	7.40	101.6	<LD
4	7.22	222.9	0.07
5	7.53	82.0	<LD
6	7.07	48.2	<LD
7	7.55	322.2	<LD
8	7.70	540.8	<LD

Table 4

Analytic results for analyzed well water samples from Matca

No.	pH	Nitrate, ppm (MAL=50 ppm)	Nitrite, ppm
1	7.54	149	0.01
2	7.04	182	1.13
3	7.40	153	0.51
4	7.34	452	0.02
5	7.66	311	0.33
6	7.46	358	0.08
7	7.23	352	0.31

Analysing the results (Tables 1-4), it can be concluded that the water samples from Clinceni contain the lowest levels of nitrate and nitrite. However, to visualize clearer the nitrate levels we represented these results graphically against the MAL in the Figure 1.

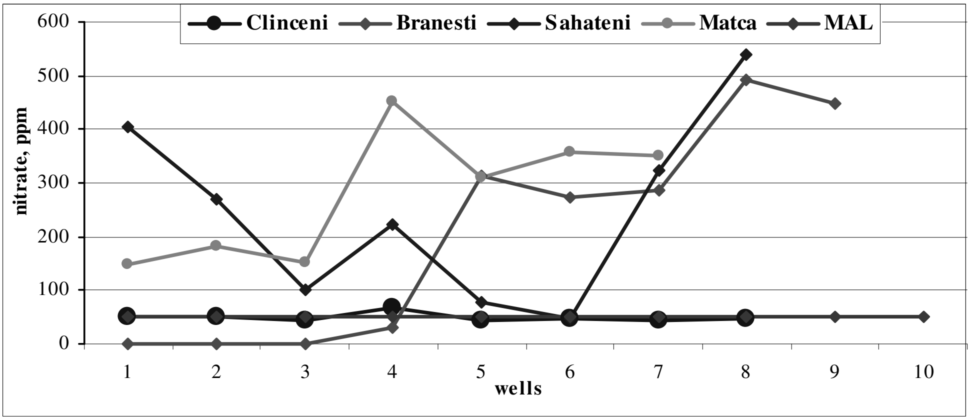

Fig. 1. Comparative data regarding nitrate contents in wells of the four villages

The data show us that, although nitrate pollution from agriculture has received a lot of attention, many private wells have been polluted with nitrates due to misuse of fertilizer on lawns that were close to shallow water wells.

From the graphic presentation, we can see clearly that in the villages near Bucharest, there are fountains with a low content of nitrate near the maximum permitted (MAL) - in Clinceni 100% and 40% in Brăneşti. At the same time, in the two localities, Săhăteni and Matca, with mainly agricultural activities, the pollution with nitrates is practically 100% above MAL.

Also, as we assumed, because of intensive cultivation of vegetables, in fields, solariums and greenhouses, in the village Matca pollution with nitrates is greater. In addition, if in communes Săhăteni and Brăneşti pollution is range from fountain to fountain with extreme values, the content near the maximum value admitted up to 10 times higher in the wells of Săhăteni, in Matca the smallest value was found 3 times MAL. Thus, if we consider that a people of 60 kg drink 2 liters of water per day, only in this way, in Matca, the consumer should exceed the maximum admitted for human consumption. Regarding the content of nitrites, we can say that for the wells in Săhăteni values obtained are not conclusive, they could only be errors of analysis.

For wells in other villages, taking into account the fact that legitimate nitrites should miss in drinking water, the values obtained may be worrisome to the wells from Matca village and to limit for other villages.

Water contamination by nitrates is one of the problems associated with vegetable growing and agriculture, generally. That is due, among other things, to the fact that nitrates are highly soluble and migrate easily into ground water through soil. It is nonetheless difficult to establish a link between nitrogen supply and water pollution. The leaching of nitrates also depends on geological, climatic and biological factors. Nitrates can be de-nitrified by microbes, however. Despite these phenomena, over-use of fertilizers always increases the nitrate level of water.

This could be the explanation of the high levels of nitrates in the water well tested in Săhăteni and Matca in particular. In addition the high levels of nitrites raise a lot of problems because these levels together nitrates ones classifies analyzed water between the most dangerous ones.

Regarding the village Brăneşti, likely pollution by nitrates is due mainly of non-metals industry, even if this production is today practically zero. Only farming household does not explain the high pollution in some wells.

CONCLUSIONS

1. Analyzing the results, it can be concluded that, excepting samples from Clinceni village, almost all water samples exceed the maximum admitted level (MAL = 50 ppm) and endanger human health.
2. Farmers apply nitrogen fertilizers to increase plant yield, but too often fertilizers are applied in excess quantities and in inefficient ways. So, they have to use controlled quantities of nitrogen fertilizers.
3. The analysis of water samples from the sources of Săhăteni, Matca, Brăneşti and Clinceni villages that were investigated were alarming, from the point of view of nitrate concentrations.
4. The graphic representation of the nitrate levels in water (Figure 1) shows that all water samples have exceeded the MAL, 50 ppm. Also, nitrite is present in well water from the villages with agriculture as main activity but however in small quantities.
5. Because the level of nitrates in drinking water exceeds the safe limits for many wells, the people have two basic choices: to obtain an alternate water supply or to use some type of treatment to remove the nitrate-nitrogen.

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QUANTIFICATION OF ENVIRONMENTAL POLLUTION IN BUCHAREST BY ASSESSMENT OF CHEMICAL QUALITY PARAMETERS FOR SNOW

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Keywords: *pollution, snow, nitrate, nitrite, lead, phosphate heavy metals*

Abstract

During the last decades, the environment has been strongly exposed to the effect of different harmful pollutants, especially from the atmosphere. A laboratory study has beens developed to monitor the environmental pollution by examining the chemical quality parameters of snow collected from Bucharest in February 2010 and, for comparison, from neighbor less polluted neighboring areas. The analyses performed on snow samples indicate the presence of substantial quantities of contaminants such as nitrite, nitrate, ammonium, heavy metals.

INTRODUCTION

The necessity to protect the environment is increasing over day by day because of the accelerated pollution as a consequence of the exploitation of natural resources and industrialization, unchecked use of chemicals and pesticides and increased the number of vehicles circulating daily. Urbanization brings along many changes in nature including pollution.

We must use our resources, knowledge and through all means check the pollution level in water, air, soil, vegetation and other natural resources to ensure health and life for us and our future generations.

Today, the measurement of environmental pollutants is a matter of routine, but this is not the case of temporary snow covers. There are some, but not many, similar studies on precipitation that were developed in time [2, 5, 14, 15].

The meltwaters contain some or all of the major constituents usually found in surface water or groundwater. On the other hand, the snow cover suggestively illustrate the level of pollution in a certain area.

The accumulation of heavy metals in the environment can have middle-term and long term health risks, and strict periodic surveillance of these contaminants is therefore advisable.

Lead as a well-known toxic heavy metal, has been receiving much attention for its widespread distribution and potential risk to the environment. The effects of lead on human health have been the subject of many scientific studies over the last decade [3, 10, 11, 12].

Lead accumulates in the human body through the food chain and endangers human health [6] moreover that as far as it known till today, it has no essential function for plants, animals and microorganisms. It inhibits the thiolic groups of some enzymatic systems, especially those that potentate hemoglobin synthesis [1].

Also, nitrate and nitrite levels are as hazardous as these species are dangerous for human health. Nitrate generally has low human toxicity, but becomes a hazard when it is reduced to nitrite by bacterial action in the human gastrointestinal tract. Thus, the toxic effects of nitrate are due to its endogenous conversion to nitrite which is involved in the occurrence of methemoglobinaemia (inability to transport oxygen to tissues), gastric cancer [9] and different health disturbances (changes in vitamin level, thyroxin production and negative influence in reproduction) [16]. Methemoglobinemy is also known as “blue baby syndrome” because its first manifestation is the bluish color of the infant’s skin.

Bucharest is a city populated by over two million people with a great pollution generated by traffic. This is sustained by Bucharest’s Environmental Protection Agency (APM) that ranks it first in the latest top of polluted cities in the European Union states, leaving Sofia, Athens or Rome behind. As a consequence, the environmental pollution in Bucharest is a significant matter that is important to be taken into consideration.

The aim of our paper aim was to evaluate the pollution level in Bucharest by the assessment of nitrogen species, phosphate and lead contents of the snow cover in February 2010.

MATERIAL AND METHODS

Studied area

Eight snow samples were collected from eight different points, as follows:

V1 - Botanic Garden, UASVM Bucharest
V2 - Unirii Square
V3 - Victoriei Square
V4 - Vatra Luminoasa Square
V5 - Bucharest-Constanta highway
V6 - melted snow from the streets
V7 - snow collected from the Fundulea, field away from the streets
V8 - drinking water from the UASVM network

Samples

The samples were collected from $1m^2$ surface (depth and width) at two periods of time (08.02.2010-one day after snowing and 18.02.2010-ten days after snowing). The major snow samples were firstly collected in pre-cleaned polypropylene bags; representative samples of 3 kg were obtained and after melting they were transferred in polyethylene bottles rinsed with distilled water. The samples were subsequently stored at 4°C for as short a time as possible before analysis to minimize physical and chemical changes. The samples were allowed until they reached room temperature before analysis. The chemical analysis of the snowmelt water was performed by using methods similar to those used for surface water sources samples.

Reagents

Analytical reagent-grade chemicals were employed for the preparation of all solutions.

The standard stock solution of 1000 ppm NO_2^- was prepared by dissolving 1.8500 g of KNO_2 in distilled water and the final volume was adjusted to 1000 ml.

The standard stock solution of 700 ppm NH_4^+ was prepared by dissolving 3.3035 g of $(NH_4)_2SO_4$ in distilled water and the final volume was adjusted up to 1000 ml.

The weighed amount of 0.4393 g KH_2PO_4 was dissolved in distilled water, the final volume was adjusted to 1000 ml and the obtained solution contained 100 ppm P.
A lead standard solution of 1000 ± 2 ppm (Merck) was used for calibration.

The working standards were prepared by dillution of the stock solution. The calibration curves for the analyzed species were linear for the studied concentration ranges.

Instrumentation and analytical methods

Prior to the analysis, all instruments were calibrated according to manufacturer's recommendations.

- pH was measured by using Inolab WTW pH-meter with combined glass electrode.
- Nitrite was quantified by the Griess reaction, involving the formation of a pink-colored azo derivative upon treatment of a NO_2^--containing sample with sulphanilic acid and naphthyl-1-amine in acidic medium. The measurements of pink complex were performed at 520 nm wavelength, after 20 minutes after the colour developed.
- The phosphate concentrations were determined by the spectrophotometric method using ammonium molybdate in sulphuric medium to form the phosphomolybdate complex that was reduced by ascorbic acid to a blue complex, molybdennium blue.

- Nitrate concentrations were determined by ionometric method. The measurements were performed by a Metler Tolledo ionometer with a nitrate selective electrode.
- The analyses of Pb in snow samples were performed by using furnace atomic absorption spectrometry (GFAAS). Before analysis, samples were digested in concentrated HNO_3. The measurements were carried out by an atomic absorption spectrometer Zeenit 700 from Analytic Jena equipped with autosampler AS52 S for dillution, monoelement lamp for lead. Also, the equipment has data processing soft Win AAS ver:3.16.0. The instrument is calibrated by the Romanian Metrology National Institute.
- The deionised water used for sample preparation was obtained by the ELIX 3 system and the ultrapure water was obtained using Simplicity UV system, both of them provided by Millipore.

RESULTS AND DISCUSSION

Snow samples collected during February 2010 were analyzed to determine the concentrations of various pollutants that are known to affect human health and also to evaluate the pollution level in Bucharest.

Samples were taken from intense circulated roads and from area less polluted, areas 50 km away from Bucharest, an isolated area with no car traffic and theoretically with no pollution.

The results of our survey are summarized below (Table 1). In order to have terms of comparison, we presented the optimum chemical parameters imposed by legislation for drinking water (Table 2) [7] and also for surface waters (Table 3) [7]. The suggestive representations of chemical parameters are presented in Figures 1, 2 and 3. Analyzing the results and graphical representations, it can be noticed that after staying in contact with noxious species, several days snow in most cases became enriched with hazardous species (nitrite and lead), thus proving the high level of pollution in our city.

The presence of significant quantities of nitrogen species in the samples was explained by the presence of nitrogen compounds in the air as a consequence of pollution (most of them are caused by the burning of fossil fuels). Nitrogen oxides, NOx, present in the air and originating in natural and anthropogenic sources (combustion, transportation) after the reactions with water came back to the earth surface in the form of acid rains [17].

Nitrites appear as intermediates in the nitrogen cycle. They are unstable and, depending on the conditions, are transformed into nitrates or ammonia [8].

The nitrate levels ranged between 5.24 and 27.86 mg/l, lower than the limits set for drinking water. The nitrite levels were between 0.02 and 0.84 mg/l, values determined probably by intense traffic and due to the presence of nitric oxides. Also, ammonium concentrations were higher and ranged between 0.51 and 3.75 mg/l.

The results of our research indicate that, in ten days, the nitrite levels of snow were increasing meanwhile ammonium levels were decreasing. It is possible that the ammonium ions to be oxidized into nitrite ions.

Of particular concern is the lead presence, presumably originating in automobile exhaust. Lead content of Bucharest snow ranges between 25.7 and 1886 μg/l, the highest concentration being recorded in Piata Unirii, an area with intense traffic, for a sample collected in 18.02.2010, after staying in contact with automobile exhaust for ten days. It can be noticed that, from all the six samples collected from Bucharest on 08.02.2010 (one day after snowing) only two contained lead below limits imposed by legislation, the other four significantly exceeding that limit (50 ppb).

However, the found lead levels were very high and dangerous because, after snow melting, the metal would pollute the soil, water and vegetation.

Table 1

Chemical parameters of snow (February 2010)

Sample	**Sampling time**	**pH**	**NO_3^-, mg/l**	**NO_2^-, mg/l**	**NH_4^+, mg/l**	**PO_4^{3-}, mg/l**	**Pb, μg/l**
V1	08.02.2010	6.53	<LD	0.02	1.91	<LD	74.3
	18.02.2010	7.49	6.21	<LD	0.74	<LD	121.5
V2	08.02.2010	7.22	6.21	<LD	1.91	<LD	25.7
	18.02.2010	6.62	<LD	0.04	0.87	0.47	1886
V3	08.02.2010	7.26	27.86	0.41	3.56	<LD	170
	18.02.2010	8.13	<LD	0.84	2.20	0.50	417
V4	08.02.2010	7.42	<LD	0.05	2.00	<LD	589
	18.02.2010	7.38	<LD	0.33	1.32	0.40	408
V5	08.02.2010	7.87	10.09	0.10	2.10	<LD	26
	18.02.2010	6.18	<LD	0.33	0.74	<LD	277
V6	08.02.2010	7.41	16.53	0.30	3.75	0.42	97.5
	18.02.2010	7.23	5.24	0.75	1.32	<LD	120
V7	08.02.2010	5.16	<LD	<LD	0.51	<LD	<LD
	18.02.2010	5.64	<LD	<LD	<LD	<LD	<LD
V8	08.02.2010	6.91	<LD	<LD	<LD	<LD	<LD
	18.02.2010	6.87	<LD	<LD	<LD	<LD	<LD

(<LD-below limit of detection of the method)

All chemical parameters of drinking water and snow collected from the Fundulea area were below the detection limit of the methods, which showed either the absence of the pollutants or their presence at harmless levels.

The pH values for snow samples were generally between the ranges settled for drinking water. The values recorded for the snow samples collected from Fundulea indicated an acidification tendency.

The phosphate levels assessed for snow samples were, in most cases, below the detection limit of the method. The presence of phosphate found in snow samples was possible to be hazardously and could not be correlated with environmental pollution. However, in recent years large quantities of phosphate have been used in beverages, detergents, fertilizers [4, 13].

The increasing phosphorus concentrations in the surface waters raise the growth of phosphate-dependent organisms that used high amounts of oxygen and prevent sunlight from entering the water, a phenomenon commonly known as eutrophication.

Table 2

Quality parameters for drinking water (STAS 1342-91)

Parameters	Accepted values	Exceptionally accepted values
pH	5.5-7.4	max. 8.5
NH_4^+ (mg/l)	0	0.5
NO_2^- (mg/l)	0	0.3
NO_3^- (mg/l)	45	-
PO_4^{3-} (mg/l)	0.1	0.5
Pb (µg/l)	50	-

Table 3

Quality parameters for surface waters (STAS 4706-74)

Parameters	Water 1st class category	Water 2nd class category	Water 3rd class category
pH	6.5-8.5	6.5-8.5	6.5-9.0
NH_4^+ (mg/l)	1	3	10
NO_2^- (mg/l)	1	3	-
NO_3^- (mg/l)	10	30	-
Pb (µg/l)	50	100	100

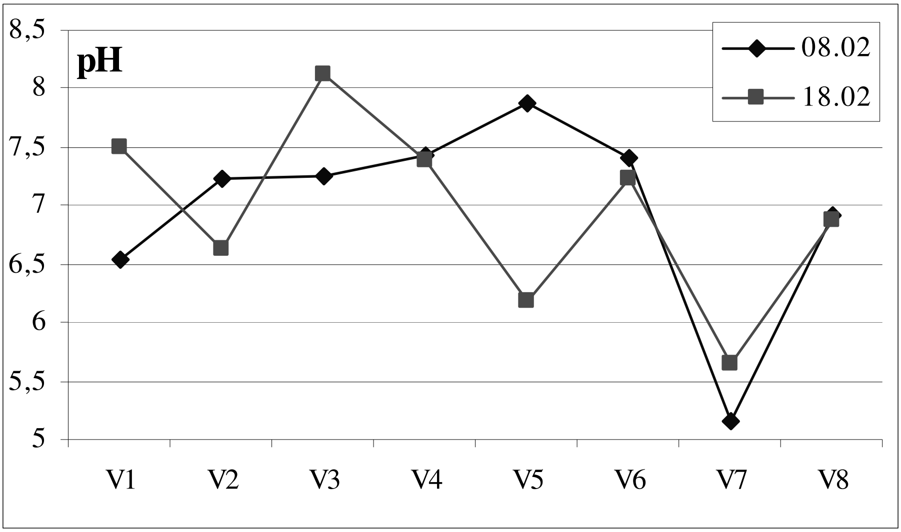

Fig. 1. pH variation in samples

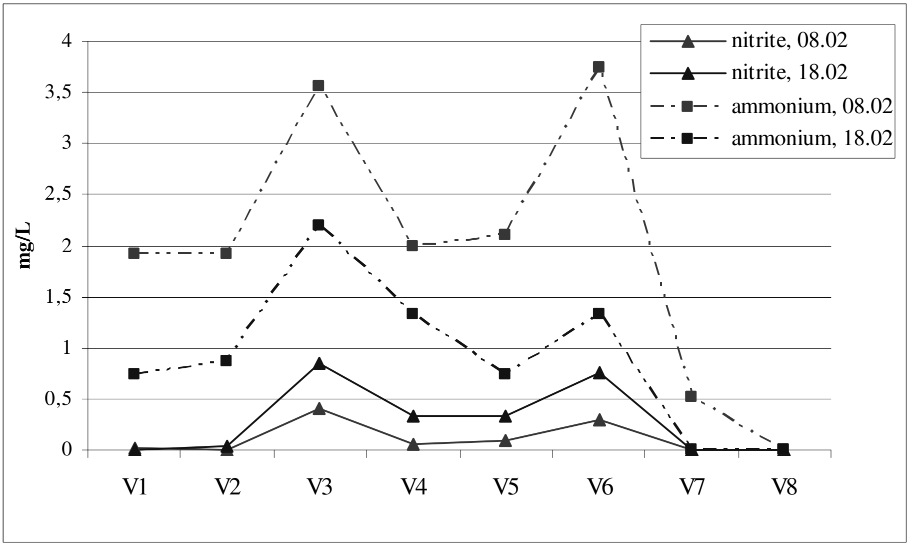

Fig. 2. Nitrite and ammonium levels in analysed samples

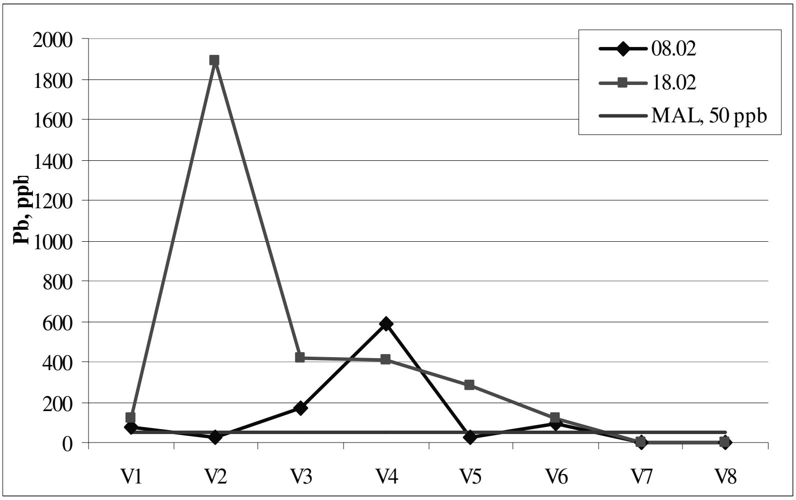

Fig. 3. Lead levels in analysed samples

CONCLUSIONS

1. In this study snow was used to estimate the pollution level in the environment of the Bucharest agglomeration and the conclusion is that our city is highly polluted with nitrogen species and lead.
2. The content of lead absorbed in the snow reached an alarming level which shows that air particles in metal concentrations can be disastrous. This is a signal which forces us to protect the environment, and strict periodic surveillance of these contaminants is therefore advisable.
3. The serious problems of pollution compared to Bucharest to take urgent action. Among them an important place must be given to creating green spaces, the planting of trees on the streets. We must not forget that we have the capital with the least green space per capita than the rules allowed in the EU.
4. Also, in order to decrease environmental pollution in Bucharest it is recommended to reduce car traffic as much as possible.

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LEVEL OF POLLUTION WITH ORGANOCHLORIDE PESTICIDES IN LAKE MOARA DOMNEASCA

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Keywords: *lake, water quality, pollution, organochloride pesticides*

Abstract

Research studies regarding various types of waters pollution with organochlorine pesticides (POC) reveal the fact that these chemical substances with high biological activity often reach the aquatic ecosystem, sometimes in significant quantities that have a negative influence on the ecosystems equilibrium.

It is well known that POC belong to the category of synthetic substances produced by industry and due to their characteristics they are included in the "Long term persistent substances List". The problem of POC degradation is a very complex one, involving photochemical as well as biological aspects, sometimes requiring long period of time. Taking that into consideration, the harmonization of target values for POC with real bearing capacity of environmental factors becomes a priority for aquatic ecosystems as regards ecological risk decrease and environmental protection.

The lakes in the surrounding area of Bucharest are damaged by the anthropogenic impact added to the specific features of the geographical area. Such is the case of Moara Domnească lake located on the Pasărea river.

The investigations were performed in the spring-autumn sampling campaigns of the period 2008-2009.

The data obtained from the POC analysis show a long term pollution caused by agricultural activities which can increase the risk for the lake ecosystem if they are not properly monitored.

INTRODUCTION

For several years, ecosystems pollution with organochlorine pesticides has become a problem in Romania; under these conditions, it has been necessary to study these pollutants both as regards their monitoring in the Romanian waters and their effects on the aquatic systems.

Organic micro pollutants are chemical substances of high risk as they have extremely toxic characteristics; they have a high degree of resistance to degradation as well as a high degree of accumulation in organisms and environment; moreover, they can be airborne easily to great distance and they can be deposited far from the emission source and they can harm human health and environment, both close to and far away from their sources.

Consequently, the investigation of organic micro pollutants in the Moara Domneasca lake has become opportune. By analysing organochlorine pesticides and atrazine, an important compound belonging to triazine herbicides, one could get a clearer image of the water quality state as well as of their local impact on the lake. This paper presents the results of the investigations performed during the spring-summer-autumn campaigns of the period 2008-2009.

MATERIAL AND METHODS

Water samples have been taken from the middle zone the lake pontoon, from the lake outlet/ exit zone (weir) and from the lake inlet/ entry zone, as well as from the lake upstream and downstream in conformity with the provisions of ISO 5667-4:1987 and ISO 5667:1991. By performing this action, care has been taken so that water samples should not get contaminated with substances that may interfere with the analysed chemical compounds. In selecting these investigation stations, the arguments originated from the necessity to identify the risk factors for Moara Domneasca lake, especially the anthropogenic river activities (local farm activities included). Four sampling campaigns were carried out during three seasons: spring (April 2008), summer (August 2008 and June 2009) autumn (November 2008).

Sediment samples have also been taken from the lake middle zone during three of the four sampling campaigns.

The method of analysing organochlorine pesticides and atrazine, a compound representative of triazine herbicides, in water samples developed in conformity with ISO 6468:2000 standard.

The water samples analysis performed in order to identify organochlorine pesticides involved the liquid - liquid extraction of samples by using methylene chloride as solvent, followed by concentration and purification [2, 4].

Sediment samples were analysed according to the following procedure [1, 3]:

- **Drying** of samples (at room temperature);
- **Dry sieving** of samples (5-10 g);
- **Extraction** of samples (US EPA 3550-ultrasound extraction in organic solvent-methylene chloride);
- **Purification/cleaning** of samples (US EPA 3610-use of a alum earth/florisil column);
- **Concentration** of the purified sample through evaporation-obtaining the extract-test sample;
- **Analysis** of the extract obtained through gas chromatography with mass spectrometry detection (US EPA 8081-organochlorine pesticides).

The sample extracts were analysed through gas chromatography by using a gas chromatograph VARIAN CP 3800 equipped with a mass spectrometry detector SATURN 2200.

RESULTS AND DISCUSSION

The data obtained from the analysis of organic micro pollutants in water and sediment samples were interpreted with the help of the Order 161/2006 regarding the approval of the Set of norms for the classification of surface water quality necessary for establishing the ecological state of water bodies [6].

The analysed substances were the following; organochlorine pesticides of HCH class (lindane), namely 4 HCH (alpha-, beta-, gamma- and delta) isomers, compounds of DDT class (dichloro-diphenyl-tetrachloroethane) (4.4' DDE, 4.4' DDD and 4.4'DDT), compounds of drines class (aldrine, endrine and dieldrine) and heptachlorine.

In the analysed water samples from Lake Moara Domneasca, heptachlorine has not been found in any of the five investigated zones.

Out of the drines class, endrine has been detected in the lake upstream zone and its value (0.023 μg/l) has exceeded the quality standard during the June campaign, 2009.

Atrazine, an important compound of the triazine herbicides is present in water samples, but its values do not exceed the value of the above mentioned quality standard.

Out of HCH class, only the delta isomer has values below the detection limit, the other isomers being in quantities that exceed the quality standard- beta HCH (0.048 μg/l).

The *sum of the HCH compounds* has registered maximal values in the upstream zone (0.104 μg/l) during the campaign of August, 2008 and it has been observed a decrease of concentrations in the upstream zone towards downstream. It has been observed as well that the level of the HCH sum in the water samples from the campaign of June, 2008 is greatly lower than that of the previous year (Figure 1).

Out of the DDT class, the main isomer 4.4' DDT is present in all five zones with significant values between 0.028-0.058 μg/l which exceeded the quality standard (0.010 μg/l) in the campaign of June, 2009; in the other campaigns, its oxidation products 4.4' DDE and 4.4' DDD were present with values between 0.011 and 0.058 μg/l.

The DDT load in the analysed samples is better shown in Figure 2 where it can be noticed the same decreasing tendency from upstream towards downstream.

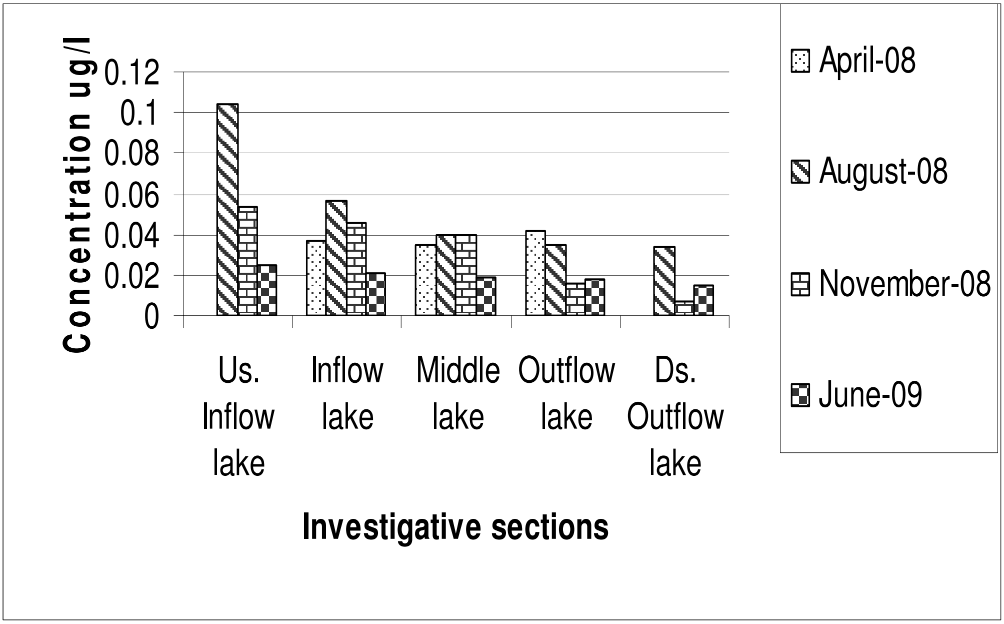

Fig. 1. Level of HCH sum in the water samples taken from Lake Moara Domneasca in 2008-2009

The DDT load in the analysed samples is better shown in Figure 2 where it can be noticed the same decreasing tendency from upstream towards downstream.

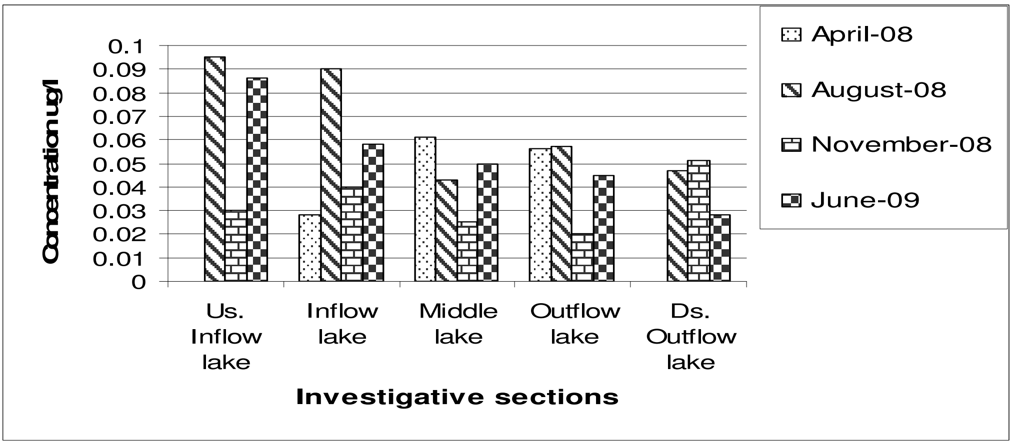

Fig. 2. Level of DDT sum in the water samples taken from Lake Moara Domneasca in 2008-2009

The level of water sample load with DDT compounds has the same tendency in June 2009 in comparison with the summer campaign of the previous year while being higher than the autumn campaign. This fact might occur due to the possible the use of fertilizers on some types of arable lands in spring-summer time.

The evolution of organochlorine pesticides in sediments is constant in all three sampling campaigns, with more diminishing values than in aqueous samples. Nevertheless, an exceeding of the quality standard can be noticed both for atrazine and organochlorine pesticides (Figure 3).

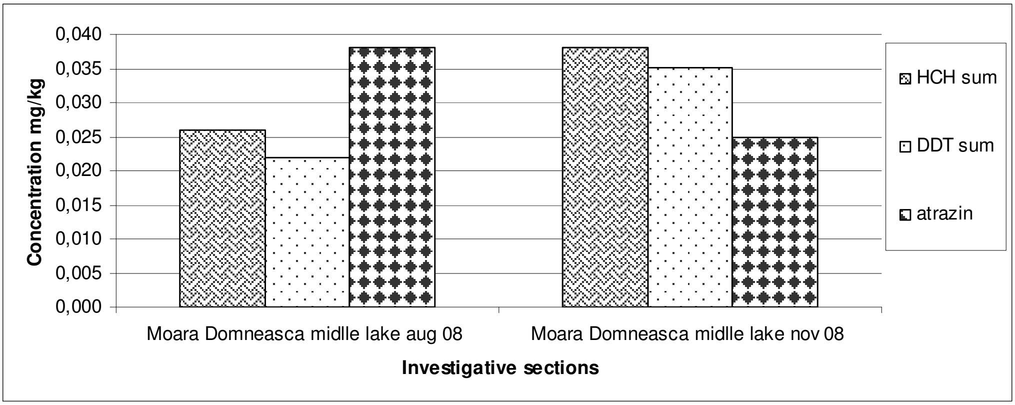

Fig. 3. Level of Lake Moara Domneasca sediment samples loading in 2008-2009

CONCLUSIONS

1. The level of load with HCH compounds is greater in summer campaigns than in autumn campaign; this occurrence is due to the possible processes of evaporation and concentration which take place during the dry season.
2. The sample load with DDT compounds is more significant in summer campaigns due to the possible use of fertilizers on some arable lands.
3. A decreasing concentration of HCH and DDT compounds can be noticed in the zone upstream towards downstream.
4. The data obtained from the analysis of organochlorine pesticides in the lake Moara Domneasca between 2008-2009 show a long term background pollution caused by agricultural activities [5].

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ISSUES REGARDING GLOBAL WARMING

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Keywords: *climate change, global warming, temperature, rainfalls*

Abstract

The article presents some problems generated by climate change related to global warming, rainfall and temperature regime on a period of 100 years.

INTRODUCTION

Global warming and climate change are two terms highly used to describe the same phenomenon but the meaning of each is in fact different. The increase of air temperature is a result of heat capture from carbon emissions, leading to global warming, and global climate change is the alteration of multiple climate factors such as temperature and rainfalls on the planet. It can be noticed that the changes happen with different intensity in different places of the Earth.

MATERIAL AND METHODS

Climate change refers to statistical significant variables of climate parameters or their changes over a period of time due to modification inside climate system and interaction of its components as a consequence of natural factors or human actions.

The greenhouse effect is a natural characteristic of the atmosphere that keeps the face of the Earth warmer than in case it didn't exist. The natural greenhouse effect is amplified by the greenhouse effect due to the concentration of greenhouse effect gas as a result of human actions. Gases that create the greenhouse effect are: carbon dioxide, methane, azoth oxide and chlorofluorocarbon. Through this process an overheating of terrestrial surface and lower troposphere is produced. The changes that take place in the concentration of greenhouse effect gases and aerosols, in solar radiation or in properties of active layer could alter the energetic balance of climate system.

The last report of IPCC (Intergovernmental Panel of Climate Change) issued on 2nd of February 2007 in Paris shows that the global warming that highlights in the increase of average global temperature, seas temperature, glaciers and polar cap melting, led to sea level growth, all this because of human actions.

The greenhouse effect due to anthropic factors together with climate system feedback lead to an increase of global temperature and have as result the climate change on local level on a bigger scale.

Due to climate system inertia, global warming will continue to grow in spite of immediate measure to reduce the emissions, but the increase of temperature will be limited depending on the level of reduction that is applied. It is highly probable (more than 90%) that the rainfall increase at high latitudes and is probable (more than 66%) that they decrease in most of the subtropical regions. The configuration of these changes is similar to the one observed during the 20^{th} century. It is highly probable that the tendency to increase of the extreme maximum temperatures and frequencies of heat waves to continue.

RESULTS AND DISCUSSION

In Romania the average annual temperature is only 0.3°C higher unlike global annual average temperature of 0.6°C between 1901 and 2000. From 1901 to 2006 the increase was 0.5°C comparing to 0.74°C at global level (1906-2005).

There have been though local differences: a higher warming in South and East of the country (up to 0.8°C in Bucharest-Filaret, Constanța and Roman) and irrelevant inside Carpathians Arch, except Baia Mare, where the effect of local human actions led to an increase of 0.7°C (Figure 1).

Starting 1961 this warming was superior to the one before and spread to all country.

Similar to global situation there have been changes in the regime of extreme events (based on data analysis done by several meteorological stations):

- Increase of frequency of tropical days per year (maximum > 30°C) and decrease of frequency of winter days per year (maximum < 0°C).
- Significant increase of minimum average temperature in summer and average maximum temperature in winter and summer (up to 2°C in South and South-East in summer).

Regarding the rainfalls from 1901 to 2000 all 14 stations observed, in a long row, a general tendency to decrease of annual rain quantity. Analyzing the short rows of observations several stations noticed an increase of drought phenomenon in South starting 1960. Accordingly they noticed an increase of maximum periods without rainfalls in South-West in winter and West in summer. As consequence of higher warming in South-East during summer, in concert with a bigger tendency to deficit, a barrenness of these counties took place. In some regions between 1946 and 1999 the frequency per year of very rainy days (the highest 12% daily quantities) and extremely rainy (the highest 4% daily quantities) increased.

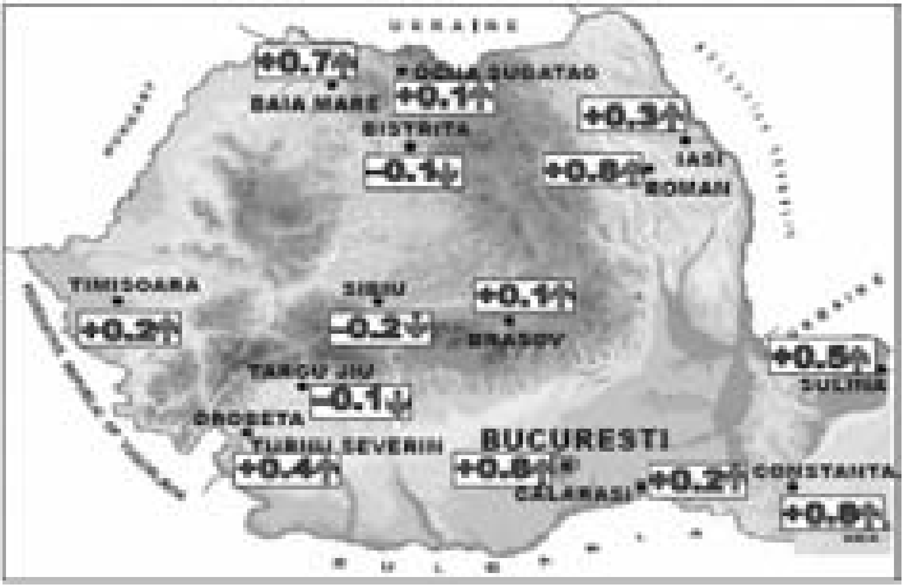

Fig. 1. The tendency of average annual temperature in (°C) from 1901 to 2000

In the last eight years (2000-2007) in Romania have taken place two extreme rainfall events perfectly opposite (the drought from 2003 and 2007 and the floods from 2005). In 2007 there has been an extreme temperature happening in the winter of 2006 that was the warmest winter ever registered in Romania, when high deviations of maximum/minimum temperature from the average multiannual regime persisted on long period of time.

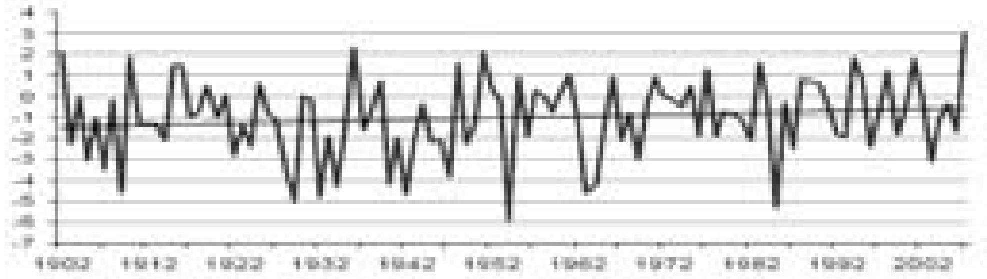

Fig. 2. Average country temperatures in winter (14 stations) from 1901 to 2007

CONCLUSIONS

1. The longest dry periods registered in the 20th century had one peak in: 1904, 1946, and 1990. The most affected area by the drought in Romania in the

last decades of 20th century and beginning of 21st century were in the South of the country, excessively in Oltenia.

2. The analysis of multiannual variation of rainfalls in Romania indicates that after 1980 a series of dry years started due to diminish of rain quantity together with a tendency of increase of annual average temperature especially in Romanian Plain and Barlad Hills.
3. The decrease of rainfalls volume from last years led to a shrinkage of most of the rivers especially in South and South-East Romania, in the context of concerted actions of several factors such as:

- increase of annual average air temperature which generated an amplification of evaporation and evapo-transpiration;
- lowering of phreatic waters level in meadows and rivers terraces, with negative implications over their supplies during dry;
- high frequency and long lasting phenomenon of drought of rivers with collector pools smaller than 500 km^2.

4. Analyzing other phenomenon in cold season, there have been found a significant increase, over all country, of annual hoarfrost days, influencing negatively the crops. The amount of snowy days also dropped off while the trend of warming during winter increased.

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ROLE OF ORGANIC FERTILIZERS IN THE ECOLOGICAL AGRICULTURE SYSTEM

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Keywords: *fertilization, microorganisms, fertilizer, platform*

Abstract

The development of new legitimate food in the system soil-plant-animal-food enables monitoring of environmental influence agricultural technologies and lead to the development of methodologies to allow a rational use of fertilizers.

Organic fertilizers are the technical means considered most effective in increasing production and the extension of their application with the continuous improvement of biological material and the fight against pests and diseases, acquired a prioritized program of developing the most appropriate technologies.

The results show that organic fertilization can be defined as a improvement of the soil system, based on increased intake of organic matter, including active biological products, both under the influence of rotation of crops, and by incorporating external sources which, by the transformations suffered under the action of microorganisms, have benefits for increasing the content of humus and nutrients.

INTRODUCTION

To achieve an ecological agriculture, it is necessary to find means that assure the maintaining and increase of the humus content, by stimulating the activity of microorganisms and preserving the physical conditions of soil.

The maintaining and qualitative features of the humus, as must be examined its role is the regulating of the vegetal metabolism of the soil.

The practical measure for incorporation measures into the fertile soil orizont by organic fertilizer has and will have continuing immediate effects on the physical, chemical and mineralogical properties of the soil.

MATERIAL AND METHODS

Fertilization of crops in a ensemble of agricultural measures which ensures the regeneration and conservation of the humus content and nutrients elements.

In the superficial layer of soil, it is necessary and imposing because the fertilization of crops with nitrogen from mineral sources industrial cannot insure only part of the humus regeneration.

Compost is an important source of humus and nutrients elements, it does not contain weed seed with germination capacity is recommended for all crops.

Over the layer of compost debris, which acts as a seeding, there is a 15-25 cm layer of straw that must be sprayed with manure must. Placing manure on the platform is made on all its width and on a thickness of 15-25 cm.

The next layer has the thickness of 3-5 cm and consists of broicen, cracked seeds, resulting from seed selection**.**

Construction of the platform continues with other alternating layers of coarse material (straw, vegetale debris) and manure, until this reaches a height of 2.2-2.5 cm.

After the storage of compostable materials, the platform is covered with leaves and straws to prevent water loss from the compost.

For the maintenance of soil fertility society promotes mixcal farming system of plant-animal type which enables regular administration of organic fertilizers.

RESULTS AND DISCUSSION

The technology of fabrication and the material component of the compost corresponds to the EU prescriptions from the order of the Council No. 2092/91, annex II, section A, referring to fattening materials and soil improvement and requirements of the International System for the Qualities Assurance.

The fermentation process generates three different stages of composting:

- Hot phase, that lasts a week and begin immediately after construction;
- Cooling phase, achieved when the temperature in the mass of the compost decreases from 50 ^{0}C to 20 ^{0}C;
- Maturation phase occurs when the temperature of the compost stabilized at 20-25 ^{0}C.

The humus from compost contribute at the aggregation of soil mineral particles and indirectly to increase soil permeability for water in air. Compost also contains all the microoelements necessary for growth and plant development (Table 1).

Table 1

Main physical and chemical properties of compost produced in SA Stepa Stupina

No.	Quality indices analyzing name	M.U.	Averages reported in humidity delivery	Averages reported in the 105 ^{0}C dry substance
1	Water	%	70.20	≤ 1
2	Organic matter (MO), loss on ignition at 600 C	%	12.21	41.00
3	Organic carbon	%	6.79	22.78
4	Ash	%	17.59	59.00
5	Apparent density	g/cm^3	-	-
6	Capacity for water	%	-	-
7	pH in aqueous suspension (1:10)	-	9.54	-
8	Total nitrogen (organic)	%	0.50	1.69
9	Concentration of soluble salts in aqueous suspension (1:10)	%	1.3	4.35
10	Electrical conductivity (EC)	mS/cm	2.03	6.8
11	**Content of soluble substances in a report peat: water of 1/10, expressed in oxides: %**			
	11.1. N - NO_3	mg/100g	5.80	19.43
	11.2. P_2O_5	mg/100g	43.0	144.05
	11.3. K_2O	mg/100g	845.63	2832.86
	11.4. CaO	mg/100g	43.33	145.15
	11.5. MgO	mg/100g	25.94	86.9
	11.6. Na_2O	mg/100g	35.56	119.12
12	**Total content of macro and microelemente determined in the ash, expressed as**			
	12.1. P	%	0.196	0.540
	12.2. K	%	0.728	2.0
	12.3. Ca	%	0.66	1.81
	12.4. Mg	%	0.31	0.84
	12.5. S	%	-	-
	12.6. Fe	%	0.15	0.42
	12.7. Mn	ppm	70.23	193.0

No.	Quality indices analyzing name	M.U.	Averages reported in humidity delivery	Averages reported in the 105 ^{0}C dry substance
	12.8. Cu	ppm	7.00	19.25
	12.9. Zn	ppm	28.27	77.7

The precise composition known, the high content of fertilizing elements and uniform physical condition gives and the manure an important role in the technologic process, both as a primary means of direct influence plant growth and development, and the continuous improvement in soil fertility.

Table 1

Main physical and chemical properties of manure produced in SA Stepa Stupina

No.	Quality indices analyzing name	M.U.	Averages reported in humidity delivery	Averages reported in the 105 ^{0}C dry substance
1	Water	%	63.61	≤ 1
2	Organic matter (MO), loss on ignition at 600 C	%	12.40	34.07
3	Organic carbon	%	6.89	18.93
4	Ash	%	23.99	65.93
5	Apparent density	g/cm^3	-	-
6	Capacity for water	%	-	-
7	pH in aqueous suspension (1:10)	-	9.24	-
8	Total nitrogen (organic)	%	0.45	1.23
9	Concentration of soluble salts in aqueous suspension (1:10)	%	0.83	2.28
10	Electrical conductivity (EC)	mS/cm	1.3	3.57
11	**Content of soluble substances in a report peat: water of 1/10, expressed in oxides: %**			
	11.1. $N-NO_3$	mg/100g	5.50	15.12
	11.2. P_2O_5	mg/100g	29.2	80.3
	11.3. K_2O	mg/100g	411.98	1132.94
	11.4. CaO	mg/100g	36.94	101.58
	11.5. MgO	mg/100g	20.28	55.75
	11.6. Na_2O	mg/100g	35.29	97.04

No.	Quality indices analyzing name	M.U.	Averages reported in humidity delivery	Averages reported in the 105 ^{0}C dry substance
12	**Total content of macro and microelemente determined in the ash, expressed as**			
	12.1. P	%	0.184	0.618
	12.2. K	%	1.55	5.20
	12.3. Ca	%	0.55	1.86
	12.4. Mg	%	0.25	0.84
	12.5. S	%	-	-
	12.6. Fe	%	0.11	0.36
	12.7. Mn	ppm	59.6	200.0
	12.8. Cu	ppm	6.7	22.5
	12.9. Zn	ppm	18.98	63.7

CONCLUSIONS

1. It was found that the degradation process begins slowly at different temperatures from the optimal, one over a period of several days (2-3 days) depending on the nature and subject to the composting mixture, after which the rate of degradation is higher.
2. This behavior can be explained by a period of adaptation from microorganisms, particularly the thermophilic ones responsible for the widest biodegradation of organic matter.
3. In conclusion, we can estimate that fertilizing with fermented manure and compost, has become important in today's modern agriculture, both because of its high efficiency in soil improvement that may not be substituted only partially with chemical fertilization, and because of te imposing economic and social conditions.

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USE OF NUTRIVANT PLUS PRODUCT WITH SOME AGRICULTURAL CROPS UNDER DIFFERENT PEDO-CLIMATIC CONDITIONS

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Keywords: *agro fund, leaf fertilization, development enhancer*

Abstract

The product Nutrivant Plus is a universal foliar fertilizer, which was tested in three experimental trials to the different agricultural and horticultural crops on the different soil and climatic conditions.

The trials were carried out on unfertilized and NP ground fertilized fields and had the following soil condition: cambic chernozem (USAMV Iaşi, luvosoil (SCD Tg. Jiu), faeoziom (INCD Pajişti - Braşov).

MATERIAL AND METHODS

Testing methodology consisted of 2-3 foliar applications of the Nutrivant Plus product, a solution of 1.0 concentration, at a rate of 500 l/ha for field crops and vegetables and 1,000 l to each application for vine; in the case of grasslands - only one application of 500 l/ha with the same concentration. Testing included eight crops: maize, sunflower, tomatoes, cucumbers, apple, vine and grassland. The experiments were organized on different soil types, on soil with or without previous fertilization.

The efficiency of experiments was referred to a control without foliar fertilization.

RESULTS AND DISCUSSION

Maize, cultivated on Cambic Chernozems, with three application, obtained a yield increase of 1569 kg kernels/ha and 104.6 kg kernels/l of applied product, respectively (Table 1).

Table 1

Yield increase determined by Nutrivant Plus product applied to maize (HS Oana hybrid), cultivated on Cambic Chernozems (USAMV Iasi)

No.	Treatment	No. of applications	Yield (kernels) (kg/ha)	Yield (kernels) increase		
				kg/ha	%	kg/l of foliar fertilizer
1.	Control	-	3536	-	100.0	-
2.	Nutrivant Plus fertilization	3	5105	1569	144.3	104.6

- *without previous fertilization of soil*

Sunflower, cultivated on Cambic Chernozems, with three applications, obtained a yield increase of 519 kg seeds/ha and 34.6 kg seeds/l of applied product, respectively (Table 2).

Table 2

Yield increase determined by Nutrivant Plus product applied to sunflower (Select variety), cultivated on Cambic Chernozems (USAMV Iasi)

No.	Treatment	No. of applications	Yield (seeds) (kg/ha)	Yield (seeds) increase		
				kg/ha	%	kg/l of foliar fertilizer
1.	Control	-	1063	-	100.0	-
2.	Nutrivant Plus fertilization	3	1582	519	148.7	34.6

- *without previous fertilization of soil*

Apple, grown on Cambic Chernozems, with three applications, obtained a yield increase of 6562 kg fruit/ha and 218.7 kg fruit/l of applied product, respectively (Table 3).

Table 3

Yield increase determined by Nutrivant Plus product applied to apple (Golden Delicious variety), cultivated on Cambic Chernozems (USAMV Iasi)

No.	Treatment	No. of applications	Yield (fruit) (kg/ha)	Yield (fruit) increase		
				kg/ha	%	kg/l of foliar fertilizer
1.	Control	-	15783	-	100.0	-
2.	Nutrivant Plus fertilization	3	22345	6562	141.5	218.7

- without *previous fertilization of soil*

Vine grown on Luvosols, with three applications, obtained a yield increase of 1105 kg grapes/ha and 36.8 kg grapes/l of applied product, respectively (Table 4).

Table 4

Yield increase determined by Nutrivant Plus product applied to vine (Chasselas doré variety), cultivated on Luvosols (SCD Tg. Jiu)

No.	Treatment	No. of applications	Yield (grapes) (kg/ha)	Yield (grapes) increase		
				kg/ha	%	kg/l of foliar fertilizer
1.	Control	-	4980	-	100.0	-
2.	Nutrivant Plus fertilization	3	6085	1105	122.1	36.8

- without *previous fertilization of soil*

Cucumbers cultivated on Luvosols, with three applications, obtained a yield increase of 4560 kg fruit/ha and 152.0 kg fruit/l of applied product, respectively (Table 5).

Table 5

Yield increase determined by Nutrivant Plus product applied to cucumbers (Cornichon variety), cultivated on Luvosols (SCD Tg. Jiu)

No.	Treatment	No. of applications	Yield (fruit) (kg/ha)	Yield (fruit) increase		
				kg/ha	%	kg/l of foliar fertilizer
1.	Control	-	11690	-	100.0	-
2.	Nutrivant Plus fertilization	3	16250	4560	139,0	152,0

- without *previous fertilization of soil*

Natural grassland, grown on Phaeozems, with only one application of Nutrivant Plus product obtained a yield increase of 909 kg hay/ha and 181.8 kg hay/l of applied product, respectively (Table 6).

Table 6

Yield increase determined by Nutrivant Plus product applied to natural grassland (*Festuca* sp., *Phleum* sp. and *Trifollium* sp.), grown on Luvosols (SCD Tg. Jiu)

No.	Treatment	No. of applications	Yield (fruit) (kg/ha)	Yield (fruit) increase		
				kg/ha	%	kg/l of foliar fertilizer
1.	Control	-	2483	-	100.0	-
2.	Nutrivant Plus fertilization	3	3392	909	136.6	181.8

- *previous fertilization of soil* with: N – 50; P_2O_5 – 50; K_2O – 50 kg/ha

Tomatoes cultivated on Luvosols, with three applications, obtained a yield increase of 7500 kg fruit/ha and 500.0 kg fruit/l of applied product, respectively (Table 7).

Table 7

Yield increase determined by Nutrivant Plus product applied to tomatoes (Select variety), cultivated on Luvosols (SCD Tg. Jiu)

No.	Treatment	No. of applications	Yield (fruit) (kg/ha)	Yield (fruit) increase		
				kg/ha	%	kg/l of foliar fertilizer
1.	Control	-	14100	-	100.0	-
2.	Nutrivant Plus fertilization	3	21600	7500	153.2	500.0

- *previous fertilization of soil* with: N – 50; P_2O_5 – 50; K_2O – 50 kg/ha

Plum, grown on Cambic Chernozems, with three applications, obtained a yield increase of 2681 kg fruit/ha and 89.3 kg fruit/l of applied product, respectively (Table 8).

Table 8

Yield increase determined by Nutrivant Plus product applied to plum (Stanley variety), cultivated on Cambic Chernozems (USAMV Iasi)

No.	Treatment	No. of applications	Yield (fruit) (kg/ha)	Yield (fruit) increase		
				kg/ha	%	kg/l of foliar fertilizer
1.	Control	-	6134	-	100.0	-
2.	Nutrivant Plus fertilization	3	8815	2681	143.7	89.3

- without *previous fertilization of soil*

CONCLUSIONS

1. Application of Nutrivant Plus product determined for all the tested crops and in all the experiment fields significant yield increases.
2. The various crops included in this experiment emphasized the quality of this product as a universal fertilizer, ensuring efficiency for a large range of crops.

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NUTRIENTS UPTAKE IN MAIZE PLANT UNDER ORGANIC FERTILIZATION TREATMENT

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Keywords: *compost, maize, nutrient, fertilization*

Abstract

The opportunity of introducing plant analysis in the context of modern agriculture has become the practice of fertilization as a tool for diagnosis and substantiation of the application of fertilizers. There were studied the changes of some chemical characteristics of maize leaves under the influence of organic fertilization with or without mineral fertilization. As organic fertilizer compost made from cattle manure was used. In the experience of maize organised on Haplic Chernozems there were taken samples of leaves which have been dried at room temperature, then in the oven, followed by the crushing process and analyzed. The combination of the two types of fertilization resulted in significant increases in total nitrogen in leaves of maize. Regarding the phosphorus content of leaves, although the organic fertilization associated with mineral fertilization determined the incraesing of available phosphorus level in soil, this increasing did not lead to statistically significant changes in phosphorus content in leaves. The effects of combining both types of fertilization have resulted in significant changes in distinct potassium content in maize leaves. The effects of the two fertilization systems were highlighted significant changes separate the calcium and magnesium insignificant for the content.

INTRODUCTION

In order to improve the biological phenomena in soil, organic fertilization seems to be a good solution. This is done with organic materials of different origins, composted after precisely established principles on the platform or in the field. It is obvious that these organic fertilizers are cheap and reach for each farmer and, in addition, be supplemented with chemical fertilizer to achieve optimal nutrient requirements for crops. On the other hand, manure, in particular, can be processed and converted into concentrated substance that can be exploited through marketing as a fertilizer, thus solving the problem of excess waste on the farm [1]. Efficiency of manure is greater when administered together with mineral fertilizers. Maintaining soil fertility depends on the balance between nutrient inputs (from different sources) and its loss by absorption in plants.

MATERIAL AND METHODS

There were organized experiments in field using the subdivided parcels method, studying the two gradients:

A factor - organic fertilization with compost made from cattle manure, in 5 doses:

a_1 – unfertilized;

a_2 – fertilized with compost equivalent to 100 kg N/ha;

a_3 – fertilized with compost equivalent to 200 kg N/ha;

a_4 – fertilized with compost equivalent to 300 kg N/ha;

a_5 – fertilized with compost equivalent to 400 kg N/ha.

B Factor – mineral fertilization with nitrogen and phosphorus, in 3 doses:

b_1 – unfertilized;

b_2 – $N_{50}P_{50}$;

b_3 – $N_{100}P_{100}$.

Experiments were organized with maize cultivated on Haplic Chernozems. There were taken samples of leaves which were dried at room temperature, then in the oven, followed by the crushing process and analyzed.

The processing of experimental data was performed using analysis of variance and Tukey test.

RESULTS AND DISCUSSION

Maize plants react positively to fertilization with organic fertilizers complex, but require a good supply of nutrients [2].

Nitrogen is a fundamental element in plants and it is found as a combination of protein, amino acids, nucleic acids, chlorophyll, etc. The combination of the two systems of fertilization (organic and mineral) resulted in lowest nitrogen content in maize leaves harvested in the variant unfertilized and the highest in the variant fertilized with compost at a dose equivalent to 200 kg N/ha. Following the incorporation of different doses of compost, the mean values of nitrogen content in maize leaves increased gradually from 1.84 to 2.13%. Changes statistically significant compared to the control variant and to the variant fertilized with compost at a dose equivalent to 100 kg N/ha, were observed only in the case of organic fertilization with the maximum dose of compost (Table 1).

Phosphorus is an essential element in plants. It exists in plants as organic compounds. In the experience organised on Haplic Chernozems it was noticed a slight upward trend in mean values of phosphorus content in maize leaves with increasing dose of compost applied from 0.26 to 0.31%, but increases are not statistically significant (Table 2).

Table 1

Effects of fertilization with composted cattle manure and mineral fertilization with nitrogen and phosphorus, on nitrogen content in maize leaves

Mineral fertilization	Compost fertilization					Mean value mineral fertilization
	Unfertilized with compost	Compost fertilization equivalent to a nitrogen rate of				
		100 kg N / ha	200 kg N / ha	300 kg N / ha	400 kg N / ha	
	%					
Unfertilized	1,68	1,79	1,93	2,03	2,16	**1,92 A**(1)
N_{50} P_{50}	1,81	1,84	1,85	2,05	2,11	**1,93 A**
N_{100} P_{100}	1,95	1,90	2,23	1,97	2,13	**2,04 B**
Mean value compost fertilization	**1,81 W**(2)	**1,84 W**	**2,00 WX**	**2,02 WX**	**2,13 X**	

(1) or (2) - Values followed by the same letter (A, B, C or W, X, Z) are not significantly different at the p=0.05 level (Tukey's honestly significant procedure)

Phosphorus had the lowest content in the unfertilized variant, and the highest in the variant fertilized with compost at a rate equivalent to 400 kg N/ha.

Table 2

Effects of fertilization with composted cattle manure and mineral fertilization with nitrogen and phosphorus, on phosphorus content in maize leaves

Mineral fertilization	Compost fertilization					Mean value mineral fertilization
	Unfertilized with compost	Compost fertilization equivalent to a nitrogen rate of				
		100 kg N / ha	200 kg N / ha	300 kg N / ha	400 kg N / ha	
	%					
Unfertilized	0,23	0,24	0,29	0,31	0,33	**0,28 A**(1)
N_{50} P_{50}	0,28	0,29	0,30	0,32	0,31	**0,30 A**
N_{100} P_{100}	0,23	0,26	0,30	0,30	0,29	**0,28 A**
Mean value compost fertilization	**0,25 W**(2)	**0,26 W**	**0,30 W**	**0,31 W**	**0,31 W**	

(1) or (2) - Values followed by the same letter (A, B, C or W, X, Z) are not significantly different at the p=0.05 level (Tukey's honestly significant procedure)

The role of potassium in the plant is multiple: increasing water absorption, reduces sweating, enhance photosynthesis, stimulating plant growth and cell division [3].

Potassium content in maize leaves, recorded minimum value in unfertilized variant and maximum value in the variant with compost fertilization equivalent to a nitrogen rate of 400 kg N/ha on a fund $N_{100}P_{100}$ mineral fertilization (Table 3).

Changes statistically significant compared to control variant, of mean values of potassium content in maize leaves were determinated after mineral fertilization with $N_{100}P_{100}$.

The increasing rates of compost applied led to increased statistically significant compared to the control of the mean value of potassium content in maize leaves, from 3.52% obtained after fertilization with compost in a rate equivalent to 100 kg N/ha to 3.81% corresponding to the variant fertilized with compost rate equivalent to 400 kg N/ha.

Table 3

Effects of fertilization with composted cattle manure and mineral fertilization with nitrogen and phosphorus, on potassium content in maize leaves

Mineral fertilization	Compost fertilization					Mean value mineral fertilization
	Unfertilized with compost	Compost fertilization equivalent to a nitrogen rate of				
		100 kg N / ha	200 kg N / ha	300 kg N / ha	400 kg N / ha	
	----- % -----					
Unfertilized	2,83	3,51	3,63	3,63	3,81	**3,48 A**(1)
N_{50} P_{50}	3,21	3,50	3,75	3,61	3,77	**3,57 AB**
N_{100} P_{100}	3,37	3,54	3,63	3,57	3,86	**3,59 B**
Mean value compost fertilization	**3,14 W**(2)	**3,52 X**	**3,67 Y**	**3,60 XY**	**3,81 Z**	

(1) or (2) - Values followed by the same letter (A, B, C or W, X, Z) are not significantly different at the p=0.05 level (Tukey's honestly significant procedure)

Calcium is present in all cells, especially in the old ones; it provides flexibility particularly in cell membranes. In small quantities, it is necessary for growth of all cells.

There were observed statistically significant increases of the calcium mean values content in leaves in mineral fertilized variant $N_{100}P_{100}$ irrespective of organic fertilization (Table 4). Organic fertilization in dose equivalent to 400 kg N/ha, resulted in increased statistically significant compared with variant fertilized with a quantity of compost equivalent to 300 kg N/ha.

Magnesium is designed to supply nitrogen and phosphorus plant cells making it indispensable in developing plant tissues.

The content of magnesium in maize leaves samples harvested in the experience organised on a Haplic Chernozems ranged 0.28-0.34%, as part of the normal concentration range.

Table 4

Effects of fertilization with composted cattle manure and mineral fertilization with nitrogen and phosphorus, on calcium content in maize leaves

Mineral fertilization	Compost fertilization					Mean value mineral fertilization
	Unfertilized with compost	Compost fertilization equivalent to a nitrogen rate of				
		100 kg N / ha	200 kg N / ha	300 kg N / ha	400 kg N / ha	
	%					
Unfertilized	0,46	0,57	0,59	0,55	0,61	**0,56 A**(1)
N_{50} P_{50}	0,58	0,58	0,58	0,46	0,64	**0,57 A**
N_{100} P_{100}	0,74	0,59	0,57	0,62	0,62	**0,63 B**
Mean value compost fertilization	**0,59 WX**(2)	**0,58 WX**	**0,58 WX**	**0,54 W**	**0,62 X**	

(1) or (2) - Values followed by the same letter (A, B, C or W, X, Z) are not significantly different at the p=0.05 level (Tukey's honestly significant procedure)

Statistically significant increases compared with the control variant of the mean value of magnesium contents in maize leaves were observed in variant fertilized with $N_{100}P_{100}$, without organic fertilization (Table 5).

Table 5

Effects of fertilization with composted cattle manure and mineral fertilization with nitrogen and phosphorus, on magnesium content in maize leaves

Mineral fertilization	Compost fertilization					Mean value mineral fertilization
	Unfertilized with compost	Compost fertilization equivalent to a nitrogen rate of				
		100 kg N / ha	200 kg N / ha	300 kg N / ha	400 kg N / ha	
	%					
Nefertilizat	0,30	0,28	0,28	0,34	0,31	**0,30 A**(1)
N_{50} P_{50}	0,28	0,33	0,30	0,32	0,32	**0,31 AB**
N_{100} P_{100}	0,34	0,32	0,31	0,37	0,33	**0,33 B**
Mean value compost fertilization	**0,30 WX**(2)	**0,31 WX**	**0,29 W**	**0,34 X**	**0,32 WX**	

(1) or (2) - Values followed by the same letter (A, B, C or W, X, Z) are not significantly different at the p=0.05 level (Tukey's honestly significant procedure)

CONCLUSIONS

1. The content of organic matter and nutrients in composted cattle manure recommends its use as organic fertilizer. The fertilization with composted cattle manure has not reported problems in terms of production quality in maize.

2. To avoid possible negative effects such as nutritional imbalance issues, it is necessary to comply with the uniform application of compost and crop-specific technologies.

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EFFICIENCY OF VITREOUS PHOSPHATO-POTASSIUM FERTILIZERS ON AUTUMN CROPS

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Keywords: *efficiency, autumn crops, vitreous fertilizers, phosphato-potassium*

Abstract

Vitreous fertilizers are new type of fertilizers, made of a vitreous matrix with low and controlled solubility in water (made of macro elements useful for plants, K, P, Mg) in which are introduced microelements (Mo, B, V, Fe) necessary to the growth and development of plants. The quantity of microelements as oxides is 1-5%.

The use of vitreous fertilizers offers many advantages: avoid underground water pollution; do not release acid anions in soil, like Cl^- *or* SO^{2-}*, harmful for plants there is no risk of soil burning when they are incorrectly dosed; in a single type of fertilizer can be embedded almost all useful elements for plants; the facility to regulate the pH of soil by the pH of glass matrix; a controlled rate of solubility in water, that can adjust easily by changing the composition of glass.*

Vitreous fertilizers were utilized in autumn plants (autumn wheat, barley), and the results are presented in the paper.

INTRODUCTION

Ideas like **"Sustainable agriculture"** are equally important in Romania and the European space. By comparison with intensive agriculture that utilizes synthetic fertilizers and pesticides in order to assure the necessary of the agricultures in nutrients and to control bad plants diseases and damages, **"the new technologies"** are oriented to the diminution of chemical interventions, reduction of the pollutant impact of agricultural activities on the environment and to release of agricultural products of superior biological quality. Today, Agricultural Policy at the European level sustains farms, processing and commercialization of modern products. It is a process in full development in Romania and of big interest for all that are involved, one way or the other, in areas of production-processing-commercialization-consumption of agricultural products.

In this context, this paper deals with the optimization of nutrient in the system soil-water-plant, by using the vitreous fertilizers from potassium-phosphate glasses containing microelements (VFM) with controlled solubility in condition of using natural resources and efficient using of amendments, according with the principles of developing sustainable agriculture regarding the European Directive about "Plant production protection" (Dir. 91/414/EEC).

Vitreous fertilizers are a new category of fertilizers which are made from a glass matrix with slow and controlled solubility in water, made up of macro useful elements such as potassium, phosphorus, magnesium, to which micronutrients (molybdenum, boron, zinc, iron, etc.) necessary for growth and development of plants are added. This type of fertilizer is made from a glassy matrix that includes micronutrients [1-3]. The elements of which glass matrix is formed are network forming oxides (P_2O_5, B_2O_3, SiO_2) and network modifiers (K_2O, CaO, MgO) that are both macro and micronutrients [4].

MATERIAL AND METHODS

The first research was conducted in a mono-factorial experience in 3 sequences of 4 variants, for wheat Dropia, according to Figure 1, on the black earth of location of Albesti Paleologu in autumn 2007.

R1	V1	V2	V3	V4
R2	V2	V3	V4	V1
R3	V3	V4	V1	V2

Fig. 1. Experimental scheme with 4 variants in 3 sequences for Dropia wheat

Variant V1 represents the unfertilized witnesses. Variant V2 is fertilized with a classic fertilizer, nitrogen, phosphorus and potassium NPK (15.15.15). It was used a quantity of 160 kg classic fertilizer per hectare. Variant V3 is fertilized with vitreous fertilizer, whose composition is shown in Table 1. It was used a quantity of 80 kg vitreous fertilizer per hectare. V4 version is fertilized with mixed fertilizer having equal parts of classic and vitreous fertilizers. It was used an amount of 120 kg combined fertilizer per hectare, formed by 80 kg of NPK and 40 kg vitreous fertilizer, respectively.

Crops were sown on 15.10.2007 and harvested on 25.06.2008.

Table 1

Oxide composition of fertilizer used in field crops

Component	**Quantity [weight %]**
P_2O_5	40
K_2O	30
MgO	17
CaO	5
Al_2O_3	2
B_2O_3	2
V_2O_5	4

Given the yields achieved, the most constant behavior occurred in the variety of wheat Dropia. This was the reason why Dropia wheat variety was selected for further testing.

The Dropia wheat crops was grown on the black earth of Albesti Paleologu, Prahova, in mono-factorial experience in 4 sequences with 5 variants as shown in figure 2. The dimensions of each variant were 10 square meters area. The compositions of vitreous fertilizers are presented in Table 2.

Table 2

Vitreous fertilizers recipes used in Albeşti-Paleologu 2008-2009

Code	**P_2O_5 mol %**	**MgO mol %**	**K_2O mol %**	**B_2O_3 mol %**	**Fe_2O_3 mol %**	**ZnO mol %**
AG2	41.84	22.45	35.71	-	-	-
AG2.1	32.08	16.98	26.42	24.52	-	-
AG2.2	40	21.05	32.63	-	6.32	-
AG2.3	38	20	32	-	-	10

Crops were sown on 10.10.2008 and harvested on 22.06.2009.

R4		V4	V5	V2	V3	V1	
R3		V5	V3	V4	V1	V2	

R2		V3	V1	V5	V2	V4	
R1		V1	V2	V3	V4	V5	

Fig. 2. Experimental scheme with 5 variants in 4 sequences for Dropia wheat V1 - Variant unfertilized; V2 - variant fertilized with AG2 (P_2O_5-MgO-K_2O); V3 - variant fertilized with AG2.1 (P2O5-MgO-K2O-B2O3); V4 - variant fertilized with AG2.2 (P_2O_5-MgO - K_2O-Fe_2O_3); V5 - variant fertilized with AG2.3 (P_2O_5-MgO-K_2O-ZnO)

RESULTS AND DISCUSSION

Winter cereals grown in 2007 are presented in different stages of vegetation in Figures 3 and 4.

Fig. 3. Winter wheat during the period of fellowship, in which the vitreous fertilizers were applied

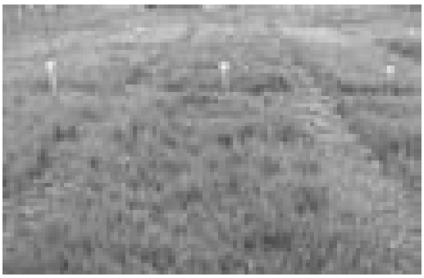

Fig. 4. Autumn wheat obtained with vitreous fertilizer (in April)

The products of autumn crops obtained in these experiments are presented in Table 3 and Figure 5 for 2007-2008 Dropia wheat and Table 4 for Dropia wheat 2008-2009.

Table 3

Influence of vitreous fertilizer on Dropia wheat production in 2007-2008

Variant	**Medium production (kg/ha)**	**Vol. production (%)**	**Difference from standard sample**
V1	2200	100	0
V2	3400	155	1200
V3	3600	164	1400
V4	4700	214	2500

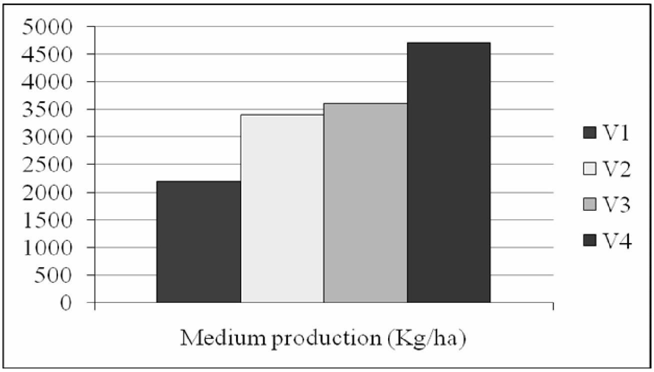

Fig. 5. Medium production of Dropia wheat per ha for the four experimental variants 2007-2008

Table 4

Influence of vitreous fertilizer on Dropia wheat production in 2008-2009

Variant	**Medium production (Kg/ha)**	**Vol. Production (%)**	**Difference from standard sample**
V1	3350	100	0
V2	4933	147	1583
V3	4090	82	740
V4	4677	114	1327
V5	4581	97	1231

CONCLUSIONS

1. All the variants in which vitreous fertilizers were used presented growths comparable with the unfertilized variant. The Dropia wheat crop 2007-2008, in the variant with vitreous fertilizer together with the classical one,

produced an increase of 2500 kg/ha in comparison with the unfertilized variant (2200 kg/ha).

2. The variant fertilized with vitreous fertilizer showed an increase of only 1400 kg/ha. The variant fertilized with classical one had a smaller production increase in comparison with the variants using vitreous fertilizers, of 1200 kg/ha. In comparison with the unfertilized variant, the use of vitreous fertilizer was 9% more efficient then the classical one.
3. In the Dropia wheat 2008-2009, it can be observed that all variant that used receipts with vitreous fertilizers were superior to the not fertilized one. The best production achievement was registered for the variant with AG2 basically receipt showing an increase of 1600 kg over the unfertilized one. AG2.1 boron receipt registered 700 kg over unfertilized one. AG2.2 iron receipt showed 1300 kg over unfertilized one. AG2.3 zinc receipt had 1200 kg over unfertilized one. The using of vitreous fertilizers, comparatively to unfertilized sample showed 22-47% increased efficiency, for all tested variants.
4. Unlike classical fertilizers, which are used only 35-40% by plants, vitreous fertilizers are totally absorbed, which protects the soil from pollution. On the other side, vitreous fertilizers used quantities was at least two times smaller than in the case of classical ones, which implies decreasing of production costs and very significant reduction of pollution, due to time reduction of using apparatus. At the same time, the soil pressing grade is significantly reduced. The use of vitreous fertilizers showed it efficiency, together with the classical ones, but also at using them without the classical ones.
5. The results presented in this paper were registered after the first two years of testing the vitreous fertilizers for autumn crops. We consider these results as preliminary, their validation following in the next year of experiments, and completed by the spring ones.

ACKNOWLEDGEMENTS

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THE INFLUENCE OF NITROGEN FERTILISATION ON THE TRITICALE CULTURE ESTABLISHED ON THE ACID SOILS FROM ALBOTA-ARGES

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Keywords: *triticale, soil, precipitations, fertilization, nitrogen*

Abstract

During the agricultural years 2006/2007 and 2007/2008, on the acid soils of Albota, Arges county, we established cultures of triticale (triticosecale) in randomized blocks. We used seven varieties, such as: Plai, Trilstar, Stil, Goru, Haiduc, Titan and TF2. The main village of Albota bears the characteristics of Climatic Area 2. The precipitations in the area were taken over by the Weather Station of Pitesti.

It was performed the fertilization of the experimental land with nitrogen in an optimum amount of 90 kg/ha and in a suboptimum amount of 12 kg/ha, and also with phosphorus in amount of 80 kg/ha. The years had different characteristics. While 2007 was extremely droughty, 2008 was a regular year according to the precipitations registered.

Due to the statistical processing via the regression and the variation method, we found that triticales are productively efficient both for optimum and suboptimum fertilized plots. Triticales are recommended for hungry soils, poorly productive for wheat because they have the genetic possibility to ensure some efficient crops in regular years of precipitations and to ensure good crops in draughty years. By administrating nitrogen in a small quantity, the remanence of chemicals in plants is very low, with significant importance for the people and animal health. The data are shown in tables.

INTRODUCTION

Triticosecale or triticale belongs to *plantae kingdom*, *Trachebionta* subkingdom, *Liliobsida* class, *Cipperaliss* order, *Poaceae* family. The binominal denomination is x *triticosecale witt*.

Triticale – a synthetic man-made species by crossing wheat (*Triticum* sp.) and rye (*Secale cereale*) which slowly entered in production because of the flows presented by the first forms especially due to the fertility of ears, the behaviour of falling, the development of endosperm and the germination in the ear [4].

According to the research made described in specialist literature, it is established that triticales react well on soils with reduced natural fertility, humid and with high acidity, such as albic or brown luvic soils.

At the same time, it emphasizes a higher tolerance compared to the toxicity of mobile aluminium ions in soil.

The purpose of this paper is to emphasize the poorer soils, to promote the triticale culture and to get maximum production with minimum nitrogen administrated. Therefore, we protect the soil by diminishing chemicals.

The experiences were placed on acid soil from Albota, Arges, on plots of 10 m^2 for each variety of triticale.

MATERIAL AND METHODS

The material is represented by the acid soil from the locality of Albota, non/fertilised in the last five years (ecologic reconversion) on which we placed the triticale culture in 2007 and 2008. The varieties of triticale sown were: Plai, Titan, Trilstar, Stil, Gorun, Haiduc and TF2.

They made experiments with nitrogen fertilisation in different rates: nitrogen optimum dose of 90 kg/ha and suboptimum dose of 18 kg/ha and the unique phosphorus fertilisation dose of 80 kg/ha. They examined the cultures established in years with different amounts of precipitations; 2007 was droughty and 2008 was regular. The results obtained were interpreted through the regression method and the variation method.

The following objectives were considered:

1. Soil characterisation.
2. Area characterisation from the agricultural and climate perspective.
3. Experiences with administration of fertilizers in two years, the droughty 2007 and the regular 2008 year according to rainfall.
4. The results in production and their interpretation by statistics.

The wet, cold and acid soils are at the same time low in fertility (about 1.5% humus; 1.0-1.5 mg/100 g soil of assimilable phosphorus; 7.8 mg/100 g. soil K_2O and 0.1% nitrogen), where small crops are obtained for most of the cultures. The depletion of organic matter, the reduced contribution of nitrogen, phosphorus, potassium, the high acidity on big surfaces, the high content of mobile aluminium, the high content of clay, the defective comprehensive drainage are features that request ameliorating measures for this kind of soils.

The acid soils where we placed the experiences from Albota have an agricultural horizon of 20-22 cm thickness with average tissue (clay-bearing), under which there is an eluvial horizon of 20-30 cm thickness, very poorly structured, pseudogley, with high content of aluminium and low content of humus. In depth, there is then the rainproof horizon with 60-70% clay preventing the entrance of water and of the radicular system. The presence of the claylike-eluvial horizon, often enriched with clay and very compressed, emphasizes the unfavourable features impressed by the fine tissue sediments.

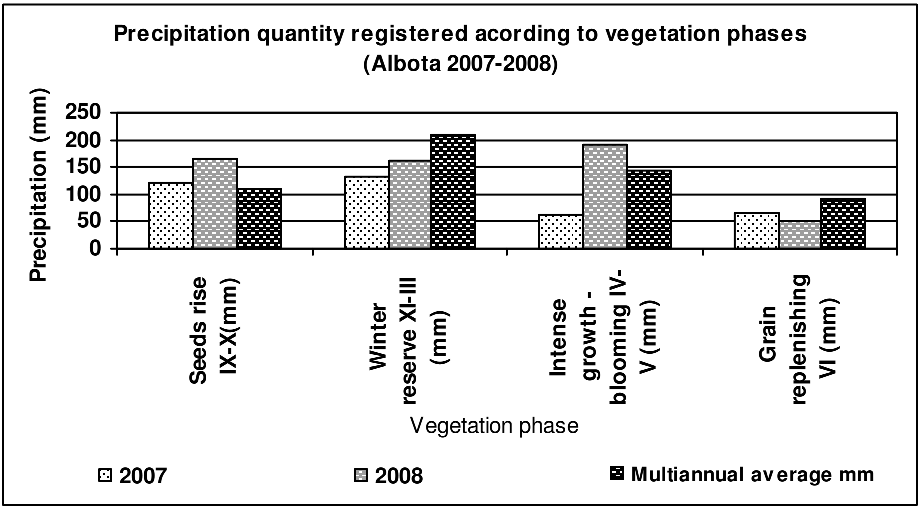

Fig. 1. Amount of precipitations registered on the vegetation stage

RESULTS AND DISCUSSION

For the varieties fertilized with the optimum amount of nitrogen, the best production stability according to the variation factors are the varieties Titan and TF2 and the lowest is Plai.

Comparing the average production to the production obtained under the most favourable conditions of culture, we can say that the variety Titan accomplished during the testing period about 85% of the maximum production, and the variety Plai accomplished only 77%. The highest production loss under unfavourable conditions of culture, compared to the soil average, was accomplished by the variety Plai, and the smallest loss the variety Titan.

By establishing the stability with the help of the regression factor and of average production [3], the same varieties with good production stability are emphasized. The varieties Plai and Haiduc have the highest production rate but a regression factor of 1.10 and 1.29 respectively which implies the tendency of these genotypes to achieve higher productions under favourable culture conditions.

For the options fertilized with optimum nitrogen amount, the best production stability according to the variation indicators are obtained by the varieties Gorun and the lowest is for the variety Haiduc. Comparing the average production to the production obtained under the most favourable culture conditions, we can say that the variety Titan achieved during the testing period about 69% of the maximum production, and Haiduc got only 58%.

Table 1

Average production obtained by the triticale varieties and the regression indicator during 2007-2008

Varieties	Triticale production							
	Optimum fertilised with 90 kg N; 80 kg K				Suboptimum fertilised with 18 kg N; 80 kg K			
	2007	2008	average	Regression indicator	2007	2008	average	Regression indicator
Plai	4350	8027	6189	1.38	3850	7801	5826	1.10
Titan	4350	6203	5277	0.69	3410	6429	4920	0.84
Trilstar	4360	6943	5652	0.97	3210	6937	5074	1.04
Stil	4160	6616	5388	0.92	3210	6656	4933	0.96
Gorun	4570	7102	5836	0.95	2980	5950	4465	0.82
Haiduc	4570	7768	6169	1.20	3250	7875	5563	1.29
TF2	4160	6433	5297	0.85	3290	6515	4903	0.90
Average	4360	7013	5687		3314	6880	5097	

Table 2

Average production of triticale varieties and its variation during the observation years

No.	Optimum azote fertilised					Suboptimum azote fertilised			
	Variety	Prod. kg/ha	s%	% from max. production	Min. average production	Production kg/ha	s%	% from max. production	Min. average production
1	Plai	6189	26.00	77	1839	5826	27.93	66	1976
2	Titan	5277	13.03	85	927	4920	21.34	69	1510
3	Trilstar	5652	18.26	81	1292	5074	26.35	63	1864
4	Stil	5388	17.37	81	1228	4933	24.36	65	1723
5	Gorun	5836	17.90	82	1266	4465	21.00	66	1485
6	Haiduc	6189	22.61	79	1599	5563	32.70	58	2313
7	TF 2	5297	16.07	82	1137	4903	22.80	67	1613
8	Average	5687	18.76	81	1327	5097	25.21	65	1783

Table 3

Increment of production due to optimum fertilization

No.	Varieties of triticale	Increment of production 2007 Kg/ha	Increment of production 2008 Kg/ha
1	Plai	500	226
2	Titan	940	-226
3	Trilstar	1150	6
4	Stil	950	-40
5	Gorun	1590	1152
6	Haiduc	1320	-780
7	TF2	870	482

The highest production loss under unfavourable culture conditions was obtained by the variety Haiduc and the lowest by the variety Gorun.

By establishing the stability with the help of the regression factor and of average production [3], the same varieties with good production stability are emphasized (Figure 2). The varieties Haiduc and Plai had the highest production rate, but a regression factor of 1.11 and 1.29, respectively, which implies the tendency of these genotypes to achieve higher productions under favourable culture condition.

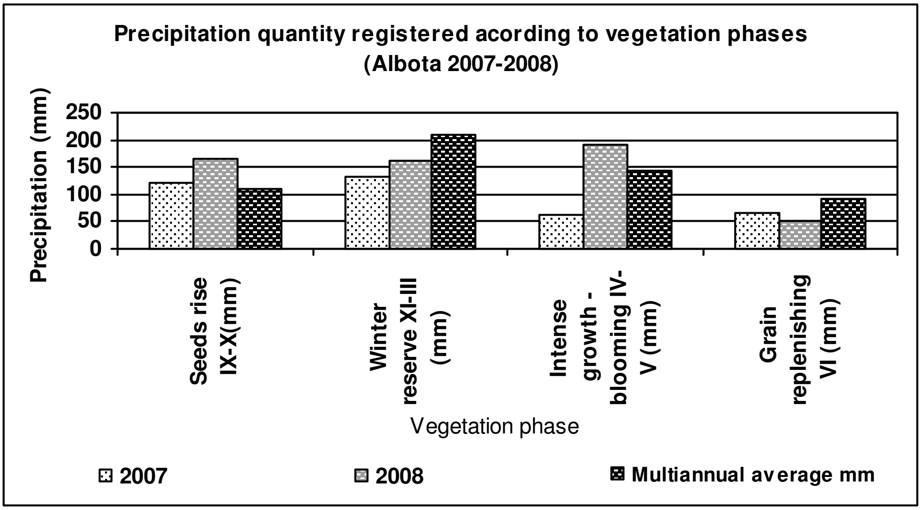

Fig. 2. Relation between the triticale average production (fertilized with nitrogen in optimum amount) and the adjustment to weather conditions (Albota 2007-2008)

CONCLUSIONS

From the study performed, the conclusions are as follows:

1. The main factor influencing the triticale production stability in the area is the water.
2. The triticale varieties were a little influenced by the lack of water and did not respond well to the good administration of water and nitrogen.
3. The varieties Titan, Gorun, TF2 and Stil have a good production stability both in conditions of optimum and of suboptimum nitrogen amount.
4. The varieties Plai and Haiduc have the highest production rate but a high regression factor which implies the tendency of these genotypes to achieve higher productions under favourable culture conditions.

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INFLUENCE OF ORGANIC AND MINERAL NITROGEN FERTILIZATION ON WHEAT YIELD ON THE REDDISH PRELUVOSOIL IN THE DANUBE PLAIN

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Keywords: *nitrogen organic and mineral fertilization, nitrogen valuation coefficient, wheat production*

Abstract

Research was performed in the course of a bifactorial experiment of 3x5 type made according to the split plot method aimed to study nitrogen organic and mineral fertilization on winter wheat in a winter wheat – winter barley – sugar beet crop rotation. The findings were that organic fertilization with 30 t/ha manure and 5 t/ha sugar beet leaves and crowns determined very significant production boosts of 5.78 q/ha and 5.63 q/ha respectively compared to the unfertilized treatment and the nitrogen mineral fertilization with no organic fertilization generated very significant production boosts up to the dose of N_{150} *where the production boost was of 16.29 q/ha.*

Combining organic fertilization – the after-effect of 30 t/ha manure – and mineral fertilization – N_{150} *led to maximum production of 46.35 q/ha.*

Highest nitrogen valuation coefficient of 12.38 kg wheat/kg N a.s. was recorded in the organic fertilization with 30t/ha manure, followed by the N_{60}*, then by the treatment with no organic fertilization combined with the dose of mineral nitrogen of* N_{60} *with 11.47 kg wheat/kg N a.s.*

INTRODUCTION

The rational valuation of the reddish preluvosoil in a system of sustainable agriculture means differentiated application in the short-term crop rotations according to the soil fertility level and the production level targeted by nitrogen organic and/or mineral fertilizers with steady amounts of phosphorus [1, 2].

The study of the valuation degree of mineral nitrogen found in the production [3, 4] is an important limiting element when determining a rational fertilization level.

The present paper aims to determine the influence of mineral and organic nitrogen on wheat production and the nitrogen valuation coefficient at different supply levels of mineral and organic nitrogen.

MATERIAL AND METHOD

Research was performed at the Belciugatele Teaching Station – Moara Domneasca Research and Production Farm in the agrotechnical experimental field on reddish preluvosoil in the northwestern Romanian Plain, in the year 2009.

Soil has a humus content of 2.1-2.2% in the A horizon, clayey-loamy texture with 55% physical clay, weakly supplied with nitrogen and phosphorus and well supplied with potasium.

The climate has an annual mean temperature 1.7°C higher than normal because the monthly normal values are exceeded in all months except for January, especially in early summer and autumn. Spring began early, in March and April the temperatures being 2.4°C and 0.8°C respectively higher than normal (Figure 1) and the summer temperatures were typical (1.3°C up to 2.0°C higher than normal).

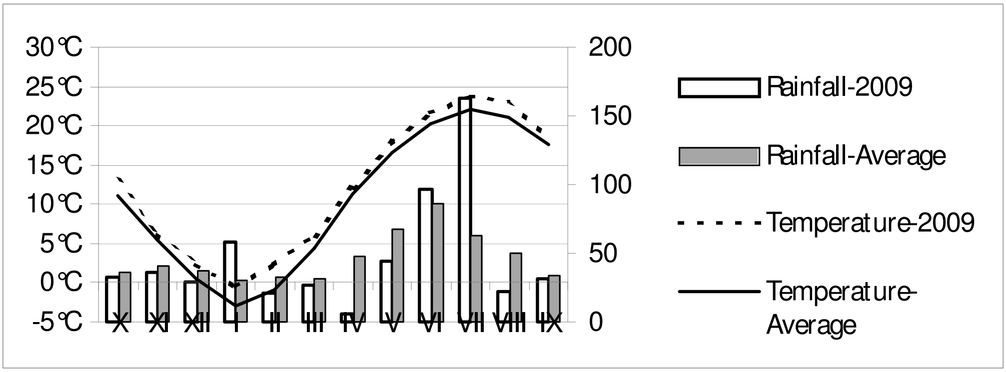

Fig. 1. Climatic conditions at Moara Domneasca in 2008/2009 and the means values

The precipitation amount of 566.8 mm was practically at the normal level. Under these circumstances, the essential thing was their distribution in the sowing-tillering period 98.0 mm being absorbed and 349.8 mm in the growing season, out of which 96.4 mm in June, the month with the most consumption, which insured relatively good water supply for the plants.

Air relative moisture had a mean annual value of 72.8%, 5.8% lower than the normal value, with mean monthly values lower than the normal ones.

On the whole, the agricultural year 2008/2009 was very favourable regarding temperature and water, with a distribution of precipitation very close to the values of plant evapotranspiration, avoiding periods of thermal and water stress and at the same time having lower than normal values of air relative moisture.

Experimental factors. The experiment was bifactorial, set according to the split plots method in 3 repetitions, with the factor A – organic fertilization and the factor B – mineral fertilization.

Factor A had following the graduations: a_1 – unfertilized organically, a_2 – fertilized with 30 t/ha manure and a_3 – 40 t/ha sugar beet leaves and crowns.
Factor B had the following graduations: a_1 – unfertilized, a_2 – N_{60}, a_3 – N_{100}, a_4 – N_{150} and a_5 – N_{200}.

RESULTS AND DISCUSSION

Production results obtained. Regarding the *influence of nitrogen organic fertilization* on winter wheat production (Table 1) there can be seen very significant production boosts of 5.78 q/ha under 30 t/ha manure and 5.63 q/ha under 40 t/ha sugar beet leaves and crowns.

Table 1

Influence of organic nitrogen fertilization on winter wheat production on reddish preluvosoil (Moara Domneasca, 2009)

Treatment	Production		Difference		Significance
	q/ha	%	q/ha	%	
a_1 – unfertilized organically	26.14	100.00	Mt	-	
a_2 – 30 t/ha manure	31.92	122.11	5.78	22.11	***
a_3 – 5 t/ha sugar beet leaves and crowns	31.77	121.53	5.63	21.53	***

$Dl_{5\%}$ = 0.762 q/ha; $Dl_{1\%}$ = 1.263 q/ha; $Dl_{0.1\%}$= 2.363 q/ha

Concerning the *influence of nitrogen mineral fertilization* on winter wheat production (Table 2), there can be seen very significant production boosts of 6.88 q/ha, 11.24 q/ha and 16.29 q/ha corresponding to the treatments b_2 – N_{60}, b_3 – N_{100} and b_4 – $N_{150;}$ the 10.81 q/ha increase in the treatment b_5 – N_{200} even very significant it's in a trend of decreasing production.

Following the *influence of nitrogen mineral fertilization* on winter wheat under no organic fertilization and under organic fertilizers there can be seen a differentiation of the expressed results by increases up to the dose of N_{150} after which its level decreases (Table 3).

With no organic fertilization, the highest production, of 42.43 q/ha, resulted from the dose of N_{150}, while the same mineral fertilizer combined with 30t/ha manure resulted in a maximum of 46.35 q/ha. When fertilizing with 40 t/ha sugar beet leaves and crowns, production was close to the one obtained with no organic fertilization, but higher than this one except for that with N_{150} which was slightly lower than under no fertilization.

Table 2

Influence of mineral nitrogen fertilization on winter wheat production on reddish preluvosoil (Moara Domneasca, 2009)

Treatment	Production		Difference		Significance
	q/ha	%	q/ha	%	
b_1 – unfertilized	26.14	100.00	Mt	-	
$b_2 - N_{60}$	33.02	126.32	6.88	26.32	***
$b_3 - N_{100}$	37.38	143.00	11.24	43.00	***
$b_4 - N_{150}$	42.43	162.32	16.29	62.32	***
$b_5 - N_{200}$	36.95	142.35	10.81	42.35	***

$Dl_{5\%}$ = 0.796 q/ha; $Dl_{1\%}$ = 1.079 q/ha; $Dl_{0.1\%}$= 1.445 q/ha

Concerning the influence of organic fertilization on wheat production (Table 4) at the same level of mineral nitrogen fertilization, there can be seen that the application of 30 t/ha manure resulted in very significant production boosts at all mineral fertilization levels in comparison with the unfertilized treatments. Compared with the treatments with no organic fertilization, the application of 40t/ha sugar beet leaves and crowns resulted in statistically insured production boosts only when under no chemical fertilization and at the dose of N_{100} while at the dose of N_{150} there was a distinctly signficant decrease.

The comparison between the fertilization with 30 t/ha manure and 40 t/ha sugar beet leaves and crowns clearly favours the application of manure, at all mineral fertilization levels, the production differences indicating manure application is better.

Mineral nitrogen valuation. Regarding the values of nitrogen valuation coefficient through the amount of wheat produced/kg a.s. nitrogen (Table 5) there can be seen that under *no organic fertilization* valuation slightly decreases from the dose of N_{60} to the doses of N_{100} and N_{150} an obvious decrease being recorded at the dose of N_{200}.

Under 30 t/ha manure, the mineral nitrogen valuation coefficient had the highest value at the dose of N_{60} with 1238 Kg wheat/kg a.s. N, with a slight decrease at the dose of N_{100}, after which its values drop when the nitrogen dose increases. Under 40t/ha sugar beet leaves and crowns, nitrogen valuation was weak, between 328 kg wheat/kg a.s. N at the dose of N_{200} and 781 Kg wheat/kg a.s. N at the dose of $N_{60.}$

Table 3

Influence of nitrogen mineral fertilization on winter wheat production on reddish preluvosoil (Moara Domneasca, 2009)

F_A – organic fertilization F_B – fertilization with mineral N	The influence of mineral nitrogen fertilization on winter wheat production at:								
	a_1 – unfertilized organically			a_2 – 30 t/ha manure			a_3 – 5 t/ha sugar beet leaves and crowns		
	Production (q/ha)	Difference (q/ha)	Significance	Production (q/ha)	Difference (q/ha)	Significance	Production (q/ha)	Difference (q/ha)	Significance
b_1 – unfertilized	26.14	Mt		31.92	Mt		31.77	Mt	
$b_2 – N_{60}$	33.02	6.88	***	39.35	7.43	***	34.40	2.63	***
$b_3 – N_{100}$	37.38	11.24	***	43.33	11.41	***	39.58	7.81	***
$b_4 – N_{150}$	42.43	16.29	***	46.35	14.43	***	40.18	8.41	***
$b_5 – N_{200}$	36.95	10.81	***	41.41	9.49	***	38.34	6.57	***

$Dl_{5\%}$ = 1.379 q/ha; $Dl_{1\%}$ = 1.869 q/ha; $Dl_{0.1\%}$= 2.503 q/ha

Table 4

Influence of organic fertilization at the same level of mineral nitrogen fertilization on winter wheat production on the reddish preluvosoil (Moara Domneasca, 2009)

Mineral nitrogen fertilization	The influence of organic fertilization on winter wheat production at the same level of mineral nitrogen application					
	$a_2 – a_1$		$a_3 – a_1$		$a_3 – a_2$	
	Difference (q/ha)	Significance	Difference (q/ha)	Significance	Difference (q/ha)	Significance
b_1 – unfertilized	5.78	***	5.63	***	- 0.15	
$b_2 – N_{60}$	6.33	***	1.38		- 4.95	000
$b_3 – N_{100}$	5.95	***	2.20	**	- 3.75	000
$b_4 – N_{150}$	3.92	***	-2.25	00	- 6.17	000
$b_5 – N_{200}$	4.46	***	1.39		- 3.07	000

$Dl_{5\%}$ = 1.439 q/ha; $Dl_{1\%}$ = 2.047 q/ha; $Dl_{0.1\%}$= 3.021 q/ha.

Table 5

Influence of organic and mineral fertilization on nitrogen valuation in wheat cultivated on reddish preluvosoil (Moara Domneasca, 2009)

F_B – mineral N fertilization	a_1 – organically unfertilized		a_2 – 30 t/ha manure		a_3 – 5 t/ha sugar beet leaves and crowns	
	Production difference (kg/ha)	Nitrogen valuation coefficient (kg wheat/ kg as N)	**Production difference** (kg/ha)	Nitrogen valuation coefficient (kg wheat/ kg as N)	**Production difference** (kg/ha)	Nitrogen valuation coefficient (kg wheat/ kg as N)
b_1 – unfertilized	Mt	-	Mt	-	Mt	-
$b_2 – N_{60}$	688	11.47	743	12.38	263	4.38
$b_3 – N_{100}$	1124	11.24	1141	11.41	781	7.81
$b_4 – N_{150}$	1629	10.86	1443	9.62	841	5.61
$b_5 – N_{200}$	1081	5.40	949	4.74	657	3.28

CONCLUSIONS

1. Organic fertilization brought very significant production boosts of 5.78 q/ha under 30 t/ha manure and 5.63 q/ha under 40 t/ha sugar beet leaves and crowns;
2. Mineral fertilization with no organic fertilization generated the highest production of 42.43 q/ha at the dose of N_{150};
3. The highest production in the experiment, 46.35 q/ha, was reached when applying 30 t/ha manure with N_{150} fertilizer;
4. The best nitrogen valuation of 1238 kg wheat/kg a.s. N was reached when applying 30 t/ha manure at the dose of N_{60}.

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INFLUENCE OF THE FERTILIZING SYSTEM ON TOTAL N, P, K AND CRUDE PROTEIN CONTENT IN CONDOR SOYBEAN

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Keywords: *soybean, fertilizing system, macronutrients, crude protein*

Abstract

Soybean is known to be one of the leguminous plants for beans having a wide spreading area on all the continents, 51% of the beans production is obtained in USA, where it takes the third place, after corn and wheat. In Romania is considered to be a leguminous plant used for its beans, being very important for human and animal feeding. It has high nutritional value, contains over 30% protein substances and 17-25% oil [2], proteins having a special feeding value.

Researche done at USAMV Bucharest in 2007, in the greenhouse of the Agrochemistry Department for the Condor species on reddish preluvosoil from Moara Domnească, had as purpose to establish the influence of the fertilization system on the soybeans quality, on the N, P, K and crude protein accumulation in the beans.

The results show that the nitrogen applied in a rate of 100 kg/ha produced the accumulation in bean of 38.74% crude protein, and variant 4 (N_0P40), fertilized with 40 kg P_2O_5 on the ha, accumulated 37.69 crude protein. In the case of variant 8 ($N_{50}P_{80}$), the content in crude protein in bean, 37.57% closed to the one in variant 4, does not justify from the economic point of view, the fertilizers costs.

INTRODUCTION

Soybean, in all countries where it is known, is important as an oleoprotein plant, due to its composition; it has multiple uses in the food industry, covering the protein deficit. Presently, owing to research and scientific discoveries in the field of alternative energetic resources, it is considered the third source of Diesel type regenerable biofuel, being outbeat by rape and sun flower. [6]

Soybean is the plant which, due to its quantitative and qualitative level, assures a part of the necessary nutritional substances needed in human feeding, animal feeding and industry. It is the first on the food oil market.

It has a great economic importance because of the multiple use of the beans which have a high protein content, over 30%, fat over 20%, approximately 15% unnitrogenated extractive substances, lecithin (1.6-2.5%), vitamin N (B_1-thiamine, B_2-riboflavin and B_6-pyridoxine) and enzymes (lipoxidaze, lipase, urease, amylase).

When one establishes the fertilization system for soybean culture, the following must be considered: soil fertility, fertilizers quantity from the previous years, previous culture, also the available quantity of minerals and organic fertilizers [5]. Of the total nutritive elements, in the beans remain 75% N, 75% P_2O_5 and 60% K_2O.

The greatest part of nitrogen and phosphorus is in the beans, while potassium is equally distributed in seeds and in vegetative parts. Soybean consumes for 100 kg seeds and the subsequent secondary biomass, 7.1 - 11 kg N, 1.6 - 4 kg P_2O_5, 1.8 - 4 kg K_2O [3, 4].

MATERIAL AND METHODS

Research done in 2007 in the greenhouse of the University of Agronomic Sciences and Veterinary Medicine, Bucharest, in pots, Mitscherlich type, having a capacity of 8 kg.

The biologic material used: semi-tardy Condor, fall resistant, having diseases resistance and a high genetic potential.

The used soil was reddish preluvosol from Moara Domnească, mixed with sand 2:1. When the experiment was started, the components analysis was made, also of the soil used [1].

For fertilization, 3 nitrogen levels were used and 3 phosphorous levels, as shown in Table 1.

Table 1

Experimental scheme

No.	Variant		N kg/ha	P_2O_5 kg/ha
1	N_0P_0 control	N_0P_0 control	-	-
2	N_1P_0	$N_{50}P_0$	50	-
3	N_2P_0	$N_{100}P_0$	100	-
4	N_0P_1	N_0P_{40}	-	40
5	N_1P_1	$N_{50}P_{40}$	50	40
6	N_2P_1	$N_{100}P_{40}$	100	40
7	N_0P_2	N_0P_{80}	-	80
8	N_1P_2	$N_{50}P_{80}$	50	80
9	N_2P_2	$N_{100}P_{80}$	100	80

For N ammonium nitrate 34.5% N was used as fertilizer and for phosphorus, superphosphate 18% P_2O_5, the rates being calculated considering the pots capacity.

At the end of the experiment, beans were analysed for establishing the macroelements content, N, K, P total forms and also the crude protein content was calculated.

RESULTS AND DISCUSSIONS

From Table 2, when the experiment was started, one finds out that the soil mixture was not very rich in nutritive elements, having a low content of soluble salts and a pH of 7.36, the reaction of a less alkaline soil.

Soybean does not need special soil, this allowing cultivating it on almost all soil types, except for heavy, acid, salty soils. The best results are obtained on the sandy-loamy, loamy and clayey-loamy soils, deep, fertile, calcium, phosphorous and potassium rich soils, with a soil reaction of: pH = 5 and pH = 8.5, the optimum being pH = 6.7.

Table 2

Components and soil mixture analysis

No.	Specification	pH	Content of soluble salts %	N-NH_4^+ ppm	N-NO_3^- ppm	NH_4^++NO_3^- ppm	PO_4^{3-} ppm	K^+ ppm
1	Sand	7.16	0.0860	21.50	traces	21.50	traces	10
2	Soil	7.26	0.0480	1.75	15.50	17.25	traces	20
3	Soil-sand mixture 2:1	7.36	0.0329	15.25	5.75	21.00	traces	20

Table 3

Influence of fertilization on Nt content, %, in soybeans

No.	Variant	Nt %	Difference	Signification
1.	N_0P_0 control	5.4130	Mt	-
2.	$N_{50}P_0$	5.8158	+0.4028	x
3.	$N_{100}P_0$	6.1989	+0.7859	xxx
4.	N_0P_{40}	6.0319	+0.6189	xxx
5.	$N_{50}P_{40}$	5.6979	+0.2849	ns
6.	$N_{100}P_{40}$	5.9042	+0.4912	xx
7.	N_0P_{80}	5.8158	+0.4028	x
8.	$N_{50}P_{80}$	6.0123	+0.5993	xx
9.	$N_{100}P_{80}$	5.6390	+0.2260	ns
DL5%=0.3363% Nt, DL1%=0.4566 %Nt, DL0.1%=0.6126 %Nt				

In the V_3 (N_{100} P_0) variant and V_4 (N_0 P_{40}) unilaterally fertilized with N_{100}, respectively P_{40}, the variation analysis indicates very significant differences, and at V_6 (N_{100} P_{40}) distinct significant difference regarding the influence of the NP fertilization system on the Nt content, %, in soybeans.

Between the Nt (%) content in soybean and the nodosities number on the roots, the correlation is significant (correlation coefficient, R = 0.6534*), is explained by the fact that a part of the N content in soybeans comes from the N fixed on the nodosities (Figure 1).

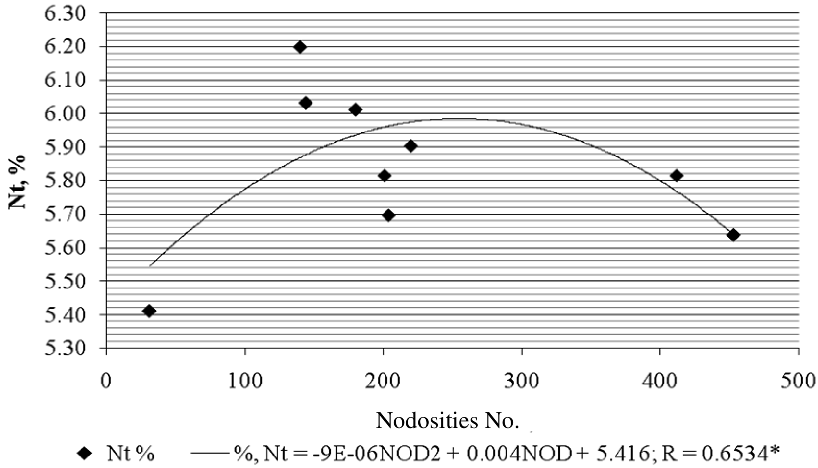

Fig. 1. Correlation between the Nt content, %, from soybeans and nodosities number on the root

Table 4

Influence of fertilization on the Pt content, %, in soybeans

No.	Variant	Pt %	Difference	Signification
1.	N_0P_0 control	0.984	Mt	-
2.	$N_{50}P_0$	0.836	-0.148	ns
3.	$N_{100}P_0$	0.766	-0.218	oo
4.	N_0P_{40}	0.804	-0.180	o
5.	$N_{50}P_{40}$	0.678	-0.306	ooo
6.	$N_{100}P_{40}$	0.813	-0.171	o
7.	N_0P_{80}	0.771	-0.213	oo
8.	$N_{50}P_{80}$	0.807	-0.177	o
9.	$N_{100}P_{80}$	0.777	-0.207	oo
DL5%=0.1515% Pt, DL1%=0.2056%Pt, DL0.1%=0.2759%Pt				

As concerning the influence of the NP fertilization system, experimented on the Pt content from the soybeans, a negative, significant difference was noticed, after interpreting the variance in V_5 ($N_{50}P_{40}$) analysis with the biggest beans production.

In the Kt case in the beans, the influence of soil fertilization in the NP system shows a very negative significant difference in variant V_3 ($N_{100}P_0$) and a positive one in the variant V_4 (N_0P_{40}).

Table 5

Influence of fertilization on Kt content, %, in soybeans

No.	Variant	Kt %	Difference	Signification
1.	N_0P_0 control	1.90	Mt	-
2.	$N_{50}P_0$	1.80	-0.10	o
3.	$N_{100}P_0$	1.70	-0.20	ooo
4.	N_0P_{40}	2.15	+0.25	xxx
5.	$N_{50}P_{40}$	1.70	-0.20	ooo
6.	$N_{100}P_{40}$	1.95	+0.05	ns
7.	N_0P_{80}	1.80	-0.10	o
8.	$N_{50}P_{80}$	1.95	+0.05	ns
9.	$N_{100}P_{80}$	2.00	+0.10	x
DL5%=0.0896%Kt, DL1%=0.1216 %Kt, DL0.1%=0.1632 %Kt				

Table 6

Influence of fertilization on crude protein content, %, in soybeans

No.	Variant	Crude protein %	Difference	Signification
1.	N_0P_0 control	33.83	Mt	-
2.	$N_{50}P_0$	36.34	+2.51	x
3.	$N_{100}P_0$	38.74	+4.91	xxx
4.	N_0P_{40}	37.69	+3.81	xxx
5.	$N_{50}P_{40}$	35.61	+1.78	ns
6.	$N_{100}P_{40}$	36.90	+3.07	xx
7.	N_0P_{80}	36.34	+2.51	x
8.	$N_{50}P_{80}$	37.57	+3.74	xxx
9.	$N_{100}P_{80}$	35.24	+1.41	ns
DL5%=1.9199% , DL1%=2.6062 %, DL0.1%=3.4966%				

As regards the quality of soybeans expressed through the crude protein content, one can notice significant difference in V_3 ($N_{100}P_0$) and V_4 (N_0P_{40}) variants in the case of the unilateral fertilization, also in V_8 ($N_{50}P_{80}$) where the N applied quantity was half of the V_3 and double in case of P as compared to V_4, the effect being the result of the synergism between the two elements.

Fertilization significantly determines the protein quantity in soybeans. By assortment, doses, applications, fertilizers determine the proteins content and also the amino acids from soybeans. The N containing fertilizers determine the proteins content variation and produces important modifications to its quality. Though P does influence the protein content only to a small extent, it has the role of maintaining the N effect and attenuating the negative influence of the big rates on the quantity and quality of protein, having as a result better assimilation and metabolism of the absorbed N forms.

CONCLUSIONS

1. The crude protein which varying in soybean between 27-50% [2], in this case vary between 33.83% at the unfertilized variant and 38.74% at variant 3 of 100 kgN/ha.
2. The quality of soybeans seen in the crude protein content presents significant differences at variants V_3 ($N_{100}P_0$) 38.74% and V4 (N_0N_{40}) 37.69%, in the case of unilateral fertilization.
3. At the variant V_8 ($N_{50}P_{80}$) in which the applied quantity of N was half reduced as compared to V_3 and doubled as compared to V_4, the crude protein content was of 37.57% this being the result of the synergism effect between N and P.
4. Because the costs for fertilizers increased, the differences of the crude protein content at V_4 (N_0P_{40}) and V_8 ($N_{50}P_{80}$) are too small to economically justify the expenses for 50 kg N and 40 kg P.

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PREVENTION AND TREATMENT OF NUTRITION DEFICIENCIES ON TOMATOES CROP IN ENVIRONMENTAL PROTECTION CONDITIONS

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Keywords: *environmental protection, fertilization, ecological features, nutrition, tomato*

Abstract

Experimentation was realized in the greenhouse of ICPA Bucharest (2006-2007), experiments were placed in Mitscherlich pots, which were introduced 20 kg soil, on two topsoils.

The test plants used were tomatoes, Dacia cultivar. The soil material used was chernozem (CZcb) from Fundulea.

The fertilizers tested were applied both to root and leaves by three treatments. The treatment variants were: unfertilized control, Neb-26, Stimusoil, Kelpak and Bionat. The experience ended with the harvesting of tomatoes fruits. The experimental results were statistically processed by the analysis of data variance, with multiple t test for insurance 5%.

INTRODUCTION

The negative status of vegetation from tomatoes, and vegetables in general, manifested by various deviations from normality color and plant forms, can be also caused by nutrient deficiency or excess of the substrate on which plants grow. Typically, the negative status of vegetation is caused by the interaction of several factors and causing or favorable conditions.

For the prevention and treatment of nutritional deficiencies in intensive crop of tomatoes in environmental protection conditions, a range of liquid fertilizers with ecological features were tested.

MATERIAL AND METHODS

The influence of unconventional fertilization methods applied to tomatoes was observed in the ICPA greenhouse. The experiments were organized in Mitscherlich pots with 20 kg of soil per pot.

The experiment soil material was Fundulea Chernozem topsoil.

The experiment included two kinds of prepared soil material, that is:

- A_1 - topsoil plus: N-300 mg/kg of soil, P_2O_5-300 mg/kg of soil, K_2O-300 mg/kg of soil, and 30 g peat/kg of soil;
- A_2 - topsoil plus: N-300 mg/kg of soil, P_2O_5-300 mg/kg of soil, K_2O-300 mg/kg of soil.

Table 1

Chemical composition of fertilizers

Components	KELPAK*	BIONAT*	STIMUSOIL	NEB - 26
	conc./UM			
N organic	0.4%	1.28%	0.125%	-
N total	0.04%	1.28%	0.125%	-
P_2O_5	0.03%	1.37%	0.175%	0.355%
K_2O	0.61%	0.24%	0.278%	0.108%
Fe	2.2 ppm	0.152%	$7.8 \cdot 10^{-4}$ %	14 ppm
Cu	1.8 ppm	0.215%	0.025%	0.048%
Zn	0.9 ppm	0.195%	$6.9 \cdot 10^{-5}$%	2.1 ppm
Mg	56.4 ppm	0.2%	0.03%	0.025%
Mn	0.8 ppm	0.078%	-	1.7 ppm
B	3.2 ppm	-	$7.3 \cdot 10^{-4}$%	2.5 ppm
Mo	-	-	$8.2 \cdot 10^{-6}$%	0.033 ppm
Sodium	0.16%	-		0.017%
Ca	0.02%	-	0.042%	0.03%
Auxin, citokinone	auxin 10.7 ppm citokinone 0.03 ppm	-	-	-
Protein	0.2%	-	0.78%	0.233%
Amino acids	0.1%	-	-	-
Other organic substances	carbohydrates 1.0%	salicylic acid 1% organic extract from plants 10%	20.87%	11%

*Amounts of organic substances are those declared by the producer

The test plant used was tomato, Dacia cultivar.

The applied treatment fertilizers included: NEB-26, STIMUSOIL for application in soil, and KELPAK, BIONAT for application on plant leaves in three splittings.

The three foliar fertilizations were carried out as follows:

- the first fertilization after 10 days from the plantation;
- the second and the third fertilization at every 7-8 days between them.

The chemical composition of tested fertilizers is presented in the table 1. The used solution concentration was 1% and the applied quantity was 30 ml solution/pot for each treatment. Treatments included: V_1 - control, V_2 - NEB-26, V_3 - STIMUSOIL, V_4 - KELPAK and V_5 - BIONAT.

RESULTS AND DISCUSSION

To quantify the influence of treatments applied to plant mineral nutrition of tomato, the leaves samples were collected from the top of the plant fully developed, the time of the first fruits. Harvesting was done at 10 days after application of the second foliar treatment. Timing of harvest was justified by the fact that tomatoes require increased quantities of N in the growth and nitrate assimilation occurs at a rate of 80% in leaves [4].

Samples of leaves were harvested for foliar diagnosis in two experimental years, 2006 and 2007. The results are presented for each experimental year and topsoil.

The contents of N determined in tomato leaves considered normal values between 2.8-4.9% (IFA**) in both experimental years.

In 2007, on A1 topsoil, in variants fertilized with Neb and STIMUSOIL nitrogen contents were situated within the optimum limits 4.0-5.5%. On both topsoils and in both experimental years were recorded low values of nitrogen content in leaves less than 2% even in ecological unfertilized control variant. Of the fertilizers tested, NEB-26 and STIMUSOIL determined increases nitrogen content in leaves, variant in which have been obtained the largest yield increases too (Tables 2-5).

P contents in tomato leaves had placed in the optimum values of 0.40-0.65%. Fertilizers tested caused increases phosphorus content in leaf, higher values being obtained in variants fertilized with KELPAK and BIONAT (Tables 2-5).

K contents in leaves had low value less than 2.5% (IFA**), symptoms of potassium deficiency is not visible, but the content fits within the average values of 1-5%, determined by Marschner in 1995, both on topsoils in all experimental years. In these conditions, the fertilizers tested had generally significant increasesd potassium content in leaf, compared to the ecological unfertilized control (Tables 2-5).

Ca contents of leaves recorded positive values under the influence of fertilizers applied in the optimal nutrition limits (Tables 2-3).

Mg contents showed the same trend growth as the calcium contents recorded in variants fertilized, the values obtained are optimal limits of 0.35-0.80% (Tables 2-5).

The contents of Fe and Cu generally showed values exceeding the upper optimal limit but stay within normal values limits in leaves from healthy plants (IFA**). In these conditions, under the influence of treatments applied, the content of these micronutrients in the leaves presented lower values than the unfertilized ecological control, which again highlighted the balancing effect on treatment on mineral nutrition plant (Tables 2-5).

Mn and Zn contents were situated within the normal limits, characteristic for healthy plants in fertilized variants (IFA**), and higher compared with the unfertilized ecological control.

CONCLUSIONS

The application of this fertilization method and the compositions of liquid fertilizers with tested ecological features, as a method and agrochemical means for fertilization of plants, present a series of advantages:

1. Applying fertilizers with organic features resulted in generally increased contents of N, P, K, Ca, Mg, Mn and Zn in tomato leaves collected at 10 days after application of the second foliar treatment, provided that the content values determined were classified in normal and optimal supply of plants with these elements.
2. In case on contents of Fe and Cu, which presented values of the optimum upper limit in leaf, under the influence of treatments applied were recorded lower values than the unfertilized ecological control variant. By increasing the nutrient content and lower content of certain others, these fertilizers balance and optimize plant mineral nutrition.
3. Prevention and curative treatment of nutrition deficiences with tomatoes crops (with minimum costs).
4. By their contents in proteins, auxin, the tested fertilizers ensure the increase of plant resistance to the stress caused by various excessive conditions.
5. Prevention of environmental chemical pollution phenomena by stimulation of photosynthesis process and increase of root uptake, that has as a result the increase of degree of productive valorization of nutritive elements in the fertilizers applied to sol and soil reserves.

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Table 2

Experimental data on the effect of liquid fertilizer with ecological features NEB 26, STIMUSOIL, KELPAK, BIONAT on the macro and microelements content of tomatoes leaves, DACIA cultivar, 2006 (A1-600 g peat + 300 mg NPK a.s./kg soil)

Treatment	N	P	K	Ca	Mg	Fe	Mn	Zn	Cu
	%					ppm			
Control unfertilized in soil	3.360	0.564	1.04	3.44	0.62	325	130	51	16
NEB-26	3.899	0.608	2.00	4.47	0.78	235	180	62	13
STIMUSOIL	3.308	0.556	2.00	4.40	0.74	278	170	66	12
KELPAK	3.617	0.572	1.16	3.86	0.71	247	170	63	11
BIONAT	3.435	0.684	1.40	4.04	0.82	203	140	62	17
Optimal limits * (Bergmann W., 1992)	4-5.50	0.40-0.65	3.00-6.00	3.00-4.00	0.35-0.80	107-50***	40-100	20-70	7-15
Optimal contents in mature young leaves (IFA**)	2.7	0.5	2.9	1.2	0.4	119	76	24	7
Normal values in leaves from healthy plants (IFA**)	2.8-4.9	0.4-0.7	2.7-5.9	2.4-7.2	0.4-0.9	101-291	55-220	20-85	10-16
Deficiency values on content of nutrients in leaves (IFA**)	< 2	< 0.2	< 2.5	< 1	< 0.3	-	-	-	-

**upper leaves fully developed when the first appearance of fruit*
***http--www_fertilizer_org-ifa-publicat-html-pubman*
****Methodology ICPA, 1980*

Table 3

Experimental data on the effect of liquid fertilizer with ecological features NEB 26, STIMUSOIL, KELPAK, BIONAT on the macro and microelements content of tomatoes leaves, DACIA cultivar, 2006 (A2-300 mg NPK a.s./kg soil)

Treatment	N	P	K	Ca	Mg	Fe	Mn	Zn	Cu
	%					ppm			
Control unfertilized in soil	3.238	0.552	1.66	3.67	0.69	391	210	56	18
NEB-26	3.285	0.500	2.28	6.23	0.72	318	200	72	16
STIMUSOIL	3.350	0.588	2.20	4.94	0.68	331	220	65	15
KELPAK	3.247	0.552	2.08	5.05	0.53	398	224	74	12
BIONAT	3.332	0.556	2.28	5.34	0.58	372	200	60	17
Optimal limits * (Bergmann W., 1992)	4-5.50	0.40-0.65	3.00-6.00	3.00-4.00	0.35-0.80	107-250***	40-100	20-70	7-15
Optimal contents in mature young leaves (IFA**)	2.7	0.5	2.9	1.2	0.4	119	76	24	7
Normal values in leaves from healthy plants (IFA**)	2.8-4.9	0.4-0.7	2.7-5.9	2.4-7.2	0.4-0.9	101-291	55-220	20-85	10-16
Deficiency values on content of nutrients in leaves (IFA**)	< 2	< 0.2	< 2.5	< 1	< 0.3	-	-	-	-

**upper leaves fully developed when the first appearance of fruit*
***http--www_fertilizer_org-ifa-publicat-html-pubman*
****Methodology ICPA, 1980*

Table 4

Experimental data on the effect of liquid fertilizer with ecological features NEB 26, STIMUSOIL, KELPAK, BIONAT on the macro and microelements content of tomatoes leaves, DACIA cultivar, 2007 (A1-600 g peat + 300 mg NPK a.s./kg soil)

Treatment	N	P	K	Mg	Fe	Mn	Zn	Cu
	%				ppm			
Control unfertilized in soil	3.740	0.496	1.92	0.56	381	215	72	18
NEB-26	4.080	0.600	1.84	0.58	351	289	64	1\8
STIMUSOIL	4.080	0.590	2.05	0.60	375	293	69	16
KELPAK	3.670	0.491	2.08	0.64	365	293	95	12
BIONAT	3.670	0.492	1.98	0.50	373	248	88	13
Optimal limits * (Bergmann W., 1992)	4-5.50	0.40-0.65	3.00-6.00	0.35-0.80	107-250***	40-100	20-70	7-15
Optimal contents in mature young leaves (IFA**)	2.7	0.5	2.9	0.4	119	76	24	7
Normal values in leaves from healthy plants (IFA**)	2.8-4.9	0.4-0.7	2.7-5.9	0.4-0.9	101-291	55-220	20-85	10-16
Deficiency values on content of nutrients in leaves (IFA**)	< 2	< 0.2	< 2.5	< 0.3	-	-	-	-

upper leaves fully developed when the first appearance of fruit

***http--www_fertilizer_org-ifa-publicat-html-pubman*

****Methodology ICPA, 1980*

Table 5

Experimental data on the effect of liquid fertilizer with ecological features NEB 26, STIMUSOIL, KELPAK, BIONAT on the macro and microelements content of tomatoes leaves, DACIA cultivar, 2007 (A2-300 mg NPK a.s./kg soil)

Treatment	N	P	K	Mg	Fe	Mn	Zn	Cu
	%				ppm			
Control unfertilized in soil	2.040	0.480	1.52	0.42	383	294	76	19
NEB-26	3.190	0.570	1.88	0.44	333	262	50	14
STIMUSOIL	3.530	0.535	1.80	0.40	331	222	82	12
KELPAK	3.247	0.582	1.96	0.40	353	294	98	15
BIONAT	3.330	0.552	1.70	0.44	330	291	95	14
Optimal limits * (Bergmann W., 1992)	4-5.50	0.40-0.65	3.00-6.00	0.35-0.80	107-250***	40-100	20-70	7-15
Optimal contents in mature young leaves (IFA**)	2.7	0.5	2.9	0.4	119	76	24	7
Normal values in leaves from healthy plants (IFA**)	2.8-4.9	0.4-0.7	2.7-5.9	0.4-0.9	101-291	55-220	20-85	10-16
Deficiency values on content of nutrients in leaves (IFA**)	< 2	< 0.2	< 2.5	< 0.3	-	-	-	-

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RESEARCH TO DETERMINE THE IMPACT OF BT TECHNOLOGY APPLIED TO MAIZE MON 810 ON SOIL QUALITY

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Keywords: *Bt technology, transgenic plant, soil, impact study*

Abstract

Develop methodology for assessing the impact of Bt technology applied to maize MON 810 on soil quality parameters, and particularly, microbial diversity was done according to the following objectives: study the influence of soil type by its physical and chemical parameters defining, transgenic plant cultivation study on microbial diversity, the study of transgenic plant cultivars of the main soil chemical properties. The criteria for selection of soil materials on which to conduct the impact study of Bt biotechnology were favorability for species taken in the study and the presence of physical (content of clay) and chemical (reaction) properties as contrasting. Thus, were used three soil types: Eutric Fluvisols, Fluvi-Eutric Cambisols and Haplic Chernozems. Research has pursued: identifying correlations between the main physical-chemical and biological attributes of soil and plant genotypes (GMOs or non-GMOs) cultivation, environmental impact assessment of Bt protein on essential soil biological processes by investigating the biological activities associated with plant debris decomposition and determination of carbon, nitrogen, phosphorus and potassium in the soil, assessing the impact of Bt technology taxonomic and genetic diversity of soil micro-organisms, assessment of possible modifications of the main physical features, chemical and biological properties of soil under the influence of Bt technology.

INTRODUCTION

GMOs (plants, microbes and animals) with useful characters are considered to be a powerful technology for the future development of sustainable agricultural systems. Plants have been genetically modified to resist insect and fungal pathogens, withstand specific herbicide application (better weed management) or environmental conditions (e.g. water logging), to improve crop quality, for biomolecule production and for bioremediation/phytoremediation of polluted soils. MON 810 is a maize variety with a single transformation event, genetically modified to express the Bt insecticidal toxin gene that confers plant resistance to attack by Ostrinia nubilalis. MON 810 has been available for commercial cultivation in European Union since 1998.

While reduced pesticide/herbicide use associated with Bt maize is, clearly beneficial, very little is known about potential non-target effects of Bt maize plants on the functional groups of biota and biological processes that are critical for plant health, and essential ecosystem functions including ecosystem health. Pre-release evaluation of GM plant varieties is generally concentrated on the genetic stability of gene insertions and agronomic aspects of GM varieties.

However, comparatively little experimental (especially quantitative) data are available on: environmental consequences of the introduced gene function and associated changes in management practices/farming systems on essential ecosystem functions and the fate of the products of engineered genes from genetically modified organisms (GMOs) e.g. persistence in the environment and gene transfer to other organisms. This needs to be an essential part of the risk assessment of any GMOs release.

Soil organism's communities, which are among the most diverse groups of earth's biota, regulate a number of processes in terrestrial ecosystems that are not only critical for productivity, but are, also, essential for maintenance of ecosystem health [3]. Micro organisms and microbial activity have a key role in stable aggregate formation. Water-stable aggregates are essential for good soil structure in all types of soils. Good soil structure is necessary to reduce soil erosion. Very few biological processes are mediated by individual species of biota; therefore, the successful functioning of most ecosystem processes requires a balance of biota interactions in the complex soil biota community. The availability of energy (carbon), the most important regulating factor of biological activity in soils, affects the composition of the soil biota community and food web structure [6, 5]. In addition, the number of trophic levels in a terrestrial food-web community and the stability of this complex community depend upon the amount and quality of carbon input and the level and type of disturbance (e.g. tillage, GM crops and use of agrochemicals).

Plant residues are one of the primary sources of carbon in soils and the majority of biota populations are concentrated near crop residues and in the plant root rhizosphere [13]. Therefore, any change to the quality of crop residue and rhizosphere inputs will potentially modify the dynamics of the soil biota composition and activity. Soil microorganisms perform a number of key functions essential to plants, organic mater mineralization, nutrient cycling, disease regulation, agrochemical degradation, and the development and maintenance of physical and chemical properties of soil. Therefore, any change to the quality of rhizosphere exudates will potentially modify the dynamics of the soil biota composition (biodiversity) and activity and may cause changes to both deleterious and beneficial microflora and micro fauna [10, 12, 2].

GM plants, through the products of introduced genes, modified rhizosphere chemistry, or altered crop residue quality, have the potential to significantly change the microbial dynamics and essential ecosystem functions such as nutrient mineralization, disease incidence, and carbon turnover and plant growth [13]. For example, a decrease in specific microbial populations would lead to a decrease in decomposition processes, have secondary effects on plant pathogen survival, and build up, as well as soil organic matter level and composition [17]. However, little experimental data are available on the consequences of plant-microbe-soil interactions due to the sustained expression and/or presence of Bt toxin in the rhizosphere. Gupta et al. [11, 14] have found significant changes in the composition of bacteria in the rhizosphere of Bt cotton compared to that of its non-GM parent variety.

There is no ongoing research on the impact of Bt maize on soil biological processes in Romania. Limited research in Europe and North America suggests significant effects of GM crops on specific soil biota. Stotzky [16] in a recent review recommends a thorough evaluation of the persistence of GM products such as Bt toxins in soil and their effects on the inhabitants of soil and other habitats.

Due to the differences in soil and climatic conditions, and the biota composition, the evaluation of GM plant effects on soil biodiversity under Romanian conditions is necessary.

MATERIAL AND METHODS

Develop methodology for assessing the impact of Bt technology applied to maize MON 810 on microbial diversity in soil was done according to the following objectives: study of the soil type influence, due to its physical-chemical parameters, on persistence and degradation of Bt insecticidal protein; study of transgenic crops on microbial diversity and study of transgenic plants cultivation on the main soil chemical properties.

The effects of maize (*Zea mays* L.), genetically modified to express the Cry1Ab crystal toxin protein, on soil microbial communities were assessed in a glasshouse experiment. Soil for the experiment was taken from three field sites where maize is usually cultivated. Plants were grown in contrasting soils in terms of clay content, and soil samples taken at the five-leaf stage and maturity.

Three soil types: Fluvi-eutric Cambisols, Eutric Fluvisols and Haplic Chernozems were used. Soil samples were analyzed by ICPA methodology [8] developed to assess main physical (particle size) and chemicals soil properties: organic carbon and humus - Walkley-Black method (modified by Gogoasa), total nitrogen content, mobile phosphorus and potassium content - Egner-Riehm-Domingo method, pH (H_2O), ratio soil/water 1/2.5 – electromechanical method using glass electrode. Also, microbiological analyses: quantitative determinations of heterotrophic bacteria (total bacteria number method) using traditional culturing methods and taxonomic determinations by usually identification methods, optical microscopy, determination keys and physiological tests [1, 9], were carried out.

Data were analyzed using standard analysis of variance (ANOVA) and presented as means with an associated least significant difference (LSD, at the 5% level), using as factors: soil type, and plant type.

RESULTS AND DISCUSSION

Choosing of the three soil types for experimentation was made considering the texture, respectively, different clay content, and reaction. Thus, the first soil type, a Eutric Fluvisols (FLeu*) has a clayey-loamy texture, argyle with Φ <0.002 mm content between 34.0-39.3% and moderate acid reaction; the second soil type, an Fluvi-Eutric Cambisols (CMeu-fv) with low argyle content about 15.1-20.0%, has a sandy-loamy texture and a slightly alkaline reaction, and, finally, the third soil type, a Haplic Chernozem (CHha) has a silty clay loam texture, argyle content between 39.3-41.6%, and weakly acid reaction.

Soil reaction

Have been recorded relatively minor variations of soil reaction in the experimental variants with GM corn, compared with non-GM corn, direction and magnitude of these changes being caused by soil type on which plants were grown.

The biggest difference of soil reaction by 0.45 pH units, was recorded in Fluvi-Eutric Cambisols (CMeu-fv) at 5 leaf stage, when soil cultivated with GM maize was acidified as compared with soil from the non GM maize variant (Figure 1). Variance analysis showed that there were no significant variations of soil reaction caused by the crop type (GM or non-GM) in any stage of analysis, but there were significant variations of pH values between the three soils types used for experimentation.

Humus content

Humus content varied considerably, with very significant differences between the three types of soil. Haplic Chernozem (CHha) is the richest in humus, compared with the other two soils used for experimentation: Eutric Fluvisols (FLeu) and Fluvi-Eutric Cambisols (CMeu-fv). Plant type (GM or non-GM hybrid) has not generated considerable variation of humus content in the two soil types. But in Haplic Chernozem, in both stages of soil analysis, humus content increase was significant and was noted in GM corn variant (Figure 2).

* Symbol according to WRB-SR-1998 in Florea & Munteanu, 2003 [7].

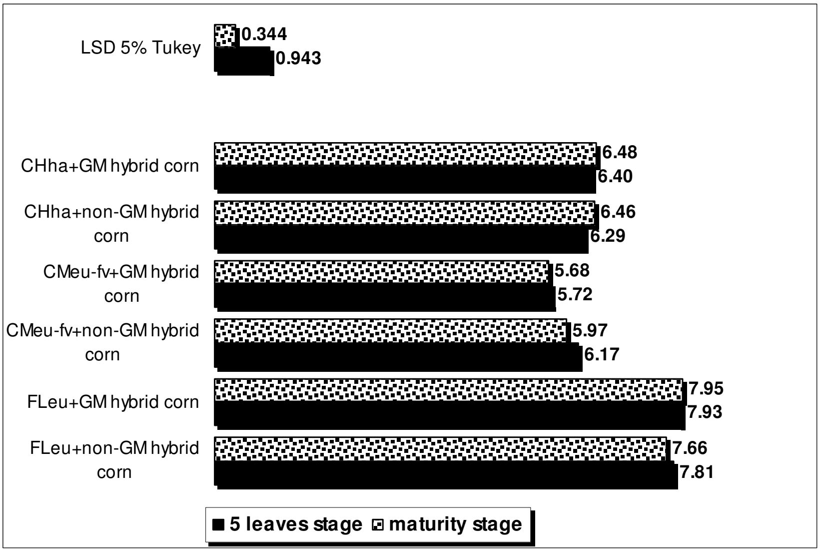

Fig. 1. pH variation in three contrasting soils, planted with GM (MON 810) and non-GM corn

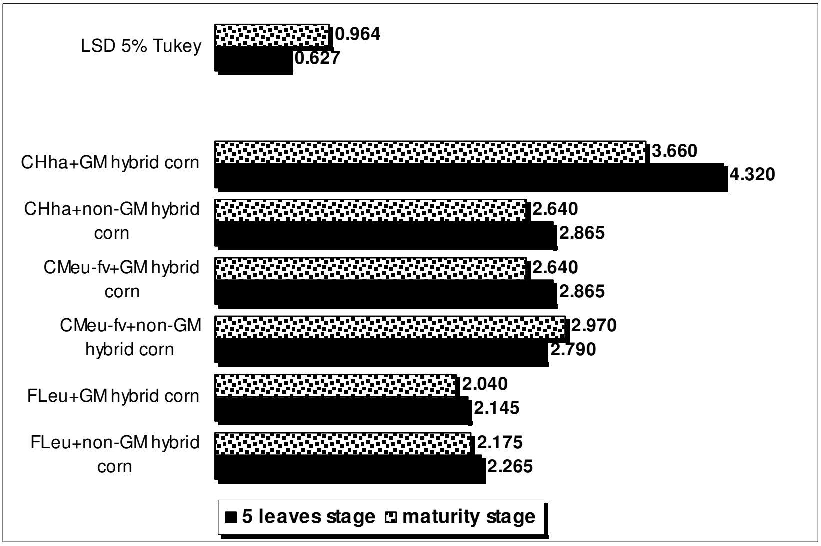

Fig. 2. Humus (%) variation in three contrasting soils, planted with GM (MON 810) and non-GM corn

Total nitrogen content

Total nitrogen content varied in the first stage of analysis, only in case of Fluvi-eutric Cambisols (CMeu-fv), where, in variant cultivated with GM hybrid was recorded an increase in total nitrogen content from 0.132 to 0.151%, without statistical significance (Figure 3). In the other two soils, total nitrogen content values were approximately equal in both type of variants (planted with GM corn or non-GM corn).

At plant maturity stage, analyses have shown, however, a very significant difference in terms of total nitrogen content in the Haplic Chernozems variants. Here, total nitrogen content marked a very significant increase in GM maize variant (0.176%) compared with those recorded in non-GM maize variant (0.146%). Because of plant growth parameters were quite close; the difference in soil nitrogen reserve may be due to different nitrogen nutrition requirements of the two types of plants.

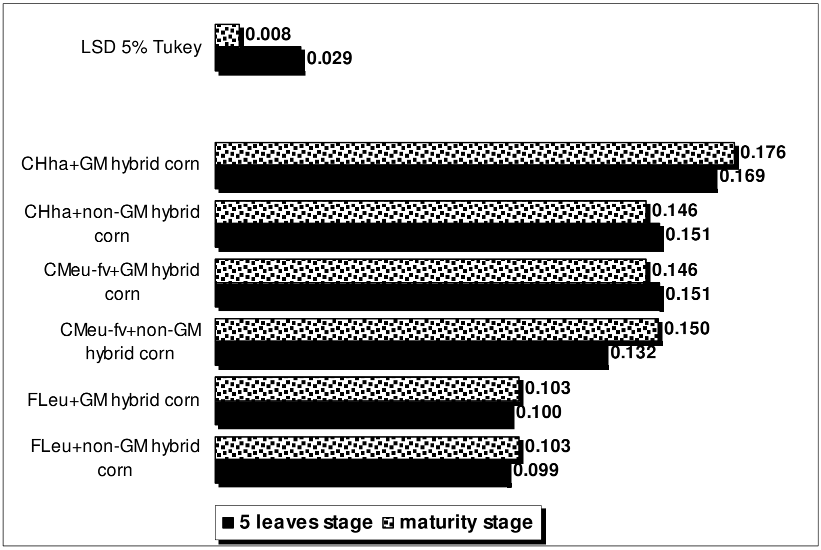

Fig. 3. Total nitrogen (%) variation in three contrasting soils, planted with GM (MON 810) and non-GM corn

Mobile phosphorus and potassium content

Phosphorus and potassium mobile contents showed variations less important to be taken into account between GM corn and the non-GM corn variants, in any stages of analysis. Significant differences were only between different degrees of initial supply of soil used for experimentation with these elements (Figure 4 and 5). Thus, Eutric Fluvisols is very well supplied with mobile phosphorus, while Fluvi-eutric Cambisols and Haplic Chernozems are significantly low supplied in mobile phosphorus, both compared with the first soil type and each other.

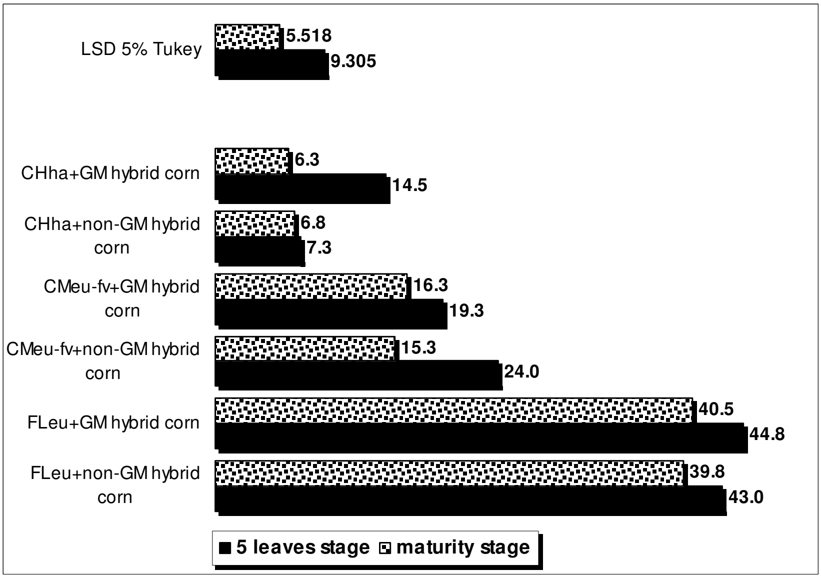

Fig. 4. Mobile phosphorus content (mg·kg^{-1}) variation in three contrasting soils, planted with GM (MON 810) and non-GM corn

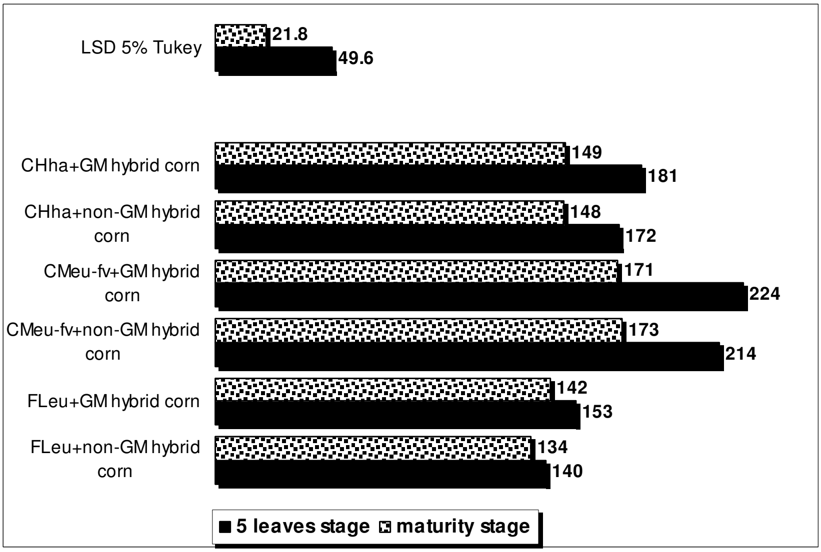

Fig. 5. Mobile potassium content (mg·kg^{-1}) variation in three contrasting soils, planted with GM (MON 810) and non-GM corn

In terms of mobile potassium content, between the three soils, the best supplied is Fluvi-eutric Cambisols, with a high content, followed by the other two soils with medium contents. An interesting aspect was observed in tests made at plant maturity, when in the Fluvi-eutric Cambisols was noted a higher reduction of potassium content in soil compared both with the initial state of this nutrient supply, and the other two soils. It seems that in this soil type, corn plants had a higher consumption of potassium than in the other two soils used for experimentation.

Soil heterotrophic bacteria

Quantitative determinations of heterotrophic bacteria in the soil did not reveal significant differences between variants cultivated with GM corn as compared with those cultivated with non-GM hybrid nor in any of the soils, and even between stages of determination. Significant quantitative differences were observed only between the three soil types, significantly higher values being determined in Haplic Chernozems, and some smaller but very close in other two soils, Eutric Fluvisols and Fluvi-eutric Cambisols (Figure 6).

Differences between the total bacteria number values recorded in variant cultivated with GM maize compared with those cultivated with non-GM maize on Haplic Chernozems, can be interpreted only as a trend, not statistically assured.

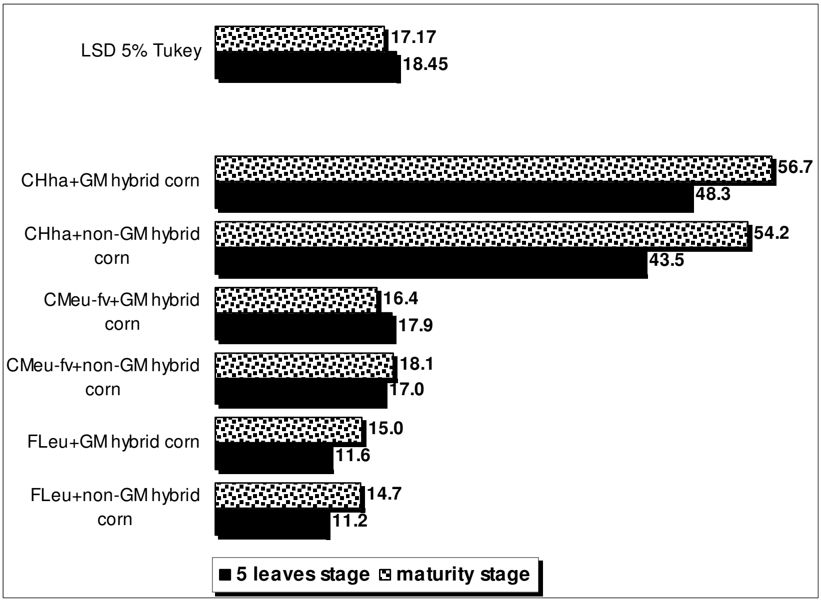

Fig. 6. Total bacteria number (colony forming units x 10^6/g dry soil) variation in three contrasting soils, planted with GM (MON 810) and non-GM corn

Soil microbial communities are very plastic in their species composition and structure and change constantly in different root zones, agricultural practices, and with respect to various other environmental variables [4, 15].

In terms of genus and species diversity of soil bacteria, no major differences were recorded between species composition of bacterial communities in soil cultivated with non-GM hybrid compared to soil cultivated with transgenic hybrid, the number of bacterial strains being quite close in samples analyzed (Table 1).

Table 1

Diversity of bacterial communities in three contrasting soils, planted with GM (MON 810) and non-GM corn

Soil type/ Hybrid type	**Bacteria genus and species (in order of frequency)**		
	Before planting	**5 leaves stage**	**Maturity stage**
FLeu+ non-GM hybrid corn	*Pseudomonas sp**** *Bacillus megaterium*** *B. circulans, B. cereus* *Arthrobacter globiformis**** *Actinomyces sp**	*Pseudomonas* sp.*** *Bacillus megaterium**** *B. circulans B. cereus* *A. globiformis**** *Actinomyces* sp.*	*Pseudomonas* sp.*** *Bacillus megaterium, **** *B. circulans, B. cereus* *A. globiformis**** *Actinomyces* sp.
FLeu+ GM hybrid corn	*Pseudomonas sp**** *Mycobacterium roseum** *B. megaterium**** *A. citreus* A. globiformis**	*Pseudomonas* sp.*** *Mycobacterium roseum** *B. megaterium***, B. cereus* *A. globiformis**, A. citreus*	*Pseudomonas* sp.*** *Mycobacterium roseum* *B. megaterium**** *A. globiformis**, A. citreus**
CMeu-fv+ non-GM hybrid corn	*Pseudomonas* sp.*** *Mycobacterium roseum** *B. sphaericus, B. circulans* *B. megaterium,**** *A. globiformis*** A. citreus,** *Actinomyces* sp.	*Pseudomonas* sp.*** *Mycobacterium roseum* *B. sphaericus, B. circulans* *B. megaterium**** *A. globiformis*** A. citreus* *Actinomyces* sp.*	*Pseudomonas* sp.*** *Mycobacterium roseum* *B. sphaericus,* *B. megaterium**** *B. citreus B. circulans,* *A. globiformis**** *Actinomyces* sp.
CMeu-fv+ GM hybrid corn	*Pseudomonas* sp.***, *Mycobacterium roseum,* *B. megaterium*** B. cereus,* *A. globiformis** *Actinomyces* sp.**	*Pseudomonas* sp.***, *Mycobacterium roseum,* *Bacillus megaterium***,* *Arthrobacter globiformis** *Actinomyces* sp.***	*Pseudomonas* sp.*** *Mycobacterium roseum,* *Bacillus megaterium**** *Bacillus circulans* *Arthrobacter globiformis**
CHha+ non-GM hybrid corn	*Pseudomonas* sp.*** *Bacillus megaterium, **** *Bacillus circulans**** *Arthrobacter globiformis** *Actinomyces* sp.**	*Pseudomonas* sp.*** *Bacillus megaterium*** *Bacillus circulans*** *Arthrobacter globiformis*** *Actinomyces* sp.**	*Pseudomonas* sp.*** *Bacillus megaterium**** *Bacillus circulans*** *Arthrobacter globiformis*** *Actinomyces* sp.**
CHha+ GM hybrid corn	*Pseudomonas* sp.*** *B. megaterium**** *B. circulans, A. citreus* *Arthrobacter globiformis****	*Pseudomonas* sp.*** *Bacillus megaterium**** *Arthrobacter globiformis**** *Arthrobacter citreus,* *Actinomyces* sp.*	*Pseudomonas* sp.*** *B. megaterium**** *A. globiformis**** *A. citreus** *Actinomyces* sp.

CONCLUSIONS

1. Research on the impact of Bt technology applied to transgenic maize MON 810 on the main soil parameter quality were conducted in green house, using three contrasting soils in terms of clay content and reaction: Eutric Fluvisols, Fluvi-eutric Cambisols and Haplic Chernozems.
2. Soil chemical parameters: pH, humus and total nitrogen contents, the contents of mobile phosphorus and mobile potassium revealed significant differences between soil types only, not between the two types of maize hybrids, GM and non-GM, used in experiment.
3. Also, quantitative determinations of heterotrophic bacteria in the soil did not reveal significant differences between variants cultivated with GM corn as compared with those cultivated with non-GM hybrid nor in any of the soils, and even between stages of determination.
4. No major differences were recorded between species composition of bacterial communities in soil cultivated with non-GM hybrid compared to soil cultivated with transgenic hybrid, the number of bacterial strains being quite close in samples analyzed.
5. Research will be continued and data from chemical and biological analysis of soil will be correlated with determinations regarding the amount of insecticidal toxin Cry1Ab released into soil (through root exudates or plant debris along with the remaining plants in the soil after harvesting) and its persistence in the three soils chosen to investigate the impact of Bt technology on soil as a major component of the environment.

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STUDIES AND METHODICAL APPLICATIONS FOR ESTIMATING THE FERTILITY STATE OF SOILS

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Keywords: *soil fertility, biological tests, biological indicators*

Abstract

The information from China (En-feng Chen et al., 1982), confirms that with 4000 years ago, the peasants considered that soil is fertile if its physical state is good, it shows a high resistance to the action of unfavourable factors and adaptation to the agricultural practices. In the second half of 20th century, agrochemists, agro-phytotechnics and farmers appreciated (and they do it today also) the level of soil fertility according to the crop size. Contrarily, biologists state that the level of soil fertility may be quantified by the level of vital and biochemical processes, chemical and physical features, and not by its vegetal productivity, which is dependent, in the greatest measure, on the agrotechnologies employed. The achieved progress in Soil Biology and Pedoenzymology, at the end of 20th century and the beginning of the 21st, lead to the establishment of some Indicators of Soil Fertility Potential: in Romania (Ştefanic, 1984; 1994 and 2001), in West Germany (Beck, 1984), in Italy (Benedetti, 1984) and in the USA (Liebig et al., 2001). The present paper shows, the mode of elaboration of the Synthetic Indicator of Soil Fertility (SISF%) is showed (Ştefanic et al., 2001).

INTRODUCTION

Agriculture experience, transmitted to descendats, made possible to associate the quality of climate and soil physical aspects with crop size. En-feng Chen *et al.* (1982), citing ancient writing sources (4000 years) from China, mentioned: „ *the Chinese peasants considered that the soil is fertile, whether its physical state is good, whether it shows high resistance to the action of unfavourable factors and adaptability to the agricultural practices”.*

The accumulation of agricultural and scietific information (particularly of soil chemistry) determined the conception of agrochemists, agronomists and of farmers, that the soil fertility is the same with soil productivity, that soil fertility may be estimated by crop size.

Soil Microbiology and then Soil Biology, at the end of the 19th century and in the first part of the 20th one, determined a biodynamic perception of soil fertility as the consequence of the physical, chemical, biochemical and vital processes developed in the loose layer from the surface of mother rocks, which in the higher plant organisms adapted themselves to growth. This is the working manner even since

1901, Vaillant wrote: „ *...both the humus content is higher, and the soil is more fertile and this fertility seems to be due, particularly, to a high number of organisms, fixing of diazote, which live here".* Prediction of defining the soil fertility by the size of vegetal production there is no in this definition! Microbiological, pedoenzymical, chemical and pedological researchs has established the decisive contribution of the vegetal cover to soil formation and evolution processes.

Agrophytotechnical interventions have determined some alterations in the soil fertility features. At the beginning, crops (for many years) were utilized as guide mark to constitute some agronomical indices for the estimation of the quality of antropic interventions on cultivated soil quality. Later, both the crops and the contents of macro- and microelements in soil, chemical reaction and physical state of soils became, for agrochemists, quide marks for other indices of soil fertility. Thus, Nieschlag (1965), cited by Davidescu (1972), proposed as Index of Fertility, IF = 33,33 Nt x (Nt : Ct) x 4 x clay %. Some index corresponds to the approximate estimation of the quality of organic matter, but suffers a statical vision of result interpretation of the soil chemical analyses.

The biological theory of soil fertility and agrotechnology recommended by Steiner (1924), Pfeiffer (1938 and 1966), Howard (1941) and the agricultural currents, included today in Ecological Agricultures, are beginning to be accepted at the present.

Soil biologists have tried to evaluate, by synthetic indicators, the level of soil fertility, as a basic feature. Thus, Ştefanic (1994), Ştefanic and Gheorghiță (2006) proposed a Synthetic Indicator of Soil Fertility, Beck (1984) proposed an Enzymatic Number of Soil Fertility and Benedetti (1984) proposed Biological Index of Soil Fertility based on soil respiration potential, ammonification and nitrification potentials.

A strange ignorance of the word semantics provoked a serious confusion: one proposes to use the syntagma *soil quality* instead of *soil fertility.* Chaussod (1996) has affirmed: *„the notion of soil quality ..... tends to replace the ancient notion of soil fertility"* and in the USA was founded, in 1993, the Institute of Soil Quality, marking an equality between Soil Quality and Soil Fertility. In fact, Fertility is a phenomenon, it is a reality that can be measured, but Quality is an abstraction that may be apreciated (good, bad *etc.*), being at the same time a subjective notion (good, in my interest, for building a house, or an airport, or for agriculture).

A group of researchers from the USA [12] who studied a limited set of treatments in a long time experiment initiated in 1983, from the west of Corn Belt, avoiding the syntagms Soil Quality and Soil Fertility, choose the syntagm Agrosystem Performance for measuring soil fertility and productivity. Here is their formula:
Agrosystem performance = f [(food production x Wfp), (raw materials production x Wrmp), (nutrient cycling x Wnc), (greenhouse gas regulation x Wggr)], where:

all letters W represent the initial of word Weight (the value of each function), and the smal letters represent the initial of the functions.

We mention that the author's intention is valuable for estimating objectively, by figures, the Agroecosystem performance, but it includes food production and raw materials which depend on the quality of technology, more than soil fertility.

Towards the end of the 20th century, the signals of alarm, regarding the continuous increase in the production expenses (for maintaining the high level of crops), increasing of agriculture product stocks in farms and alarming and rapid degradation of fertile soils determined the European Comission for Agriculture to propose, in 1991, at the Conference Bruxelles, New Communitary Agricultural Policies, that to stimulate the farmers to use managerial practices of production, fewer intensive, dimminishing, in this way, the impact on the enviroment and the surplus of crops. That new official attitude stimulated the manifestation of the scientific biological currents and the agronomical recommendation for the protection of fertile soil, degradated by agrotechnologies oriented towards *„to pull up from soils some rich crops”*.

Towards the 20th century and the beginning of the 21st it became extremely necessary to find some control tests of the agricultural soil evolution and application of biological agrotechnologies which stop the antropic degradation of soils with good fertility, as well as the improvement of acid and salinized soils.

Ştefanic (1984, 1994 a and b) and Ştefanic *et. al.,* (1997; 2001; 2008; 2010) elaborated and improved laboratory technology for a complex analysis of the horizon 0-20 cm of soils and calculated a Synthetic Indicator of Soil Fertility (SISF%), for grouping the analysed sols in different classes of fertility potential.

MATERIAL AND METHODS

a. Analysis of the main physiological potentials of soil:* respiration–R (MEV=150 mg CO_2), cellulolyse–C (MEV=100 g cellulose) and, unsymbiotical dinitrogen fixation, from atmosphere –UDFA (MEV= 20 mg N)

b. Analysis of the main pedoenzymatic potentials:* catalase-K (MEV=2000 cmc), saccharase-S (MEV=3500 mg), total amidase–At (MEV=0.8, and total phosphatase-Pt MEV=25 mg).

*– all methods (*a* and *b*) are original or improved by Ştefanic, and Ştefanic *et al.,*1984, 1988, 1994, 1997, 1998, 2000, 2006).

c. Chemical analysis of of soil: humus-Ct (MEV=4.25 g), extractable organic carbon- Ce-(MEV=1.40 g), huminic acid-Cah (MEV=0.80 g), fulvic acid-Caf (MEV=0.60 by Kononova and Belcikova method (1968) and Salfeld, (1974), total nitrogen, Kjeldahl-Nt (MEV=0.250 g), organical phosphorus-PO (MEV=25 mg), by Legg and Black method (1955), chemical reaction-pH (MEV=8.30), base saturation-V% (MEV=100).

d. Pedo-genetic Indicator (Ştefanic *et al.,* 2001): a conversion of Humic Class Note (Chiriță, 1955) from the soil colour, in Humus Content Interval of Soil (HCIS), MEV = 19.5

N.B.: One established for each test a maximum value – Maximum Empiric Value (MEV), for transforming the test values of an analysis in percents by the formula: X%=Xa x 100 : MEV where: X%= test result in percent; Xa=test result to be transformed in percent; MEV= maximum empiric value indicated for each test.

The test results, transformed in percent values, have become *Primary Specific Indicators (PSI%)* with which one makes the first quantifications for calculating the *Modular Synthetic Indicators for quantifyng the level of soil vitality* by the formulae:

1. Indicator of Vital Activity Potential : (IVAP%)=R%+C%+UDFA% : 3;
2. Indicator of Enzymic Activity Potential (IEAP%)= K%+S%+At%+Pt% : 4, and
3. Biologic Synthetic Indicator (BSI%)= IVAP% + IEAP% : 2

RESULTS AND DISCUSSION

Table 1

Modular and synthetic indicators of fertility level, on different soil types

Soil type	IPAV (%)	IEAP (%)	BSI (%)	CSI (%)	VETL (%)	PGI (%)	SISF (%)
Vermic-typical chernozem (Valu lui Traian)	31.15	48.46	38.17	70.93	54.55	97.50	76.02
Cambic chernozem (Fundulea)	37.21	44.90	41.05	66.69	53.87	77.00	65.43
Argiloilluvial chernozem (Caracal)	44.80	25.41	35.10	64.69	49.89	89.00	69.44
Reddish preluvosol (Simnic)	31.01	14.30	22.65	41.72	32.18	40.50	36.34
Albic luvisol (Albota)	12.28	19.65	15.96	48.02	31.88	13.50	22.74
Albic luvisol (Livada)	20.22	24.19	22.20	39.88	31.04	13.50	22.27
LD 5%	3.33	2.32	1.86	1.91	1.35		1.35
1%	4.43	3.08	2.47	2.55	1.81		1.81
0.1%	5.76*	4.01*	3.32*	3.32*	2.35*		2.35*

*) utilized LD for comparison

Modular Synthetic Indicator for quantifying the chemical features of soils-Chemical Synthetic Indicator (CSI%) by the formula:

CSI%= {[(C%+Ce%+Cah%+Caf%+Nt%+V%) : 6] + pH%} : 2

Modular Synthetic Indicator for quantifying the level of Energetic and Trophic Level of Soil (SIETLS%) by the formula: SIETLS% = BSI% + CSI% : 2

Modular Synthetic Indicator for quantifying the Pedo-Genetic Potential (IPGP%)
IPGP% = HCIS% x 100 : MEV   in which: HCIS = humic content interval of soil ü
Synthetic Estimation of Soil Fertility

At the end, being in possession of all calculation elements, we can compute the Synthetic Indicator of Soil Fertility (SISF%), by the formula:

SISF% = (SIETL% + IPGP%) : 2

CONCLUSIONS

1. By the Synthetic Indicator of Soil Fertility, calculated based on the Modular Indicators, both the level of Fertility Potential of agricultural soils and of those with other utilization modes, may be quantified objectively.

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RESEARCH CONCERNING INFLUENCE OF CROP ROTATION TO WINTER WHEAT ON THE REDDISH PRELUVOSOIL FROM MOARA DOAMNEASCA

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Keywords: *crop rotation, sustainable agriculture*

Abstract

This paper presents the average data in 1999-2009 years in the crop rotations field of Moara Domnească-Ilfov. The bifactorial experiment began in 1981 and was conducted in 4 repetitions. The variants have for A – Factor the crops rotations and for b – factor – nitrogen applications. A – factor we have: a_1 – wheat monoculture, a_2 – rotation wheat – maize, a_3 – rotation soya – wheat – maize, a_4 – rotation pea – wheat – sugar beet – maize. The B factor – nitrogen: b_1 – N_o and b_2 – N_{100}. In every experimental plot, we performed determinations on weeds, soil macroelements analyses, bulk density, total porosity and wheat yields in crop rotation. Finally, we proved that crop rotations are the central point of sustainable agriculture systems.

INTRODUCTION

Crop rotation with crops carefully studied are basic links of the sustainable agricultural system, but more than this, in terms of ecological agriculture practice, their role has taken on new valences: maintaining the balance in agricultural ecosystems, maintaining and enhancing soil fertility, reducing the energy consumption, control of weeds, pests and diseases, improving the efficiency of agro-fitotechnical measures from culture technology, achieving high yields, stable and high quality, etc.

All these favorable effects are achieved without additional investments but only through a good organization and performance skills of the persons that lead the production process in agriculture. Through the research undertaken, we want to strengthen in this paper the idea according to which the crop rotation is the main element of the system of sustainable agriculture [1, 2, 3, 4].

MATERIAL AND METHOD

This paper presents the average data collected during a long interval of time (between 1999 and 2009) in crop rotation fields from Moara Domnească Research Station belonging Faculty of Agriculture, UASMV Bucharest. It is important to mention that the experiment on crop rotations was founded in 1981, so it is 29 years old. This bifactorial experiment under split the method în 4 repetitions. The variants: A – Factor the crop rotation we have: a_1 – wheat monoculture, a_2 – 2 years rotation: 1. wheat – 2. maize; a_3 – 3 years rotation: 1. soya – 2. wheat – 3. maize; a_4 – 4 years rotation: 1. pea – 2. wheat – 3. sugar beet – 4. maize and B – Factor nitrogen: b_1 – N_o and b_2. – N_{100}. P_{70} was applied to all experimental plots.

The following technical operations and analyses were performed:

- weeding status, determined by the help of square frame 2-3 weeks before harvesting wheat crop;
- soil physical analyses: bulk density and total porosity, at 40 cm deep, after harvesting the crop on the agrofond N_0;
- soil chemical analyses: pH, humus (%), total nitrogen, carbon/nitrogen ratio, accessible phosphorus and mobile potassium, at 20 cm deep; for quantification of the results was used ICPA-1997 Methodology [5];
- the quantification of the crop yield on variants and repetitions and its calculation at sown area has been done in STAS conditions.

RESULTS AND DISCUSSION

1. The influence of crop rotation and of nitrogen to weed biomass (Table 1).

Determination of weed biomass allowed us to formulate the following observations:

a) The highest values regarding weed biomass were recorded on wheat monoculture on the agrofondul N_0 of 316 g/m^2 and on N_{100} of 206 g/m^2;

b) Starting of using rotation in wheat crop lead to a significant decrease of the weeding status, been recorded differences by comparison of monoculture of 73.1 - 78.8% on the agrofond N_0 and of 79.6 - 85.5 % on the agrofond N_{100};

c) Application of nitrogen dose of 100 kg/ha determined the decreasing of weeding level up to cu 34.8% in monoculture and up to 52.2% for crop rotation. This is explained through the fact that winter wheat under the influence of fertilizers and of a better previous plant produces more tillers, has a higher growth rate and inhibits the development of the weeds.

2. The influence of crop rotation on physical parameters as bulk density and total porosity (Table 2).

a) In all cases, the values of bulk density increased from surface to depth, as it follows: on 5 - 10 cm depth varies between 1.29 and 1.34 g/cm^3; on 15 - 20 cm depth between 1.36 and 1.42 g/cm^3; on 25 - 30 cm depth between 1.45 and 1.52 g/cm^3 and on 35 - 40 cm depth varies between 1.54 and 1.55 g/cm^3;

b) The values of total porosity decreased with depth from 46.5 - 48.4% on 5 - 10 cm depth to 38.1 - 38.3 % on 35 - 40 cm depth;

c) Crop rotation favorably influences the bulk density with up to 0.05-0.06 g/cm^3 and total porosity with up to 1.7-2.3%.

Table 1

Influence of crop rotation and of nitrogen to weed biomass

Crop rotation	N-dose	Weed biomass			
		g/m^2	%	difference %	
Monoculture	N_0	316	100.0	100.0	-
	N_{100}	206	65.2	-	100.0
2 years rotation (maize - wheat)	N_0	85	100.0	26.9	-
	N_{100}	42	49.4	-	20.4
3 years rotation (soya - wheat - maize)	N_0	75	100.0	23.7	-
	N_{100}	38	50.1	-	18.5
4 years rotation (pea - wheat - sugar beet - maize)	N_0	67	100.0	21.2	-
	N_{100}	32	47.8	-	14.5

Table 2

Bulk density and total porosity of reddish preluvosoil from Moara Domnească cultivated wheat in a crop rotations

Crop rotation	Bulk density (g/cm^3)	Soil depth (cm)			
	Total porosity (%)	5 – 10	15 – 20	15 – 30	35 – 40
Monoculture	bulk density	1.34	1.42	1.52	1.55
	total porosity	46.5	43.2	39.1	38.1
2 years rotation (maize - wheat)	bulk density	1.29	1.36	1.45	1.54
	total porosity	48.4	45.5	42.0	38.3
3 years rotation (soya - wheat - maize)	bulk density	1.29	1.36	1.46	1.54
	total porosity	48.4	45.5	41.6	38.3
4 years rotation (pea - wheat - sugar beet - maize)	bulk density	1.30	1.37	1.47	1.54
	total porosity	48.0	45.1	41.2	38.3

3. The influence of crop rotation and of nitrogen on some chemical properties of the soil (Table 3).

The chemical soil analyses: pH, humus (%), total nitrogen, carbon/nitrogen ratio, accessible phosphorus and mobile potassium, present variable influences that evidenced the following aspects:

a) The soil reaction was moderately acidic, ranging between 5.10 and 5.40, with no clear influences due to crop rotation; it has observed a decreasing tendency of soil reaction on the agrofond N_{100} that can be attributed to nitrogen fertilizers with acidic reaction. Differences between N_0 and N_{100} are lower with 0.19-0.30 pH units.

b) The humus content of the soil indicates a middle content, ranging between 2.14-2.33%, with an increasing tendency on nitrogen fertilized agrofond;

c) The total nitrogen level is between 0.123-0.145%, with an increasing trend under crop rotation and nitrogen dose influences;

d) Carbon/nitrogen ratio ranges between 9.31 and 10.08, lower values being recorded at crop rotation with nitrogen fertilized agrofond;

e) The mobile phosphorus from soil indicated a middle content with values between 42 and 54 ppm, higher values being observed at monoculture due to low absorption level;

f) The mobile potassium from soil ranges between 144-183 ppm, higher values being recorded at monoculture due to low level of extraction.

Table 3

pH, humus, N-total, carbon/nitrogen ratio, P-accessible, K-mobile analyses at 20 cm deep in reddish preluvosoil of crop rotations from Moara Domnească

Crop rotation	N-dose	pH	Humus (%)	Nt (%)	C/N	P_{AL} (ppm)	K_{AL} (ppm)
Monoculture	N_0	5.34	2.14	0.123	10.08	53	183
	N_{100}	5.15	2.26	0.130	10.08	54	180
2 years rotation (maize - wheat)	N_0	5.40	2.19	0.129	9.85	46	153
	N_{100}	5.10	2.29	0.134	9.93	44	140
3 years rotation (soya - wheat - maize)	N_0	5.37	2.21	0.138	9.28	47	150
	N_{100}	5.14	2.31	0.144	9.31	42	144
4 years rotation (pea - wheat - sugar beet - maize)	N_0	5.32	2.21	0.136	9.41	45	158
	N_{100}	5.12	2.33	0.145	9.31	43	150

4. The influence of crop rotation and of nitrogen on wheat yield (Table 4).

The crop yields have raised a lot under the influence of nitrogen and crop rotation, as it follows:

a) The highest yields has been recorded at 3 and 4 years crop rotation and was of 24.7 q/ha and 24.6 q/ha on agrofond N_0 and of 38.0 q/ha respectively, 37.8 q/ha pe N_{100}, with yield gain statistically assured of 6.5-6.4 q/ha on N_0 şi 7.8-7.4 q/ha on N_{100}.

b) Nitrogen dose of 100 kg N/ha assured crop yields of 12.2-13.3 q/ha, yield gain statistically assured very significant.

Table 4

Wheat yields in crop rotation at Moara Domnească (average 1999-2009)

Crop rotation	**N-rate**	**Wheat yields**				
		q/ha	**%**	**difference q/ha**		
Monoculture	N_0	18.2	100.0	Mt.	Mt.	-
	N_{100}	30.4	167.0	12.2***	-	Mt.
2 years rotation (maize - wheat)	N_0	22.5	100.0	Mt.	4.3*	-
	N_{100}	35.6	158.2	13.1***	-	5.2**
3 years rotation (soya - wheat - maize)	N_0	24.7	100.0	Mt.	6.5**	-
	N_{100}	38.0	153.9	13.3***	-	7.8***
4 years rotation (pea - wheat - sugar beet - maize)	N_0	24.6	100.0	Mt.	6.4**	-
	N_{100}	37.8	153.6	13.2***	-	7.4***
Dl 5% (q/ha)				3.76		
Dl 1% (q/ha)				5.13		
Dl 0.1% (q/ha)				6.91		

CONCLUSIONS

1. Crop rotation determined the decreasing of weeding level in comparison with monoculture with 73.1-78.8% on the agrofond N_0 and with 79.6-85.5 % on the agrofond N_{100}.
2. The application of nitrogen dose of 100 kg/ha led to the decreasing of weeding level with up to 34.8% in monoculture and up to 52.2% in crop rotation.
3. Crop rotation favorable influences the bulk density with up to 0.05-0.06 g/cm^3 and total porosity with up to 1.7-2.3%.
4. The chemical soil analyses (pH, humus, total nitrogen, carbon/nitrogen ratio, accessible phosphorus and mobile potassium) evidenced improvement tendencies under crop rotation influence.
5. The application of 100 kg N/ha determined production yields of 12.2-13.3 q/ha, an increase which is statistically assured a highly significant.

6. Crop rotation of 3 and 4 years conducted on the highest yields of 24.7 q/ha and 24.6 q/ha respectively, on the agrofound N_0 and 38.0 and 37.8 q/ha, respectively on N_{100}, with yield gain statistically assured of 6.5-6.4 q/ha on the agrofond N_0 and 7.8-7.4 q/ha on the agrofound N_{100}.

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MINIMUM TILLAGE AND ORGANIC AGRICULTURE AS ALTERNATIVES FOR SUSTAINABLE AGRICULTURE

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Keywords: *conservative, agriculture, minimum tillage*

Abstract

"A sustainable agriculture is an ecological agriculture economically viable, socially responsable, protect resources and serve as the basis for future generations" P. Allen.

Continued use of the classic tillage of the soil has led to a gradual increase in production, but causes adverse events disturbing on the most important resources of agricultural production, soil, by physical and chemical degradation.

This paper is a synthesis of research on agricultural technology systems belonging to the conservative side (with a correct pedological foundation and by avoiding mistakes in plant growing agricultural technology, which reduces soil degradation), research carried out both in our country and abroad that supports this type of farming like an alternative for preserving the natural fertility of the soil and a method of environmental protection, with beneficial effects on human health and the positive economic impacts.

INTRODUCTION

Soil degradation is a highly complex process that causes or enhances the action of one or more limiting factors. In conventional agriculture, the intensification of land degradation is determined mostly by human activities, and less than some limiting factors, which generally have a permanent character, cannot be removed, so that agricultural technology must be adapted. This category included soil texture, too high or too low content of clay or sand. Also other limiting factors affecting natural fertility and soil productivity are: primary compaction, acidity, salinity, excess and water scarcity, low content of organic matter and nutrients, nutritional imbalances; some of them can be remedied by measures more or less simple ameliorative agriculture.

MATERIAL AND METHODS

Tillage systems: *Conventional*-ploughed at different cm; *Unconventional*-disck harrow, chisel + rotary harrow, paraplow.

Physical properties as: soil bulk density, by the core method (Black and Hartage, 1986); water stable aggregates by the procedure of Kemper and Rosenau (1986);

aggregate size distributions were determined on the soil samples collected from the fields before sowing of different cultures, during the vegetation season and immediately after harvesting.

The Anova procedure was used to evaluate the significance of each tillage treatment on macrostructural hidrostability degree. Treatment means were separeted by the least signifiance differences test and all significant differences were reported at the 5%, 1% and 0.1%.

RESULTS AND DISCUSSION

At present, there is an increase of the technologies with reduced soil tillage. In the U.S., from 1972 to 1981 with work surfaces and sown directly into stubble varieties increased from 12 to 39 million ha, representing about 9, respectively, 30% of the total sown area [3]. Intensifying and worsening the effects of degradation as a result of technical mistakes has led the international scientific community to launch a comprehensive program that has identified the main processes of soil degradation (dismantling, erosion, compaction secondary, agrochemical degradation, acidification, biological disturbances) cases and affected areas globally. Technological systems were tested varieties belonging to conservative agriculture for the first time in the U.S. and have seen a spectacular development in U.S., Canada, Brazil, Argentina where occupies between 12 and 40% of arable land.

FAO is promoting a change in the concepts and understanding regarding soil tillage and a reduction in the intensity and use of tillage equipment. It favors a greater use of conservation tillage techniques and related equipment and sustainable soil management practices. FAO has helped to disseminate information on the benefits of conservation tillage through education, technology transfer and input programmes as American Network of Conservation Tillage (RELACO) dedicated to the dissemination of conservation tillage systems.

The main objective of RELACO which started its activities in 1986, was to improve the utilization of soil, water and plant nutrients by generating and transferring tillage practices which prevent soil degradation. RELACO now has a membership of 16 countries (Argentina, Bolivia, Brazil, Costa Rica, Nicaragua, Paraguay, Peru, Dominican Republic, Venezuela, Chile, Columbia, Cuba, Ecuador, El Salvador, Honduras and Mexico).

The entrance of Chile into the global economy has led to important changes in the production of annual crops. Since 1991, there has been a negative tendency in agricultural productivity due to the use of inappropriate tillage systems intensify the natural soil degradation processes. As a consequence of the observed degradation problems, new tillage practices have been introduced into the coastal mountain range, which allows inverting without seeding, harrowing or disturbing the soil, so that seeds are sown through the residues of the preceding crop.

Costa Rica showed also a high degree of soil erosion by tillage practices. Land use is intensive with a minimum of two crops per year, and hardly any crop rotation is practiced. The project MAG/FAO has piloted representative farms where was reduced number of disking, and especially of passes with the rotary cultivator type.

During the last 50 years, Mexico has suffered an accelerated deterioration. The potential contribution of conservation tillage has shown that it considerably diminishes soil erosion. In addition, there is a reduction in the number of weed species, the effect being most pronounced in systems with more than 60% residual cover. Thus, the area sown with conservation tillage in Mexico is 45.000 hectares, which represents only about 2% of the potentially cultivable lands, whilst the problem of soil degradation due to erosion continues year to increase at accelerated rates.

A part of Paraguay is a fragile ecosystem. The agriculture of this region has been for about 60 years developing. The main crops are peanuts, cotton, sesame and euphorbia, with few winter crops. Soils show a reduction in productivity due to mono cropping, inadequate tillage and wind erosion.

Also for many years, in Venezuela, conventional tillage was a common practice. This has created serious problems of surface and subsurface compaction, erosion, surface crusting and sealing. Pilot plots have been established in farmers fields to enter direct sowing and minimum tillage on basic grain-producing in various regions.

Research projects designed to evaluate the effect of existing cover in conservation tillage systems on temperature, humidity, infiltration and other soil physical characteristics were carried out.

Studies in England showed that conventional tillage (1980-1995), organic carbon content was reduced by 50%, causing aggregates structural hidrostability damage, which affects water retention properties, the buffering, the availability of nutrients and biological activity and show the necessity of conservation soil tillage.

In a recent project by the UK Department of Environment Food and Rural Affairs [9] about the effects of minimal tillage, contour cultivation and in-field vegetative barriers on soil erosion and phosphorus loss is evaluated the potential for minimum tillage, also examine cost-effectiveness. Water erosion of agricultural soils has for many years, been recognized as a global environmental problem. In areas of the UK where soils are light in texture and readily erodible this problem can be serious, with rates of erosion typically between 0.5 and 200 mg $ha^{-1}yr^{-1}$.

Half of the field was cultivated with minimum tillage (shallow tillage with a tine cultivator) and half was conventionally laughed. Within each cultivation treatment there were different treatment areas. In the first year of the experiment, one TA was cultivated up and down the slope, one TA was cultivated on the contour, with a beetle bank acting as a vegetative barrier partway up the slope, and one had a mixed direction cultivation treatment, with cultivation and drilling conducted up and down the slope and all subsequent operations conducted on the contour. In the second year, this mixed treatment was replaced with contour cultivation.

The results showed no significant reduction in runoff, sediment losses or total phosphorus losses from minimum tillage when compared to the conventional plough treatment, but there were increased losses of total dissolved phosphorus with minimum tillage.

Research undertaken over the soil and conditions in the last 40-50 years, in central Europe showed the wheat crop suitability conservative tillage systems [3, 4].

In Romania, the system works for the maintenance of soil has not expanded greatly because of the impossibility of fitting a range of specialized machines that perform a single pass a large number of operations and technology mainly due Drills Cutter equipped mainly with the patina requires good preparation germinative bed [4]. Tillage with paraplowul or carved tamping can replace tillage land, with arable horizon short and reduced infestation with perennial weeds species, to grow deep-rooting plants-corn, sunflower. Gus and collaborators showed, in 1991, that the maintenance of soil work clearly helped to conserve soil and increase its fertility.

After Hays (1972) and Carter (1994) - quoted by Petcu (1998), the system works requires the maintenance of soil: basic work to be done without turning the swath, in which loosening runs with carved or disc harrow, harrow or rotary cultivators, arrows, etc.; number of ground works to be reduced to the classical system.

The experiment carried out during 2000 - 2005 in the experimental field of Research Centre - Sustainable Agricultural Minimum Systems Technology and discipline of the UASVM Agrotechnics Cluj had good results with paraplaw system work.

In a recent project in Romania [16], the technology variety sowing in the Banat plain on a preluvosol with moderate suitability to direct sowing, the results favorable for soybean crop and winter wheat, and a trend-sensitive growth and presence compaction enlighten secondary soil profile and accumulation of phosphorus in the upper soil profile. Recommended long-term crop rotation and making entries on the ground only under optimum conditions of soil moisture traficability. The result was improvement of soil fertility and productivity of fine textured.

Also, this technology tested on chernozem cambic fine textured, moderately compacted, at the Burnas plain required a good management of the plant remains cropping. The land must be free of any weeds, diseases or pests. Seeding can be performed only under optimum conditions of soil workability to allow a good contact between soil-seed. Complex equipment include: displaced mill, drill, roller track in aggregate with CASE – 7340.

The results obtained in the Burnas plain showed that fewer crossings surface for carrying various items of raising and processing of soil before planting can help reduce time increasing physical soil degradation of compaction by avoiding secondary emphasis, increasing soil permeability water, avoid excess water from the surface, improving the potentials of aeration, storage conditions and the available water for workability [16].

It is interesting to note that on other continents carry out complex research regarding environmental effects of organic and conventional agriculture interdisciplinary. So, long periods of time farms in North Island (New Zealand) have developed the organic technology (biodynamic). Organic farms have improved physical and chemical soil properties.

In Finland 3,900 organic farms were registered in 2008 (5.6% of all farms) and 150.000 ha (6.5% of the country's agricultural area). Finland is the largest producer of organic oats in Europe (second in the world after Canada).

Research in organic farming has a long tradition in Germany, Biodynamics Research Institute founded in 1950, is one of the first private institute in the world.

At the end of 2007 were recorded about 18,703 certified organic farms which cultivate 865.000 hectares (Figure 1). Compared with 2006, the number of organic farms increased by 6.5% and surfaces organically grown by 4.8%. Overall, 5% of germane farmers have grown 5.1% of Germany's total land area under organic standards. The total number of companies, including agro-ecological producers, manufacturers, and trade companies has increased by 11.9% (total 26,820 companies in 2007). In 2007, retail trade of organic products increased to 1.18 billion euros [10, 11, 12].

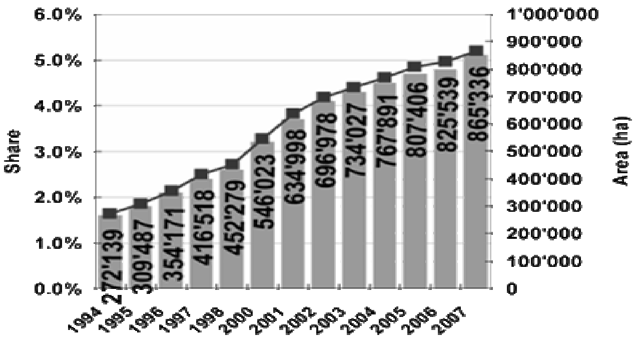

Fig. 1. Evolution of land farmed organically in Germany, 1994 - 2007. Source: soil, AGöL, BLE, ZMP, August, 2008

In Romania, systematic research on organic vs. differentiated technologies conventionally have been started recently with the implementation of European Union schemes, which subsequently pursued a practical implementation of results through development of agro-environmental programs. Research was carried out under the Phare project "Demonstration Centres for Sustainable Agriculture in the Danube Basin and the Regional Study on Market Aspects".

Organic fertilization was performed with composted manure from the cattle farm. The effects of organic and conventional agricultural technologies on soil and groundwater (Figure 2) were studied in a network of piezometric installed ICPA Bucharest. The study links mobile fauna in differentiated technologies impact culture was carried out by installing a network of traps Barber and taxonomic determinations from ICPA Bucharest, while soil samples for evaluation were collected edaphic mezofauna samples and analyzed by a team of researchers at the ICB Iaşi [17]. Under organic practices, about 175 earthworms were found per square meter compared to 21 frames per square meter in the conventional variants These large differences are due obviously fundamentally different way of dealing with chemical pesticides. During 2003-2005, the impact of conventional technologies on organic soil was monitories in farms from Călăraşi County (2005). So, the plots were developed under organic certification and inspection program. Maintaining an acceptable level of soil organic matter was done almost as in typically Mediterranean organic farms based on plant debris and green manure, as a consequence of reduced livestock sector. Only organic vegetable plots were fertilized in 2005 with 5 t/ha compost sheep/cattle. Plant protection treatments were carried out with cupric substances allowed in organic production.

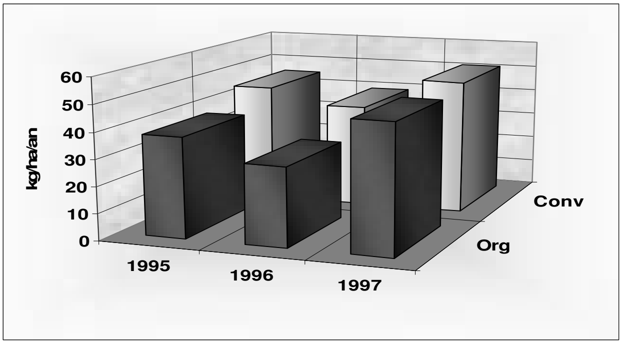

Fig. 2. Flow of nitrogen to groundwater under conventional and organic farming technologies (green) on a clay soil, Cincşor, Braşov. Source: Ştefănescu and al., 2000

The experiment showed that it was desirable to maintain the pragmatic agriculture, rather than conducting assessments of the academic type [17].

Although investigations in Călăraşi were relatively short, there is a slight trend of improvement in the chemical, physical and biological soil properties in ecological agriculture. The conventional plots were recorded in soil nitrate in normal quantities but higher than the ecological (green). Also, in conventional plots were found traces of pesticide residues and very high levels of cadmium content. Analytical data on the structural stability indicate a slight superiority of water stability under organic practices.

According to these results, it is recommended for organic farms in southern Romania to carry out more careful crop rotation program with regular organic fertilization. Also, it would be useful to organize a field experimental approach to include complex impact of soil physical characteristics. The motivation of this approach is fundamental lack of relevant data at European level and the results of previous research showing that among the problems of soil degradation on agricultural land in East Central European area is secondary compaction (FAO, 1999).

CONCLUSIONS

1. The international agricultural policies adopted in the years 1960 - 1970 helped increase the area under cereals and root hoes. Therefore, there was also increased tillage, high risk on the occurrence and worsening erosion, which spread rapidly, especially in Asia and Africa, also Europe, including in our country.
2. Fluid erosion and wind erosion have become, by far, the worst forms of land degradation, affecting about 1094 million ha, can be found in all continents.
3. Secondary compaction captive over the past six decades is the best known form of physical degradation in conventional farming systems, intensive mechanized.
4. The worldwide area affected by deterioration-compaction is about 83 million hectares, of which most 68 million ha, are common in Europe.
5. Mechanical technologies and preventive measures recommended should be developed locally to avoid the primary and secondary soil compaction.
6. Organic farming schemes connected with agroambiental have become notable in European policies.
7. FAO supported the creation of a network, called Latin American Network of Conservation Tillage dedicated to the dissemination of conservation tillage systems.
8. Argentina, Paraguay, Chile, Bolivia, Mexico, Venezuela, U. K. applied in different conditions of soil and climate a conservative agriculture with minimum tillage or no tillage;

9. In our country, research on soil systems maintenance work has been performed in recent years focusing on quantitative aspects (production) and their impact on soil quality and environment.
10. For the organic farms in southern Romania a crop rotation program with organic fertilization was carried out. Also, it would be useful to organize a field experimental approach to include complex impact of soil physical characteristics.
11. In Romania, most relevant research has been carried out under Phare project "Demonstration Centres for Sustainable Agriculture in the Danube Basin and the Regional Study on Market Aspects" with results in the agricultural area of the town Cincşor.
12. Finland is the largest producer of organic oats in Europe, and Germany research in organic farming has also a long tradition.

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NEW RESULTS FOR MAIZE CROPS CULTIVATED IN THE NO-TILLAGE SYSTEM AT THE "RAMIRA" AGRICULTURAL COMPANY FROM MÂRŞA, GIURGIU COUNTY

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Keywords: *Ramira, conventional, no-tillage, Gaspardo, Regina model*

Abstract

In Romania, maize is the main cultivated plan and maize crops are extremely important from an economic point of view. Research with the no-tillage system applied to maize crops were made in the Romanian Plain, Şarpe (1968, 1987, 2000, 2008, 2009), in Banat, Motiu (2004) and in the Flood Plain of the Danube River, Şarpe (2004, 2005, 2007, 2008). The results obtained in Romania confirm the results of the research made in other countries: Philips and Young (1973), Köller (1999), Derpsch (2001).

"Ramira" is the first agricultural company from Giurgiu County which in 2009 cultivated maize in the no-tillage system on a 200 hectares area of land, the results obtained being quite remarkable.

In the conventional system, under the weather conditions of the year 2009, the grain yield recorded from the maize crops amounted to 7,200 kg/ha, while in the no-tillage system a grain yield of 7,500 kg/ha was recorded - so the yields obtained in the technological systems were practically equal. However, there were small differences in terms of fuel consumption. For example, in the no-tillage system, a ***78 litres/ha*** *fuel consumption was recorded, while in the no-tillage system this amounted to only* ***25 litres/ha****. Big differences were also recorded as regards the expenses in the conventional and no-tillage systems. In the conventional system, the expenses made for all the mechanical works performed from the sowing stage to the harvesting stage, these expenses amounted to RON 2,350.00 per hectare, while in the no-tillage system, they amounted to only RON 610,00 per hectare.*

INTRODUCTION

The no-tillage system is the most COST-EFFICIENT farming system which, according to Derpsch (2001), is practiced on hundreds of millions of hectares in the USA, Brazil, Argentina, and even in Paraguay.

In Romania, numerous research studies regarding application of the no-tillage system to maize crops were made at Fundulea, in the Romanian Plain by Şarpe (1968, 1987, 2000, 2008, 2009), in Banat by Motiu (2004) and in the Flood Plain of the Danube River by Şarpe and Poienaru (2004, 2005, 2007, 2008, 2009). The results obtained were quite remarkable, demonstrating the economic and practical efficiency of the no-tillage system. Based on this research, many agricultural companies from Romania are currently using the no-tillage system on large surfaces. Thus, for example, the S.C. 3 Brazi Agricultural Company uses the no-tillage system applied to maize, barley, wheat and soybean crops on approximately 45,000 hectares.

The no-tillage system presents some other economic advantages:

- reduces soil erosion - there are some 4 million hectares of eroded soil in Romania;
- diminshes the number of farming machines from 10 to only 3: sowing machine, herbicide-application equipment, and harvesting combine;
- reduces considerably the working time-and consequently labour productivity per hectare and per ton of product increases.
- the most important advantage of the no-tillage system is the diminution of the mechanical work related expenses and the considerable increase of the **PROFIT** recorded by cultivated hectare.

The results obtained at the ”Ramira” agricultural company shall be a good example and reference for all the similar companies from the county of Giurgiu as well as for the neighbouring counties.

MATERIAL AND METHODS

The research activities referred to herein were carried out at the ”Ramira” Agricultural Company from the Mârşa commune, Giurgiu County, situated on a brownish-reddish in different stages of podzolization, which contains 1.5-2.0% humus, 39% clay and has a 5.5 pH. The previous crops on the respective plots of land. In spring 2009, certain species of annual and perennial weeds were present in both plots of land, such as *Cirsium arvense* and *Sonchus arvensis*. For the chemical control of these species, 5 days before sowing a treatment with the Roundup herbicide was applied in doses of 4 litres/ha. The maize was sowed in the interval April 11th-14th, 2009, operation performed by means of a six-row Gaspardo sowing machine, Regina model whereas in the classical system sowing was performed by means of a SPC 8 Romanian sowing machine. The weather conditions were moderately favourable, as startinf from October 2008 and until September 2009 the totally recorded rainfall amounted to 510 litres/square metre.

RESULTS AND DISCUSSION

In Table 1 we present the data regarding the selectivity and efficacy of herbicides as well as the grain yield.

Table 1

Selectivity, efficacy and grain yield recorded for the Rebera Pioneer hybrid S.C. "Ramira", Marsa, Giurgiu County

Dominant weed species

1. Cirsium arvense	*7. Chenopodium album*
2. Sonchus arvense	*8. Polygonum aviculare*
3. Sonchus venalis	*9. Sonchus oleraceus*
4. Capsella bursa pastoris	*10. Xanthium strumarium*
5. Veronica hederifolia	*11. Solanum nigrum*
6. Echinochloa crus-galli	

Herbicides applied	**Doses (l/ha)**	**Time of appl.**	**Selectivity (EWRS grades)**	**Weed control (%)**	**Yield kg/ha**	**Yield %**
Classical system						
1. Unhoed	-	-	1.0	0.0	900	12
2. Hoed 3 times (manually and mechanically)	-	-	1.0	94.0	7200	100
No-tillage system						
3. Untreated	-	-	1.0	0.0	890	12
4. Merlin Duo + Ceredin Super	3.5	preem	1.0	98.0	7500	104
EWRS grades 1 = Without phytotoxic symptoms; 9 = Totally compromised maize plants						
LSD: 0% = 180 kg/ha; 1% = 230 kg/ha; 0.1% =310 kg/ha						

Analyzing the data presented in Table 1, we shall notice that the Pioneer Rebera hybrid tolerated very well the Merlin Duo and Ceredin Super herbicides. As regards the weed control in the classical system in a separate 10 hectare-plot, by 3 mechanical hoeing runs and 3 manual hoeing runs, a 94% weed control level was achieved. In the no-tillage system, where the Merlin Duo herbicide was applied in doses of 3.5 l/ha after sowing, and the Ceredin Super in a dose of 1 l/ha in the vegetation stage, when the maize plants had 3-5 leaves, the level of weed control amounting to 98%.

A grain yield of 7,200 kg/ha was recorded in the conventional system and respectively of 7,500 kg/ha in the no-tillage system, so the grain yields recorded in the two systems were practically equal. As regards the un-hoed variant in the conventional system, the grain yield was very small, that is only 900 kg/ha, and in the no-tillage system it was 890 kg/ha. However, there were big differences in terms of fuel consumption, as it stands out from Table 2.

Table 2

Fuel consumption in litres/hectare "Ramira" Agricultural Company, Marsa commune, Giurgiu County, 2009

CONVENTIONAL SYSTEM Mechanical and manual works	Consump. (litres/ha)	NO-TILLAGE SYSTEM Mechanical works	Consump. (litres/ha)
1. Autumn ploughing + harrowing	30.0	1. -	-
2. Teramix	8.0	2. -	-
3. Combinator	7.0	3. -	-
4. Sowing by SPC-8	6.0	4. Sowed by Gaspardo, Regina	7.0
5. 1st mechanical hoeing	4.0	5. Appl. of herbicides before sprouting	1.5
6. 1st manual hoeing	-	6. -	-
7. 2nd mechanical hoeing	4.0	7. Appl. of herbicides on vegetation	1.5
8. 2nd manual hoeing	-	8. -	-
9. 3rd mechanical hoeing	4.0	9. -	-
10. 3rd manual hoeing	_	10. -	-
11. Harvesting by Claas combine	15.8		15.0
TOTAL CONSUMPTION	78.0	TOTAL CONSUMPTION	25.0

As illustrated by the table above, the fuel consumption in the conventional system from the maize sowing to the maiaze harvesting stage amounted to 78 litres of Diesel fuel, while in the no-tillage system it was of only 25 litres per hectare.

Big differences were also recorded as regards the expenses incurred with the mechanical works in the two systems, conventional and no-tillage, as illustrated by Table 3 below.

Table 3

Cost of maize cultivation mechanical and manual works "Ramira" Agricucltural Company, Marsa Commune, Giurgiu County, 2009

CONVENTIONAL SYSTEM Mechanical and manual works	Cost (RON/ha)	NO-TILLAGE SYSTEM Mechanical works	Cost (RON/ha)
1. Autumn ploughing + harrowing	270	1. -	-
2. Teramix	90	2. -	-
3. Combinator	40	3. -	-
4. Sowing by SPC-8	60	4. Sowed by Gaspardo, Regina	70
5. 1st mechanical hoeing	170	5. Appl. of herbicides before sprouting	120
6. 1st manual hoeing	360	6. -	-
7. 2nd mechanical hoeing	170	7. Appl. of herbicides on vegetation	120
8. 2nd manual hoeing	360	8. -	-
9. 3rd mechanical hoeing	170	9. -	-
10. 3rd manual hoeing	360	10. -	-
11. Harvesting by Claas combine	300		300
TOTAL RON	2,350	TOTAL RON	610

According to the data presented in Table 3 above, maize cultivation costs from the ploughing to the harvesting stage amounted to RON 2,350 in the conventional system and to only RON 610 in the no-tillage system.

The most important results from a cost-efficiency perspective are the ones presented in Table 4, in which we analysed the profit of a hectare of maize cultivated in the conventional and respectively no-tillage system.

Table 4

Profit in ron-hectare of maize cultivation in the conventional and no-tillage systems "Ramira" Agricucltural Company, Marsa Commune, Giurgiu County, 2009

Maize yield (kg/ha)	Maize cost (RON/kg)	Maize value (RON/ha)	Cost of materials and mechanical works/1 ha	PROFIT in RON for 1 maize crop hectare
CONVENTIONAL SYSTEM				
4,000	0.54	2,000	3,480	-1,480
4,500	0.54	2,250	3,480	-1,230
5,000	0.54	2,500	3,480	-980
5,500	0.54	2,750	3,480	-730
6,000	0.54	3,000	3,480	-480
6,500	0.54	3,250	3,480	-230
7,000	0.54	3,500	3,480	+20
NO-TILLAGE SYSTEM				
4,000	0,54	2,000	1,610	+ 390
4,500	0,50	2,250	1,610	+ 640
5,000	0,54	2,500	1,610	+ 870
5,500	0,54	2,750	1,610	+ 1,140
6,000	0,54	3,000	1,610	+ 1,390
6,500	0,54	3,250	1,610	+ 1,640
7,000	0,54	3,500	1,610	1,830
Note: The price of maize franco-warehouse is ranged between RON 0.495 and RON 0.595 per kg (an average of RON 0.545/kg). Agricultural Profit, issue No. 33 of September 2009				

Based on the relevant results obtained at the "Ramira" Agricultural Company we have elaborated the following Strategy for the control of annual and perennial weeds.

STRATEGY For the control of annual and perennial weeds in maize crops cultivated in the no-tillage system

This strategy is valid only for the farmers which use the no-tillage system and cultivate various types of maize hybrids.

In spring, time will be allowed to annual and perennial weeds such as Cirsium arvense, Sonchus arvensis, Taraxacum officinale affinale and Convulvulus arvensis to spring in mass. The plot must be then treated by glyphosate-based herbicides such as Roundup, Cosmic, Dacglisat 50WL6, Dominator, Gallup, Glialua 36 CE, Glisocig 360, Glifotim, Elyfas, Glyphogan 480, Glyphostock Kawasate, Sanglypho and Rocco. All these herbicides contain 360 g/l glyphosate active substance.

Glyphosate-based herbicides must be applied 1-7 days before the maize is sowed or within 5 days after it has been sowed in a dose of 4.5-6.0 litres per hectare.

Application of glyphosate-based herbicide is strictly forbidden after the maize has sprung, because the crop will be "burnt" by these herbicides.

One of the following herbicides shall be applied together (tankmix) with the glyphosate-based herbicides:

Merlin Duo in a dose of 3-5 litres/ha

Gardoprim Plus Gold 500 SC in a dose of 5-7 litres/ha

Dual Gold 960 EC in a dose of 2-3 litres/ha

Frontier Forte in a dose of 2-3 litres/ha

Proponit 720 EC in a dose of 4-5 litres/ha

After the maize has sprung, when plants have 3-5 or maximum 7 leaves and the annual and perennial weeds are 5-10 cm tall and even 15-20 cm tall, the Ceredin Super in a dose of 1 l/ha shall be applied - this herbicide being able to destroy over 700 species of annual and perennial dicotyledonous weed species which infest maize crops from Romania and Europe.

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TILLAGE SYSTEM INFLUENCE UPON SOIL QUALITY FACTORS

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Keywords: *minimum tillage, soil fertility, water conservation*

ABSTRACT

Soil tillage works by their direct actions and indirect ones influenced the layer of tiled soil and its sub-tilled layer (Gus et al., 2004).

The quality of the soil tillage and seed bed is directly related with different factors, the leading one consisting as the soil type. The soil type influences through texture, structure, humus content and total Na capacity exchange.

Research results underline the relationship between the soil tillage quality and the amount of clay regarded as the capacity of soil fragmentation after a tillage system, the optimum moment for soil tillage, soil humidity in the arable layer. The type of predecessor plant and soil humidity also influenced the quality of soil tillage.

INTRODUCTION

The agronomic value of soil structure is given in particular by its influence exerted on soil settlement status and thus on the water, air, nutritional, thermal and biological regime.

A soil with good structure is slightly permeable, retains water within capillary pores and between aggregates there is air. As a result, on the surface of soil aggregates there take place anaerobic processes leading to mobilization of nutrients; meanwhile, within the aggregates develop processes leading to the accumulation and retention of humus. In this way, a balance between humification and mineralization is being created. Along with the degradation of soil aggregates, the capillary pore volume is reduced and water retention capacity decreases, evaporation being more intense, as well as erosion.

Growing plants in general and soil tillage system used especially involves the soil structure in two opposing processes: the destruction and the recovery one. The system capacity to favor one or the other of these processes result in deterioration or improvement of soil structure.

Human interventions on soils to the establishment and maintenance of crops, bring important changes in energy relations of pedogenesis and induce phenomena of ‘disruption’ of the natural evolution of the soil. Following such changes, particularly in the arable layer, it creates an artificial environment, where the changes of soil characteristics are variable depending on the type and intensity of tillage system. Tillage causes in the first place changes of physical characteristics and in particular of soil structure, which further influences soil chemical and biological characteristics.

MATERIAL AND METHODS

The present results where obtained in the experimental plots of the Agricultural Faculty of Cluj-Napoca, Soil Science Department, on a Faeoziom soil, with a humus content of 4.72%, a pH of 6.8, sandy-loam texture (43-45% loam in the Ap horizon) (V-74%), medium content of nitrate (0.204%), good content of potassium (149 ppm) and good content of phosphorus (18 ppm).

From the climatic point of view the experimental plot area is characterized by multi annual precipitation with values between 550-650 mm. The thermal regime has values between 8.0-8.2ºC.

The experiment was conceived as a monofactorial one:

1 – worked with reversible plough
2 – worked with chisel
3 – worked with paraplow
4 – worked with rotary harrow

RESULTS AND DISCUSSION

The system of soil tillage with plough, chisel, paraplow and rotary harrow influenced the quality of soil structure by modifying the weight of macroaggregate fractions and the microaggregates percent in the 0-10 cm depth (Table 1).

Compared to the control, where the soil was worked with plough, in the variants worked with conservative unconventional systems chisel and paraplow, the stable aggregates percent is maintained or increases. The increase is identified in the chisel work variant, with a value of 3.2%.

Compared to the ploughed classic system, where the percent of hydrostable macroaggregates is 95.4%, in the conservative systems with chisel and paraplow, the quality of structure is maintained and improved, the stable macroaggregates percent being 95.05% for paraplow work, and 98.6% for chisel work.

The mechanic effects of rotary harrow in 0-10 cm depth lead to a decrease or degradation of soil structure quality, the percent of hydrostable aggregates being 85.85%, approximately 10% smaller than in classic variant, with plough.

Table 1

Influence of soil tillage system on the quality of soil structure

No. of fractions	Size of aggregates (mm)	Tillage system			
		Plough (%)	Chisel (%)	Paraplow (%)	Rotary harrow (%)
I	> 5	10.20	17.70	17.20	11.55
II	5 - 3	15.65	13.65	11.40	9.40
III	3 - 2	13.95	10.80	13.20	7.60
IV	2 - 1	39.50	37.30	25.25	25.10
V	1 – 0.5	10.45	10.60	15.15	20.50
VI	0.5 – 0.25	5.65	8.50	12.85	11.70
Total content of macro aggregates		95.40	98.55	95.05	85.85
VII	Total content of micro-aggregates	4.60	1.45	4.95	14.15

The looseness degree of soil, determined at the end of production cycle, confirms the differences related to the soil work and the depth of collecting the soil samples (Table 2).

Table 2

Bulk density values (g/cm^3) varying with de soil tillage system

Specification	Depth (cm)	Soil tillage system			
		Plough	Chisel	Paraplow	Rotary harrow
Bulk density, g/cm^3	0-10	1.22	1.28	1.28	1.10
	10-20	1.26	1.36	1.33	1.35
	20-30	1.28	1.39	1.39	1.40
	30-40	1.35	1.42	1.39	1.40
	40-50	1.43	1.44	1.43	1.44

The differences in looseness are observed between the soil working ways only in the first 30 cm, no change being observed beyond this depth. In the first 30 cm, the best looseness degree was registered on the plot worked with plough, where the bulk density was lower than 1.28 g/cm^3, and the lowest looseness was registered on the plot worked with rotary harrow, where the bulk density is 1.40 g/cm^3. In what concern the looseness degree at the beginning of the production cycle, obvious differences are recorded in the first 10 cm depth, where rotary harrow gave bulk density values of 1.10 g/cm^3 and the plough 1.22 g/cm^3. For the variants worked with chisel and paraplow, the apparent density values are virtually equal, 1.28 g/cm^3. Differences can also be observed in the 10-20 cm depth, with the mention that the best looseness is registered in the plough variant, followed by the paraplow, rotary harrow and chisel variants.

The quality of germination bed, especially number of clods, their size and the amount of vegetal remains, is different, varying with the tillage system used as basic work of soil (Table 3).

For the ploughed variant, the degree of clods grinding is 78.65%, the clods having an average size of 57 mm and an apparent density of 1.20 g/cm^3, and the optimal depth for sowing is ensured.

As for the uniformity of the germination bed, on argic phaeozem, the rotary harrow variant gave the lowest rippling coefficient, 1.11 at soil surface and 1.18 at the base of germination bed. The degree of clods grinding was the best, 81.7% compared to all other variants used.

Table 3

Characterization of germination bed based on soil working variant

Feature	**Plough**	**Chisel**	**Paraplow**	**Rotary harrow**
Clods (% g/g) VM with $\Phi > 5$ mm IV	21.35 11.9-30.8	21.2 12.2-30.2	21.1 15.0-27.2	18.3 10.4-26.2
Degree of grinding (% g/g)	78.65	68.8	68.9	81.7
Balanced average VM diameter (mm) VI	3.85 3.5-4.2	4.6 2.7-6.5	4.65 2.4-6.9	3.2 2.3-4.1
Average VM size (mm) VI	57 51-63	56 49-62	56 48-63	53 45-61
Uniformity of germination bed surface – rippling coefficient	1.21	1.12	1.09	1.11
Uniformity of the germination bed base - rippling coefficient	1.19	1.21	1.25	1.18
Apparent VM density (g/cm^3) VI	1.20 1.0-1.40	1.28 1.01-1.35	1.26 1.01-1.32	1.1 0.9-1.30
Vegetal residues at the surface	few	many	many	many

VM-average value, VI-interval of variation

In the unconventional systems, worked with chisel or paraplow, the quality of germination bed secure the introduction of seeds in soil, with the mention that the grinding degree is under 68.9% (for plough variant GM=78.65%, for rotary harrow variant GM=81.70%), the average diameter of clods is 4.60 mm, the apparent density is 1.26-1.28g/cm^3, and many vegetal residues are at soil surface.

At the unconventional systems, the depth for preparation of germination bed is smaller, which creates vulnerability when water lacks for seed germination, leading to risks on soils with clayey and clayey-sandy texture in droughty years. The more vegetal remains are in the germination bed worked with unconventional systems, the greater is the benefit for water accumulation, microorganisms' activity, erosion prevention but lower for seeding.

CONCLUSIONS

1. The plough tillage system, chisel, paraplow and rotary harrow influenced the soil structure quality by percent modification of the soil fragmentation (macroagregates and microagregates) distinct values on the soil depth between 0 and 10 cm. Compared with the control, the experimental variants where the soil was tilled using unconventional methods like chisel and paraplow the percent of stabile aggregates is maintained or increased. These values are more obvious for the chisel soil tillage system with an increase of 3.2%. Compared with the plough tillage system where the macroagregates percent is 95.4 % the conservative systems like chisel and paraplow maintain or improve the soil structure quality, the macroagregates percent recording values of 95.05% for the paraplow tillage system and 98.6% for the chisel tillage system. The mechanical effects of the rotary harrow on the depth of 0-10 cm lead to a degradation of soil structure quality, the percent of hidrostabile aggregates reaching values of 85.85% with 10% smaller than the control.
2. The loose capacity differences are recorded between different tillage systems only in the firs 30 cm soil depth. After this depth, any differences were not observed. For the first 30 cm soil depth the highest loose soil capacity was recorded for the plough tillage system where the apparent density hasn't overcome the value of 1.28 g/cm^3, on the other hand the lowest loose soil capacity was recorded for the rotary harrow tillage system with a value of bulk density situated at 1.40 g/cm^3.
3. The quality of the seed bed, especially the number of lumps, their size and the quantity of vegetal residues is different with the adopted tillage system. For the experimental variant tilled with the plough the fragmentation number of the lumps 78.65%, with an average size of 57 mm and a bulk density of 1.20 g/cm^3, assuring an optimum depth for seed emergence. Regarding the uniformity of the seed bed on the argic phaeozem soil, for the rotary harrow

tillage systems where observed the lowest percent of uniformity of 1.11 on soil; surface and 1.18 at the seed bed base. The fragmentation degree of lumps recorded the highest values 81.7%, compared with all the tillage systems studied. The unconventional tillage systems, chisel soil tillage or paraplow soil tillage the quality of the seed bed offers seed emergence capacity with the prediction that the lumps fragmentation degree did not exceed the limit of 68.9% (for the plough tillage variant GM=78.65%, rotary harrow tillage system, GM=81.70%), the medium diameter of lumps is 4.60 mm, bulk density 1.26-1.28 g/cm^3 and many vegetal residues at the soil surface.

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REDDISH PRELUVOSOILS FROM D.S. BANU MARACINE AND THEIR SUITABILITY FOR MAIZE CROP IN FUNCTION OF TILLAGE

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Keywords: *reddish preluvosoil, tillage, no till, maize*

Abstract

Within the 2005-2007 period, on the reddish preluvosoil from Didactical Station Banu Maracine there was set up an experiment on tillage effect to physical features of the soil as well as maize yield. The present paper emphasizes the yield obtained durin three years of trials. The conclusion is that, on the soils with a high clay content and rainfed, wide crops (maize) are not recommended with unconventional tillage system or no till.

MATERIAL AND METHODS

The reddish preluvosoil where the experiments were located is characterised by a soil profile as follows: Ao-AB-Bt_1-Bt_2-C.

The soil is compacted at the surface, the bulk density is 1.36 g/cm^3 within Ao horizon, the total porosity is 49% and the penetration resistance is 32 kgf/cm^2. It has a middle humus content, of 2.52% within the first horizon and under 1.0% into the B horizons.

The total nitrogen content is 0.131% within the first horizon and it decreases to 0.056% into inferior horizons which indicates a middle to low humus supplying. The soil reaction. The soil reaction is low acid, the pH value being between 6.06 and 6.47.

Generally, it can be said that the reddish preluvosoil were the experiment took place is middle supplied by humus and nutrients.

The experiment was performed in the same place and has comprised the following variants: V_1 (control) - deep plow (21-25 cm) + disc harrow; V_2 - shallow plow (13-17 cm); V_3 - disc harrow (two tillages); V_4 - direct drill.

The maize hybrid was Florencia (*Zea mays,* conv. *dentiformis*). This hybrid is included into the FAO group 490 and it was homologated for the western and south-eastern zone. It is a simple hybrid with a high yielding potential of around 12-14 t/ha. The Florencia hybrid is known for its good results in stress conditions.

RESULTS AND DISCUSSION

As regard the rainfall, in 2005 there were enough rains for the maize crop. With the control variant that was deeply plowed at 21-25 cm the yield was 4,422 kg/ha (Table 1, Figure 1).

By reducing the depth of the plow to 13-17 cm the yield has decreased to 2.6%, of 4,309 kg/ha. In comparison with the control variant there is a 113 kg/ha shortage that is not significant.

Tabel 1

Influence of tillage system on the maize crop yield on the reddish preluvosoil (2005)

Variant	Tillage	Yield			Sign.
		kg/ha	%	± Ctrl.	
V_1	Deep plow 21-25 cm	4,422	100	-	-
V_2	Shallow plow 13-17 cm	4,309	97.4	- 113	-
V_3	Disc two times	4,145	93.5	- 277	0
V_4	Direct drill	4,027	91.1	- 395	00

$DL_{5\%}$=170.9 kg/ha
$DL_{1\%}$=279.1 kg/ha
$DL_{0.1\%}$=438.7 kg/ha

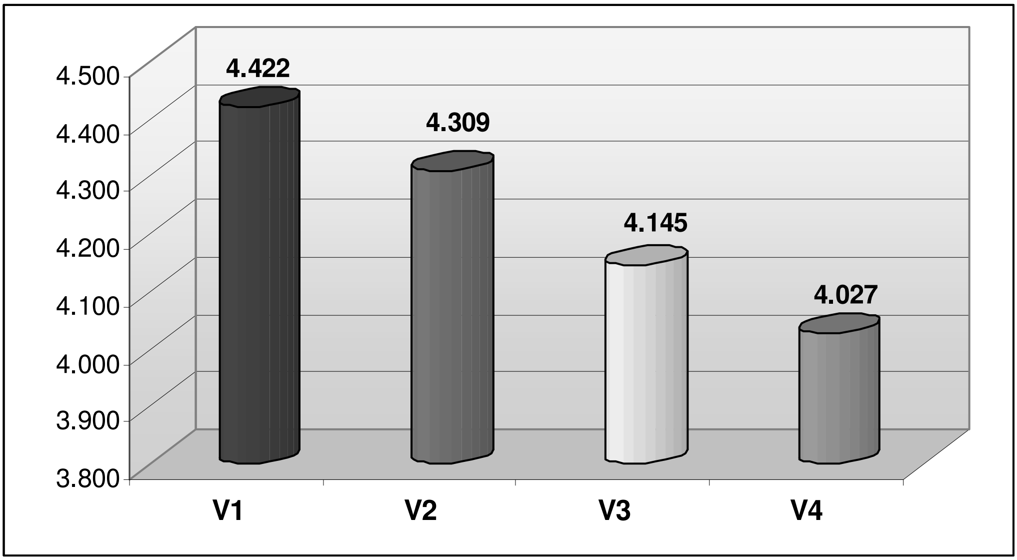

Fig. 1. Influence of tillage system on the maize crop yield in 2005

The 2006 year has more favorable during the vegetation period. The maize yield was between 4,098 kg/ha with no tillage and 4,750 kg/ha with deep plow control.

With the case of shallow plow the yield was 4,582 kg/ha and with two discing the yield was of 4,363 kg/ha (Table 2, Figure 2). In comparison with the control variant the yield minuses have varied between 3.5% (V_2) and 13.7% (V_4) while the yield loss have been of 168 kg/ha that is not significant with V_2, of 387 kg/ha with V_3 which is significant and 652 kg/ha with V_4 which is very significant.

Table 2

Influence of tillage system on the maize crop yield on the reddish preluvosoil (2006)

Variant	Tillage	Yield			Sign.
		Kg/ha	%	± Ctrl.	
V_1	Deep plow 21-25 cm	4,750	100	-	-
V_2	Shallow plow 13-17 cm	4,582	96.5	- 168	-
V_3	Disc two times	4,363	91.9	- 387	00
V_4	Direct drill	4,098	86.3	- 652	000

$DL_{5\%}$=226.1 kg/ha
$DL_{1\%}$=342.4 kg/ha
$DL_{0.1\%}$=550.0 kg/ha

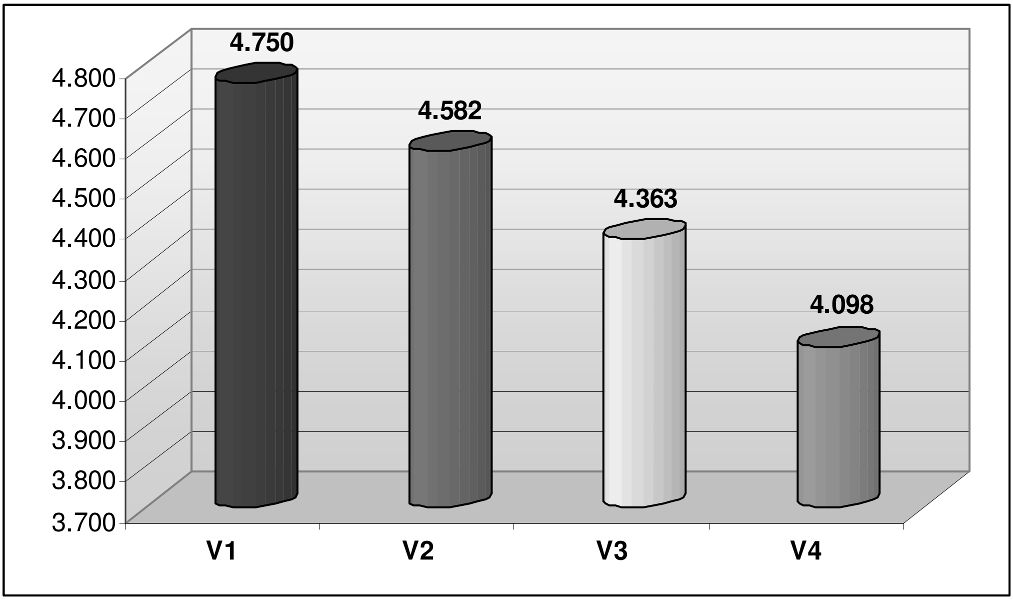

Fig. 2. Influence of tillage system on the maize crop yield in 2006

The 2007 year has been not favorable because of drought. This why the maize yields have been low (under 2 t/ha). With the first variant that was deeply plowed there were obtained 1,915 kg/ha. With the shallow plowed variant the yield has been of 1,711 kg/ha, 10.7% lower than control, 204 kg/ha (significantly negative). Preparing the seedbed by two disc tillage there were given 1,506 kg/ha. The percent loss was of 21.4% and the yield one of 409 kg/ha (Table 3, Figure 3).

Table 3

Influence of tillage system on the maize crop yield on the reddish preluvosoil (2007)

Variant	Tillage	Yield			Sign.
		kg/ha	%	± Ctrl.	
V_1	Deep plow 21-25 cm	1,915	100	-	-
V_2	Shallow plow 13-17 cm	1,711	89.3	- 204	0
V_3	Disc two times	1,506	78.6	- 409	00
V_4	Direct drill	1,185	61.9	- 730	000

$DL_{5\%}$=201.6 kg/ha
$DL_{1\%}$=305.3 kg/ha
$DL_{0.1\%}$=490.4 kg/ha

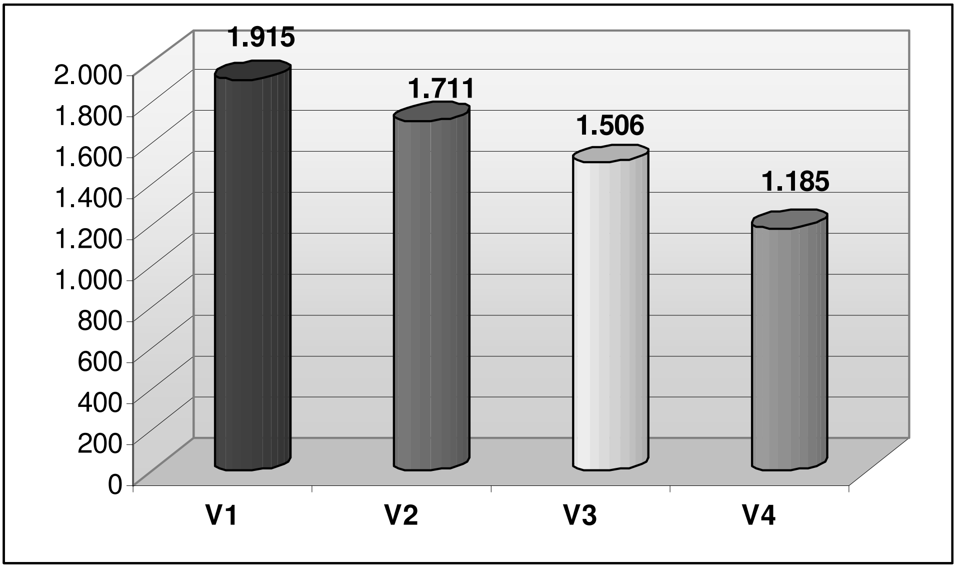

Fig. 3. Influence of tillage system on the maize crop yield in 2007

With the direct drilled variant there was recorded a yield of 1,185 kg/ha, 32.2% less than control. The yield shortage is significant, of 730 kg/ha. Calculating the maize average yield during the three years of experiment we have obtained the following results:

- with the control variant where there was performed a deep plow the maize yield was of 3,696 kg/ha (Table 4, Figure 4);
- with the shallow plowed variant the yield was of 3,534 kg/ha with a shortage of 162 kg/ha which means 4.4% (not significant);
- by replacing the plowing with two disc tillages made when preparing the seedbed the yield was of 3,338 kg, 9.7% less than control or 358 kg/ha minus (distinct significant)
- with the direct drilling the yield has been the least, of only 3,103 kg/ha, 16% less than control. The yield shortage was very significant, of 593 kg/ha.

In conclusion, the best results were given by the control variant which was plowed annually at 21-25 cm depth. The shallow plowing has determined not significantly yield shortage or significantly yet the disc tillage two times on a not plowed soil has determined significant, distinct significant and very significant losses. Direct drilling has determined negative distinct significant differences only in 2005 and very significant in other years. The level of yields was correlated with the rainfall in 2007 which was a dry year with decreasing effect on yield. With the condition of silty clayey or clayey texture the crop has positively reacted to deep tillage when the water and air regime were improved.

Table 4

Influence of tillage system on the maize crop yield on the reddish preluvosoil (2005-2007)

Variant	**Tillage**	**Yield**			**Sign.**
		kg/ha	%	± Ctrl.	
V_1	Deep plow 21-25 cm	3,696	100	-	-
V_2	Shallow plow 13-17 cm	3,534	95.6	- 162	-
V_3	Disc two times	3,338	90.3	- 358	00
V_4	Direct drill	3,103	84.0	- 593	000

$DL_{5\%}$=199.5 kg/ha
$DL_{1\%}$=308.9 kg/ha
$DL_{0.1\%}$=493.0 kg/ha

CONCLUSIONS

1. Due to the texture of the reddish preluvosoil and the imposibility of irrigating these soils, the maize crop is not recommended to be cultivated without tillage.

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REMANENT EFFECT OF MERLIN DUO AND GARDORPRIM PLUS GOLD 500 SC HERBICIDES APPLIED TO WINTER WHEAT CROPS

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Keywords: *Merlin Duo, Gardoprim Plus Gold 500 SC, winter wheat, remanent effect*

Abstract

The remanent effect of herbicides was studied by many foreign researchers: Hurle 1980, Hime and coll. 1991, Wuerzer 1985.

In Romania, the largest number of experiments regarding the remanent effect of herbicides based on atrazin and simazin upon various crops have been made by dr. Şarpe and his collaborators. During the past 10 years, studies have been also made regarding the remanent effect of dicamba and 2,4-D herbicides upon various crops, namely maize, sunflower, sugar beet and flax fand hemp, as well as upon genetically-modified peas and winter wheat.

The experiments regarding the remanent effect of Merlin Duo and Gardoprim Plus Gold 500 SC are the ***first ones of this type and unique*** *in Romania, being carried out in the Flood Plain of the Danube river.*

In the years 2007-2008, experiments were performed at the Agrofam-Holding Agricultural Company from Fetesti, Ialomita County, situated in an area with alluvial soil specific to the aforementioned Flood Plain, the aim being to study the remanent effect of the herbicides ***Merlin Duo,*** *which contains 37,5 g/litre isoxaflutol + 375 g/litre terbuthylazin,* ***Gardoprim Plus Gold 500 SC,*** *which contains 312,5 g/litre S – metalochlor + 187,5 g /litre terbuthylazin.*

The Merlin Duo herbicide was applied in doses of 3 and 6 liters per hectare, and the Gardoprim Plus Gold 500 SC was applied in doses of 5 and 10 litres per hectare. Both herbicides were applied in July, after the wheat was harvested. After apllication, the herbicides were incorporated by disking 15-18 cm deep into the ground. In the spring of 2008, before the soybean was sowed, the land was laboured 10 cm deep by the disk and the combinator.

Based on the observations made every month during the vegetation stage and on the yield obtained, the authors have reached the conclusion that the Merlin Duo and Gardoprim Plus Gold 500 SC did not present any remanent effects on the alluvial soil from the Flood Plain of the Danube river.

INTRODUCTION

The remanent effect of herbicides was studied by many foreign researchers. In France, Beraud and coll., quoted by Ghinea (1987), studied the effect of trifluralim herbicide applied to rape crops in doses of 1,000 and 2,400 g/ha and find out that wheat yield did not diminish in comparison with the wheat yield recorded in case of crops sowed after rape untreated with herbicides. Hurle, K., Walker, A., (1980) studied the interaction of different herbicides with the soil. In Belgium, Salambier I. (1975) did not identify any toxic effects nor differences in terms of yield recorded in case of winter wheat crops sowed after potatoes treated with metobromuron, metriluzin, linuron + terbacil and linuron + cyanazin. Studying the persistence of some herbicides on a clayish soil from Italy on a few test plants: wheat, maize, sugar beet, lettuce and zucchini, Cesari and collab. (1975) asserted that the herbicides based on simazin, atrazin, diuron and benztiazuron are the most persistent.

In Romania, the largest number of experiments regarding the remanent effect of herbicides have been made by Şarpe and his collaborators (1981, 1987).

The herbicide Gesaprim 50 WP, based on atrazin, applied in doses of 5 and 10 kg/ha to maize crops on the chernozem soil from Fundulea proved not to be phytotoxic for the winter wheat, rape, flax and sunflower crops. In his PhD. thesis, Mr Iulian Şarpe (2005) studied the remanent effect of several herbicides: Icedin Super, which contains 100 g/l dicamba + 300 g/l 2.4-D acid, Glean 75 DF which contains 75% chlorsufuron and Grodyl, which contains 75% amidosulfuron. The remanent effect of the Glean 75 DF herbicide was extremely evident on sunflower crops, while no phytotoxic symptoms were observed as far as the herbicides Icedin Super and Grodyl are concerned. At the Şimnic Research Station, situated on a podzol soil type, the most powerful effect of the Glean 75 DF herbicide was on sugar beet. In the variant treated with 15 g/ha, the yield of biomass diminished by 90%, and in the variants treated with 25-35 g/ha doses, the biomass production was totally compromised. However, at the Teleorman Station, situated on a chernozem-type soil, much richer in humus, the remanent effect of the Glean 75 DF herbicide was very weak or it was practically absent. Thus, in case of winter wheat treated by 15 g/ha, after which sugar beet was sowed in the spring, a 42,300 kg/ha root yield was recorded, whereas the yield recorded with the reference plot was 42,380 kg/ha the two values being practically equal.

MATERIAL AND METHODS

At the Agrofam-Holding company of Feteşti, situated in the Flood Plain of the Danube river, on an alluvial soil, which contains 3.5 - 4.0% humus and 35 - 40% clay, the following herbicides were used to study the remanent effect on soybean crops:

1. **Merlin Duo,** which contains 37.5 g/l isoxaflutol + 375 g/l terbuthylazin.
2. **Gardoprim Plus Gold 500 SC**, which contains 312.5 g/l S-metalochlor + 187.5 g /l terbuthylazin.

After the winter wheat was harvested, a 15 to 18-centimeter-deep disking operation was performed by means of a BISO heavy disk. Both herbicides were applied by means of RAU equipment. After application, the herbicides did not incorporate into the soil. In spring, the soil was submitted again to a 15-cm-deep disking operation, and before sowing another 10-cm-deep intervention was made by means of a combinator machine. The type of winter wheat sowed for this experiment was the Dropia cultivar produced at the National Institute for Agricultural Research from Fundulea.

The experiment was displayed by the linear method with 3 repetitions, because all the works were executed mechanically. After the winter wheat sprouted, the researchers monitored the plants and observed the level of phytotoxicity, conferring grades according to the scale established by the EWRS (European Weed Research Society). At the same time, measurements were made to determine the density of the wheat plants and the grain yield per hectare, calculated according to the STAS humidity.

RESULTS AND DISCUSSION

In Table 1 we present the results regarding the density of the winter wheat plants, recorded for the Dropia winter wheat cultivar.

Analyzing the data presented in Table 1, we shall find out that the density of the plants in the 3-4 leaves stage in the variants treated by the herbicide Merlin Duo in doses of 3.0 and 6.0 litres per hectare was of 519-520 per square meter, and in the variant which was not treated the density recorded was of 520 plants per square meter. Similar results were also recorded in the variants treated by the herbicide Gardoprim Plus Gold 500 SC. In the plots treated by 5.0 litres and 10.0 litres per hectare, the density recorded amounted to 519 and respectively 520 stems per square meter, being equal to the one recorded in case of the untreated reference plot.

The density recorded in the phase when the wheat plants had 8-10 leaves was not much different from the one recorded in the 3-4 leaves stage. Very small differences were recorded in case of the variants treated by the herbicides Merlin Duo and Gardoprim Plus Gold 500 SC as compared to the untreated variant, in whose case the number of plants was 1140 per m^2 compared to the level of density of 1141 plants per m^2 recorded in the 3-4 leaves stage.

At the same time, in the in-blossom phase, the density recorded for the untreated variant was of 1141 stems per m^2. In the variants treated by the herbicides Merlin Duo in doses of 3.0 and 6.0 l/ha, the density was 1140 – 1141 stems per m^2. In case of the variants treated by doses of 5.0 and 10.0 l/ha of Gardoprim Plus Gold 500 SC, the density of wheat plants was practically equal to the one recorded in case of the variant treated by the herbicide Merlin or of the untreated variant.

Table 1

Determination of soybean plant density recorded for the Dropia winter wheat cultivar S.C. "Agrofam Holding", Fetesti, 2007 – 2009

Herbicides applied after the winter wheat has been harvested	Doses (litres/ha)	Wheat stems density
In the 3-4 leaves stage		
1. Untreated (reference plot)	-	520/m^2
2. Merlin Duo	3.0	519/m^2
3. Merlin Duo	6.0	521/m^2
4. Gardoprim Plus Gold 500 SC	5.0	519/m^2
5. Gardoprim Plus Gold 500 SC	10.0	520/m^2
In the 8-10 leaves stage (sprouted)		
1. Untreated (reference plot)	-	1140/m^2
2. Merlin Duo	3.0	1139/m^2
3. Merlin Duo	6.0	1140/m^2
4. Gardoprim Plus Gold 500 SC	5.0	1140/m^2
5. Gardoprim Plus Gold 500 SC	10.0	1141/m^2
In the 50%-in-blossom stage		
1. Untreated (reference plot)	-	1141/m^2
2. Merlin Duo	3.0	1140/m^2
3. Merlin Duo	6.0	1141/m^2
4. Gardoprim Plus Gold 500 SC	5.0	1140/m^2
5. Gardoprim Plus Gold 500 SC	10.0	1132/m^2
Upon harvesting		
1. Untreated (reference plot)	-	1030/m^2
2. Merlin Duo	3.0	1031/m^2
3. Merlin Duo	6.0	1030/m^2
4. Gardoprim Plus Gold 500 SC	5.0	1030/m^2
5. Gardoprim Plus Gold 500 SC	10.0	1029/m^2

The last density measurement was made before harvesting. For the variants treated by the herbicide Merlin Duo in doses of 3.0 and 6.0 l/ha, the density recorded was of 1031-1030 stems per m^2, and in the variants treated by the herbicide Gardoprim

Plus Gold 500 SC in doses of 5.0 and 10.0 l/ha the density was of 1030-1030 stems per m^2, while in case of the untreated variant, the density recorded was of 1030 plants per m^2. We can therefore draw the conclusion that the herbicides Merlin Duo and Gardoprim Plus Gold 500 SC **did not reduce** winter wheat plant density when applied to the Dropia winter wheat cultivar.

The phytotoxic effect of the herbicides Merlin Duo and Gardoprim Plus Gold 500 SC was observed in 3 distinct stages of the winter wheat plants (3-4 leaves, 8-10 leaves and in the in-blossom stage). The results recorded are presented in Table 2 below.

Table 2

The phytotoxic effect caused by the herbicides Merlin Duo and Gardoprim Plus Gold 500 SC S.C. "Agrofam Holding", Fetesti, 2007 - 2009

Herbicides applied after the winter wheat has been harvested		Doses (litres/ha)	EWRS grades
In the 3-4 leaves stage			
1.	Untreated (reference plot)	-	1.0
2.	Merlin Duo	3.0	1.0
3.	Merlin Duo	6.0	1.5
4.	Gardoprim Plus Gold 500 SC	5.0	1.0
5.	Gardoprim Plus Gold 500 SC	10.0	1.0
In the 8-10 leaves stage (sprouted)			
1.	Untreated (reference plot)	-	1.0
2.	Merlin Duo	3.0	1.0
3.	Merlin Duo	6.0	1.0
4.	Gardoprim Plus Gold 500 SC	5.0	1.0
5.	Gardoprim Plus Gold 500 SC	10.0	1.0
In the 50 %-in-blossom stage			
1.	Untreated (reference plot)	-	1.0
2.	Merlin Duo	3.0	1.0
3.	Merlin Duo	6.0	1.0
4.	Gardoprim Plus Gold 500 SC	5.0	1.0
5.	Gardoprim Plus Gold 500 SC	10.0	1.0
EWRS grades: 1.0 without any phytotoxic symptom 1.5 very weak phytotoxic symptoms (insignificant) 9.0 a rate of plant destruction of 80-90%.			

Analysing the data presented in Table 2, we can assert that the herbicides Merlin Duo and Gardoprim Plus Gold 500 SC did not have a phytotoxic effect upon the winter wheat. When assessing the level of phytotoxicity in the 3-4 leaves stage, and only in the variant treated by Merlin Duo in a dose of 6.0 l/ha, the EWRS grade conferred was 1.5, because some plants presented insignificant symptoms of phytotoxicity, leaves presenting a slight yellowish colour.

When assessing the level of phytotoxicity in the 8-10 leaves stage and in the in-blossom stage, these symptoms (yellowish leaves) have disappeared. We can therefore state that the herbicides Merlin Duo and Gardoprim Plus Gold 500 SC **did not have any phytotoxic** symptoms upon winter wheat plants.

The results regarding the grain yield are more important. In Table 3 below, we present the grain yield recorded at the Dropia winter wheat cultivar.

Table 3

Yield recorded at the Dropia winter wheat cultivar
S.C. "Agrofam Holding", Fetesti, 2007-2009

Herbicides applied after the winter wheat has been harvested	Doses Litres/ha	Yield	
		kg/ha	%
In the 3-4 leaves stage			
1. Untreated (reference plot)	-	4,480	100.0
2. Merlin Duo	3.0	4,495	100.3
3. Merlin Duo	6.0	4,488	100.0
4. Gardoprim Plus Gold 500 SC	5.0	4,498	100.4
5. Gardo prim Plus Gold 500 SC	10.0	4,488	100.0
DL 5% = 192 kg/ha; DL 1% = 312 kg/ha; DL 0.1% = 427 kg/ha			

The grain yield recorded in the variants treated by the herbicide Merlin Duo in doses of 3.0 and 6.0 l/ha amounted to 4,495-4,488 kg/ha, and in the untreated variant (reference plot), the seed yield amounted to 4,480 kg/ha which entitles us to state that the yields recorded were practically equal. Similar results were recorded for the plots treated by the herbicide Gardoprim Plus Gold 500 SC – the grain yield recorded in this case amounting to 4,498-4,488 kg/ha.

CONCLUSIONS

1. The winter wheat plant density did not diminish following to the treatments by application of the herbicides Merlin Duo and Gardoprim Plus Gold 500 SC. With both herbicides, the density amounted to 1029-1031 wheat ears per square meter, being practically equal to the one recorded in case of the untreated variant (reference plot).

2. Neither of the aforementioned herbicides, namely Merlin Duo and Gardoprim Plus Gold 500 SC, have caused any phytotoxic symptoms to the winter wheat plants.
3. The grain yields recorded in case of both herbicides, namely Merlin Duo and Gardoprim Plus Gold, were practically equal to the one obtained from the untreated reference plot.

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ESTABLISHMENT OF OPTIMAL PERIOD OF HERBICIDES APPLICATION FOR WINTER WHEAT AND ITS IMPORTANCE FOR WEED CONTROL AND YIELD

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Keywords: *optimal period, selectivity, efficacy*

Abstract

In order to determine with maximum accuracy the optimal herbicide treatment period for winter wheat, a trial field was organized at Moara Domneasca by the Agrotechnical Department, Faculty for Agriculture between 2008-2009.

The soil type is reddish brown, pH value 6.7, organic material content 2.6% and clay content over 40%. Five herbicides were tested and their effect was compared with a check field were no herbicides were used, known as standard. The following herbicides were studied:

- *Dicopur D (2.4 D) dosage 1 litre/ha;*
- *Dicopur Top (2.4 D + dicamba) dosage 1 litre/ha;*
- *Buctril universal (bromoxinil) dosage 1 litre/ha;*
- *Mustang (florasulam + 2.4 D) dosage 0.5 litre/ha;*
- *Kingstar 75 WG (tribenuron methyl) dosage 0.020 kg/ha.*

These herbicides were applied in four different stages of development for the wheat plants as follows:

- *the first treatment was made during the tillering period (stage D-F; Keller & Baggiolini scale) (Figure 1);*
- *the second treatment was made at the end of the tillering and the beginning of the first inter-node formation (stage F-H);*
- *the third treatment was made at the stage of 2-3 internodes (stage H-J);*
- *the fourth treatment was made at the stage of buds, before emerging of the live (stage J-L).*

The experiment was made by the method of divided patches with two factors, in four replications, having the harvested plot of 10 square meters, with 2 factors:
The factor A was period of treatment with herbicides;
The factor B was type of herbicides.
The winter wheat variety cultivated was Boema, produced by INCDA Fndulea.
The herbicides were applied mixed with 250 liters water/ha.

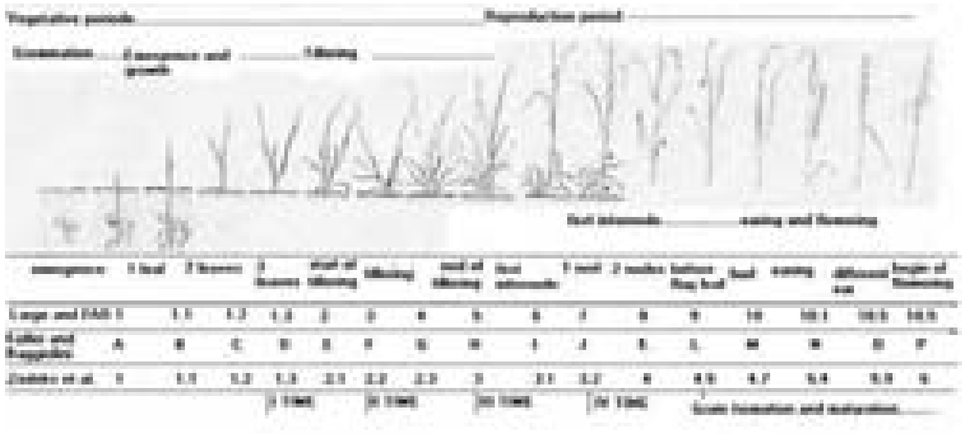

Fig. 1. Development stages of winter wheat and setting of application periods

There have been made measurements regarding the weeds before the treatment with herbicides, they were repeated after 30 days and before harvesting.

The measurements were made by counting the weeds by different species and by weighting the dried weeds in kg/ha.

There have been made measurements regarding the selectivity of the herbicides on wheat plants following the EWRS (European Weed Research Society) notes, by measuring the density per square meter, by counting the number of spikes on the ears, by counting the number of thin beans, by MMB and by yield.

The analysis of the data concluded that the appliance of herbicides in the second period, that is at the end of the tillering period and at the stage of first inter-node formation, efficiency was very good and the yield was the highest.

The earlier or the later the application moment of the treatment, compared to this optimal period, the less effect was obtained as regards weed control and the less yield was harvested.

INTRODUCTION

In Romania, in the past 10 years, due to the lack of financial resources, these research works, although very important for the agricultural practice, were less approached. The fact that Romania has become a member of the European Community was the reason why sorts, hybrids and even technologies were adopted without a prior and thorough research. In our country are used today varieties from all over the world (especially Europe and USA, but also from Asia and Australia) and this leads to massive yield reductions due to the lack of adaptability to the local conditions. Well known are the severe droughts from the past years that led to low wheat yields. Not the last factor that contributed to diminished yields was the improper usage of herbicides (sometimes too early, other times too late) or the miss choice from the range of herbicides on the market.

These are the reasons for which we consider this research issue very important, the conclusions should establish the best period of herbicide treatment for the winter wheat crops in order to get the maximum for the weed control, and the maximum of yield. The farmers should also become more familiar to the proper usage of herbicides, should understand the risks of early or late applications of the treatments.

MATERIAL AND METHODS

The trial field was organized in the fields of the Faculty of Agriculture from Moara Domneasca between 2008-2009, on a brown-reddish soil, with a pH value of 6.4 and a organic material content of 2.6%.

Five herbicides were tested:

- Dicopur D (600 g/l 2.4 D) dosage 1 litre/ha;
- Dicopur Top (344 g/l 2.4 D+120 g/l dicamba) dosage 1 litre/ha;
- Buctril universal (280 g/l bromoxinil + 280 g/l ester 2,4D) dosage 1 litre/ha;
- Mustang (6.25 g/l florasulam + 300 g /l acid 2.4 D) dosage 0.5 litre/ha;
- Kingstar 75 WG (tribenuron methyl 75%) dosage 0.020 kg/ha.

These dosages were the ones used for the registration of these herbicides in Romania.

There were made four treatments in four different stages of development of the wheat plants (Zadoks et al and Keller et. Baggiolini scale, Figure 1):

- the first application was made during the tillering period (stage D-F), the weeds were undeveloped, with 2-3 leaves, some of the weeds were in different stages of emerging;
- the second application was made at the end of the tillering and formation of the first inter-node (stage F-H), all the weeds are emerged and have 4-6 leaves and are 2-4cm high, it is considered the optimal period;
- the third application was made at the stage of 2-3 internodes (stage H-J) and the weeds were 10-14 cm high;
- the fourth application was made at the stage of buds, before emerging of the flag (stage J-L) and the weeds were 25-30 cm high or more.

The trial field was organized by the divided patches method in four replications, the area of the plot being 10 square meters. The quantity of water used for the tests was 250 litres.

Measurements regarding the selectivity of the wheat plants and the efficiency on weeds using the EWRS scale (European Weeds Research Society-Table 1).

Table 1

EWRS Scale used for measurement of efficacy and selectivity of herbicides

EWRS NOTES	Efficacy on weeds	EWRS NOTES	Selectivity on wheat
1	Destroyed weeds 98-100%	1	Wheat plants destroyed 1-2%
2	Destroyed weeds 80-95%	2	Wheat plants destroyed 5-15%
3	Destroyed weeds 75%	3	Wheat plants destroyed 25-30%
4	Destroyed weeds 50%	4	Wheat plants destroyed 30-40%
5	Destroyed weeds 30-50%	5	Wheat plants destroyed 40-60%
6	Destroyed weeds 20-25%	6	Wheat plants destroyed 60-70%
7	Destroyed weeds 15-20%	7	Wheat plants destroyed 70-80%
8	Destroyed weeds 5-10%	8	Wheat plants destroyed 80-95%
9	All species of weeds developed resistance	9	Wheat plants destroyed 100%

Measurements were made before harvesting regarding the infestation with weeds by weighting the dried plants.

Measurements were made for plant density on square meter, number of ears, number of spikes in ear, number of kernels in ear, number of thin beans in ear, MMB and yield per ha.

All the experiments were evenly fertilized with complex fertilizers that provided a balanced nutrients support for the plants and diseases and pests were fought against with the same products.

As regards the climate for the period 2008-2009, the weather was favorable for wheat cultures. The lack of rainfall in autumn determined an unevenly emerge of the wheat plants, but the situation was compensated in spring due to the sufficient rainfalls.

The variety cultivated was Boema, produced by Fundulea Insitute.

RESULTS AND DISCUSSION

The level of infestation with weeds species in the experiment was a normal one and the dominating weeds were the following (Table 2).

Table 2

Species of weeds registered in the trial field of Moara Domneasca in 2008-2009

Annual dicotyledonous			Perennial weeds		
No.	**Species**	**Number /m²**	**No.**	**Species**	**Number /m²**
1	Stellaria media	14.0	1	Cirsium arvense	5
2	Sinapis arvensis	10.0	2	Convolvulus arvense	5
3	Fumaria sleicleri	10.0	3	Sonchus arvense	4
4	Galium aparine	8.0	4	Polygonum aviculare	4
5	Polygonum convolvulus	7.0			
6	Capsela bursa pastoris	5.0			
7	Chenopodium album	5.0			
8	Thlaspi arvense	2.0			
9	Papaver rhoes	1.5			
10	Veronica hederifolia	8.0			`
	Total	10 species		Total	4 species

The results obtained in weed control are shown in Table 3. The analysis of these results emphasizes the fact that the best effect on weed control is obtained for the second period of the application that corresponds to the phase when the weeds reach their full growth (four leaves stage) and also the wheat plants reach their full growth. The application made in the first period when the wheat plants are tillering and the weeds were not entirely emerged reduced the weed control compared to the second period or a new infestation with weeds took place after the application.

The applications made in the third and fourth period reduced even more the weed control due to the development of the weeds far over 15-40 cm high, their foliar mass being consistent. Among the products, the best results in weed control were obtained for the second application with Dicopur Top (more than 96%) and Kingstar (more than 98%) followed by Mustang (95%) and Buctril Universal (95%). A less effective product was Dicopur D based on 2.4 D, as the low efficacy for certain species of weeds as Convolvulus avense, Galium aparine, Veronica hederifolia and Papaver rhoeas is known.

As regards the selectivity of the herbicides for the wheat plants, the reduced effect was registered for the second application (Table 3). Herbicides like Dicopur D, Dicopur Top and Mustang affected the wheat plants especially on the third and fourth application; the number of ears, MMB and the number of thin beans emphasize this conclusion. It is known the fact that herbicides based on 2.4 D and Dicamba applied later than the beginning of stem forming lead to pollen sterility.

As regards the effects of different herbicides on productivity, they are shown in Table 4.

Table 3

Influence of application period and type of herbicides on weed control for winter wheat Boema (Moara Domneasca; 2008-2009)

Herbicides	Dosage (l, kg/ha)	Weed control			
		EWRS NOTES	Weight of weeds (kg/ha)	Weed control (%)	Selectivity (EWRS) NOTES
First application – beginning of tillering					
Untreated	STANDARD	8.0	2351	MT	MT
Dicopur D	1.0	2.5	796	66	1.1
Dicopur Top	1.0	1.5	278	90	1.1
Buctril Univ.	0.8	1.7	410	83	1.0
Mustang	0.5	2.0	311	87	1.0
Kingstar 75	0.02	1.0	215	91	1.0
Second application – end tillering and first inter-node (considered optimal stages)					
Untreated	MT	0	2411	MT	MT
Dicopur D	1.0	2.0	510	84	1.6
Dicopur Top	1.0	1.5	105	96	1.1
Buctril Univ	0.8	1.0	215	95	1.0
Mustang	0.5	1.0	210	95	1.0
Kingstar 75	0.02	1.0	100	98	1.0
Third application – 2-3 inter-nodes					
Untreated	MT	9.0	2451	MT	MT
Dicopur D	1.0	3.0	1002	70	2.0
Dicopur Top	1.0	1.5	471	89	2.5
Buctril Univ	0.8	2.0	510	79	1.5
Mustang	0.5	2.0	670	76	2.0
Kingstar 75	0.02	1.5	310	89	1.5
Fourth application – bud stage (before appears the flag leaf)					
Untreated	MT	8.0	2456	MT	MT
Dicopur D	1.0	3.5	1040	68	2.8
Dicopur Top	1.0	1.5	650	74	3.5
Buctril Univ	0.8	2.5	615	75	2.5
Mustang	0.5	2.0	710	71	3.0
Kingstar 75	0.02	1.5	501	80	1.5

Table 4

Influence of different periods of application and different herbicides on some productivity elements for winter wheat cultures - Boema (Moara Domneasca 2008-2009)

Herbicides	Dosage (kg, l/ha)	Number of ear/-s	Number of sterile ears	Number of beans/ ear	No. of thin beans in ears	Weigh of kernel in ear (gr)	Density (Pls/m^2)	MMB (gr)
First application – Beginning of tillering								
Untreated	MT	18.9	1.0	52	8	1.56	510	49.5
Dicopur D	1.0	17.9	2.8	49	9	1.53	508	47.2
Dicopur Top	1.0	18.1	3.2	49	10	1.38	509	46.2
Buctril Univ	0.8	18.2	2.4	50	6	1.51	512	47.9
Mustang	0.5	18.1	3.4	52	4	1.57	519	48.0
Kingstar 75	0.02	18.1	2.7	53	2	1.58	549	49.15
Second application – End of tillering, first inter-node								
Untreated	MT	18.9	1.0	50	6	1.53	508	49.9
Dicopur D	1.0	18.7	2.8	51	8	1.58	511	50.3
Dicopur Top	1.0	18.5	3.5	50	8	1.49	509	49.8
Buctril Univ	0.8	18.9	2.0	52	3	1.57	510	50.1
Mustang	0.5	18.6	1.5	53	4	1.51	511	50.4
Kingstar 75	0.02	18.5	2.0	53	3	1.53	515	50.7
Third application – 2-3 inter-nodes								
Untreated	MT	18.1	1.8	52	5	1.48	511	47.7
Dicopur D	1.0	18.4	6.5	43	8	1.15	510	40.2
Dicopur top	1.0	18.3	6.5	40	11	1.01	509	39.5
Buctril Univ	0.8	18.2	2.7	49	4	1.38	501	46.9
Mustang	0.5	18.1	3.5	46	5	1.30	508	45.7
Kingstar 75	0.02	18.4	3.1	49	6	1.39	507	46.9
Fourth application – bud stage								
Untreated	MT	18.5	1.8	51	5	1.49	510	47.1
Dicopur D	1.0	18.6	4.9	38	10	0.86	507	34.2
Dicopur top	1.0	18.5	9.5	30	16	0.76	506	30.2
Buctril Univ	0.8	18.4	3.8	45	7	1.28	511	41.5
Mustang	0.5	18.1	5.7	39	11	1.20	504	40.9
Kingstar 75	0.02	18.2	4.3	40	8	1.30	501	45.8

Table 5

Influence of different periods of treatment and type of herbicides on Boema winter wheat yield – trial field (Moara Domneasca 2008-2009)

Herbicides	Dose (l, kg/ha)	Yield			
		kg/ha	%	Difference (kg/ha)	Significance
First application – beginning of tillering					
Untreated	MT	2750	MT	MT	-
Dicopur D	1.0	3210	117	460	***
Dicopur Top	1.0	3220	117	470	***
Buctril Univ	0.8	3150	115	400	**
Mustang	0.5	3250	118	500	***
Kingstar 75	0.02	3300	120	550	***
Second application – end of tillering, first inter-node					
Untreated	MT	2796	MT	MT	-
Dicopur D	1.0	3220	115	424	***
Dicopur Top	1.0	3415	122	619	***
Buctril Univ	0.8	3400	122	604	***
Mustang	0.5	3390	121	594	***
Kingstar 75	0.02	3450	123	654	***
Third application – 2, 3 inter-nodes					
Untreated	MT	2786	MT	MT	-
Dicopur D	1.0	2605	94	-181	
Dicopur Top	1.0	2590	93	-196	
Buctril Univ	0.8	3157	113	371	**
Mustang	0.5	2560	103	162	
Kingstar 75	0.02	3296	118	510	***
Fourth application – bud stage					
Untreated	MT	2730	MT	MT	-
Dicopur D	1.0	2400	88	-330	00
Dicopur Top	1.0	2398	87	-332	00
Buctril Univ	0.8	2780	102	50	
Mustang	0.5	2490	98	-240	
Kingstar 75	0.02	3008	110	278	

LSD5% = 286 kg/ha
LSD1% = 310 kg/ha
LSD0.1% = 415 kg/ha

The analyses of the results lead to the following conclusion:

Applied in the second period all the herbicides have the best effect on weeds and the wheat plants are less affected, thus being formed the most ears, the highest number of beans in ear, the highest density, the lowest number of thin beans and a very good MMB.

The earlier or the later we apply the treatment with respect to this second period, the effect is a negative one for all elements of productivity, especially for the herbicides Dicopur D, Mustang and Buctril Universal.

The high number of thin beans obtained for the third and fourth periods for Dicopur D (8-10), Dicopur Top (8-15), Mustang (4-11) reveal the fact that for these herbicides and for these periods the process of floral organs genesis takes place and, the pollen becomes sterile. Also the weeds have a long period for growth and they severely compete with the wheat plants for nutrients, water and vegetation factors.

The results regarding the influence of herbicides applied in different periods to the beans yield are shown in Table 5.

It is very clear, analysing the results, that the best yield is obtained when herbicides were applied in the second period. Applied later, the treatment leads to the decrease of the yield, especially for Dicopur D (-181 kg/ha for the third period and -330 kg/ha for the fourth period); Dicopur Top (-196 kg/ha for the third period and -332 kg/ha for the fourth period) and Mustang (-240 kg/ha for the fourth period). The analysis of the results displayed in figure no. 5 shows the fact that the product based on Tribenuron methyl can be applied until the fourth period with no effect on the yield, but it is not advisable to wait until this period as weeds compete for the nutrients and water with the wheat plants.

CONCLUSIONS

The results obtained after the application of herbicides in different periods led to the following:

1. When herbicides were applied in the second period, all the herbicides had the best effect in weed control and the best selectivity (tolerance) for the wheat plants;
2. The highest yields were obtained when herbicides were applied in the second period (end of tillering-forming of the first inter-node). The application made later, until the bud stage led to big losses of yield and had negative effect on productivity factors;
3. The herbicides that contain 2.4 D, dicamba or esters of these chemicals can be applied only in the second period (end of tillering - forming of the first inter-node). After this period, some other products based on other active substances must be used – for example Tribenuron methyl;
4. That does not affect the yield and the productivity elements.

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WEED MANAGEMENT IN MAIZE CROP IN THE PEDOCLIMATIC CONDITIONS OF THE ROMANIAN PLAIN

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Abstract

Weeds occur in any crop and their control is a problem for every farmer.

The implementation of a sustainable agriculture system which meets the requirements of input minimization in the agricultural ecosystem, while reducing their impact on the environment, and preserving biodiversity, requires a weed management strategy specific toeach area, starting from the weed spectrum.

Maize crop is sensitive to weeding in the first 4 weeks after the emergence and if the weeding extent exceeds the sensitivity threshold, the crop is compromised.

At present the companies producing herbicides offer a wide range of products.

The objective of the research carried out in 2008 and 2009 was to find the best weed control strategy in maize crop.

The experiment was bifactorial with the factor A being weed control (Titus 25 DF, Mistral 4 SC, 2.4 D Diamine 600 RV, Bromotril 40 EC, Lontrel 300, Banvel 480 S, Peak 75 WG and two controls one hoed and the other unhoed) and the factor B being the fertilization level. The weed control was between 30.1% for the herbicide 2.4 D Diamine 600 RV, unfertilized and 82% for the herbicide Titus under fertilization.

INTRODUCTION

Weed still creates a lot of problems in agriculture, and the specific biological features of weeds along with the local climatic conditions, the biodiversity of the flora make it impossible for a unique schema of weed maintenance to be elaborated. Weed control is part of a long lasting agricultural system. Building an agricultural system for a long period of time in order to fulfil the requirements of input minimisation in the agricultural ecosystem, along with the reduction of the impact on the environment and preserving the biodiversity, requires a weed management strategy starting from the need for a good management. Maize crop is very sensitive to weeding in the first four weeks after the emergence and if, during this period, weeding exceeds the sensitivity threshold the maize crop is compromised.

For the moment, the companies producing herbicides offer a wide range of products and farmers deal with difficulties in taking the best decision when dealing with weeds. Under these circumstances, farmers have to be aware of the weeding spectrum on their plantations and the best active substances in order to control the weed population. The main objective of the research was to find a better strategy in controlling weed in the maize crop.

MATERIAL AND METHODS

In order to achieve the goal taken into discussion in 2008 and 2009, a monofactorial experiment with the following scales has been made.

	Variant	Active substances	Period	Rate
a_1	Unhoed an unherbicided control	-		-
a_2	Hoed control	-		-
a_3	Titus 25 DF	Rimsulfuron 20%	post	80 g/l
a_4	Mistral 4 SC	Nicosulfuron 40 g/l	post	1 l/ha
a_5	2,4 D Diamine 600 RV	Acid 2.4 D 600 g/l	post	1 l/ha
a_6	Bromotril 40 EC	Bromoxinil 400 g/l	post	1 l/ha
a_7	Lontrel 300	Clopiralid 300 g/l	post	0.5 l/ha
a_8	Banvel 480 S	Dicamba 480 g/l	post	0.4 l/ha
a_9	Peak 75 WG	Prosulfuron 75%	post	20 g/ha

The surface of the experimental plot was of 42 m, it was worked in 4 sequences and fertilization was done with 100 kg N/ha and 70 kg P/ha.

RESULTS AND DISCUSSION

After three weeks from the emerging of the maize crop, before the herbicide treatments, the weeding spectrum was determined as in Table 1, for which the average was calculated in participation and maintenance. The media a=S/N where S represents the whole number of plants from a certain species found in all the determination points, and N the number of determination points, the average number of weed from a certain species. Participation P%=m*100/M where M=Em represents the average number of weed/mp, the sum of all the average species of weed identified. The constant, K%=n*100N, where n is the number of points in which a certain species was represented.

There were identified a number of 19 species from which 9 were dicotyledonous species and 3 monocotyledonous. The average number of plants out of every species varied between 0.3 pl/mp for *Convolvulus arvense* and 7.2 pl/mp for *Echinochloa cruss galli*, and the average number of weed was 34.7 pl/mp. The participation of different species was between 0.9% for *Convolvulus arvense* and 20.7% for *Echinochloa cruss galli*, whereas dicotiledonated species represent 54.8%. The weed constant varied from 42% for *Sorghum halepense* to 92% for *Amaranthus retroflexus.*

Analyzing the data in Table 2, in which the results of determination are represented regarding the weeding in the maize crop after 2 weeks since the post-emerging treatments in controlling the weed, it was found that the crop that had not been bred, not herbicidated was a number of 45.9 weed/mp from which 24.2 pl/mp were yearly dicotyledonous. In the case of cropped control the weed number drops to 2.6 pl/mp out of which *Cirsium arvense* represents 1.2 pl/m, the other species representing under unit values of the media. Other species: *Fumaria* sp, *Matricaria inodora, Galium aparine, Abutilon theoprasti, Capsella bursa-pastoris, Strellaria media, Viola tricolor.*

Table 1

Maize crop weeding before applying post-emerging treatment

Species	Average	Participation (%)	Constant (%)
Amaranthus retroflexus	2.6	7.5	92
Solanum nigrum	2.4	6.9	90
Polygonum convolvulus	1.9	5.5	76
Chenopodium album	2.0	5.8	80
Galinsoga parviflora	1.6	4.6	70
Hibiscus trionum	2.6	7.5	58
Xanthium strumarium	3.4	9.8	76
Annual dicotyledonous	16.5	47.6	
Convolvulus arvensis	0.3	0.9	46
Cirsium arvense	2.2	6.3	58
Perenial dicotyledonous	2.5	7.2	
Setaria sp.	5.7	16.4	90
Echinochloa cruss-galli	7.2	20.7	84
Annual monocotyledonous	12.9	37.2	
Sorghum halepense	2.8	8.1	42
Perenial monocotyledonous	2.8	8.1	0
Total	34.7	100.0	0

The influence of herbicide treatment on weeding shows that, when applying the herbicides treatment comparatively with the uncropped witness there was recorded a small average number of weed with values, when applying TITUS 25 DF herbicides of 8.3 pl/mp and 2.4 D diamine 600 RV. Applying Titus 25 DF and Mistral 4SC totally fights against monocotyledonous species and reduces the dicotyledonous number. Herbicides Bromotril 40 EC, Lontrel 300, Banvel 480 S, Peak 75 WG fight mostly against the number of dicotyledonous weeds and less the number of monocotyledonous weeds.

Table 3 presents the data regarding the fighting degree against weeds from the maize crop, 2 weeks after applying the post-emerging treatments. Analysing the data from the table, there is clear evidence that, according to the inbred control variation, in which the degree of fighting against weed is 0%, the appliance of different herbicides treatments had as a result the growth in the degree of fighting against weeds up to values from 81% for Titus 25 DF and 30% for 2.4D Diamine 600 RV.

Herbicides Titus 25 DF and Mistral 4SC determine a degree of 100% when fighting against monocotyledonous, and Bromotril 40 EC, Lontrel 300, Branvel 480 S, Peak 75 WG fight 50% of the dicotiledonated weeds but only 10% of the dicotyledonous species.

In Table 4, based on the results concerning the degree of fighting against weed, the specific weed-herbicide patterns were established, considering that a herbicide is efficient when the degree of fighting against weeds exceeds 60%.

CONCLUSIONS

1. Titus 25 DF may be successfully used on a dosage recommended by the producer in order to control the following species: *Amaranthus retroflexus, Polygonum convolvulus, Chenopodium album, Galinsoga parviflora, Xanthium strumarium, Setaria* sp., *Echinochloa cruss-galli, Sorghum halepense*. Reducing the dosage to 75% allows the efficient control over monocotiledonated species and over some dicotyledonous species, such as *Amaranthus retroflexus, Chenopodium album* and *Xanthium strumarium*. Mistral 4SC fights against *Setaria* sp., *Echinochloa cruss-galli*, *Sorghum halepense* and *Amaranthus retroflexus* and *Solanum nigrum* at 100% of the dosage and, if reduced to 75% it cannot fight efficiently against *Solanum nigrum.*
2. The herbicide 2.4 D Diamine 600 RV fights against *Amaranthus retroflexus*, *Chenopodium album* and *Cirsium arvense* at a dosage of 100%, and at 75% of the dosage it can only fight efficiently against *Amarantus retroflexus* and *Chenopodium album*.
3. Bromotril 40 EC fights efficiently against *Amarantus retroflexus, Solanum nigrum, Polygonum convolvulsus, Chenopodium album* and *Galinsoga parviflora.*
4. Lontrel 300 fought against *Amaranthus retroflexus*, *Solanum nigrum, Polygonum convolvulsus* and *Xanthium strumarium*.
5. Banvel 480 S fought efficiently against all dicotyledonous species in 100% of the dosage and has not fought against *Convolvulsus arvense*.
6. Peak 75 WG efficiently controlled the following species: *Amaranthus retroflexus, Solanum nigrum, Polygonum convolvulus, Galinsoga parviflora, Hibiscus trionum, Convolvulus arvensis, Cirsium arvense*, the reducing of the dosage to 75% was followed by a decreasing of the efficiency so that the

following species were been fought against: *Polygonum convolvulus, Galinsoga parviflora* and *Convolvulus arvensis*.

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Tabel 2

Structure of weeding the maize crop 2 weeks after applying post-emerging treatments

	Variant	*Amaranthus retroflexus*	*Solanum nigrum*	*Polygonum convolvulus*	*Chenopodium album*	*Galinsoga parviflora*	*Hibiscus trionum*	*Xanthium strumarium*	*Convolvulus arvensis*	*Cirsium arvense*	*Setaria* sp.	*Echinochloa cruss galli*	*Sorghum halepense*	Da*	Dp**	Ma***	Mp****	Total
a_1	Unhoed and unherbicided control	3.8	3.2	3.1	2.3	2.9	3.8	5.1	0.7	2.3	6.9	8.6	3.2	24.2	3	15.5	3.2	45.9
a_2	Hoed control	0	0	0	0	0	0	0.2	0.2	1	0.1	0	1.1	0.2	1.2	0.1	1.1	2.6
a_3	Titus 25 DF	0.2	2.8	1.2	0	0	3.1	0	0.6	0.4	0	0	0	7.3	1	0	0	8.3
a_4	Mistral 4 SC	0.2	1.2	1.9	1.3	2	3	4.2	0.5	1.8	0	0	0.2	13.8	2.3	0	0.2	16.3
a_5	2.4 D Diamine 600 RV	0	2.6	2.6	0	2.6	3.1	4.9	0.6	0.9	6.2	5.8	2.8	15.8	1.5	12	2.8	32.1
a_6	Bromotril 40 EC	0	0.3	0.6	0	0.2	1.8	4.8	0.7	1.8	6.4	7.8	2.6	7.7	2.5	14.2	2.6	27
a_7	Lontrel 300	0	1	0.2	1.8	2.2	3.6	0	0.6	0	6.6	8.5	2.4	8.8	0.6	15.1	2.4	26.9
a_8	Banvel 480 S	0	0.2	0.2	0	0.6	0	0.2	0	0	6.8	8	3	1.2	0	14.8	3	19
a_9	Peak 75 WG	0	0.3	1.2	1.5	0.8	0.2	2.8	0.2	0.4	6.6	8.4	2.8	6.8	0.6	15	2.8	25.2

*Annual dicotyledonous, **Perenial dicotyledonous, ***Annual monocotyledonous, ****Perenial monocotyledonous

Tabel 3

Degree of weed control (by species) of the maize crop 2 weeks after postemergent treatments (%)

	Variant	*Amaranthus retroflexus*	*Solanum nigrum*	*Polygonum convolvulus*	*Chenopodium album*	*Galinsoga parviflora*	*Hibiscus trionum*	*Xanthium strumarium*	*Convolvulus arvensis*	*Cirsium arvense*	*Setaria* sp.	*Echinochloa cruss-galli*	*Sorghum halepense*	Da*	Dp**	Ma***	Mp****	Total
a_1	Unhoed and unherbicided control	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
a_2	Hoed control	100	100	100	100	100	100	96.1	71.4	56.5	98.6	100	65.6	99.2	60	99.4	65.6	94.3
a_3	Titus 25 DF	94.7	12.5	61.3	100	100	18.4	100	14.3	82.6	100	100	100	69.8	66	100	100	81.9
a_4	Mistral 4 SC	94.7	62.5	38.7	43.5	31.0	21.1	17.6	28.6	21.7	100	100	93.8	43.0	23	100	93.8	64.5
a_5	2.4 D Diamine 600 RV	100	18.8	16.1	100	10.3	18.4	3.9	14.3	60.9	10.1	32.6	12.5	34.7	50	22.6	12.5	30.1
a_6	Bromotril 40 EC	100	90.6	80.6	100	93.1	52.6	5.9	0.0	21.7	7.2	9.3	18.8	68.2	16	8.4	18.8	41.2
a_7	Lontrel 300	100	68.8	93.5	21.7	24.1	5.3	100	14.3	100.0	4.3	1.2	25.0	63.6	80	2.6	25.0	41.4
a_8	Banvel 480 S	100	93.8	93.5	100	79.3	100	96.1	100	100	1.4	7.0	6.3	95.0	100	4.5	6.3	58.6
a_9	Peak 75 WG	100	90.6	61.3	34.8	72.4	94.7	45.1	71.4	82.6	4.3	2.3	12.5	71.9	80	3.2	12.5	45.1

*Annual dicotyledonous, **Perenial dicotyledonous, ***Annual monocotyledonous, ****Perenial monocotyledonous

Tabele 4

Specific patterns for herbicide-weed species they controlled

	Variant	*Amaranthus retroflexus*	*Solanum nigrum*	*Polygonum convolvulus*	*Chenopodium album*	*Galinsoga parviflora*	*Hibiscus trionum*	*Xanthium strumarium*	*Convolvulus arvensis*	*Cirsium arvense*	*Setaria* sp.	*Echinochloa cruss-galli*	*Sorghum halepense*	Da*	Dp**	Ma***	Mp****	Total
a_1	Unhoed and unherbicided control	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
a_2	Hoed control	YES	YES	YES	YES	YES	YES	YES	YES	no	YES	YES	YES	YES	YES	YES	YES	YES
a_3	Titus 25 DF	YES	no	YES	YES	YES	no	YES	no	YES	YES	YES	YES	YES	YES	YES	YES	YES
a_4	Mistral 4 SC	YES	YES	no	no	no	no	no	no	no	YES	YES	YES	no	no	YES	YES	YES
a_5	2.4 D Diamine 600 RV	YES	no	no	YES	no	no	no	no	YES	no	no	no	no	no	no	no	no
a_6	Bromotril 40 EC	YES	YES	YES	YES	YES	no	no	no	no	no	no	no	YES	no	no	no	no
a_7	Lontrel 300	YES	YES	YES	no	no	no	YES	no	YES	no	no	no	YES	YES	no	no	no
a_8	Banvel 480 S	YES	YES	YES	YES	YES	YES	YES	YES	YES	no	no	no	YES	YES	no	no	no
a_9	Peak 75 WG	YES	YES	YES	no	YES	YES	no	YES	YES	no	no	no	YES	YES	no	no	no

*Annual dicotyledonous, **Perenial dicotyledonous, ***Annual monocotyledonous, ****Perenial monocotyledonous

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WEED CONTROL IN SUNFLOWER CROP IN NORTH-EASTERN BUCHAREST

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Keywords: *weed management, herbicides, weed control, sunflower*

Abstract

In Romania there are over 60% of the weed species occuring in Europe and the weeding extent of agricultural fields is very high.

Weed control is a technological measure which is a part of any cropping system. Sunflower crop is especially sensitive to weeding in the first 5-6 weeks after emergence and post emergent weed control is very delicate. There is a limited number of products available for dicotyledonous weed control and they must be applied according to the growing season of the weeds and the crop.

It is imperative for the farmers to set the best strategy for weed control (dicotyledonous after emergence) in maize crop and this helps implement a sustainable agriculture system to also preserve resources and insure steady yields.

Research was carried out in the pedoclimatic conditions of Moara Domneasca, in the years 2008 and 2009.

The experiment was bifactorial where factor A was weed control (Wt unhoed, Wt hoed, Focus ultra, Fusilade forte, Targa 10 EC, Modown 4 F, Racer 25 EC) and factor B was fertilization (unfertilized, $N_{100}P_{70}$).

The findings were that the weeding extent varied between 22.4% when applying the herbicide Racer under no fertilization and 61% for the herbicide Targa 10 EC under fertilization.

The mean yields obtained in the two experimenting years were between 1400 kg per ha when applying Modown and 410 kg per ha in the unhoed and unfertilized control.

INTRODUCTION

Introducing an agricultural precision system and elaborating a strategy of controlling weeds, which may answer to the needs for a long lasting agricultural system must preserve the biological diversity, to use small amounts of herbicide, to prevent the pollution of the soil and to be efficient.

Sunflower is the crop which becomes very sensitive to weeding during the first period of vegetation, up to the 6-8th level of leaves growth, this being the reason for which controlling the weeds, especially the dicotyledonous species, is a problem.

The target of the research was establishing the best active substances in order to control efficiently the weeding of the sunflower crop during its post-emerging period.

MATERIAL AND METHODS

In order to achieve the objective established in 2008 and 2009, a single factorial experience in 7 graduations was set up.

	Variant	Active substance	Period	Rate
a_1	Unhoed and unherbicided control	-		-
a_2	Hoed control	-		-
a_3	Focus ultra	Cicloxidim 100 g/l	post	3-4 l/ha
a_4	Fusilade forte	Fluazifop-P-butil 150 g/l	post	1.3 l/ha
a_5	Targa 10 EC	Quizalofop-p-etil 100 g/l	post	0.4 l/ha
a_6	Modown 4 F	Bifenox 480 g/l	post	1.5 l/ha
a_7	Racer 25 EC	Fluorocloridon 250 g/l	post	3 l/ha

Research took place in the experimental field of Weed Science Department.

It was done in four sequences.

Fertilization was done in two parts when preparing the seed bed and a 50% of dosage was applied on it, while the rest was applied on vegetation.

Sowing was realized on the 2nd of April 2008 and on the 25th of March 2009, and springing was seen on the 11th of April 2008 and on the 15th of April 2009.

RESULTS AND DISCUSSION

Three weeks after the sunflower crop sprung, before applying the herbicide treatment, the range of weeding was determined as seen in Table 1- for which the average, the participation and the constant were calculated. When analyzing the data from chart 1 one can see that there a number of 16 species of weeds was identified out of which 5 were annual dicotyledonous species, 2 perennial dicotyledonous species, 2 annual monocotyledonous species and a perennial monocotyledonous species. To all these, a number of 5 annual dicotyledonous species of 1% participation are added.

The average number of plants from each species varied from 0.6 pl/mp for *Cirsium arvense* and 5.6 pl/mp for *Setaria* sp., and the average number of weeds was of 30.4 pl/mp. The participation of different species was between 0.6% for *Convolvulus arvense* and of 20.9% for *Setaria* sp., while the dicotyledonous species represented 55.48%. The constant of weed species in the sunflower solarium after 50 determinations varied between 46% for *Cirsium arvense* and 86% for *Xanthium strumarium.*

In Table 2 presents the results of the determinations of the sunflower crop weeding structure 2 weeks after applying the post-emerging treatments. Analyzing the data from the table, one can see that in the inbred control variant there was a number of 39.7 weeds/mp, out of which 19.4 pl/mp were annual dicotyledonous. For the bred control the number of weeds falls up to 2.2 pl/mp, out of which sorgum halepense represents 1.2 pl/mp, the other species being represented in a much smaller number.

Table 1

Weeding of the sunflower crop before applying post-emerging treatments (average,participation, constant)

Species	Average	Participation (%)	Constant (%)	
Amaranthus retroflexus	2.5	7.7	80	Other species: *Fumaria* sp. *Abutilon theophrasti, Capsella bursa-pastoris, Strellaria media, Viola tricolor*
Chenopodium album	1.3	4	82	
Hibiscus trionum	2.3	7.1	76	
Portulaca oleracea	2.2	6.8	80	
Solanum nigrum	2.8	8.6	70	
Xanthium strumarium	5.1	15.7	86	
Annual dicotyledonous	**16.2**	49.8		
Convolvulus arvensis	1.7	5.2	76	
Cirsium arvense	0.2	0.6	46	
Perenial dicotyledonous	**1.9**	5.8		
Setaria sp.	5.6	20.9	58	
Echinochloa cruss-galli	4.2	15.7	52	
Annual monocotyledonous	**9.8**	36.6		
Sorghum halepense	2.5	7.7	58	
Perenial monocotyledonous	**2.5**	7.7		
Total	**30.4**	100		

It is seen that, when applying the herbicide treatment comparing with the inbred control there had been some downfalls on the average number of weeds, to values between 17.3 pl/mp when applying Targa 10 EC and to 26.7% when applying Racer 25 EC. The greatest amount of weeding was seen in the variants treated with Modown, while the smallest amount of weeding was seen in the variants treated with Targa 10 EC. Herbicides Focus ultra, Fusilade forte and Targa 10 EC especially reduced the number of weeds from the monocotyledonous species, while herbicides Modown 4 F and Racer 25 EC reduced the weeding with the dicotyledonous species.

In Table 3 there are the data regarding the degree of fighting against weeds from the sunflower crop 2 weeks after applying the post-emerging treatments. Analyzing the data from the table, we can see that, in comparison with the inbred control where the degree of fighting against the weeds is of 0%, applying the herbicide treatments has determined a growth in the degree of weed control up to values from 24.7% for Modown 4 F to 52.2% for Targa 10 EC.

It is seen that herbicides Focus ultra, Fusilade forte and Targa 10 EC determine a degree of fighting against monocotyledonous species of over 98.6%, while herbicides Modown 4F and Racer 25 EC fight against dicotyledonous weeds up to 50% but only fight 1.6% against monocotyledonous species.

In Table 4 there are the specific weed-herbicide patterns in the sunflower crop after the research done in 2008 and 2009 in the weather conditions from the M Domneasca.

It is seen that Focus ultra controls well the monocotyledonous species and amaranthus retroflexus. Herbicide Fusilade forte fights against monocotyledonous species. Targa 10 EC efficiently controls the annual monocotyledonous species. Herbicide Modown 4F efficiently controls the annual dicotyledonous species. Herbicide Racer 25 EC fights against dicotyledonous species except for amaranthus and hibiscus trionum.

CONCLUSIONS

1. Herbicides Focus ultra, Fusillade forte, Targa 10 EC reduced the number of weeds from the annual and perennial monocotyledonous species, reduced the weeding degree from these species and had a degree of 100% when fighting against them.
2. Herbicides Modown 4F and Racer 25 EC reduced the number of weeds from the dicotyledonous species, reduced the weeding degree with dicotyledonous species and had an 80% degree of fighting against the annual dicotyledonous species.
3. Based on the determinations the specific weed-herbicide patterns for the sunflower crop the following conclusions were drawn:
4. In the sunflower crop, the chemical control of the dicotyledonous species is poor, *Xanthium strumarum, Convolvulsus arvensis, Cirsium arvense.*
5. Focus ultra - *Amaranthus, Setaria* sp., *Echinochloa cruss-galli, Sorghum halepense.*
6. Fusilade forte - *Setaria* sp., *Echinochloa cruss-galli, Sorghum halepense*.
7. Targa 10EC - *Cirsium arvense, Setaria* sp., *Echinochloa cruss-galli, Sorghum halepense*.
8. Modown 4F - *Amaranthus retroflexus*, *Chenopodium album, Hibiscus trionum, Portulaca oleracea, Xanthium strumarium.*
9. Racer 25EC - *Amaranthus retroflexus, Chenopodium album, Portulaca oleracea, Solanum nigrum.*

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Table 2

Weeding structure in the sunflower crop 3 weeks after applying the post-emerging treatments (nr. mediu/m^2) (average2008-2009)

	Variant	*Amaranthus retroflexus*	*Chenopodium album*	*Hibiscus trionum*	*Portulaca oleracea*	*Solanum nigrum*	*Xanthium strumarium*	*Convolvulus arvensis*	*Cirsium arvense*	*Setaria* sp.	*Echinochloa cruss-galli*	*Sorghum halepense*	Da*	Dp**	Ma***	Mp***	Total
a_1	Unhoed and unherbicided control	2.8	1.4	2.6	3.6	2.8	6.2	1.8	0.8	6.8	7.1	3.8	19.4	2.6	13.9	3.8	39.7
a_2	Hoed control	0	0	0	0	0	0	0.8	0.2	0	0	1.2	0	1	0	1.2	2.2
a_3	Focus ultra	0.2	1.3	2.6	3.8	0.8	6.1	1.7	0.6	0	0	0.2	14.8	2.3	0	0.2	17.3
a_4	Fusilade forte	2.7	1.2	2.4	3.4	2.4	5.8	1.6	0.4	0	0	0	17.9	2	0	0	19.9
a_5	Targa 10 EC	1.2	1.1	1.3	3.4	2.2	4.2	1.5	0.2	0.2	0	0.2	13.4	1.7	0.2	0.2	15.5
a_6	Modown 4 F	0.2	0.2	0.4	0.4	0.6	2.2	1.6	0.6	5.9	6.1	3.4	4	2.2	12	3.4	21.6
a_7	Racer 25 EC	0.2	0	2.4	0.2	0.2	4.9	1.8	0.5	6.5	6.4	3.6	7.9	2.3	12.9	3.6	26.7

*Annual dicotyledonous, **Perenial dicotyledonous, ***Annual monocotyledonous, ****Perenial monocotyledonous

Table 3

Degree of fighting against weeds in the sunflower crop 2 weeks after applying the post-emerging treatments (%)

	Variant	*Amaranthus retroflexus*	*Chenopodium album*	*Hibiscus trionum*	*Portulaca oleracea*	*Solanum nigrum*	*Xanthium strumarium*	*Convolvulus arvensis*	*Cirsium arvense*	*Setaria* sp.	*Echinochloa cruss-galli*	*Sorghum halepense*	Da*	Dp**	Ma***	Mp****	Total
a_1	Unhoed and unherbicided control	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
a_2	Hoed control	100	100	100	100	100	100	55.6	75.0	100	100	68.4	100	61.5	100	68.4	94.5
a_3	Focus ultra	92.9	7.1	0.0	-5.6	71.4	1.6	5.6	25.0	100	100	94.7	23.7	11.5	100	94.7	56.4
a_4	Fusilade forte	3.6	14.3	7.7	5.6	14.3	6.5	11.1	50.0	100	100	100	7.7	23.1	100	100	49.9
a_5	Targa 10 EC	57.1	21.4	50.0	5.6	21.4	32.3	16.7	75.0	97.1	100	94.7	30.9	34.6	98.6	94.7	61.0
a_6	Modown 4 F	92.9	85.7	84.6	88.9	78.6	64.5	11.1	25.0	13.2	14.1	10.5	79.4	15.4	13.7	10.5	45.6
a_7	Racer 25 EC	92.9	100	7.7	94.4	92.9	21.0	0.0	37.5	4.4	9.9	5.3	59.3	11.5	7.2	5.3	32.7

*Annual dicotyledonous, **Perenial dicotyledonous, ***Annual monocotyledonous, ****Perenial monocotyledonous

Table 4

Specific weed-herbicides patterns in the sunflower crop

	Variant	***Amaranthus retroflexus***	***Chenopodium album***	***Hibiscus trionum***	***Portulaca oleracea***	***Solanum nigrum***	***Xanthium strumarium***	***Convolvulus arvensis***	***Cirsium arvense***	***Setaria* sp.**	***Echinochloa cruss-galli***	***Sorgum halepense***	**Da***	**Dp****	**Ma*****	**Mp******	**Total**
a_1	Unhoed and unherbicided control	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
a_2	Hoed control	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**NO**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
a_3	Focus ultra	**YES**	NO	NO	NO	YES	NO	NO	NO	**YES**	**YES**	**YES**	NO	NO	**YES**	**YES**	NO
a_4	Fusilade forte	NO	NO	NO	NO	NO	NO	NO	NO	**YES**	**YES**	**YES**	NO	NO	**YES**	**YES**	NO
a_5	Targa 10 EC	NO	NO	NO	NO	NO	NO	NO	**YES**	**YES**	**YES**	**YES**	NO	NO	**YES**	**YES**	**YES**
a_6	Modown 4 F	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	NO	NO	NO	NO	NO	**YES**	NO	NO	NO	NO
a_7	Racer 25 EC	**YES**	**YES**	NO	**YES**	**YES**	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

*Annual dicotyledonous, **Perenial dicotyledonous, ***Annual monocotyledonous, ****Perenial monocotyledonous

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HARMFULNESS THRESHOLD PRODUCED BY UNSEMELLING CAMOMILE (*MATRICARIA INODORA* L.) IN WHEAT WINTER CROP

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Keywords: *Harmfulness thresholds, Matricaria inodora (MATIN)*

Abstract

In the year 2009, an experiment with 5 treatments was performed at the Moara Domneasca Experimental Station.

The objective was to find the harmfulness threshold produced by the weed Matricaria inodora (MATIN) on the wheat crop fertilized with 200 kg N/ha. The densities of MATIN were: 0; 1; 2; 4; and 6 plants/m^2.

Densities were stabilized by hand weeding. The obtained results showed that MATIN is a harmfulness weed. For the wheat crop, fertilized with 200 Kg N, the threshold in 2009 was 1.8 plant/m^2.

INTRODUCTION

Nowadays, agriculture is facing two situations: to increase production and find sustainable solutions that should lead to higher production and, at the same time, to protect the environment and preserve agricultural resources (soil, water, biodiversity, etc.) [3, 1, 4]. Weeds are components of the biodiversity.

There are two kinds of effects in the agroecosystems: negative, due to the competition for the vegetation factors; positive, thanks to the important role of the weed in habitat formation in the agricultural ecological system.

Thus, they are components of the phytocenosis.

They should not be destroyed totally [5]. In the last 5-10 years, scientists have worked to perform sustainable weed management.

Consequently, new information is necessary about competition, the harmfulness threshold, its level for every weed species, an economic and energetic survey [6, 2].

MATERIAL AND METHODS

The experiments started in 2008. The results presented in this paper are part of the research for our doctoral thesis. Its objective was to determine the harmfulness threshold produced by MATIN in the winter wheat crop of variety Dropia, fertilized with 200 kg N/ha. The experiment had 5 treatments, i.e. 5 plant densities of MATIN, presented in Table 1.

The plot surface was 3.75 m^2 (that is, 10 wheat plant surface was 2 m^2). The experiment had 5 repetitions. Seeds of MATIN collected during July and August period, were spread the second day after the sowing of the wheat crop, and buried slightly by hand harrowing.

Weeding was made manually starting on the 10th of April, periodically until the 20th of May. At the beginning, more density of Matin was left and gradually only the right numbers were saved according to every treatment marked by a red thread.

At the harvesting time, wheat plants were cut from the soil, the plants of MATIN were separated, labelled and put into a shed to dry until they reached a constant weight.

For the wheat crop, it was determined the number of grains per plant, the yield at the 14% humidity, the 1000 grains weight.

RESULTS AND DISCUSSION

Part of the obtained results is presented in Tables 1, 2 and 3. Analysing the data, the conclusions are as follows:

1. The dry weight of the MATIN (Table 1) increased, as normally, with their density
2. Calculated for a hectare, the values varied between 720-4380 kg/ha. The weight of a plant decreased slightly on average.

Table 1

***Matricaria inodora*, dry weight of the plants at the wheat harvest time, 2009 year**

No.	**Densities of MATIN (pl/m^2)**	**Dry weight**		
		g/m^2	g/plant	kg/ha
1	0	-	-	-
2	1	72	72	720
3	2	143	75.5	1430
4	4	280	70	2800
5	6	408	68	4080

DL 5%=4.0 g/m^2
DL 1%=7.2 g/m^2
DL 0.1%=15.0 g/m^2

Table 2

Winter wheat yields influenced by densities of *Matricaria inodora*

No.	Densities of MATIN pl/m^2	Yields kg/ha	D	%	Signific.
1	0	4020	Mt	100	Mt
2	1 pl	3860	160	96	-
3	2 pl	3746	274	93	x
4	4 pl	3565	455	88	xx
5	6 pl	3360	650	83	xx

DL 5%=250 kg/ha
DL 1%=447 kg/ha
DL 0.1%=735 kg/ha

Calculation of the harmfulness threshold: the value of DL 5% is 250 kg/ha. Comparing this value with that from column D (Differences), it is observed that this value is close to the value of 274 kg/ha. The value of 274 kg/ha is determined by the density of the treatment no 3, i.e. two plants MATIN/ha.

If the difference 274 kg/ha is caused by the density of 2 plants/ha; 250 kg/ha would be determined by the density of 1.8 plant of MAINT/m^2.

Table 3

1000 grain weight of wheat, Dropia variety, depending on weediness by *Matricaria inodora*, the year 2009

Nr.	*Matricaria inodora*		Wheat grains		
	Density no./m^2	Dry weight g/m^2	Weight of 1000 grains	D	%
1	0	0	47	Mt	100
2	1	72	46.2	-0.8	98
3	2	138	44.8	-2.2	95
4	4	296	43.7	-3.3	93
5	6	438	42	-5.0	89

DL 5%=3
DL 1%=5
DL 0.1%=8

CONCLUSIONS

1. The lowest to the highest density is from 72 to 68 g/plant.

2. The values of wheat yields (Table 2) decrease gradually with the increasing density of MATIN. Expressed as percentage, the decrease was between 4 and 17%.
3. The weed MATIN is a very harmful threshold for a crop fertilized with 200 kg N, being 1.8 plant/m^2.
4. The 1000 wheat grains decreased with the increase of the density of MATIN. In percentage, this means from 100% to 89%.

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COMPETITION BETWEEN WEEDS AND MAIZE PLANTS

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Keywords: *competition, critical period of competition*

Abstract

The paper presents the results of our research performed at the experimental field of the complex farm-crops and animals – Miloşeşti – Ialomiţa. The experiment has 10 treatments which differ by the periods in which mechanical cultivations and on the rows manuals hoeings are performed. These variations of works gives the opportunity to know the critical period of competition during the vegetation period.

The maize hybrid Olt Has been cultivated. The weediness has been determined numerically and gravimetrically. For the maize plants the roots and aerial weights and yields have been determined. The analysis of the obtained results conduct to the conclusion that the critical period of weediness for the maize crop starts with the phase, 20 days from the rising (20 DAR) and becomes intensely in the period 20-40 DAR. The highest damages are produced by the weedings in the plant rows.

INTRODUCTION

It is known that weedness are competitors of the cultivated plants for the vegetation conditions. But the same time they are components of the biodiversity and contribute to establish the equilibrium in the agroecosystem [2].

In the last 5-6 years, Sustainable Management of the weeds is consolidated more and more. The complex measures of this system must be established for the conditions of every zone or farm [1, 3]. Information regarding the competition between weeds and cultivated plants, critical periods of the competition, harmfulness threshold, news machines to recognize the weeds in the field are necessary.

Our paper contains contributions to the realization of these demands.

MATERIAL AND METHODS

Research was performed on the experimental field of the complex-farm crops and animals - Miloşeşti - Ialomiţa. The experiment had 10 treatments (Table 1) with different periods in the performing mechanical cultivation and manual hoeing in the rows of the plants. These difference give the possibility to establish the critical period of the competition between the weeds and the maize plants during the vegetation period. The Olt hzbrid was grown. The surface of a plot was 23.1 m^2.

The experiment has 4 replications. Determinations were performed regarding the weediness numerically and gravimetrically, in three replications. In the phase of milk-wax, was determined the weight of the plant roots, for the 0-30 cm soil depth, the maize yields was calculated for 15.5% humidity.

Table 1

Treatments of the experiment

No.	Cultivations and their periods DAR = days after maize rising				
	Mechanical			Manual on rows	
	I 20 DAR	II 40 DAR	III 60 DAR	I 20 DAR	II 40 DAR
1	Yes	Yes		Yes	Yes
2	No	Yes	Yes	Yes	Yes
3	Yes	Yes		No	Yes
4	No	Yes	Yes	No	Yes
5	Yes	No	Yes	Yes	Yes
6	Yes	Yes		Yes	No
7	Yes	No	Yes	Yes	No
8	Yes	Yes		Yes	Yes
9	Yes	Yes		Yes	Yes
10	No cultivation				

RESULTS AND DISCUSSION

The paper presents only part of the results.

The data regarding weediness at the time of the first cultivation (at 20 DAR) showed no important differences between treatments; they varied 75-83 plants/m^2 and from these half were monocotiledonate and half dicotiledonate.

At the harvest of the maize, the number and the dry weight of the weeds varied depending on the treatments as shown in Table 2.

Table 2

Weediness at the harvest of maize

Treatments no.	**Weeds**		**Dry weight**	
	No./m^2	%	kg/ha	%
1 st.	56	100	420	100
2	58	104	415	99
3	67	120	537	128
4	72	129	526	125
5	57	102	417	99
6	61	109	438	104
7	65	116	550	131
10	140	250	1800	328

DL5% - 30
DL1% - 58
DL0.1% - 95

Table 3

Root weight of the maize plants on the milk-wax phase

Treatments no	**Soil depth - cm**			**Total**	**%**
	0-10	10-20	20-30		
1(st)	26	8	3	37	100
4	20	6	2	28	75
7	25	6	2	33	89

DL for Total: 5% = 3; 1% = 5; 0.1% = 8

Table 4

Weight of the aerial plants of maize on the milk-wax phase

Treatments no	**g/pl**	**D**	**%**	**Signification**
1(st)	240	Mt	100	Mt
4	160	-80		000
7	210	-30		00

DL5% = 20; 1% = 32; 0.1% = 59

Data regarding the roots and aerial weights of the maize plants demonstrate a very intense competition of the weeds during the period 20-40 DAR.

Data regarding the yield (Table 5), also demonstrate that there is a critical period of competition during this period.

Table 5

Yields of maize - 2009

Treatments no.	kg/ha	D	%	Signification
1	5700	St.	100	St.
2	5130	-570	90	00
3	4610	-1090	81	000
4	4110	-1590	74	000
5	5290	-410	93	0
6	5010	-690	88	00
7	4740	-960	77	000
8	5760	60	101	-
9	5650	-50	99	-
10	2250	-3450	39	000

DL5% = 380 kg/ha
DL1% = 570 kg/ha
DL0.1% = 830 kg/ha

CONCLUSIONS

1. The critical period of the competition between weeds and corn plants starts at 20 DAR and becomes more intensive by 40 DAR.

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RESEARCH REGARDING FERTILIZATION AND WEED MANAGEMENT IN A PLUM TREE ORCHARD IN NORTH-EASTERN BUCHAREST

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Keywords: *weed management, fertilysers, production, biomass*

Abstract

High and steady yields are a major objective for any agricultural holding and, in the case of fruit tree plantations, the specific market requirements are an additional goal.

The implementation of a sustainable agriculture system requires a smaller amount of pesticides, less environmental pollution, more efficient technologies, biodiversity and resource conservation by means of input reduction, output and holding lucrativity increase and resource redistribution.

The paper aims to find the best fertilization and weed control solution in a plum tree plantation in the pedoclimatic conditions of Moara Domneasca.

The findings were that the obtained yields varied greatly according to the fertilizer and herbicide treatments. Thus, the application of a total herbicide in fractionated doses resulted in more efficient weed control compared to a single dose application. Regarding fertilization, the best results were obtained in the treatments with both soil and leaf applications.

Concerning yield levels, they varied between 6.9 t/ha in the treatment with no herbicidation and no fertilization and a maximum level of 14.6 t/ha, where weed control was performed by applying two doses of herbicide and combined soil and leaf fertilization.

INTRODUCTION

The plum tree, one of the oldest fruit tree species, with a high adaptability to the climatic conditions, is grown in a territory extending from the plain to the mountains.

Plums have a high nutrient value, with a sugar content of 16-20%, potasium 170 mg%, Ca 12 mg%, Mg 10 mg%, P 18 mg%, Na 1mg%, Fe 0.5 mg%, Cl 1.5 mg% etc. According to the F.A.O. Annals vol. 51 (1997) the biggest plum producing countries are: China with 2700 thousand tones, U.S.A. with 830 thousand tones and Romania with 600 thousand tones. Spectacular increases in plum tree production have been recorded in the latest years in China, U.S.A., Turkey, Spain, Iran, Chile, Japan and Pakistan.

High and steady yields with low inputs are the goal of any farmer, but this goal needs to be consistent with the requirements of environmental protection, pollution reduction and biodiversity conservation. Weed control is a major problem for any agricultural holding because weeds use a part of the applied fertilizers and they are hosts to pests and diseases.

When setting up an optimal fertilization scheme in an orchard, one needs to take into account the planned yield and the quality of the obtained fruit.

Research aimed to identify the best fertilization and weed control treatments in a Stanley plum tree plantation in the pedoclimatic conditions in Moara Domneasca.

MATERIAL AND METHODS

In order to reach the objectives for 2008 şi 2009, a bifactorial experiment was set up in the Stanley plum tree plantation where:

Factor A ***weed control***

a_1	Unweeded unherbicided	
a_2	Clean-up 2 l/ha	Gliphosat 360 g/l
a_3	Clean-up 4 l/ha	Gliphosat 360 g/l
a_4	Clean-up 2 + 2 l/ha	Gliphosat 360 g/l

Factor B ***fertilization***

b_1	unfertilized	
b_2	Complex N:P:K 500 g/pom	20:20:20
b_3	Complex N:P:K 500 g/tree +Foliar Murtonik 2 kg/ha	20:20:20 + 20:20:20 + microelements
b_4	Complex N:P:K 500 g/tree +Foliar Murtonik 2+2 kg/ha	20:20:20 + 20:20:20 + microelements
b_5	Complex N:P:K 500 g/tree + Foliar Fertitel 2 kg/ha	20:20:20 + 6,6:6:4,1 + microelements
b_6	Complex N:P:K (500 g/tree) + Foliar Fertitel 2+2 kg/ha	20:20:20 + 6,6:6:4.1 + microelements

The soil was reddish preluvosoil with a content in humus of 2.2%, loamy-clayey texture and pH 6.2.

The assessed indicators were weed expansion and weed control extent when harvesting and yield levels.

RESULTS AND DISCUSSION

The data analysis in Table 1 regarding the influence of weed control methods factor A on the biomass in the plum tree plantation in the unherbicided treatments indicates that the mean weed biomass in the unherbicided treatments was 1621

g/m^2, and the application of herbicides led to a very significant reduction in weed biomass in all treatments and the fractionated application of the same herbicide dose decreases weed biomass, but this decrease is not statistically assured.

The analysis of the influence of weed control method factor A on weed biomass for each fertilization method (the same graduation of factor B) reveals that, in all tested fertilization treatments, the application of herbicides reduces very significantly the weed biomass in comparison with the unherbicided treatments.

Table 1

Weed biomass in the plum tree plantation under weed control and fertilization methods, Moara Domneasca 2008-2009 (g/m^2)

	Factor A											
	a_1	$a_1b_n - a_1b_1$	a_2	$a_2b_n - a_2b_1$	a_3	$a_3b_n - a_3b_1$	a_4	$a_4b_n - a_4b_1$	$a_2 - a_1$	$a_3 - a_1$	$a_4 - a_1$	Mean b
Unfertilized	1552	Mt	556	Mt	398	Mt	340	Mt	-996	-1154	-1212	712
Complex N:P:K 500 g/tree	1627	75	581	25	407	8	365	25	-1046	-1220	-1262	745
Complex N:P:K 500 g/tree +Foliar Murtonik 2 kg/ha	1635	83	589	33	440	42	374	33	-1046	-1195	-1262	759
Complex N:P:K 500 g/tree +Foliar Murtonik 2+2 kg/ha	1652	100	623	66	457	58	398	58	-1029	-1195	-1253	782
Complex N:P:K 500 g/tree + Foliar Fertitel 2 kg/ha	1619	66	573	17	448	50	349	8	-1046	-1170	-1270	747
Complex N:P:K 500 g/tree Foliar Fertitel 2+2 kg/ha	1640	88	597	41	437	39	392	52	-1043	-1203	-1248	767
Mean a	1621		586		431		370		-1034	-1190	-1251	752

	A	B	AxB	BxA
DL5%	88	56	112	63
DL1%	145	91	181	95
DL0.1%	183	146	256	138

When analysing the influence of fertilization factor B on weed biomass there can be seen that the application of fertilization determined significant weed biomass increases only in b4 treatment fertilized with Complex and two leaf doses of Murtonik.

The analysis of the influence of factor B on weed biomass for each weed control method (the same graduation for factor A) shows that the application of different fertilization methods led to increases in weed biomass in all the tested weed control treatments in comparison with the unfertilized witness treatments. These increases are statistically assured as significant only in b4 (complex + 2xMurtonik).

The largest weed biomass was of 1652 g/m^2 recorded in the unherbicided treatment fertilized with complex fertilizer and two doses of Murtonik and the lowest in the unfertilized treatment herbicided in fractions.

Table 2 holds the data regarding weed control extent in the plum tree plantation under fertilization and different weed control methods.

When analysing the influence of weed control methods factor A on the weed control extent one can see that the mean weed control extent in the unherbicided treatments was of - 4.2% in comparison with the unfertilized and unherbicided treatment used as witness.

Table 2

Weed biomass in the plum tree plantation under weed control methods and fertilization, Moara Domneasca 2008-2009 (%)

	Factor A											
	a_1	a_1b_n - a_1b_1	a_2	a_2b_n - a_2b_1	a_3	a_3b_n - a_3b_1	a_4	a_4b_n - a_4b_1	a_2 - a_1	a_3 - a_1	a_4 - a_1	Mean b
Unfertilized	0.0	Mt	64.2	Mt	74.3	Mt	78.1	Mt	64.2	74.3	78.1	54.1
Complex N:P:K 500 g/tree	-4.8	-4.8	62.6	-1.6	73.8	-0.5	76.5	-1.6	67.4	78.6	81.3	52.0
Complex N:P:K 500 g/tree +Foliar Murtonik 2 kg/ha	-5.3	-5.3	62.0	-2.1	71.7	-2.7	75.9	-2.1	67.4	77.0	81.3	51.1
Complex N:P:K 500 g/tree +Foliar Murtonik 2+2 kg/ha	-6.4	-6.4	59.9	-4.3	70.6	-3.7	74.3	-3.7	66.3	77.0	80.7	49.6
Complex N:P:K 500 g/tree + Foliar Fertitel 2 kg/ha	-4.3	-4.3	63.1	-1.1	71.1	-3.2	77.5	-0.5	67.4	75.4	81.8	51.9
Complex N:P:K 500 g/tree Foliar Fertitel 2+2 kg/ha	-5.7	-5.7	61.5	-2.6	71.8	-2.5	74.7	-3.3	67.2	77.5	80.4	50.6
Mean a	-4.4		62.2		72.2		76.2					51.6

	A	B	AxB	BxA
DL5%	5.4	3.3	6.1	3.8
DL1%	8.8	5.6	9,6	6.3
DL0.1%	11.2	7.5	12,8	8.4

The application of herbicide doses led to a very significant weed control extent in all the studied treatments. There can also be seen that the application of the same fractionated dose of herbicide determined an increased weed control extent, but this increase was not statistically assured.

The analysis of the influence of weed control methods factor A on the weed control extent for each fertilization method (the same graduation of factor B) shows that, in all the tested fertilization treatments, the application of herbicides leads to very significant increases in weed control extent in comparison with the unherbicided treatments.

Regarding the influence of fertilization factor B on weed control extent, there can be seen that the application of fertilization determined reductions in weed control extent, but these reductions aren't statistically assured as significant except for the b4 treatment where complex fertilizers and two leaf doses with Murtonik were applied.

When assessing the influence of fertilization (factor B) on weed control extent for each weed control method (the same graduation of factor A), there can be seen that in all the tested weed control treatments the application of different fertilization methods was followed by a reduction in weed control extent in comparison with the unfertilized witness treatments. These reductions of the weed control extent are significant only in the treatment b4 (complex + 2xMurtonik).

The smallest weed control extent was recorded in the unherbicided treatment fertilized with complex fertilizer and two Murtonik doses.

The analysis of the influence of the weed control method factor A on plum yield (Table 3) shows that the mean yield in the unherbicided treatments was of 9.9 t/ha and it reached 12.8 t/ha when herbiciding with Clean-up in a dose of 2+2 l/ha.

Table 3

Yields obtained under weed control methods and fertilization in a Stanley plum tree plantation in Moara Domneasca Farm (t/ha)

	Factor A											
	a_1	a_1b_n - a_1b_1	a_2	a_2b_n - a_2b_1	a_3	a_3b_n - a_3b_1	a_4	a_4b_n - a_4b_1	a_2 - a_1	a_3 - a_1	a_4 - a_1	Mean b
Unfertilized	6.9	Mt	8.1	Mt	8.2	Mt	8.7	Mt	1.2	1.30	1.8	8.0
Complex N:P:K 500 g/pom	9.3	2.4	10.1	2	10.9	2.7	11.3	2.6	0.8	1.60	2.0	10.4
Complex N:P:K 500 g/pom +Foliar Murtonik 2 kg/ha	10.8	3.9	11.7	3.6	12.7	4.5	13.2	4.5	0.9	1.9	2.4	12.1
Complex N:P:K 500 g/pom +Foliar Murtonik 2+2 kg/ha	11.6	4.7	12.9	4.8	13.8	5.6	14.9	6.2	1.3	2.2	3.3	13.3
Complex N:P:K 500 g/pom + Foliar Fertitel 2 kg/ha	9.7	2.8	10.6	2.5	11.4	3.2	13.8	5.1	0.9	1.7	4.1	11.4
Complex N:P:K 500 g/pom Foliar Fertitel 2+2 kg/ha	11.3	4.4	12.1	4	13.2	5	14.6	5.9	0.8	1.9	3.3	12.8
Mean a	9.9		10.9		11.7		12.8					11.3

	A	B	AxB	BxA
DL5%	0.71	0.92	0.63	1.03
DL1%	0.93	1.31	1.02	1.67
DL0.1%	1.39	1.98	1.35	2.48

The influence of weed control method factor A on plum yield for each fertilization method (the same graduation of factor B).

The analysis of data regarding plum yield shows that in all tested fertilization treatments, the application of herbicide doses determines significant yield boosts. These boosts are very significant when herbiciding with a dose of 4 l/ha Clean-up.

The influence of fertilization factor B on plum yield

The mean data in Table 1 show that the application of fertilization led to very significant yield boosts in all the tested fertilization treatments in comparison with the unfertilized treatment.

The influence of fertilization factor B on plum yield for each weed control method (the same graduation of factor A)

When assessing the results fo the obtained plum yield, there can be seen that in all the tested weed control treatments the application of different fertilization methods was followed by a significant yield boost in comparison with the unfertilized witness treatments. The biggest yield was of 14.9 t/ha and it was recorded in the treatment herbicided with 4 l/ha Clean-up and fertilized with complex fertilizer and two doses of Murtonik.

CONCLUSIONS

The analysis of the presented data reveals the following conclusions:

1. The mean plum yield in the unherbicided treatments was of 9.9 t/ha and reached 12.8 t/ha when herbiciding with Clean-up 2+2 l/ha.
2. The application of weed control methods and fertilization led to significant increases in plum yields.
3. The application of weed control methods led to an increase in weed control extent and a reduction in weed biomass.

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RESEARCH REGARDING THE ECONOMIC EFFICIENCY OF THE TECHNOLOGIES APPLIED TO AN APPLE ORCHARD IN NORTH-EASTERN BUCHAREST

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Keywords: *weed management, fertiysers, economic efficiency, profit*

Abstract

In the Bucharest area, the steady increase in fresh fruit demand and the need to increase the profitability of agricultural fields resulted in setting up a fruit tree plantation at the Moara Domneasca Teaching Farm.

The main goal of any farmer is to obtain high quality yields to meet the market requirements, but there are also sustainability issues provided by yield levels and the ability to back up expenses.

Given the need for high and steady yields while reducing pollution extent, fertilizers and pesticides inputs, the economic efficiency and the output maximization can be achieved only through the optimization of fertilizer and herbicide inputs.

The present paper aims to analyse economic efficiency for the applied technologies so as to determine the best fertilization and weed control solution in an apple orchard in the pedoclimatic conditions of Moara Domneasca.

Following the performed research, there was observed that the yields varied greatly between 8.3 t/ha and 18.1 t/ha according to the fertilizer and herbicide treatments.

The production expenses varied between 4200 lei/ha for the unfertilized and unherbicided treatments and had a maximum level of 6900 lei/ha.

Regarding economic efficiency, the best results were obtained in the treatments where weed control was performed through two herbicide applications, and fertilization was performed both on soil and leaves.

INTRODUCTION

High and steady yields with low inputs are the goal of any farmer, but this goal needs to be consistent with the requirements of environmental protection, pollution reduction and biodiversity conservation.

Weed control is a major problem for any agricultural holding because weeds use a part of the applied fertilizers, which are no longer available for plants when applied, even if they are returned to the soil when destroying the weeds. Weeds are hosts to pests and diseases that decrease yield quality and by efficient control of weeding, these populations are indirectly controlled. Setting up an adequate weed management strategy in a sustainable agriculture system focused on biodiversity conservation and the reduction of pesticides consumption means reducing weed expansion up to the damage threshold, given that a total weed destruction is neither necessary nor efficient.

When setting up an optimal fertilization scheme in an orchard, one needs to take into account the planned yields, fruit quality and the holding profitability, all of which require an integrated approach to apple tree cropping system with all the technological elements interconnected.

The goal of the research was to identify the best fertilization and weed control treatments economically speaking for apple tree growing technology in the pedoclimatic conditions of Moara Domneasca.

MATERIAL AND METHODS

In order to assess the economic indicators in the years 2008 and 2009, a bifactorial experiment was set up where:

Factor A ***weed control***

a_1 -	Unweeded unherbicided	
a_2 -	Clean-up 2 l/ha	Gliphosat 360 g/l
a_3 -	Clean-up 4 l/ha	Gliphosat 360 g/l
a_4 -	Clean-up 2 + 2 l/ha	Gliphosat 360 g/l

Factor B ***fertilization***

b_1 -	Unfertilized	
b_2 -	Complex N:P:K 500 kg/ha (500 g/tree)	20:20:20
b_3 -	Complex N:P:K 500 kg/ha (300 g/tree) + Foliar Murtonik (3 kg/ha)	500 kg/ha 20:20:20 + 20:20:20 + microelements
b_4 -	Complex N:P:K 500 kg/ha (300 g/tree) + Foliar Murtonik (3 kg/ha)	500 kg/ha 20:20:20 + 20:20:20 + microelements
b_5 -	Complex N:P:K 500 kg/ha (300 g/tree) + Foliar Fertitel	500 kg/ha 20:20:20 + 6,6:6:4.1 + microelements

Research was carried out in the intensive apple tree plantation of Delicios breed sited in Moara Domneasca Farm in North-Eastern Bucharest.

RESULTS AND DISCUSSION

When analysing *the influence of the weed control method factor A on apple production (Table 1),* there can be seen that the mean apple yield in the unherbicided treatments was of 13.3 t/ha and it reached 15.7 t/ha when herbiciding with 4l/ha Clean-up.

The influence of the weed control method factor A on the amount of apple production for each fertilization method (the same graduation of factor B)

The data analysis regarding apple production shows that in all the tested fertilization treatments, the application of herbicides determine yield boosts, which are significant when applying a single treatment with Clean-up 2l/ha and very significant boosts when applying a dose of 4 l/ha.

The influence of fertilization factor B on apple production

The mean data in Table 1 show that fertilization led to very significant yield boosts in all the tested fertilization treatments in comparison with the unfertilized treatment.

The influence of fertilization factor B on apple production for each weed control method (the same graduation of factor A)

When assessing the results regarding the obtained apple production, there can be seen that in all weed control treatments, the application of different fertilization methods was followed by a very significant increase in production in comparison with the unfertilized witness treatments. The highest production was recorded in the treatment herbicided with 4 l/ha Clean-up and fertilized with complex fertilizer and two applications of Murtonik.

Table 1

Yields obtained under different weed control and fertilization methods in a Delicios apple plantation in Moara Domneasca Farm (t/ha)

	Factor A				**Yield boost**							
	a_1	b_n-b_1	a_2		a_3		a_4		a_2 - a_1	a_3 - a_1	a_4 - a_1	Mean b
b_1-unfertilized	8.3	S Mt	9.4	S Mt	10.2	Mt	10.8	S Mt	1.1^{*}	1.9^{***}	2.5^{***}	9.7
b_2-Complex N:P:K 500 kg/ha	13.2	4.9	14.1	4.7	14.8	4.6	15.6	4.8	0.9^{*}	1.6^{***}	2.4^{***}	14.4
b_3-Complex + Murtonik 2 l/ha	14.9	6.6	16.3	6.9	16.9	6.7	17.2	6.4	1.4^{**}	2^{***}	2.3^{***}	16.3
b_4 -Complex + Murtonik 2+2 l/ha	15.8	7.5	16.9	7.5	17.8	7.6	18.1	7.3	1.1^{*}	2^{***}	2.3^{***}	17.1
b_5-Complex + Fertitel 2 l/ha	14.5	6.2	15.8	6.4	16.1	5.9	16.9	6.1	1.3^{**}	1.6^{***}	2.4^{***}	15.8
Mean a	13.3		14.5		15.1		15.7		1.16^{**}	1.82^{***}	2.4^{***}	

	A	B	AxB	BxA
DL5%	0.61	1.09	0.73	1.23
DL1%	0.83	1.61	1.12	1.97
DL0.1%	1.39	2.28	1.55	2.88

In Table 2, there can be seen the mean expenses in the Golden Spur apple plantation in the two experimenting years. When analysing data, one can notice that the lowest expenses, were recorded for the unweeded and unfertilized treatments. Apart from these steady expenses all the applications involve increases in expenses.

The analysis of the mean variable expenses for factor A show that in comparison with the unweeded and unherbicided, the application of herbicides determines expenses increases of up to 1630 lei/ha.

Fertilization application leads to increases in expenses of up to 1190 lei/ha in comparison with the unfertilized treatments.

The mean expenses for factor A – weed control – vary between 5014 lei/ha for the unweeded and unherbicided treatments and 6644 lei/ha for the treatments where the Clean-up herbicide was applied in a dose of 2+2 l/ha.

The mean expenses for factor B fertilization varied between 5208 lei/ha in the unfertilized treatments and 6288lei/ha when fertilizing with Complex+Murtonik 2+2 l/ha (b_4).

Table 2

Yield expenses in the apple tree plantation when applying weed control and fertilization, averages of 2008-2009 (lei/ha)

		a_1 unweeded	a_2 Clean-up 2 l/ha	a_3 Clean-up 4 l/ha	a_4 Clean-up 2 + 2 l/ha	
		-	800	1600	1630	Mean b
b_1-unfertilized	-	4200	5000	5800	5830	5208
b_2-Complex N:P:K 500 kg/ha	960	5160	5960	6760	6790	6168
b_3-Complex + Murtonik 2 l/ha	1020	5220	6020	6820	6850	6228
b_4 -Complex + Murtonik 2+2 l/ha	1140	5280	6080	6880	6910	6288
b_5-Complex + Fertitel 2 l/ha	1190	5210	6010	6810	6840	6218
Mean a		5014	5814	6614	6644	

The analysis in Table 3 of the data regarding the levels of yields obtained in the apple tree plantation show that the lowest income was of 8300 lei/ha and was recorded in the unfertilized and unweeded treatments while the highest income was of 18100 lei/ha and was recorded in the a_4b_4 treatment herbicided with Clean-up 2+2 l/ha and fertilized with Complex + Murtonik 2+2 l/ha.

The mean values of income when applying methods of weed control (factor A) varied between 13300 lei/ha where there was no herbicide and 15700 lei/ha in the treatments herbicided with Clean 2+2 l/ha.

The mean values of income when applying different fertilization methods (factor B) varied between 9675 lei/ha in the unfertilized b_1 treatment and 17150 lei/ha in the b_4 treatment fertilized with Complex 500 kg/ha + Murtonik 2+2 l/ha.

Table 3

Income obtained in the apple tree plantation under weed control and fertilization (lei/ha)

Treatments	a_1	a_2	a_3	a_4	Mean b
	unweeded	Clean-up 2l/ha	Clean-up 4l/ha	Clean-up 2 + 2 l/ha	
b_1-unfertilized	8300	9400	10200	10800	9675
b_2-Complex N:P:K 500 kg/ha	13200	14100	14800	15600	14425
b_3-Complex + Murtonik 2 l/ha	14900	16300	16900	17200	16325
b_4 -Complex +Murtonik 2+2 l/ha	15800	16900	17800	18100	17150
b_5-Complex + Fertitel 2 l/ha	14500	15800	16100	16900	15825
Mean a	13300	14500	15100	15700	

Table 4 contains the data regarding the profit obtained in the apple tree plantation under weed control and fertilization.

Table 4

Profit obtained in the apple tree plantation when applying weed control and fertilization methods (lei/ha)

Treatments	a_1	a_2	a_3	a_4	Mean b
	unweeded	Clean-up 2l/ha	Clean-up 4l/ha	Clean-up 2 + 2 l/ha	
b_1-unfertilized	4100	4400	4400	4970	4467
b_2-Complex N:P:K 500 kg/ha	8040	8140	8040	8810	8257
b_3-Complex + Murtonik 2l /ha	9680	10280	10080	10350	10097
b_4 -Complex +Murtonik 2+2 l/ha	10520	10820	10920	11190	10862
b_5-Complex + Fertitel 2 l/ha	9290	9790	9290	10060	9607
Mean a	8286	8686	8486	9056	0

Data analysis show that the profit levels were between 4100 lei/ha in the unweeded and unfertilized treatments and 11190 lei/ha in the a_4b_4 treatment herbicided with Clean-up 2+2 l and fertilized with Complex+Murtonik 2+2 l/ha.

The analysis of the influence of factor A weed control on the profit obtained in the apple tree plantation indicates a variation between 8286 lei/ha in the unweeded treatments and 9056 lei/ha in the treatments where weed control was performed with the herbicide Clean-up 2+2 l/ha.

When analyzing the influence of fertilization factor B on profit there can be seen that it was of 4467 lei/ha in the unfertilized treatments and 10862 lei/ha in the treatments fertilized with Complex+Murtonik 2+2 l/ha

CONCLUSIONS

The analysis of yields, expenses, income and profit renders the following conclusions:

1. The mean apple yield in the unherbicided treatments was of 13.3 t/ha and reached 15.7 t/ha when herbiciding with Clean-up 2+2 l/ha.
2. The application of weed control methods led to significant yield boosts;
3. The application of fertilization led to yield boosts.
4. The lowest expenses were recorded in the unweeded and unfertilized treatments.
5. The application of weed control and fertilization methods determine increases in production expenses.
6. The lowest income was recorded in the unweeded and unfertilized treatments.
7. Weed control and fertilization application led to income increases.
8. The lowest profit was in the unweeded and unfertilized treatments.
9. Fertilization and weed control determine increases in profit.

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MANAGEMENT RECOMMENDATIONS AND OPTIONS TO IMPROVE CROP SYSTEMS AND YIELDS ON SOUTH-EAST ROMANIA IN THE CONTEXT OF REGIONAL CLIMATE CHANGE SCENARIOS OVER 2020-2050

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Keywords: *climate change, agriculture, yields, adaptation*

Abstract

Climate is one of the most important factors determining the productivity of agricultural production systems. The aim of this paper is to analyze possible climate change effects on winter wheat and maize growth, development and yielding, using the results and conclusions provided by six S-E Romania agrometeorological stations and applying the simulation models CERES-Wheat and CERES-Maize in combination with the RegCM3 climatic predictions at a very fine resolution (10 km) over 2020-2050.

A comparative analysis of the results obtained showed that future changes in regional scenario-based climate evolutions can have negative effects upon yield increase, development and formation. For both analyzed crops, the vegetation season gets shorter and there are fewer days available to reaching full ripeness. This shortening of the vegetation season is more marked in maize crops than in winter wheat. Such a forcing is mainly due to a probable increase in air temperature, estimated by the regional model. As to the possible effects of climate change upon yields, they depend on the genetic type (C_3 or C_4), direct effects of increased CO2 concentrations on photosynthesis, local conditions and the severity of changes in climate evolution according to the two scenarios.

INTRODUCTION

Romania is characterized by a warmer and moderately dry climate, with a large variability in the monthly precipitation amounts and their distribution.

Climate change has a major impact in agriculture by affecting the quantity and quality of yields and altering the soil water balance, plant water requirements, and length of vegetation period. Future climate projections show that the Romanian agricultural areas may be affected in a negative way by a number of climate changes that are predicted by regional climate models. Adapting to climate change through a better crop system management will benefit mainly from the knowledge given by our responses to severe climate events, when plans to adapt to and mitigate predictable climate change risks are implemented.

MATERIAL AND METHODS

The present paper deals with the effects of possible climate change effects on winter wheat and maize growth, development and yielding, using the results and conclusions provided by six S-E Romania agrometeorological stations and applying the simulation models CERES-Wheat and CERES-Maize in combination with the RegCM3 climatic predictions (Georgi et al. 1993) at a very fine resolution (10 km) over 2020-2050. This model has been continuously improved through user contributions provided by research centers worldwide, including Romania (Caian, 1998).

The simulation models CERES-Wheat (D.C. Godwin et al., 1989) and CERES-Maize (J.T. Ritchie et al., 1989) as well as the Seasonal Analysis Program, integrated in the DSSAT v3.5 decision system, were used in assessing the impact of climate change upon winter wheat and maize crops.

As regards the specific data on winter wheat and maize phenological development and growth, there were chosen only species whose genetic coefficients represent the average conditions over 1961-1990, as they are closer to the real values (phenology, yields) recorded in fields or standard platforms at the agrometeorological stations involved. Used as inputs, the management variables of wheat crops resulted from calibrating and validating the model and they take different values according to the agro-climatic area; mean seeding date ranges between 8 and 11 October, average seed density 600-400 pl/m^2, distance between rows 8-12.5 cm and seeding depth 4-6 cm. As to maize crops, seeding date and density were chosen according to the current average conditions: seeding date 15-22 April, density 45,000-60,000 pl/ha.

To assess the winter wheat and maize response in the current clime conditions, there were used 1961-1990 climate data series: low and high temperatures, standard deviation in high and low temperatures, precipitation, and standard deviation in precipitation, asymmetry coefficient for precipitation distribution, probability of a “dry” day (no precipitation) after a rainy one, probability of a wet day after a wet day, number of days with precipitation and solar radiation.

RESULTS AND DISCUSSION

To evaluate the climate change impact upon maize and winter wheat, CERES models were run for current climate conditions (1961-1990) as well as for the 2020-2050 regional climate scenario-anticipated conditions, considering the direct effect of increased CO_2 concentrations (from 330 to 450 ppm) upon the photosynthesis processes. The results simulated under climate change conditions were compared to those obtained for the current climate. Thus, changes in yield levels and the length of vegetation period, as well as in cumulated precipitation and evapotranspiration during the vegetation season were quantified.

According with the RegCM3/2020-2050/SRES A1B scenario, climate predictions indicate lows higher by 2.4°C- 6.9°C, mostly in the warm season. Monthly mean highs are 2-5°C lower than in current climate conditions. Changes in monthly precipitation range from -33.8 mm to +29.7 mm. Precipitation amounts increase on the whole about 6-29.7 mm in the cold season (X-IV) and decrease during the warm season (V-IX) by 4-33.8 mm in comparison with the current clime conditions (Figure 1- for ex. Fundulea station).

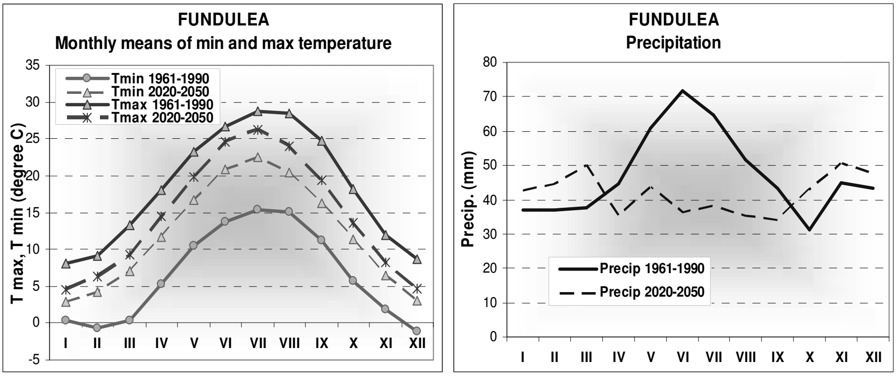


Fig. 1. Multi-annual monthly means of air temperature highs/lows and precipitation amounts under current climate conditions (1961-1990) and RegCM3 / 2020-2050 / SRES A1B predictions at Fundulea station

Analyzing the results simulated on the grounds of 2020-2050 climate change estimations made by regional climatic models highlighted that the future climate evolutions may he have important effects upon crops and they are conditioned by an interaction between the following factors: current climate changes on a local scale, severity of climate scenario-forecasted parameters, how the increased CO_2 concentrations influence photosynthesis, and the genetic nature of plant types.

Table 1

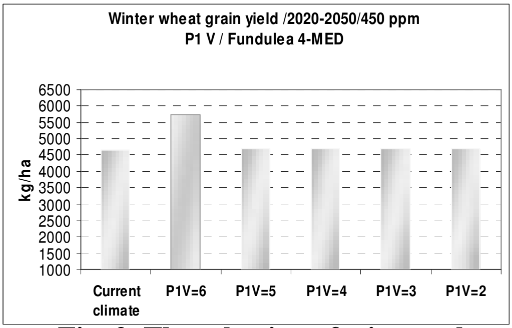
The winter wheat growing season duration

Site	Current climate / 1961-1990	Scenario / 2020-2050	Absolute differences (days)
Buzau	274 days	263 days	-11
Calarasi	269 days	254 days	-15
Fundulea	279 days	262 days	-17
Grivita	284 days	268 days	-16
Rm. Sarat	270 days	255 days	-15
Galati	272 days	259 days	-13

Under current climate conditions, the mean length of the vegetation season (from seeding time to ripeness) ranges between 269 and 284 days, decreasing by

11-17 days with climate change. The fastest growth occurs at Fundulea station, where the winter wheat ripens 17 days earlier than under current clime conditions (Table 1).

For the winter wheat crop the most suitable genotype under climate condition 2020-2050 are varieties with high vernalization (P1V=6.0) and with moderate photoperiod requirement (P1D=3.5), Figure 2.



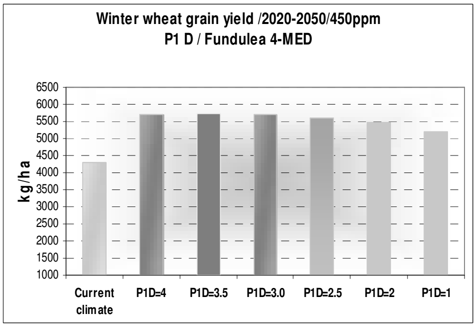


Fig. 2. The selection of winter wheat genotype under climate scenario

A 30-year mean of winter wheat yields, simulated under current climate conditions, ranges between 3599 kg/ha at Galati and 5016 kg/ha at Calarasi. Given the probable climate conditions according to the RegCM3/2020-2050/SRES A1B scenario-predicted future evolution, the mean wheat yield is higher by 8.5% - 58.9% than the 1961-1990.

If climate changes according to the analyzed scenario, the maize yields will decrease at every analyzed station due to higher temperatures that shorten the vegetation season (Table 2), coupled with a water stress, mainly during the phenological phases of grain formation and filling.

Table 2

The changes of maize growing season duration under climate scenario

Site	Current climate / 1961-1990	Scenario / 2020-2050	Absolute differences (days)
Buzau	138 days	118 days	-20
Calarasi	139 days	119 days	-20
Fundulea	141 days	115 days	-26
Grivita	148 days	119 days	-29
Rm. Sarat	144 days	122 days	-22
Galati	140 days	117 days	-23

In current clime conditions, the average maize yield ranges between 4463 kg/ha at Buzau and 7005 kg/ha at Calarasi. Analyzing the simulated results highlighted that for maize, which is more sensitive than wheat to local climate and future climate severity, average grain yields tend to decrease lightly on the whole by roughly 2-

4% at Grivita, Rm. Sarat and Galati, and more abruptly, by 18-33% as against the current climate conditions at the other three stations (Figure 3). Maize yields get lower due to a shortening of the vegetation season by 20-29 days, following an increase in temperature, as well as due to water stress during grain filling, caused by diminished scenario-forecasted precipitation amounts. Being also a C4 plant, maize benefits less from the effect of increased CO_2 concentrations upon photosynthesis.

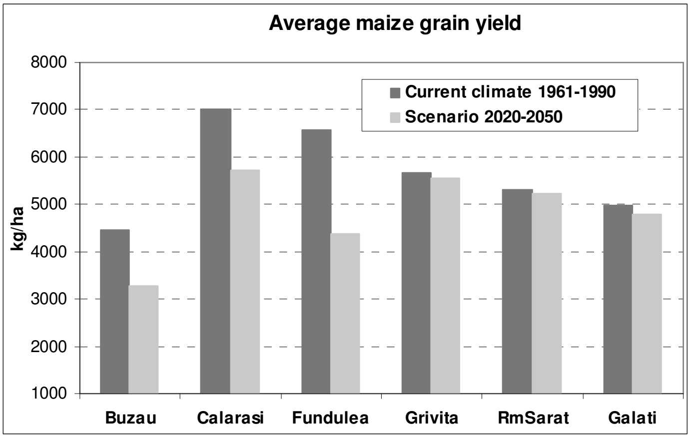


Fig. 3. Average maize yield simulated under current conditions and RegCM3/2020-2050/SRES A1B scenario

Site	Current climate / 1961-1990	Scenario / 2020-2050	Relative differences (%)
Buzau	4463 kg/ha	3290 kg/ha	-26.3
Calarasi	7005 kg/ha	5722 kg/ha	-18.3
Fundulea	6585 kg/ha	4383 kg/ha	-33.4
Grivita	5675 kg/ha	5569 kg/ha	-1.9
Rm. Sarat	5314 kg/ha	5224 kg/ha	-1.7
Galati	4970 kg/ha	4781 kg/ha	-3.8

A comparative analysis of the results obtained showed that future changes in regional scenario-based climate evolutions can have negative effects upon yield increase, development and formation. For both analyzed crops, the vegetation season gets shorter and there are fewer days available to reaching full ripeness. This shortening of the vegetation season is more marked in maize crops than in winter wheat. Such a forcing is mainly due to a probable increase in air temperature, estimated by the regional model.

As to the possible effects of climate change upon yields, they depend on the genetic type (C_3 or C_4), direct effects of increased CO_2 concentrations on photosynthesis, local conditions and the severity of changes in climate evolution according to the two scenarios. So, maize yields decrease at every analyzed station in comparison with the current clime case, due to higher temperatures leading to shorter vegetation seasons associated with water stress, mainly during the phenological stage of grain formation and filling. In winter wheat, grain yields are higher than in current clime conditions at every station of the six analyzed, due to a positive effect of increased CO_2 concentrations in the atmosphere (from 330 ppm to 450 ppm) upon photosynthesis and water use, which counterbalances the negative effect of a shorter vegetation period.

CONCLUSIONS

1. Analyzing the results simulated on the grounds of 2020-2050 climate change estimations made by regional climatic models highlighted that the future climate evolutions may he have important effects upon crops and they are conditioned by an interaction between the following factors: current climate changes on a local scale, severity of climate scenario-forecasted parameters, how the increased CO_2 concentrations influence photosynthesis, and the genetic nature of plant types. Winter wheat can benefit from the interaction between increased CO_2 concentrations and higher air temperatures, while maize is vulnerable to climate change, mainly in the case of a scenario predicting hot and droughty conditions.
2. As against the current climate conditions, the RegCM3 scenario estimates that air temperature increases will shorten the vegetation season for every analyzed station and both crop types.
3. If climate changes according to the analyzed scenario, the maize yields will decrease at every analyzed station due to higher temperatures that shorten the vegetation season, coupled with a water stress, mainly during the phenological phases of grain formation and filling. In winter wheat, the yields will increase in comparison with the current clime conditions as a consequence of increased CO2 concentrations in the atmosphere (affecting photosynthesis) and of using water supplies to counter-balance the negative effect of shorter vegetation periods.
4. The cumulated amounts of water lost to evapotranspiration during the vegetation season in both crop types will decrease in every analyzed case, to a higher degree in maize crops, following an interaction between the two opposite processes: a high temperature-related shortening of the vegetation period and the physiological effect of increased CO_2 concentrations upon crops. Beside maize, wheat is more efficient in using the available soil water reserves given the regional climate predictions over 2020-2050 as against the current conditions due to higher CO_2 assimilation rates, though this

interaction can be restricted by higher temperatures and smaller amounts of available soil water.

5. The results shown in this paper are very important and they can contribute to laying the grounds of and developing management options to adapt to and mitigate climate change-related negative effects affecting crop systems.

ACKNOWLEDGEMENTS

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RESEARCH ON THE INFLUENCE OF CLIMATE CONDITION ON HYBRIDS MAIZE IN THE BIG ISLAND OF BRAILA

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Keywords: *corn, density, rainfalls, irrigation*

Abstract

The stage of climatic factors in accordance with the stage of growth and development of maize plants allow a proper assessment of the production.

The experiment was placed in the Big Island of Braila ecosystem, on an alluvial gleize soil type, in the crop year 2008.

For a better of track the influence of climatic factors, the experiment was placed in three randomized block sequence and three variants.

The maize hybrid which was taken as the only control that benefitt from irrigation.
Due to low rainfalls and high temperatures, the yield values recorded between 4,326 kg/ha and 5,572 kg/ha; the control recorded a yield of 6,930 kg/ha.

INTRODUCTION

The Big Island of Braila represents an area favourable to maize growth.

Considering that maize is a valuable plant both biologically and economically, the cultivated area has considerable increased over the last years.

For a successful harvest, the choice of hybrids has a great importance considering the fact that the Big Island of Braila is situated in an area which has high thermal potential and irregular precipitation during the maize vegetation period. Thus, the elimination of these variations in point of precipitation can be done by applying irrigation, a measure which contributes to the improvement of the quality and quantity of maize production.

During the research undergone in the Big Island of Braila, when two maize hybrids were experimented under irrigation and non-irrigation conditions, it has been demonstrated that under natural conditions of the ecosystem, the quality and quantity of the resulting production is closely related to the maintenance of a good water supply throughout the entire vegetation period. This is because the water from rainfalls is not enough for obtaining a high rate of production.

It was noticed that the highest level of water consumption was recorded from the beginning of earring until the first stage of in-wax ripening. After this stage, the maize needs for humidity were significantly reduced, and temperature became the main factor for its full maturation.

MATERIAL AND METHODS

Research was developed in a station for two years, 2007 and 2008 within the Pescarus Farm from the Big Island of Braila, having in view the development of the PR36R10 and Florencia hybrids under irrigation and non-irrigation conditions.

The soil type on which the experiment was located was gley typically immersed. On the ploughed stratum, the soil was mainly alkaline, with 8.15 pH value, the humus content was good (3.49%), very well supplied with nitrogen (0.37%), potassium (130 ppm) and phosphorus (31.2 ppm).

The experiment was located bifactorially, the shape of the lots was rectangular with two factors, each factor having two degrees, as follows:

- factor A – the hybrid: a_1 = Florencia; a_2 = PR36R10;
- factor B – water conditions: b_1 = non-irrigated; b_2 = irrigated.

The experiment consisted of three replications (n = 3) and there were 12 plots.
The sowing density for both hybrids was 70,000 germinated seeds/ha.

Within the experiment, there was observed the influence of several factors on the maize production. In this hereby research paper, some of the results are presented regarding the influence of the irrigation system on the harvest obtained from the two hybrids as well as the density of maize crop.

RESULTS AND DISCUSSION

The annual average temperature recorded in 2007 had values almost equal to the reference year, the only difference being in September, when a negative deviation of -4.5^{0}C was recorded (Figure 1).

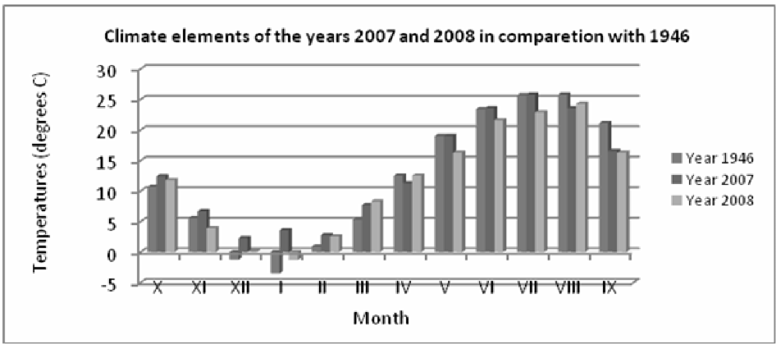

Fig. 1. Climate elements - temperatures

The average rainfall in 2007 was 194 mm during the maize vegetation period while 2008 recorded an average rainfall of 327 mm.

A very important role in maize growth and development is played by temperature which was closely related to precipitations.

Throughout the two experimental years, by analyzing the water factors recorded within the Lunca Station from the Big Island of Braila, we can notice that 2008 recorded values of rainfall higher than in 1946 and in the first year of the experiment (Figure 2).
The temperatures of the farming year 2008 had positive deviations in September, the rest of the values being inferior to the temperatures in the reference year.

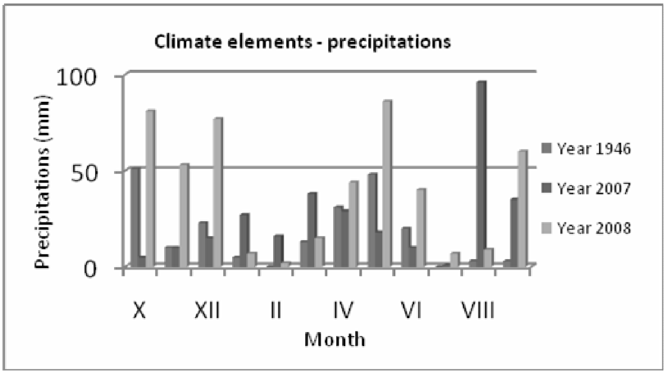

Fig. 2. Climate elements - precipitations

For the analyzed hybrids, observations were performed concerning uniformity and density when maize springs, the maize obtained and humidity at harvest time. Both hybrids were harvested on the 5th of October (2007 and 2008) for the option of the irrigated soil and on the 11th for the hybrids cultivated on non-irrigated soil. The harvest of the hybrids at the same date in both years was possible owing to the favourable weather conditions for the crop. According to the data in table no1, the percentage of the sprung plants varied between 89% and 97.5%, which demonstrates that during the period between seeding and springing, maize had optimum conditions. If we correlate rainfall during the two years and density at the moment of springing and also the average harvest obtained, we can notice that hybrid Florencia recorded the highest crop in 2008, that is 8,530 kg/ha.

Humidity at harvest time recorded for both hybrids was of 17%. The harvest obtained from a non-irrigation soil with both hybrids had values around 7,050 kg/ha, recording higher values in 2008 compared to 2007.

Table 1

Harvests obtained from hybrids on a non-irrigated soil

Year	Hybrids	Density at sprung (plants)	Percent of the sprung plants (%)	Average harvest (kg/ha)
2007	Florencia	63,200	90.28	8,154
	PR36R10	61,210	87.44	6,310
2008	Florencia	63,200	90.28	7,631
	PR36R10	64,730	92.47	7,210

Analyzing the data in Table 2, we can notice that the percentage of sprung plants was between 87.44% and 92.47%. Thus, the percentage was clearly lower, compared to the hybrids cultivated on an irrigated soil.

Table 2

Harvests obtained from hybrids on a irrigated soil

Year	Hybrids	Density at sprung (plants)	Percent of the sprung plants (%)	Average harvest (kg/ha)
2007	Florencia	66,000	94.28	8,300
	PR36R10	64,850	92.64	7,235
2008	Florencia	68,300	97.57	8,530
	PR36R10	62,530	89.32	7,100

The average crops were between 6,300-8,154 kg/ha, lower than the crops cultivated on an irrigated soil. Therefore, the only hybrid that recorded a larger harvest on non-irrigated soil was PR36R10, which had a production growth of 110 kg/ha.

CONCLUSIONS

1. The type of soil on which the two harvests were sown had a major role in obtaining the crops, because it was noticed that the harvest of the two hybrids were far lower as compared to other areas from the Big Island of Braila.
2. The difference of harvests considering, the harvest from an irrigated soil and the one on a non-irrigated soil for the two hybrids, varied between 100 and 900 kg.

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RESEARCH ON THE REMANENT EFFECT OF ORGANIC FERTILIZATION ON SILO MAIZE PRODUCTION

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Keywords: *fertilization, manure, yield, influence*

Abstract

In the last decade, it has become imperative to implement a system of sustainable development meant to preserve and improve soil resources, protect biodiversity and reduce pollution, given the changes undergone in agricultural ecosystems and the raised prices of chemical fertilizers.

Under these circumstances, organic fertilization represents a viable alternative to increase soil fertility, humus supply in soil so as to obtain high and steady yields with maximized inputs and minimum impact on the environment and end consumers.

This paper aims to determine the remanent effect of stable manure on silo maize production.

In order to attain this objective in the period 2002-2005, in the pedoclimatic conditions in Belciugatele Didactic Station, a bifactorial experiment was carried out to assess the influence of the studied hybrid (Vultur, Milcov, Paltin) and the amount of the applied manure (40, 50, 60, 70 t/ha) on silo maize production.

Following the research there could be seen that the highest yields were obtained at rates of 70 t/ha, the most productive being the Paltin hybrid and least productive the Milcov hybrid. All the hybrids had very significant yield boosts when increasing the applied manure doses.

In the second and third year of organic fertilization, the recorded yields were smaller compared to the ones obtained in the first year of fertilization.

INTRODUCTION

Lately the tracts of land cultivated with maize decreased from 3227 thousand ha in 1996 to 2520 thousand ha in 2006 (2007 statistical yearbook), the selling prices remained the same and the prices of chemical fertilizers have substantially grown.

A major goal of sustainable development is to improve silo maize forage quality, taking into consideration the impact on environment and on the primary consumer (the animal). In order to monitor the remanent effect of organic fertilization on the production, on the forage quality and on soil properties, a bifactorial experiment was carried out, focusing on the hybrid influence and the manure dosis on biomass production.

MATERIAL AND METHODS

Research was carried out at Belciugatele Didactic Station, belonging to UASVM Bucharest.

To attain the goal set for the period 2002-2005 a bifactorial experiment was carried out where:

Factor A - Hybrid with three graduations	Factor B - Manure with 4 graduations
-a1-Vultur	-b1-40 t/ha
-a2-Paltin	-b2-50 t/ha
-a3-Milcov	-b3-60 t/ha
	-b4-70 t/ha

The surface of the experimental plot was of 20 m^2. The sowing density was of 70,000 plants/ha. The direct effect (year I) of manure was studied during 3 years: 2002, 2004, 2005. The remanent effect in the third year was studied in 2005.

The natural conditions where the experiment was carried out. The mean daily temperatures during the growing season did not exceed 25 ^{0}C. The rain fall pattern during the experimenting period shows that the year 2002 had high precipitations (838.5 mm), the year 2004 was dry (591.0 mm), the average of precipitations not exceeding the multiannual average on 10 years (609.7 mm) and the year 2005 had the highest precipitations, recording 1120.6 mm, which exceeded the known multiannual figures.

The soil is cambic chernozem (phaeozem) with loamy-clayey texture, humus content of 3% at the surface and 1% at the depth of 1 m, pH between 6.3-6.8.

RESULTS AND DISCUSION

Influence of the interaction between the hybrid and the manure doses on yield (whole plant), in the first year.

Influence of fertilization on production in the first year after applying manure

The amount of the silo maize yield in the first year after applying manure variest between 12 and 15 t/ha. When analyzing the influence of fertilization amount in Table 1 on mean yields for the three hybrids there can be seen that the increase in fertilization amount leads to statistically insured yield boosts. The boosts vary between 0.33 t/ha when fertilizing with 50 t/ha and 1.33 t/ha when fertilizing with 70 t/ha.

The influence of fertilization on production for each hybrid after applying manure

When analysing the data in Table 1, there can be seen that for all the studied hybrids the increase in fertilization amount leads to yield boosts, which are very significant for the fertilization with 60 t manure in comparison with the witness treatment b_1 fertilized with 40 t manure/ha.

Influence of hybrid on production in the first year after applying manure

Of all the studied hybrids the Milcov hybrid has the best reaction to increasing the fertilizer amount which leads to very significant yield boosts

Influence of the interaction between hybrid and manure doses on production (whole plant), in the second year.

Influence of fertilization on production in the second year after applying manure

When analyzing the data presented Table 2, there can be seen that in the second year after applying manure, the mean production level for the three hybrids was between 12.03 t/ha when fertilizing with 40 t/ha and 14.03 t/ha when fertilizing with 70 t/ha. The yield boosts obtained in comparison with the treatment fertilized with 40 t/ha are very significant and vary between 0.52 t/ha when fertilizing with 50 t/ha and 2 t/ha when fertilizing with 70 t/ha.

Influence of fertilization on production for each hybrid in the second year after applying manure

There can be seen that for all the studied hybrids the increase in fertilization amount leads to yield boosts, which are very significant when fertilizing with more than 60 t manure/ha compared with the control treatment b_1 fertilized with 40 t manure/ha. When fertilizing with 50 t manure/ha the obtained yield boosts are significant for the Milcov hybrid and distinctly significant for the other two hybrids. Of the three hybrids the Milcov hybrid had the best reaction to increasing fertilization amount.

Influence of hybrid on production in the second year after applying manure

When fertilizing with 40 t manure/ha, the yield level was between 11 and 13.09 t/ha and when fertilizing with 70 t manure/ha the yields were between 11.97 and 14.07 t/ha. When comparing the yield level for the three studied hybrids there can be seen that no matter the manure amount applied the highest yield was recorded in the Paltin hybrid.

Influence of the interaction between hybrid and manure doses on production (whole plant) in the third year.

Influence of fertilization on production in the third year after manure application

Analysing the data in Table 3, there can be seen that in the third year after applying manure, the mean production level for the three hybrids was of 11.31 t/ha when fertilizing with 40 t/ha and 13.01 t/ha when fertilizing with 70 t/ha. The yield boost obtained in comparison with the treatment fertilized with 40 t/ha are very significant and vary between 0.5 t/ha when fertilizing with 50 t/ha and 1.7 t/ha when fertilizing with 70 t/ha.

Table 1

Production of dry matter in the first year of manure application

Manure doses	Influence of hybrid on production												Influence of fertilization on production					
	b_1 40 t/ha			b_2 50 t/ha			b_3 60 t/ha			b_4 70 t/ha								
Hybrid	Prod	Dif. a_n-a_1	Signif	Prod	Dif. a_n-a_1	Signif	Prod	Dif. a_n-a_1	Signif	Prod	Dif. a_n-a_1	Signif	Dif. b_2-b_1	Signif	Dif. b_3-b_1	Signif	Dif. b_4-b_1	Signif
a_1 Vultur	13.0	-	Mt	13.0	-	Mt	14.0	-	Mt	14.0	-	Mt	0	-	1.0	***	1.0	***
a_2 Paltin	14.0	1.05	***	14.0	1.01	***	15.0	1.28	***	15.0	0.93	***	0	-	1.0	***	1.0	***
a_3Milcov	12.0	-0.13	-	13.0	-0.58	00	13.0	-0.44	0	14.0	-0.63	00	1.0	***	1.0	***	2.0	***
Average of	13.0			13.3			14.0			14.3			0.33	*	1.0	***	1.3	***

B Dl 5%=0.32 t dm/ha Dl 1%=0.58 t dm/ha Dl 0.1%=0.83 t dm/ha
AxB Dl 5%=0.34 t dm/ha Dl 1%=0.49 t dm/ha Dl 0.1%=0.76 t dm/ha
BxA Dl 5%=0.30 t dm/ha Dl 1%=0.42 t dm/ha Dl 0.1%=0.59 t dm/ha

Table 2

Production of dry matter in the second year after applying manure

Manure doses	Influence of hybrid on production												Influence of fertilization on production					
	b_1 40 t/ha			b_2 50 t/ha			b_3 60 t/ha			b_4 70 t/ha								
Hybrid	Prod	Dif. a_n-a_1	Signif	Prod	Dif. a_n-a_1	Signif	Prod	Dif. a_n-a_1	Signif	Prod	Dif. a_n-a_1	Signif	Dif. b_2-b_1	Signif	Dif. b_3-b_1	Signif	Dif. b_4-b_1	Signif
a_1 Vultur	12.0	Mt	Mt	12.51	Mt	Mt	13.16	Mt	Mt	13.48	Mt	Mt	0.51	**	1.16	***	1.48	***
a_2 Paltin	13.09	1.09	***	13.65	1.14	***	14.28	1.12	***	14.96	1.48	***	0.56	**	1.19	***	1.87	***
a_3Milcov	11.0	-1	ooo	11.49	- 1.02	ooo	12.75	-0.41	o	13.66	0.18	-	0.49	*	1.75	***	2.66	***
Average of	12.03			12.55			13.40			14.03			0.52		1.37		2.00	

B Dl 5%=0.31 t dm/ha Dl 1%=0.50 t dm/ha Dl 0.1%=0.78 t dm/ha
AxB Dl 5%=0.34 t dmha Dl 1%=0.48 t dm/ha Dl 0.1%=0.83 t dm/ha
BxA Dl 5%=0.41 t dm/ha Dl 1%=0.66 t dm/ha Dl 0.1%=0.90t dm/ha

Table 3

Production of dry matter in the second year of manure application

Manure doses	Influence of hybrid on production (t/ha)												Influence of fertilization on production (t/ha)					
	b_1 40 t/ha			b_2 50 t/ha			b_3 60 t/ha			b_4 70 t/ha								
Hybrid	**Prod**	**Dif. a_n-a_1**	**Signif**	**Prod**	**Dif. a_n-a_1**	**Signif**	**Prod**	**Dif. a_n-a_1**	**Signif**	**Prod**	**Dif. a_n-a_1**	**Signif**	**Dif. b_2-b_1**	**Signif**	**Dif. b_3-b_1**	**Signif**	**Dif. b_4-b_1**	**Signif**
a_1 Vultur	11.37	Mt	Mt	11.89	Mt	Mt	12.32	Mt	Mt	12.98	Mt	Mt	0.52	***	0.95	***	1.61	***
a_2 Paltin	12.55	1.18	***	12.95	1.06	***	13.61	1.29	***	14.07	1.09	***	0.4	***	1.06	***	1.52	***
a_3Milcov	10.0	-1.37	ooo	10.6	-1.29	ooo	11.58	-0.74	ooo	11.97	-1.01	ooo	0.6	***	1.58	***	1.97	***
Average of	11.31			11.81			12.50			13.01			0.51		1.20	***	1.70	***

B Dl 5%=0.19 t dm/ha Dl 1%=0.30 t dm/ha Dl 0.1%=0.42 t dm/ha
AxB Dl 5%=0.17 t dm/ha Dl 1%=0.27 t dm/ha Dl 0.1%=0.40 t dm/ha
BxA Dl 5%=0.12 t dm/ha Dl 1%=0.16 t dm/ha Dl 0.1%=0.22 t dm/ha

Influence of fertilization on production for each hybrid in the third year after applying manure There can be seen that, for all the studied hybrids the increase in fertilization leads to yield boosts which are very significant when fertilizing with over 40 t manure per ha. The level of yield boosts is between 0.4 and 1.52 t/ha for Paltin hybrid and between 0.6 and 1.97 t/ha for Milcov hybrid. Of the three hybrids the Milcov hybrid best reacts to an increased fertilization.

Influence of hybrid on production in the second year after applying manure
When fertilizing with 40 t manure/ha, the yield level was between 10 and 11.37 t/ha, and when fertilizing with 70 t manure/ha the yield was between 11.97 and 14.07 t/ha. By comparing the level of the obtained yields for three hybrids with the same fertilizer amount, there can be seen that the Paltin hybrid had the highest yields.

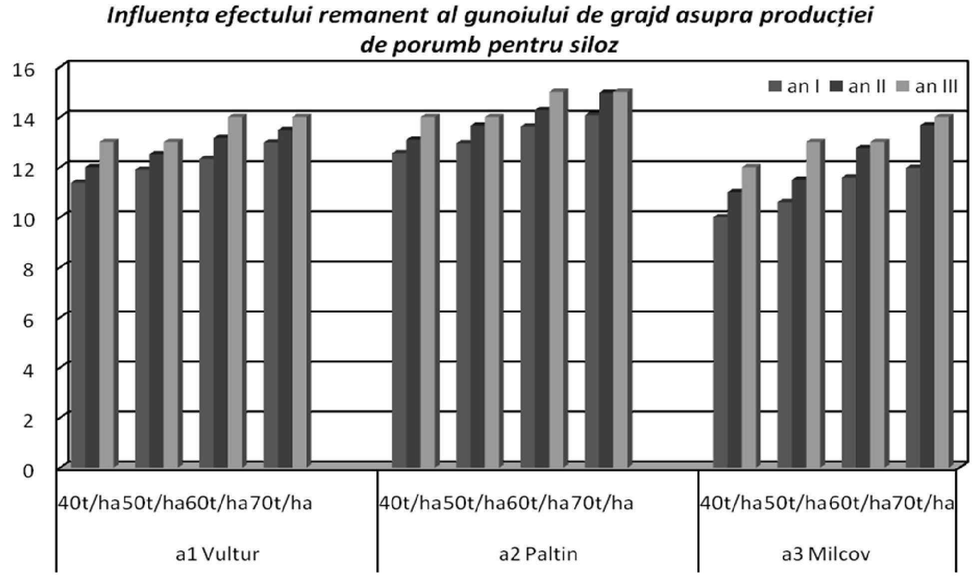

Fig. 1. Influence of the remanent effect of manure on silo maize production

The data presented in Figure 1 and Table 4 show that the remanent effect of manure is most active in the third year, when all the studied hybrids were at maximum levels.

The highest production level for the four fertilization graduations and the three years was recorded in the Paltin hybrid.

Table 4

Silo maize production mean values of dry matter for the three experimenting years (t/ha)

	a1 Vultur	**a2 Paltin**	**a3 Milcov**	*Average*
Year I	12.14	13.29	11.03	*12.16*
Year II	12.78	13.99	12.22	*13.00*
Year III	13.50	14.50	13.00	*13.67*
Average	*12.81*	*13.93*	*12.09*	

CONCLUSIONS

1. Organic fertilization had significant impact on silo maize production, the recorded yield boosts being very significant for all the studied hybrids and for all the fertilization treatments.
2. The highest yields were obtained at rates of 70 t/ha.
3. The hybrid with the best use of manure effect was the Paltin hybrid, a semilate hybrid.
4. The effect of manure was active both in the second and the third year from the application, but yields were 25% lower.

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INFLUENCE OF CHEMICAL FERTILIZATION ON SILO MAIZE PRODUCTION

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Keywords: *hybrid, chemical fertilizers, yield, influence*

Chemical fertilization is an agrotechnical measure essential in cropping systems and it guarantees yield boosts. At present, when setting up a cropping system, the main criterion to take into account is the influence of a certain technological part, in this case fertilization, of on the agricultural production; however the concept of sustainable development also requires the assessment of the impact on the primary consumer, along with complying with other requirements of environment protection and biodiversity conservation. In order to improve the influence of nitrogen and phosphorus chemical fertilizers inputs on biomass production in silo maize, when grown on the phaeoziom from Belciugatele Didactic Station, a monofactorial experiment was carried out, the fertilization having different doses of nitrogen and phosphorus. In the course of the experiment the Vultur hybrid especially designed for biomass production was used. Following the research carried out between 2002 and 2005, it was observed that the dry biomass production levels were between 6.27 and 8.13 t/ha; the increase of the chemical fertilizer doses applied led to yield boosts compared to the unfertilized treatments. Significant yield boosts were obtained in all three experimenting years when applying $N_{100}P_{50}$ and $N_{150}P_{100}$ formulas; between these two there were no significant differences. The increase of dosage over $N_{150}P_{100}$ results in lower yields

INTRODUCTION

Cropping systems, especially for forage crops, are assessed and improved according to some performance criteria, among which production, forage quality, environment protection and the influence on the primary consumer (the animal) play important roles.

Provided the imperative implementation of sustainable development, the improvement of the forage quality for silo maize is a major objective, which is assessed regarding input optimization and that’s why the research approaches both the genetic potential of the used hybrids and the technological parts.

Among the technological parts impacting on the quantity and quality of silo maize production, the objective of the research carried out in this paper is to determine the influence of fertilization on the elements of biomass production and quality.

MATERIAL AND METHODS

Research was carried out in the period 2002-2005, in Belciugatele Didactic Station, in UASVM Bucharest.

The experiment was monofactorial, with 5 treatments: V_1-N_0P_0; V_2-$N_{50}P_{50}$; V_3-$N_{100}P_{50}$; V_4-$N_{150}P_{100}$; V_5-$N_{200}P_{100,}$ using the tiered seating system, in 4 replications. The active substance for phosphorus is expressed in P_2O_5.The surface of the experimental field was of 30 square metres.

In the course of research, the Vultur maize hybrid was sown at a density of 70,000 plants/ha.

The natural conditions where the experiment was carried out:

The temperature during sowing was over 8 ^{0}C (10.7 ^{0}C). During the growing season the mean temperature didn't go upper than 25 ^{0}C.

The rainfall pattern recorded in the course of the experiment shows that the year 2002 had high precipitations (838.5 mm); the year 2004 was dry (591.0 mm), with the precipitation amount lower than the multiannual average of 10 years (609.7 mm) and the average of the three studied years (777.7 mm); the year 2005 had the highest precipitations, mounting to 1120.6 mm, higher than the known multiannual figures.

The soil is cambic chernozem (phaeozem) with the following features: loamy-clayey texture, deeply humified (3% at the surface and 1% at 1 m depth); pH of 6.3-6.8, very high content in P, 72 ppm P_{AL}, very high content in K, 310 ppm K_{AL}, the C/N ratio of 11.4.

RESULTS AND DISCUSSION

The influence of chemical fertilization on production (entire plant), 2002-2005 average. According to the data presented in Table 1 there can be estimated that on the average of the three experimenting years, the increase in the applied rates of chemical fertilizers led to statistically assured production only in some for some treatments.

In comparison with the unfertilized treatment, the treatments with applied rates of $N_{50}P_{50}$ and $N_{200}P_{100}$ had no statistically assured production differences. The highest production was of the $N_{100}P_{50}$ treatment, with 16.85 t d.m./ha, 26.6% higher than the witness treatment and a production boost of 3.54 t d.m./ha, statistically assured as significant.

With an insignificant difference compared to the previous treatment, there was the $N_{150}P_{100}$ treatment where the production boost was 3.27 t d.m./ha higher than that of the unfertilized treatment.

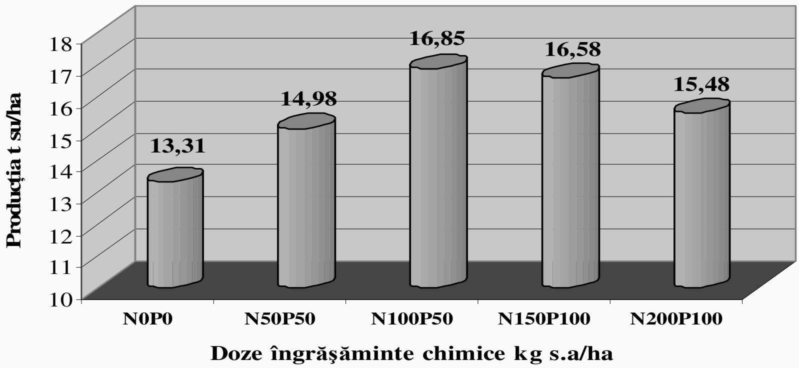
Table 1

Chemical fertiliser influence on silage maize yield.
Entire plant, the average of 2002-2005

Variants		Prod.		Dif.		Signif.
		t dm/ha	%	t dm/ha	%	
V1	N_0P_0	13.31	100	Mt	Mt	Mt
V2	$N_{50}P_{50}$	14.98	112.6	1.67	12.6	-
V3	$N_{100}P_{50}$	16.85	126.6	3.54	26.6	*
V4	$N_{150}P_{100}$	16.58	124.6	3.27	24.6	*
V5	$N_{200}P_{100}$	15.48	116.3	2.17	16.3	-

Dl 5%=2.54 t dm/ha; Dl 1%=3.70 t dm/ha; Dl 0.1%=5.54 t dm/ha

Fig. 1. Influenţa fertilizării chimice asupra producţiei de porumb pt. siloz. Planta întreagă, media anilor 2002-2005



In conclusion, the treatments fertilized with $N_{100}P_{50}$ and $N_{150}P_{100}$ led to the highest productions. The highest production boost was recorded in the treatment fertilized with doses of 100 kg N and 50 kg P (Figure 1).

The influence of chemical fertilizers on production (cobs and husks), the 2002-2005 average. Analysing the data in Table 2 and Figure 2, the cob and husk production had significant production boosts (0.92 t d.m./ha), in the treatment fertilized with rates of $N_{50}P_{50}$.

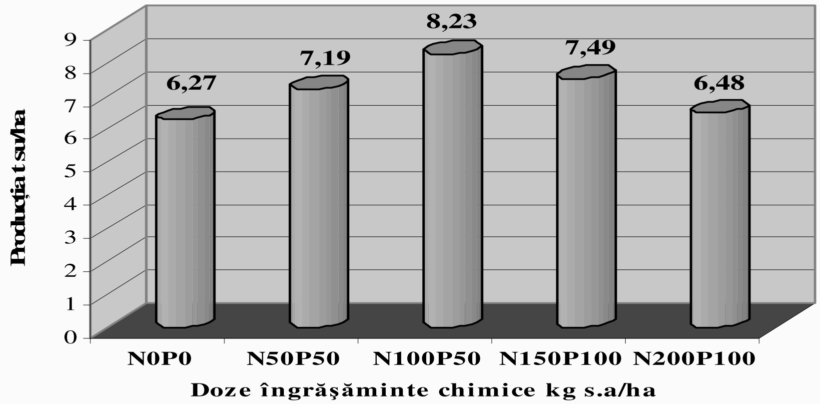
Table 2

Chemical fertiliser influence on silage maize yield. Maize cob and maize husks, the average of 2002-2005

Variants		Prod.		Dif.		Signif.
		t dm/ha	%	t dm/ha	%	
V1	N_0P_0	6.27	100	-	Mt	Mt
V2	$N_{50}P_{50}$	7.19	114.7	0.92	14.7	*
V3	$N_{100}P_{50}$	8.23	131.3	1.96	31.3	***
V4	$N_{150}P_{100}$	7.49	119.5	1.22	19.5	**
V5	$N_{200}P_{100}$	6.48	103.4	0.21	3.4	-

Dl 5%=0.82 t dm/ha; Dl 1%=1.20 t dm/ha; Dl 0.1%=1.79 t dm/ha

Fig. 2. Influența fertilizării chimice asupra producției de porumb pt. siloz. Ştiuleți + pănuşi, media anilor 2002-2005



Applying a rate of $N_{100}P_{50}$ V_3 led to a production of 8.23 t d.m./ha with a very significant boost of 1.96 t d.m./ha, higher than the unfertilized treatments. The increase of doses to $N_{150}P_{100}$ led to a distinctly significant production boost (1.22 t d.m./ha).

The treatment fertilized with 200 kg N and 100 kg P gave a yield boost of 0.21 t d.m./ha, with no statistical assurance, insignificantly higher than the unfertilized treatment.

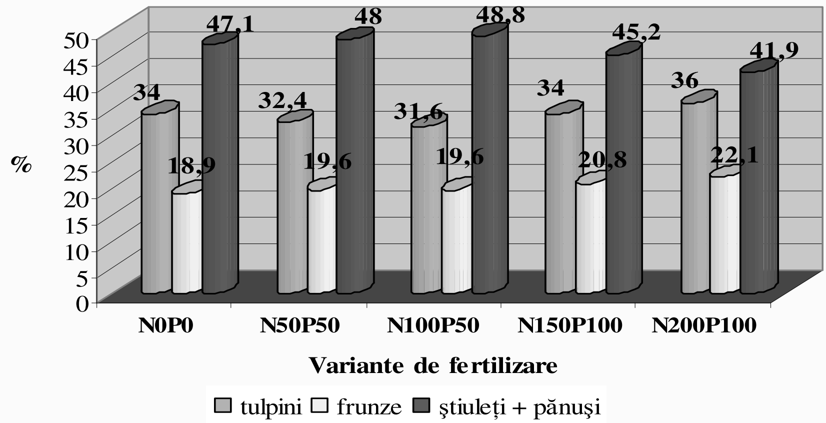
The influence of chemical fertilizers on production (cobs and husks), the 2002-2005 average.

Table 3

Percentage of yields components, average of 2002-2005

Variants	Entire plant	Maize stalks		Maize leaves		Maize cob and husks	
	t dm/ha	t dm/ha	%	t dm/ha	%	t dm/ha	%
N_0P_0	13.31	4.53	34.0	2.51	18.9	6.27	47.1
$N_{50}P_{50}$	14.98	4.85	32.4	2.94	19.6	7.19	48.0
$N_{100}P_{50}$	16.85	5.34	31.6	3.30	19.6	8.23	48.8
$N_{150}P_{100}$	16.58	5.65	34.0	3.45	20.8	7.49	45.2
$N_{200}P_{100}$	15.48	5.57	36.0	3.43	22.1	6.48	41.9

Fig. 3. Ponderea componentelor de producție în alcătuirea recoltei, media anilor 2002-2005



Following the data in Table 3, there can be seen that the percentage of the stalks in the plant output was an average between 31 and 36%, slightly decreasing up to the rate of 150 kg d.s. N, where the output percentage increases. Regarding leaves, the increase in the applied rates of chemical fertilizers led to a slight increase, the output percentage being of 18-22%. The cobs and the husks make for 41-48% of biomass output, the increase of fertilizer doses leading to an increase of cob and husk percentage up to rates of 150 kg d.s. N, where it decreases (Figure 3).

CONCLUSIONS

1. Analysing the experimental data in the period 2002-2005, in the climatic conditions of the phaeozem zone, under no irrigation, the Vultur hybrid can

give biomass production of 16.85 t d.s./ha (26.6% higher than the production of the unfertilized treatment) when fertilizing with rates of $N_{100}P_{50}$.

2. In years with precipitation higher than the multiannual average, the crop uses more efficiently the applied nitrogen and less efficiently when there is scarce moisture.
3. Nitrogen leads to important biomass increases.
4. It is recommended to apply small doses of nitrogen when there are low precipitations or there is no irrigation.

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CURRENT STATUS REGARDING THE USE OF DIGITAL EDUCATIONAL MATERIAL AND INTERNET TOOLS ABOUT ORGANIC AGRICULTURE AND AGROECOLOGY IN THE EUROPEAN AGRICULTURAL UNIVERSITIES

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Keywords: *organic agriculture, agroecology, education material, Internet*

Abstract

This paper presents the results of the analysis performed in the context of the "Organic.Edunet" project (A Multilingual Federation of Learning Repositories with Quality Content for the Awareness and Education of European Youth about Organic Agriculture and Agroecology) regarding the use of digital educational material and Internet tools about Organic Agriculture and Agroecology in the European agricultural universities (15 partners from 10 European countries). The Organic.Edunet project aims to facilitate the access, usage and exploitation of digital educational content related to Organic Agriculture and Agroecology. This will be achieved by deploying a multilingual online federation of learning repositories by Organic.Edunet Web portal - www.organicedunet.eu - that facilitates end-users' search, retrieval, access and content use in the learning repositories.

INTRODUCTION

Organic.Edunet is an international project which will help universities and schools across and beyond Europe to make easier and better use of the Internet technologies in order to enhance their educational offerings in the field of Organic Agriculture (OA) and AgroEcology. It will deploy a multilingual online environment (the Organic.Edunet Web portal) that will facilitate end-users' search, access and use of the content in the learning repositories. In this way, the digital content that can be used to educate European Youth about the benefits of OA and Agroecology will become easily accessible, usable and exploitable. This project is funded under the FP6 - eContent*plus* programme, a multiannual Community programme to make digital content in Europe more accessible, usable and exploitable. The consortium project consists of 15 contractor organizations from 10 countries: Greece (Greek Research and Technology Network - coordinator; Agricultural University of Athens, Ellinogermaniki Agogi); Spain (University of Alcala); Sweden (Royal Institute of Technology); Norway (Norwegian University of Life Sciences); Austria (Austrian Federal Ministry of Education, Arts and Culture, BG&BRG

Schwechat); Estonia (Miksike Learning Folders, Estonian University of Life Sciences); United Kingdom (University of Nottingham); Hungary (Corvinus University of Budapest, Association for Hungarian Organic Farming); Romania (University of Agronomic Sciences and Veterinary Medicine Bucharest); Germany (University of Duisburg-Essen).

MATERIAL AND METHODS

Research was performed in 2009. The questionnaire based survey for the Universities, was based on the dissemination of the questionnaire by the participating University partners. The partners invited colleagues and collaborators from the Academic and Research area to complete the questionnaires, using locally translated versions in the languages of the partners, and through two different versions: the online one, and a corresponding hard copy version. The online version allowed participants in the survey to directly insert their data into the system, while the use of the hard copies, allowed the collection of extra answers during meetings and workshops that were later inserted to the system by agents of the participating partners. The use of hard copies also helped in collecting input from people that normally would not complete the online version. We collected 571 questionnaires from agricultural universities of Romania, Hungary, Estonia, Germany, Norway, Greece and Russian Federation. In order to be able to collect as much information as possible from all partners, the questionnaires were first setup in English, which was the agreed common language, and then in the following languages: Russian, Estonian, German, Greek, Hungarian and Romanian.

RESULTS AND DISCUSSION

Regarding **the gender of the participants,** a 60-40 percentage of men and women respectively participated, which is about balanced. Taking into account that the number of men that are occupied in the Academic and Research related professions is higher than that of women (70 percent men, 30 percent women according to the latest statistics in focus released by Eurostat in "Statistics in focus: Women employed in science and technology", Eurostat Science and Technology, 2008), the above rate indicates that, in the survey, the opinion of women researchers was taken seriously under consideration. Regarding the **level of education,** the majority of the participants belong to the categories of Professors and/or senior researchers (Figure 1).

Student knowledge about OA & AE. Regarding the knowledge of students in OA & AE issues, it was limited, at the undergraduate level, reaching up to about 33% for the students that have at least a good knowledge of the subjects (Figure 2).

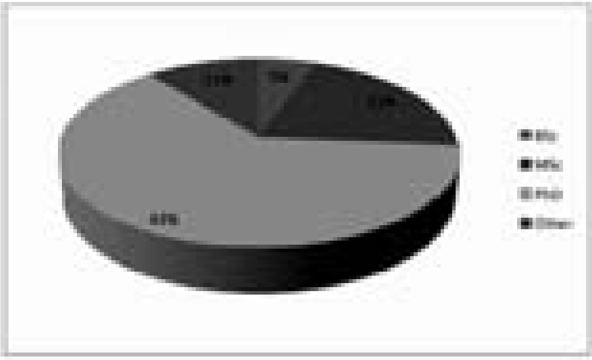


Fig. 1. Level of education in all the participating countries

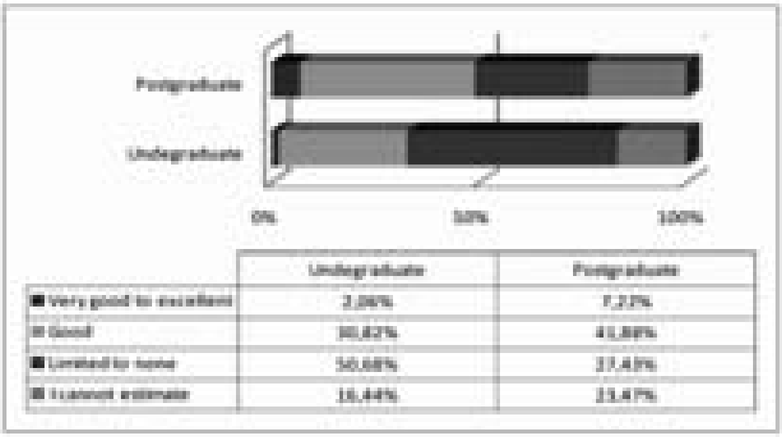
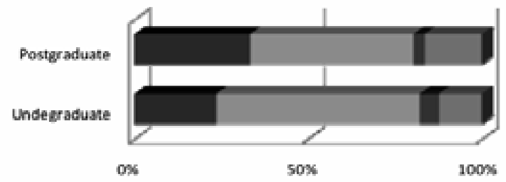


Fig. 2. Students knowledge about OA & AE in all the participating countries

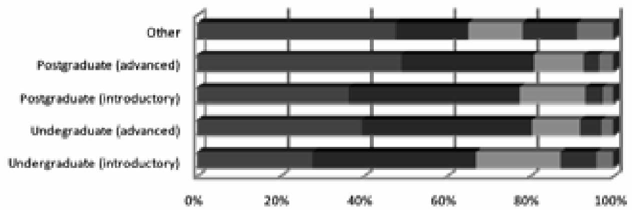
Student interest in OA & AE. Regarding the interest of students in OA & AE, in general, it remains the same for undergraduate and postgraduate students, surpassing the percentage of 80% (Figure 3). However, the distribution between excellent/very good and good changes indicates that in the postgraduate level the interest increases. Combined with the results of the previous question, the knowledge in the areas of OA & AE, creates interest, and therefore, it is expected that the results of Organic.Edunet will not only make more students interested in the above areas, but will also stimulate the interest of people that already have a positive attitude towards learning about OA & AE.



	Undegraduate	Postgraduate
Very good to excellent	23,78%	33,46%
Good	58,39%	46,91%
Limited to none	5,59%	3,27%
I cannot estimate	12,24%	16,36%

Fig. 3. Student interest in OA & AE in all the participating countries

Incorporating OA & AE topics into current courses. The majority show a big interest in incorporating OA & AE topics at both undergraduate and postgraduate level (Figure 4). Regarding the level of education, specialized knowledge is preferred, and in the case of undergraduate, the difference of preference between basic and advanced information is large.



	Undergraduate (introductory)	Undegraduate (advanced)	Postgraduate (introductory)	Postgraduate (advanced)	Other
Very appropriate	27,84%	39,68%	36,51%	49,17%	47,83%
Appropriate	39,22%	40,87%	41,08%	31,82%	17,39%
Neutral	20,39%	11,51%	15,77%	11,98%	13,04%
Not so much appropriate	8,63%	5,16%	4,15%	3,72%	13,04%
Not at all	3,92%	2,78%	2,49%	3,31%	8,70%

Fig. 4. Ability of incorporating OA & AE topics into current courses

Easiness of introduction of digital / electronic resources in courses taught. In general, the participants feel comfortable with the use of electronic media in their courses, with the percentage of people considering the use of digital and electronic tools at least easy, reaching about 80%.

Importance of Internet technologies for courses taught. Continuing the search of familiarity and attitude towards ICT and Internet technologies, this question comes to verify that not only there is familiarity with electronic and digital media as tools for the educational process, but also the belief that the use of internet technologies (which resides at the core of the educational philosophy of Organic.Edunet) is important for their taught courses. The percentage (77%) is similar to the previous 79% that considers that the introduction of digital and electronic resources is easy to perform.

Preference in use of digital/electronic teaching resources. There is clear preference to the transformation of traditional resources (available in the past in paper form) to a digital form - over 60%. Regarding the format, two types seem to have higher preferences than the rest: Documents and websites.

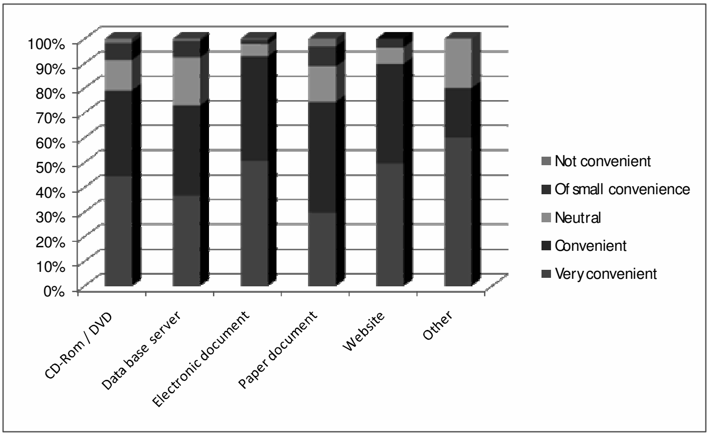


Fig. 5. Importance of Internet technologies for courses taught

CONCLUSIONS

1. The survey shows that the interest for the topics of OA & AE is greater than the common knowledge of the field. This goes for undergraduates as for postgraduates as well, although postgraduates have a higher knowledge in general. The results show a clear need for more information and learning materials for all levels of higher education.
2. However, the interest for OA/AE and the relevance of these topics in existing courses are higher in the higher educational levels (MSc and PhD). It seems like a higher knowledge of the field gives way for a higher interest for the field.
3. The relevance of digital resources is regarded as high among the participants of the survey. The results show that both the easiness of implementing digital resources, as well as the importance of this action, is high. However, the use of digital resources is mostly used as an added tool in the existing teaching process. The participants of the survey found it most interesting to use the

portal as a tool to help students find relevant and updated materials on OA & AE topics, in forms like articles, case studies, best practices etc.

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„ORGANIC.BALKANET" PROJECT – A SUPPORT FOR INNOVATIVE TRAINING PRACTICES AND E-LEARNING CONTENT ABOUT ORGANIC AGRICULTURE IN BALKAN REGION

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Keywords: *e-learning, innovative training, organic agriculture, Balkan region*

Abstract

The paper presents the activities, aims and objectives of "Organic.Balkanet" - a Leonardo da Vinci Project. The overall aim of "Organic.Balkanet" project is to facilitate the transfer of innovative training practices and e-learning content to vocational education of young and unemployed agricultural professionals, as well as to agricultural professionals. This project focuses on the development of the skills and competences of VET (Vocational Educational Training) and guidance professionals, including their continuous professional development and their learning of languages on topics related to Organic Agriculture (OA) in the Balkan area. The project will deploy a multilingual online environment (the Organic.Balkanet Web Portal) that will facilitate end-users' online search, retrieval, access and use of digital training objects in the online learning repository.

INTRODUCTION

Conventional agriculture production has been applied through heavy reliance on non-renewable resources (mechanization, fertilizers, pesticides etc.) resulting in numerous agricultural burdens such as soil degradation, water run-off, pollution, reduced biodiversity and landscape image, escalating production costs. Public awareness of the irreversible damage done to the environment has led to calls for a more responsible attitude towards our natural heritage. In addition, consumers' fears, triggered by food scares and technological developments such as genetic modification and food irradiation, have been translated into serious concern about food safety, ever-increasing demands for quality assurance and for more information about production methods.

Against this background, Organic Agriculture (OA) has come to the fore as an agricultural approach that can not only produce safer products but is environmentally sound too: it combines traditional conservation-minded farming methods with modern farming technologies and relay more on in-farm inputs instead of external inputs excluding completely synthetic pesticides and fertilizers.

However, organic farming is still hampered by lack of clarity: both consumers and the agricultural professionals are not always sure what OA is, what are its benefits, which products are covered by OA, and which restrictions OA implies. This is the reason why the European Action Plan for Organic Food and Farming (2004) has identified the need for actions supporting the training and education of all stakeholders related to OA, covering aspects related to production, processing and marketing of OA products and their benefits, and targeting OA products as the preferred option for both producers and consumers.

The European Commission, through its strategic Action Plan and a number of funded initiatives of the 6th FP has aimed at promotion and further understanding of OA concepts and methods, and at the cultivation of a consumer culture that will facilitate the development of the OA products market. In addition, large international organisations such as the United Nations' Food and Agriculture Organisation (FAO) and the International Federation of Organic Agriculture Movements (IFOAM), as well as non-profit associations such as the Soil Association in UK (http://www.soilassociation.org), drive their own awareness and education initiatives for the promotion of OA methods and practices around the world. Furthermore, agricultural universities around the world have included OA-related and Agroecology courses in their educational programs, aiming to prepare agricultural professionals so that they can appropriately support and guide farmers through the selection and adoption of OA methods.

Recent European and national initiatives have increased the production of relevant e-learning content in a digital format. Such initiatives have various goals and are implemented in different socio-cultural and linguistic contexts. For instance, they may aim at promoting OA and educating producers/farmers and consumers about its benefits, or at training agricultural professionals on the theory, methods and practices of OA. Characteristic examples include the content developed in the context of the eContent project BIOAGRO and eContent*plus* project ORGANIC.EDUNET or the classroom resources for primary and secondary education that the Soil Association has published online (http://www.soilassociation.org).

On the other hand, these constitute dispersed resources that are individually listed in separate sites, and their exploitation in actual training scenarios in European, national, regional, local and/or sectoral training systems and practices remains to be seen.

The existing e-learning content could be appropriately adapted, transferred and validated in order to support lifelong learning of agricultural professionals on OA and sustainable and environmental friendly management of resources.

MATERIAL AND METHODS

The „Organic.Balkanet" is an EU project funded under the Leonardo da Vinci Programme that it will help to transfer training methods content that is currently used in the context of secondary and higher education mainly for agronomists (e.g. graduate education of students in agricultural universities, post-graduate training of young agronomists) to support (a) vocational training needs of agronomists that require focused vocational training on OA topics and (b) lifelong learning needs of farmers that want to acquire new skills and cultivate new products.

The consortium includes partners that have diverse backgrounds and expertises, so that they deal successfully with the complexities of the proposed project: University of Agronomic Sciences and Veterinary Medicine Bucharest – Faculty of Agriculture (Romania) coordinator, Universidad de Alcalá (Spain), Greek Research & Technology Network (Greece), University of Maribor - Faculty of Agriculture (Slovenia), Ruse University "Angel Kanchev" (Bulgaria), Association for Organic Agriculture Northeast Slovenia (Slovenia), Biomold Association (Romania).

RESULTS AND DISCUSSION

The access to information technology is vital for the harmonious development of each country in the region, and for the region as a whole. The common element of the approaches to the various areas of development is represented by the new technologies, more exactly by a more active presence of the Internet in the rural area. Information Technology allows widely access to information and knowledge for all citizens. A large use of information technology in all activities of human existence marks a new stage of human civilization, called "Information Society". Information Society means changes in all domains: in administration (e-government), in business (electronic commerce), in education (long-distance education), in culture (multimedia centers and virtual libraries) and in the manner of working (long-distance work). All these transformations are the product of the large use of the Internet. The Internet influences the way we live, the way we do business, the manner of working, the way we study and communicate, and even the way we spend our spare time. The technological support of this new society is done by the convergence of three sectors: Information technology, communications and e-content development.

Currently, there is an increasing production of OA-related information in an electronic format. This content aims to support the goals of each initiative, either through promoting OA and educating producers/farmers and consumers about its benefits, or through the education of agricultural experts about the theory, methods and practices of OA. On the other hand, these constitute dispersed resources that are individually listed in separate sites, and with no clear plan for their educational exploitation. The systematic collection and categorization of educational resources related to OA, the development of an integrating online environment that will increase their use and reuse, as well as the study of educational scenarios for using this content in the context of training structures and programmes throughout Europe, is an area that remains to be explored.

The overall aim of “Organic.Balkanet” is to facilitate the transfer of innovative training practices and e-learning content to vocational education of young and unemployed agricultural professionals, as well as to agricultural professionals.

The need for initiatives that will focus on the education of all OA stakeholders has been identified on an EU level. The issues that “Organic.Balkanet” addresses need a European-level and not a regional approach. The collaboration of partners among countries with (i) different experience in applying OA methods and (ii) different expertise on the topics of the OA training curriculum, illustrates the benefits from this transnational approach that aims to transfer knowledge and experience among partners. Furthermore, the organisation of the valorisation activities (European Workshop and network of affiliated partners) targets to the effective generalisation of the results to other organisations and countries as well. The option of allowing candidate advisors to specialize the generic “Organic.Balkanet” training curriculum according to the particular needs of the farmers in their regions shows that linguistic and cultural preferences will be also considered.

Also, “Organic.Balkanet” categorizes and publishes in an online learning repository the transferred content from previous initiatives in the form of digital training objects.

The main objectives of this project are: to deploy a multilingual online environment that will facilitate end-users’ online search, retrieval, access and use of digital training objects in the online learning repository; to design a number of training scenarios that will introduce the use of the transferred e-learning content to support training of agricultural professionals in the participating user organizations; to carry out a set of focused pilot trials to validate the proposed training scenarios and the transferred e-learning content; to promote the cooperation of stakeholders in this particular content area and support the sustainability of project results.

Several outcomes of the Organic.Balkanet project are expected to retain their educational usefulness and value, supporting vocational training programs for agricultural professionals around Europe in the years to follow:

• The high-quality training resources on how to apply OA methods and practices;

• The Organic.Balkanet training program (as a whole, or some of its components such as the targeted competences, the curriculum topics, or the training session) for young and unemployed agricultural professionals;

• Overall, about fifteen trained experts will remain in the participating countries and regions, and will continue training farmers on OA methods and practices, marketing efforts, and access to certification processes.

In the framework of our project a training program will be developed, on how candidate advisors can train/support farmers on OA methods and techniques. The innovation of the proposed program is that it (a) integrates components and best practices from previous successful initiatives, (b) includes pedagogical components on how advisors should approach and train farmers, (c) adopts a blended training approach, since it combines physical training that includes visits to farms and real-life examples with a variety of digital training resources that can be accessed online, and (d) provides candidate advisors with a suggested curriculum framework that they can appropriately adapt and specialize for approaching the farmers in their regions.

In the second year of the project a pilot training seminar of one week will be organized by partners and will train a selection of about fifteen candidate advisors from three different countries (i.e. Slovenia, Bulgaria and Romania) using the above results. Also, the pilot Organic.Balkanet advisors will offer an appropriately developed training session for farmers in their regions a series of at least three validation seminars (one in each user country).

The various languages in which the project results will be provided, making them more accessible, usable and exploitable in the different countries and cultures covered by the project, are presented below: E-learning content will be in English, Greek, Slovenian, Bulgarian, Romanian, and Organic.Balkanet Web portal will be available in English, Slovenian, Bulgarian, Romanian, Spanish, Greek.

The following solutions have been adopted by Organic.Balkanet in order to respect multicultural/multilingual aspects of the OA content, making it thus more accessible, usable and exploitable in the different countries and cultures covered by the project:

• Content that already exists in several languages will populate the learning repositories of the project. More specifically, the repositories will include content contributed by the participating content producers' five languages (i.e. English, Greek, Slovenian, Bulgarian, and Romanian).

• To support the description of the content with appropriate metadata, the metadata schema to be developed by the project is going to be produced in the four different languages identified above. Thus, it will be possible to develop metadata records describing the content resources in any of these five languages.

• To support the creation and population of learning repositories by content producers in their own language, the software suite of tools for repositories will be also provided in four different language versions.

• To offer to end-users a multilingual environment for searching, retrieving and accessing content from the learning repositories, the Organic.Balkanet Web portal will be developed in the four main languages of the project's educational institutions.

• The educational scenarios to be studied and proposed will focus both on the national particularities of the educational systems in pilot user organisations, as well as on educational programs that are offered on a cross-border level. Thus, the cases of different national educational systems will be considered and, in addition, cross-cultural cases will be studied.

CONCLUSIONS

1. The access to information technology is vital for the harmonious development of each country in the region, and for the region as a whole.
2. Currently, there is an increasing production of OA-related information in an electronic format.
3. This content aims to support the goals of each initiative, either through promoting OA and educating producers/farmers and consumers about its benefits, or through the education of agricultural experts about the theory, methods and practices of OA.
4. The overall aim of "Organic.Balkanet" project is to facilitate the transfer of innovative training practices and e-learning content to vocational education of young and unemployed agricultural professionals, as well as to agricultural professionals.
5. This project focuses to develop the skills and competences of Vocational Educational Training (VET) and guidance professionals, including their continuous professional development and their learning of languages on topics related to Organic Agriculture (OA) in the Balkan area.
6. The project will deploy a multilingual online environment (the Organic.Balkanet Web Portal) that will facilitate end-users' online search, retrieval, access and use of digital training objects in the online learning repository.

ACKNOWLEDGEMENTS

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YIELD RESULTS OBTAINED FROM AN ASSORTMENT OF SUNFLOWER HYBRIDS CULTIVATED AT MOARA DOMNEASCĂ RESEARCH FARM IN THE PERIOD 2006-2008

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Keywords: *sunflower*, *hybrids*, *yield components*, *seed yield*

Abstract

The paper presents the research results with respect to the yield components and seed yield carried out in an assortment of twenty four sunflower hybrids in the years 2006, 2007 and 2008. Research was carried out in field experiments located on a reddish preluvosoil within Moara Domnească Research Farm belonging to the University of Agronomic Sciences and Veterinary Medicine of Bucharest (15 km far from Bucharest on North-East direction). The less favourable climatic conditions of the years 2006 and 2007 affected the yield components and the seed yield, especially in the year 2007 which can be characterised as a very drought year. Practically, the average seed yield for the studied hybrids in 2007 was three and a half times less than in 2008. The sunflower hybrids with the highest seed yield as average for the three experimental years were Saxo, Fly and Lindor, while the hybrids with the smallest seed yield were Rigasol OR, Alexandra and Opera PR. The highest seed yield in 2007 was realised by the hybrid Mateol, which shows a good drought resistance.

INTRODUCTION

The sunflower grower has to choose the hybrids for his crops from a highly diversified offer of Romanian and foreign hybrids accepted for cultivation in our country and which is changing from one year to another. Therefore, it is absolutely necessary for him to know the yielding characteristics of sunflower hybrids, especially the foreign ones and the new ones that are less known or even unknown. Also, it is absolutely necessary for the sunflower grower to know the behaviour of the different hybrids under soil and climatic conditions specific from his cultivation area. The cultivated hybrid has a great importance among the factors that influence the yielding capacity, and knowing its characteristics contributes in a large extent to the quantitative and qualitative achievement of the yield.

MATERIAL AND METHODS

In the years 2006, 2007 and 2008, research in field experiments was carried out on twenty sunflower hybrids, respectively: Huracan, Kasol, Lindor, Masai, Mateol, Podium, Saxo, Sunko, Fly, Rigasol, Rigasol OR, Fleuret OR, Arena, Melody, NK

Armoni, Alexandra, NK Dolbi, NK Ferti, Opera PR, Sanay. Additional to these twenty hybrids, in the years 2007 and 2008 research in the experimental fields were carried out on Rocky hybrid and, in the year 2008 on the hybrids Delfi, Brio and Rumbasol.

The field experiments were carried out on a reddish preluvosoil located 15 km far North-East from Bucharest (Ilfov County), within Moara Domnească Research Farm belonging to the University of Agronomic Sciences and Veterinary Medicine of Bucharest. The experiments had random plots with four replications in the year 2006 and three replications in the years 2007 and 2008. The surface of each plot was 29.4 m^2 in 2006 (6 rows at 0.7 m between rows and 7 m along the rows), 21.0 m^2 in 2007 (6 rows at 0.7 m between rows and 5 m along the rows) and 17.5 m^2 in 2008 (5 rows at 0.7 m between rows and 5 m along the rows).

Sowing was performed on 11 April 2006, 18 April 2007 and 11 April 2008. The crop technology was the regular one for sunflower in Southern Romania, with an application of 200 kg of complex fertiliser (18:48:0).

To the studied sunflower hybrids, determinations were performed in view to establish the seed yield, but also the yield components, which are the density of plants per surface unit, number of seeds on sunflower head, the weight of the seeds expressed through the weight of thousand seeds (MMB), and the weight of seeds per head.

RESULTS AND DISCUSSION

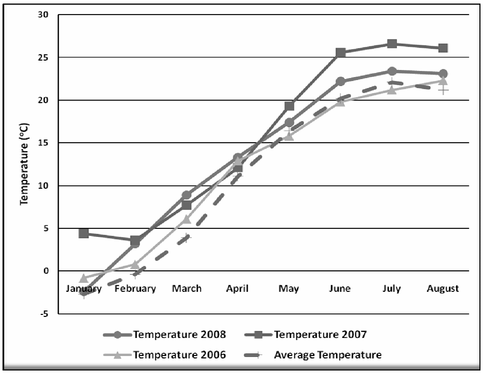
For the experimental area, the climatic conditions of the years 2006, 2007 and 2008 were not so favourable to sunflower (Figure 1, Figure 2).

In the year 2006, temperatures were not so high compared to the multiannual average values, but rainfall was much less then the multiannual average values. Thus, a drought period was recorded in May, June and July.

The year 2007 was completely unfavourable to sunflower because of the severe drought during April, May and June, as well as because of the extremely high temperatures recorded all over the year, but especially in the period May – August.

The year 2008 was not very favourable to sunflower because of the drought during June and July, and because of the high temperatures recorded all over the year. The soil water content was very low in spring because of the missing rainfall in January (0.5 mm) and February (0.5 mm) and the very low amount of rainfall in March. However the rainfall in April and May was heavier than the multiannual average compensating the missing water in the soil and providing a good reserve for the next months.

Plant density was about 52,000 plants per hectare for all the studied hybrids, with an average of 51,300 plants per hectare in 2006, 52,700 plants per hectare in 2007 and 51,600 plants per hectare in 2008.



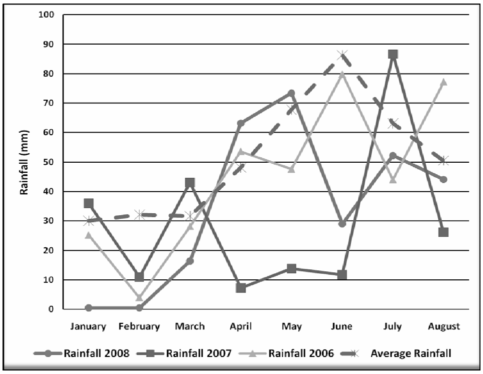


Fig. 1. Temperatures registered at Moara Domnească Research Farm

Fig. 2. Rainfalls registered at Moara Domnească Research Farm

The average number of seeds on sunflower head for the studied hybrids was the highest in 2008 (1361 seeds per head), and the smallest in 2007 (750 seeds per head). In the three experimental years (2006, 2007 and 2008), the number of seeds on sunflower head varied from 588 (Fleuret OR hybrid, in 2007) to 1633 (Saxo hybrid, in 2008). Among the studies hybrids, the highest number of seeds per head in all the three experimental years was realised by the hybrids NK Dolbi and NK Ferti, while the smallest number of seeds per head in all the three experimental years was realised by the hybrids Rigasol and Rigasol OR (Table 1).

As for the number of seeds on sunflower head, the average weight of thousand seeds (MMB) for the studied hybrids was the highest in 2008 (50.7 g), and the smallest in 2007 (27.1 g). In the three experimental years (2006, 2007 and 2008), the weight of thousand seeds varied from 19.7 g (NK Armoni hybrid, in 2007) to 65.6 g (Lindor hybrid, in 2008). In the year 2007, when there were registered the smallest values of weight of thousand seeds, the hybrids which realised the highest values of weight of thousand seeds were Fleuret OR (43.0 g) and Rigasol (36.1 g). In average for all the three experimental years, the sunflower hybrids with the highest values of weight of thousand seeds were Lindor and Rigasol, while the hybrids with the smallest values of weight of thousand seeds were Arena, Rocky, NK Dolbi, Alexandra, NK Ferti. A good value of the weight of thousand seeds is associated with a small value of the number of seeds on sunflower head (as for example for Lindor and Rigasol hybrids), while a small value of the weight of thousand seeds (MMB) is associated with a good value of the number of seeds on sunflower head (as for example for NK Dolbi and NK Ferti hybrids) (Table 1).

As for the number of seeds on sunflower head and the weight of thousand seeds, the average weight of seeds per head for the studied hybrids was the highest in 2008 (70.4 g), and the smallest in 2007 (19.8 g). In the three experimental years (2006, 2007 and 2008), the weight of seeds per head varied from 13.1 g (Opera PR hybrid, in 2007) to 87.8 g (Fly and Delfi hybrids, in 2008). In 2008, Rumbasol hybrid also had a good value of the weight of seeds per head (87.7 g). In average for all the three experimental years, the sunflower hybrids with the highest values of the weight of seeds per head were Fly, Mateol, Saxo, Lindor, which lead to the idea that a good value of the weight of seeds per head is obtained from good values of number of seeds on sunflower head and of weight of thousand seeds.

Table 1

Number of seeds on head and weight of thousand seeds (MMB) in different sunflower hybrids (Moara Domnească Research Farm)

Sunflower hybrid	Number of seeds on head						Weight of thousand seeds (MMB)					
	2006		2007		2008		2006		2007		2008	
	g	t test	g	t test	g	t test	q/ha	t test	q/ha	t test	q/ha	t test
1. Huracan	895	-73	-	-	1289	-72	35.8	- 4.5	-	-	45.6	- 5.1
2. Kasol	1296	328**	665	-85	1481	120	37.4	- 2.9	24.8	-2.3	54.2	3.5
3. Lindor	811	-157	598	-152	1380	19	47.7	7.4*	34.2	7.1*	65.6	14.9*
4. Masai	1098	130	870	120	1319	-42	39.4	-0.9	19.9	-7.2^{o}	51.8	1.1
5. Mateol	967	-1	746	-4	1430	69	48.9	8.6*	35.1	8.0*	55.7	5.0
6. Podium	843	-125	770	20	1364	3	41.4	1.1	22.8	-4.3	49.0	-1.7
7. Saxo	881	-87	773	23	1633	272	41.0	0.7	30.3	3.2	49.0	-1.7
8. Sunko	1200	232*	694	-56	1462	101	35.1	-5.2	28.2	1.1	49.0	-1.7
9. Fly	926	-42	803	53	1443	82	34.7	-5.6	26.2	-0.9	57.5	6.8
10.Rigasol	700	-268	665	-85	1171	-189	48.6	8.3*	36.1	9.0**	54.4	3.7
11.Rigasol OR	722	-246	599	-151	-	-	46.0	5.7	33.1	6.0*	-	-
12.Fleuret OR	869	-99	588	-162	1430	69	37.8	-2.5	43.0	15.9***	48.5	-2.2
13.Arena	1347	379**	722	-28	1491	130	30.8	-9.5^{o}	22.1	-5.0	47.5	-3.2
14.Melody	933	-35	748	-2	1274	-87	40.1	-0 2	23.9	-3.2	48.2	-2.5
15.NK Armoni	914	-54	781	31	1209	-152	40.1	-0.2	19.7	-7.4^{o}	51.4	0.7
16.Alexandra	973	5	681	-69	1314	-47	37.6	-2.7	26.2	-0.9	42.7	-8.0
17.NK Dolbi	1171	203	1078	328**	1319	-42	37.3	-3.0	21.1	-6.0^{o}	45.7	-5.0
18.NK Ferti	1105	137	984	234	1355	-6	40.7	0.4	23.0	-4.1	46.6	-4.1
19.Opera PR	845	-123	601	-149	1319	-42	44.4	4.1	21.8	-5.3	54.5	3.8
20.Sanay	873	-95	694	-56	1146	-215	40.6	0.3	27.7	0.6	56.5	5.8
21.Rocky	-	-	943	193	1402	41	-	-	22.2	-4.9	45.6	-5.1
22.Delfi	-	-	-	-	-	-	-	-	-	-	51.9	1.2
23.Brio	-	-	-	-	-	-	-	-	-	-	44.8	-5.9
24.Rumbasol	-	-	-	-	-	-	-	-	-	-	50.6	-0.1
Average	***968***	**-**	***750***	**-**	***1361***	**-**	***40.3***	**-**	***27.1***	**-**	***50.7***	**-**

In view to produce a high quantity of seed per head, it is not enough to have high values only for the number of seeds on sunflower head or for the weight of thousand seeds, but to have good values for both of these low yield components (Table 2).

Table 2

Weight of seeds on head and seed yield at different sunflower hybrids (Moara Domnească Research Farm)

Sunflower hybrid	Weight of seeds on head						Seed yield					
	2006		2007		2008		2006		2007		2008	
	g	t test	g	t test	g	t test	q/ha	t test	q/ha	t test	q/ha	t test
1. Huracan	36.2	1.4	-	-	59.9	- 10.5	19.4	1.6	-	-	30.3	- 2.3^{o}
2. Kasol	35.4	0.6	16.6	- 3.2	73.0	2.6	18.2	0.4	7.6	-2.8	36.6	0.5
3. Lindor	38.6	3.8	20.2	0.4	75.7	5.3	19.0	1.2	9.6	-0.8	40.9	4.8
4. Masai	36.5	1.7	17.3	- 2.5	68.6	- 1.8	19.3	1.5	8.4	-2.0	36.2	0.1
5. Mateol	35.0	0.2	26.2	6.4	79.7	9.3	14.9	-2.9 o	13.8	3.4	39.7	3.6
6. Podium	32.5	- 2.3	17.6	- 2.2	74.6	4.2	17.3	0.5	9.7	-0.7	40.6	4.5
7. Saxo	33.6	- 1.2	23.3	3.5	77.5	7.1	17.1	-0.7	10.3	-0.1	43.1	7.0**
8. Sunko	45.3	10.5***	19.5	- 0.3	65.1	- 5.3	22.4	4.6***	9.8	-0.6	29.3	- 6.8^{oo}
9. Fly	34.8	-	21.1	1.3	87.8	17.4	18.2	0.4	10.8	0.4	41.4	5.3
10.Rigasol	28.1	- 6.7^{ooo}	23.9	4.1	59.0	- 11.4	14.5	-3.3^{oo}	12.9	2.5	30.7	- 5.4^{o}
11.Rigasol OR	26.7	-8.1^{ooo}	19.6	- 0.2	-	-	14.0	-3.8^{oo}	10.7	0.3	30.3	- 5.8^{o}
12.Fleuret OR	33.2	- 1.6	23.8	4.0	64.0	- 6.4	18.0	0.2	10.6	0.2	34.0	- 2.1
13.Arena	36.6	1.8	16.0	- 3.8	66.5	- 3.9	18.9	1.1	8.9	-1.5	35.2	- 0.9
14.Melody	33.1	- 1.7	18.3	- 1.5	77.0	6.6	17.6	-0.2	10.6	0.2	35.8	- 0.3
15.NK Armoni	34.2	- 0.6	15.7	- 4.1	58.8	- 11.6	19.0	1.2	8.5	-1.9	29.2	- 6.9^{oo}
16.Alexandra	31.0	- 3.8	17.8	- 2.0	51.9	- 18.5^{o}	16.5	-1.3	9.7	-0.7	30.2	- 5.9^{o}
17.NK Dolbi	37.4	2.6	22.7	2.9	62.4	- 8.0	20.2	2.4	12.7	2.3	32.9	- 3.2
18.NK Ferti	36.9	2.1	22.2	2.4	61.0	- 9.4	19.1	1.3	11.9	1.5	34.7	- 1.4
19.Opera PR	33.7	- 1.1	13.1	- 6.7	68.1	- 2.3	16.7	-1.1	7.6	-2.8	32.2	- 3.9
20.Sanay	37.7	2.9	19.7	- 0.1	63.5	- 6.9	15.8	-2.0	11.8	1.4	36.7	0.6
21.Rocky	-	-	21.0	1.2	64.5	- 5.9	-	-	11.6	1.2	34.8	- 1.3
22.Delfi	-	-	-	-	87.8	17.4	-	-	-	-	39.9	3.8
23.Brio	-	-	-	-	84.1	13.7	-	-	-	-	45.7	9.6***
24.Rumbasol	-	-	-	-	87.7	17.3	-	-	-	-	40.2	4.1
Average	***34.8***	-	***19.8***	-	***70.4***	-	***17.8***	-	***10.4***	-	***36.1***	-

As the yield components, the average seed yield for the studied hybrids was the highest in 2008 (36.1 q/ha), and the smallest in 2007 (10.4 g). Practically, the average seed yield for the studied hybrids in 2007 was three and a half times less than in 2008, which shows how less favourable was the year 2007 for growing sunflower in South of Romania (Table 2).

In average for all the three experimental years (2006, 2007 and 2008), the seed yield varied from 7.6 q/ha (Kasol and Opera PR hybrids, in 2007) to 45.7 q/ha (Brio hybrid, in 2008). Also in average for the three experimental years, the sunflower hybrids with the highest seed yield were Saxo, Fly and Lindor hybrids, while the hybrids with the smallest seed yield were Rigasol OR, Alexandra and Opera PR. In the very dry year 2007, Mateol hybrid produced the highest seed yield (13.8 q/ha), which shows the drought resistance of this hybrid (Table 2).

CONCLUSIONS

1. The less favourable climatic conditions from the years 2006 and 2007 affected the yield components and the seed yield, especially in the year 2007 which can be characterised as a very drought year. Good values for the yield components and seed yield were obtained in 2008.
2. In the three experimental years, the number of seeds on sunflower head varied from 588 (Fleuret OR hybrid in 2007) to 1633 (Saxo hybrid in 2008).
3. In the three experimental years, the weight of thousand seeds (MMB) varied from 19.7 g (NK Armoni hybrid, in 2007) to 65.6 g (Lindor hybrid, in 2008).
4. A good value of the weight of thousand seeds (MMB) is associated with a small value of the number of seeds on sunflower head and vice-versa.
5. In the three experimental years, the weight of seeds per head varied from 13.1 g (Opera PR hybrid, in 2007) to 87.8 g (Fly and Delfi hybrids, in 2008).
6. For a high weight of seed per head, it is necessary to have good values both for the number of seeds on sunflower head and the weight of thousand seeds.
7. In the three experimental years, the seed yield varied from 7.6 q/ha (Kasol and Opera PR hybrids, in 2007) to 45.7 q/ha (Brio hybrid, in 2008).
8. In average for the three experimental years, the sunflower hybrids with the highest seed yield were Saxo, Fly and Lindor, while the hybrids with the smallest seed yield were Rigasol OR, Alexandra and Opera PR.
9. Mateol hybrid produced the highest seed yield in 2007 (13.8 q/ha), which shows the drought resistance of this hybrid.

ACKNOWLEDGEMENTS

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RESEARCH ON PRODUCTIVITY AND YIELD QUALITY OF MAIZE AND COWPEA INTERCROPPING IN THE ORGANIC AGRICULTURE SYSTEM

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Keywords: *maize, cowpea, intercropping, organic agriculture, yield quality*

Abstract

The paper researches the productivity and yield quality of maize and cowpea intercropping in order to evaluate their adaptability to the natural conditions of South Romania and to organic cultivation.

The experiment was carried out in the 2007-2009 period, in Moara Domneasca Experimental Field, on reddish preluvosoil, in randomized variants, in 4 replications. The seeds used for experiments were organic. Maize and cowpea were sown in alternating rows (1 row of maize, 1 row of cowpea), in 70 cm distance between maize rows and 35 cm distance between rows of cowpea and rows of maize, at a 5 cm depth. Maize crop had a density of 5 plants/m^2 and cowpea crop of 12 plants/m^2. There were determined the productivity compounds, land equivalent ratio and yields.

The average grain yield for maize in monoculture was of 35.51 q/ha and in intercropping with cowpea of 33.56 q grains/ha. In monoculture, the average cowpea yield was of 18.38 q/ha and in intercropping with maize 8.03 q/ha, were harvested.

In terms of chemical composition, maize intercropped with cowpea contains 9.35% proteins, 4.79% fats and 68.94% starch. Cowpea seeds had 24.69% protein, 0.87% fats and 40.15% starch.

INTRODUCTION

Nowadays, in the developed regions of the world, conventional agriculture, which is more and more monoculture or pure crop-oriented, modifies landscapes and hurts the ecosystems, including biodiversity.

Thus, at both world and European levels, a new concern has occured, related to the connection between agricultural practices, environmental problems and the long-term stability of agricultural production systems. The organic agriculture system must be regarded as an integrant part of the sustainable development strategies and as a viable alternative to conventional agriculture.

One of the non-polluting agricultural practices, which also represent a way of increasing crop diversity, would be the introduction of intercropping in the organic agriculture system [1].

Cereals-grain legumes intercropping play an important role in subsistence food production in both developed and developing countries, especially in situations of limited water resources [3]. Plant growth factors such as light, water and nutrients are more efficient utilized and converted to crop biomass by intercropping. Intercropping cereals and grain legumes can be adequate for both organic and conventional farmers because grain legumes such as cowpea are richer in protein compared to cereals.

MATERIAL AND METHODS

Research was carried out in the years 2007-2009 in Moara Domneasca Experimental Field and its main purpose was to study the productivity and yield quality of maize and cowpea in intercropping, in order to know their adaptability to reddish preluvosoil area pedoclimatic conditions of the central part of Romanian Plain and in the organic agriculture system.

In this experiment, a program of phenological observations and biometrical measurements was developed and a series of parameters were followed, such as: agronomical parameters (productivity compounds and seed yields), competition parameters (land equivalent ratio) and quality parameters (protein, fat and starch contents).

The seeds used for experiments were organic. Maize and cowpea were sown in alternating rows (1 row of maize, 1 row of cowpea), in 70 cm distance between maize rows and 35 cm distance between rows of cowpea and rows of maize, at a 5 cm depth. Maize crop had a density of 5 plants/m^2 and cowpea crop of 12 plants/m^2 [2]. The spatial distribution was as shown below (Figure 1).

X35 cm O35 cm X

X O X

X O X

X O X

X O X

70 cm

Legend:

X – maize plants

O – cowpea plants

Fig. 1. Spatial distribution for maize–cowpea intercropping

RESULTS AND DISCUSSION

A. Results for maize. As far as the productivity compounds are concerned, maize from monoculture formed cobs of 20.5 cm long, with an average of 14.8 rows/cob, 41 grains/row and 597 grains/cob. Grains weight/cob was of 169.6 g, grain productivity of 79.2% and TGW of 284.2 g.

On 3 years average, maize intercropped with cowpea formed cobs of 20.2 cm long, 14.6 grain rows/cob, 39.8 grains/row and an average of 584.3 grains/cob. Grains weight/cob was 164.9 g, grain productivity of 78.7% and TGW was 282.4 g (table 1).

Table 1

Productivity compounds at maize, in monoculture and in intercropping
(Moara Domnească Experimental Field, 2007-2009)

Productivity compounds	Maize monoculture	Maize-cowpea intercropping
	Average 2007-2009	
Cob length (cm)	20.5	20.2
Number of rows/cob	14.8	14.6
Number of grains/cob	597.1	584.3
Number of grains/row	41.3	39.8
Cob weight (g)	214.1	209.2
Grain weight/cob (g)	169.6	164.9
Grain productivity (%)	79.2	78.7
TGW (g)	284.2	282.4

In terms of chemical composition, maize grains from monoculture had the following content: 12.71% moisture, 10.13% proteins, 5.30% fats and 66.94% starch. When intercropped with cowpea, maize grains had a content of 12.8% moisture, 9.35% proteins, 4.79% fats and 68.94% starch (Table 2).

Table 2

Chemical composition of maize and cowpea seeds, in monoculture and in intercropping (Moara Domnească Experimental Field, 2007-2009)

Type of culture	Moisture (%)	Protein (% d.m.)	Fat (% d.m.)	Starch (%)
Maize (monoculture)	12.71	10.13	5.30	66.94
Cowpea (monoculture)	11.05	25.50	1.09	42.06
Maize intercropped with cowpea	12.80	9.35	4.79	68.94
Cowpea intercropped with maize	10.78	24.69	0.87	40.15

Based on productivity compounds and sowing density, there were determined the yields, both for maize grown in monoculture and in intercropping with cowpea. In monoculture, maize yield was in average of 35.51 q/ha. Compared with the control, maize yield in intercropping was 1.95 q/ha less, i.e. of 33.56 q/ha (Figure 2).

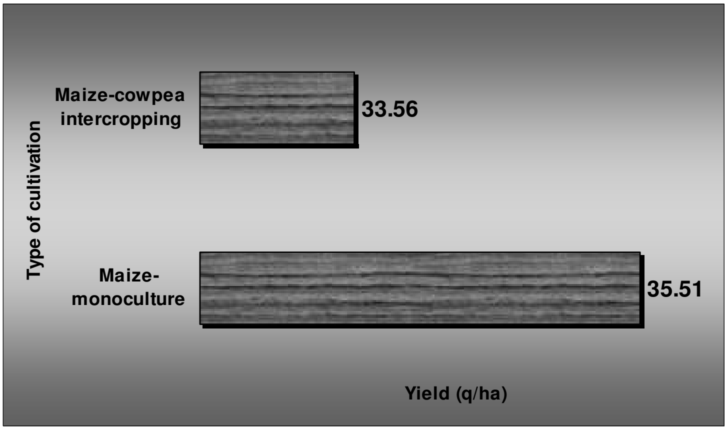

Fig. 2. Average maize yields, in monoculture and in intercropping with cowpea (Moara Domnească Experimental Field, 2007-2009)

B. Results for cowpea. In terms of productivity compounds, cowpea plants from monoculture had 49.0 cm height, formed on average 9.3 pods/plant, 76.6 grains/plant, 8 grains/pod, grain weight/plant was 8.0 g and TGW was 119.8 g.

By comparison, in intercropping with maize, there was a competition for light, water and nutrients, so cowpea plants had on average a 47.3 cm height, formed only 7.5 pods/plant, 59.0 grains/plant, 7.9 grains/pod, grains weight/plant was 6.5 g and TGW was 113.2 g (Table 3).

Table 3

Productivity compounds at cowpea, in monoculture and in intercropping with maize (Moara Domnească Experimental Field, 2007-2009)

Productivity compounds	**Cowpea monoculture**	**Maize-cowpea intercropping**
	Average 2007-2009	
Plant height (cm)	49.1	47.3
Number of pods/plant	9.3	7.5
Number of grains/plant	76.6	59.0
Number of grains/pod	8.0	7.9
Grains weight/plant (g)	7.2	6.5
TGW (g)	119.8	113.2

During the 3 experimental years, in monoculture, there were harvested 18.38 q grains/ha, and in intercropping with maize, cowpea yield was 8.03 q/ha, 10.35 q/ha less than at the control (Figure 3).

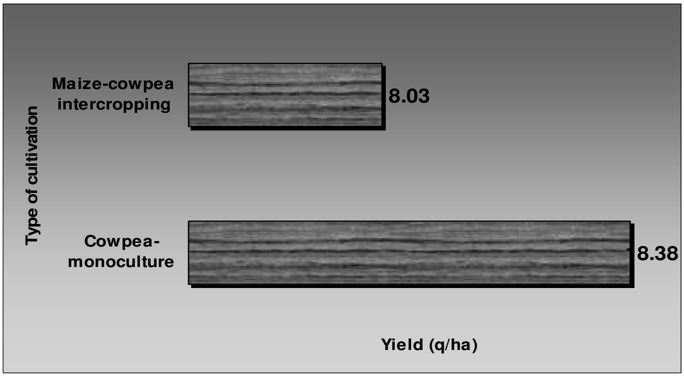

Fig. 3. Average cowpea yields in monoculture and in intercropping with maize
(Moara Domnească Experimental Field, 2007-2009)

For cowpea in monoculture, the moisture content was of 11.05% and in intercropping with maize average was of 10.78%. The protein content was 25.5% in monoculture and 24.69% in intercropping. In monoculture, the cowpea seeds contain 1.09% fats and 42.06% starch and in intercropping with maize, fat content was 0.87% and starch was 40.15% (Table 2). For maize-cowpea intercropping, the protein yield was of 5.87 q/ha (Table 4).

Table 4

Protein yields of maize and cowpea, in monoculture and in intercropping
(Moara Domnească Experimental Field, 2009)

Type of crop	Seed yield (q/ha)		Total yield (q/ha)	Protein yield (q/ha)		Total protein yield (q/ha)
	Maize	Cowpea		Maize	Cowpea	
Maize (monoculture)	36.22	-	36.22	3.66	-	3.66
Cowpea (monoculture)	-	24.63	24.63	-	6.28	6.28
Maize-cowpea	33.34	11.19	44.53	3.11	2.76	5.87

The partial and total land equivalent ratio (LER) was also determined during the research. Thus, in the 2007-2009 period, partial LER ranged between 0.43 for cowpea and 0.94 for maize. The total LER was of 1.37, which means that there is a real advantage of intercropping maize with cowpea compared to monoculture. This value means that an area planted as monoculture would require 37% more land to produce the same yield as in intercropping (Table 5).

Table 5

Land equivalent ratio for maize-cowpea intercropping

(Moara Domneasca Experimental Field, 2007-2009)

Total LER	Type of crop	Yields in intercropping (q/ha)	Yields in monoculture (q/ha)	Partial LER
	Maize	33.56	35.51	0.94
	Cowpea	8.03	18.38	0.43
	-	-	-	**1.37**

CONCLUSIONS

1. The maize plants from intercropping behaved almost like the ones from monoculture. This means that there wasn't a real competition for light, water and nutrients between maize and cowpea plants.
2. The average maize grain yield in monoculture was 35.51 q/ha. In intercropping with cowpea, maize yield was 1.95 q/ha lower than the control, i.e. 33.56 q/ha.
3. When intercropped with cowpea, maize grains contain 12.8% moisture, 9.35% proteins, 4.79% fats and 68.94% starch.
4. Cowpea plants from monoculture developed better than in intercropping. This means that cowpea compete with maize for water, nutrients and light.
5. When grown in monoculture, cowpea plants produced 18.38 q/ha and in intercropping with maize, the yield was 10.35 q/ha lower than in monoculture, respectively 8.03 q/ha.
6. Cowpea seeds from intercropping contain 10.78% moisture, 24.69% proteins, 0.87% fats and 40.15% starch.
7. For maize-cowpea intercropping the protein yield/ha was 5.87 q/ha.
8. The total LER for maize-cowpea intercropping was 1.37, which means that there is a real advantage of intercropping maize with cowpea as compared to monoculture. This value means that an area planted as monoculture would require 37% more land to produce the same yield as in intercropping.

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RESEARCH ON ECOLOGY, PRODUCTIVITY AND YIELD QUALITY OF *LENS CULINARIS* MEDIK. SPECIES IN THE CENTRAL PART OF THE ROMANIAN PLAIN

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Keywords: *lentil, organic agriculture, genotype*

Abstract

The main objective of the research was to study the biology, ecology and productivity of a less common species of agricultural crops – lentil (Lens culinaris), aiming to evaluate the adaptability of this species to the natural conditions of the Southern part of Romania and to the organic agriculture production system.

The experiment was carried out in Moara Domneasca Experimental Field, located on the reddish preluvosoil area from the Central part of Romanian Plain.

On average of three experimental years, lentils crop was sown between March 14-April 5, the plants reached the harvesting maturity in the first two decades of July, after an average vegetation period of 86 days, when there were accumulated 1120.6 GDD (Growing Degree Days)(Σt> 5ºC).

After harvesting, the lentil plants had 25.5 pods/plant, with 1.37 seeds/pod and TGW values of 37.2 g.

The yields illustrate the favorability of the natural conditions for lentils and a good productivity of the tested biological material. The highest productive genotypes, on average during experimental three years, proved to be Laird and Richlea, with average yields of 14.27 q/ha, respectively 13.54 q/ha, exceeding by 1.36 q/ha and respectively 1.14 q/ha.

INTRODUCTION

Lentil (*Lens culinaris*), a grain pulse, is a bushy annual plant from the legume family, grown for its lens-shaped seeds. It is about 38 cm tall and the seeds grow in pods, usually with two seeds in each pod.

Lentil is used mainly for human consumption as a protein source in diverse kinds of products ranging from deserts to soups, stews and vegetarian dishes. Lentil is 25% protein-second only to soybeans as a source of edible protein.

Lentils are an excellent source of vitamin A and provide fiber, potassium, B vitamins, and iron. Unlike meat, poultry, fish and eggs, this protein source contains no cholesterol and virtually no fat. Lentils, eaten with a grain, such as rice, wheat, or barley, provide all the essential amino acids required by the human organism in a balanced diet.

MATERIAL AND METHODS

The main objective of the research was to study the biology, ecology and productivity of *Lens culinaris* species, in order to know their adaptability to the climatic conditions of the reddish preluvosoil area from the central part of the Romanian Plain and in organic agriculture production system. The research was carried out in Moara Domneasca Experimental Field located near Bucharest, during 2007-2009 period.

The experiment was organized based on the multi-stage block method with randomized plots in 4 replication, with 7 experimental variants, namely: V_1- genotype "Beluga", V_2 - genotype "Sorte du Puy", V_3 - genotype "Laird" (Turkey), V_4 - genotype "Richlea" (France), V_5 - genotype "Masoor" (Turkey), V_6 - genotype "Estonia" (Greece) and V_7 - local population „De Moara Domnească".

On average during the 3 experimental years, lentils was sown between March 14 and April 5, and the sowing parameters were: 50 cm spacing between rows, with a density of 220 plants/m²; the sowing depth was of 3-4 cm. The dimensions of the experimental plot were 4 m wide and 5 m length, the plot area being 20 m^2.

In these experiments, there was developed an observations and measurements program concerning morphological and biological peculiarities of studied genotypes, productivity compounds and seeds yields, chemical composition and yield quality.

RESULTS AND DISCUSSION

Phenological data. During the 3 experimental years, lentils was sown between March 14 and April 5 and the optimum recommended period for this area. Under these conditions, lentils plants emerged within the first two decades of April, the period between sowing and emergence being 9-14 days. A special case was registered in 2008, when sowing was realized on March 14 and the period from sowing to emergence was 18-23 days.

Lentils crop bloomed in the third decade of May, after 50-51 days from the emergence, with some exceptions: in 2007, when "Beluga" genotype bloomed later, on June 3, in 2008, when 2 genotypes ("Laird" and "Richlea") bloomed earlier, on May 19 and in 2009, when "Beluga" and "Sorte du Puy" genotypes bloomed on June 2 (Figure 1).

Research showed that in the experimental area, lentils reached harvesting maturity in the first two decades of July; an exception was 2007, when the plant reached maturity earlier, in the third decade of June, due to drought.

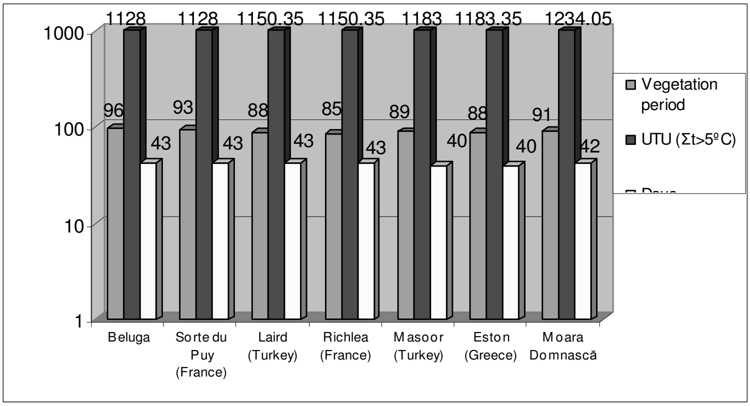

Fig. 1. Duration of vegetation and flowering-maturity period at lentils genotypes (Moara Domneasca Experimental Field, 2007-2009)

Lentil plants had a vegetation period of 86 days, when they accumulated 1120.6 GDD, with an exception in 2009, when the vegetation period was of 101 days and the accumulation of heat was of 1226.8 GDD (Σt>5ºC).

Throughout the experimental cycle, under the experimental area conditions, lentils plants had an average height of 32-40 cm, with a growing rate of 0.40 cm/day. 41-47 leaves formed on stems, with 1.14-1.54 days necessary for a leaf formation and the average heat consumption was 19.12 UTU/leaf. Regarding the leaf area, "Richlea" genotype presented the highest value of 164.9 cm^2/plant (Figure 2).

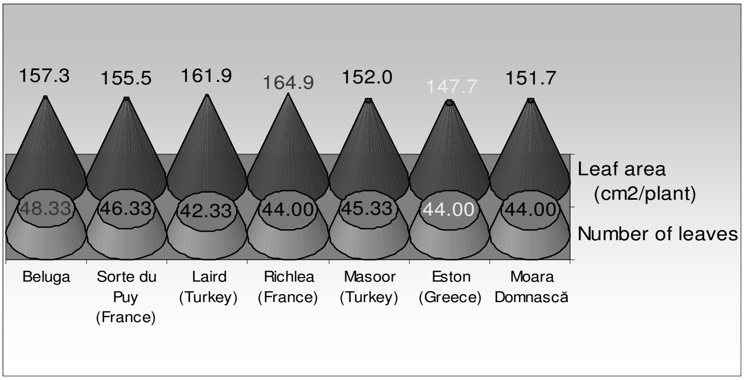

Fig. 2. Dynamics of leaves growing at lentils genotype
(Moara Domneasca Experimental Field, 2007-2009)

Determinations of morphological characters and productivity compounds. When harvested, lentil plants had on average of 25.5 pods/plant, 1.37 seeds/pod and a TGW of 37.2 g (Table 1). Seed moisture was of 14.2% at harvesting and it was according to the moisture standards for this species.

Table 1

Productivity compounds of lentils genotypes
(Moara Domneasca Experimental Field, 2007-2009)

Productivity compounds	Biological material (genotype)							
	Beluga (France)	Sorte du Puy (France)	Masoor (Turkey)	Richlea (France)	Laird (Turkey)	Eston (Greece)	Moara Domneasca	Average
Plant height (cm)	35.9	38.7	37.7	39.7	39.4	36.2	35.3	37.4
Number of pods/plant	26.1	24.9	26.2	24.3	23.0	28.1	25.7	25.4
Number of fertile pods/plant	23.4	22.3	23.8	22.4	21.7	25.5	23.7	23.2
Number of sterile pods/plant	2.6	2.6	2.4	1.9	1.4	2.5	2.0	2.2
Seed number/plant	41.3	34.5	35.1	26.2	22.6	34.6	34.1	32.6
Seed number/pod	1.7	1.5	1.5	1.2	1.0	1.3	1.4	1.4
Seeds/plant (g)	0.8	1.2	1.1	1.7	2.0	1.1	1.0	1.3
TGW (g)	21.7	29.0	31.5	51.1	63.9	32.0	31.1	37.2

The production data resulted in three experimental years illustrates the favorability of natural conditions for lentils and a high productivity of the tested biological material. Seeds yields for the experiments with different genotypes of lentil were on average of 12.91 q/ha, the limits ranging between 11.43 q/ha at “Beluga” genotype and 14.27 q/ha at “Laird” genotype. Highest productive genotypes in the three experimental years, proved to be Laird and Richlea genotypes, with average yields of 14.27 q/ha, and 13.54 q/ha respectively, exceeding the average by 1.36 q/ha and respectively 1.14 q/ha (Table 2).

The chemical composition of the lentil seeds was as follows: 22.18% proteins, 3.03% fats, 33.29% glucides, 4.00% ash, while the energetic value was 259.97 kcal. The highest protein values were determined for “Laird” and “Richlea” genotypes seeds - 22.85% and 22.67% - and the lowest protein content was found at “Sorte du Puy” genotype, with 21.14%. Fat content ranged from 2.78% at “Moara Domneasca” genotype to 3.40% at “Sorte du Puy” genotype (Table 3).

Glucides content was 33.29% on average with low differences between genotypes, the highest content being recorded at “Laird” genotype with 33.98% and the lowest at “Eston” genotype with 32.87%.

Table 2

Seed yields at comparative crops with lentil genotypes
(Moara Domneasca Experimental Field, 2007-2009)

Biological material (genotype)	Yield		Difference (q/ha)	Significance
	q/ha	%		
Beluga	11.43	88.52	-1,49	ooo
Sorte du Puy	12.67	98.06	- 0,25	o
Masoor (Turkey)	12.77	98.89	-0,15	-
Richlea (France)	13.54	104.83	0,62	*
Laird (Turkey)	14.28	110.53	1,36	***
Eston (Greece)	12.74	98.66	-0,18	-
Moara Domneasca	12.86	99.56	-0.06	-
Average	**12.92**	**100.00**	**Mt**	**-**

$DL_{5\%}$= 0.237 q/ha
$DL_{1\%}$= 1.057q/ha
$DL_{0.1\%}$= 1.316 q/ha

Table 3

Chemical composition of lentils genotypes (% d.m.)
(Moara Domneasca Experimental Field, 2009)

Genotype	Proteins	Lipids	Glucids	Ash	Energetic value (kcal %)
Beluga	21.78	3.25	32.98	4.11	259.02
Sorte du Puy	21.14	3.40	33.57	4.04	255.86
Laird	22.85	2.95	33.98	3.94	265.00
Richlea	22.67	2.81	33.21	3.91	259.77
Masoor	22.27	3.06	33.43	4.13	263.28
Eston	22.34	3.02	32.87	4.07	258.92
Moara Domnească	22.21	2.78	33.02	3.84	256.74
Average	**22.18**	**3.03**	**33.29**	**4.00**	**259.97**

Table 4

Protein yields of lentil genotypes

(Moara Domneasca Experimental Field, 2009)

Species	Protein yields		Difference (q/ha)	Significance
	q/ha	%		
Beluga	2.59	86.71	-0.38	ooo
Sorte du Puy	2.76	93.36	-0.21	ooo
Laird	3.35	113.99	0.38	***
Richlea	3.17	106.99	0.20	***
Masoor	2.87	99.30	-0.1	o
Eston	3.09	99.30	0.12	**
Moara Domnească	3.02	99.65	0.05	-
Average	**2.97**	**100**	Mt	-

$DL_{5\%}$= 0.071 q/ha
$DL_{1\%}$= 0.107 q/ha
$DL_{0.1\%}$= 0.172 q/ha

Table 4 presents protein yields based on seed yields and protein content. The protein yields ranged between 2.59 q protein/ha and 3.35 q protein/ha, the average being 2.97 q protein/ha. Most productive genotypes were found to be "Laird" with 3.35 q protein/ha, exceeding the average by 0.38 q/ha, and "Richlea", with 3.17 q/ha and an increase of protein yield with 0.20 q/ha. The lower protein yields were recorded in "Beluga" and "Sorte du Puy" genotype, which produced 2.59 q protein/ha, respectively 2.76 q protein/ha (Table 4).

It can be noticed that "Richlea" and "Laird" genotype gave the highest seed yields, had the highest seeds protein content and gave the highest protein yields.

CONCLUSIONS

1. In the 3 experimental years, the lentils plants had a vegetation period of 86 days, when they accumulated 1120.6 GDD, an exception being 2009, when the vegetation period reached 101 days and the accumulation of heat was 1226. 8 GDD ($\Sigma t>5°C$).
2. Production data illustrates the favorability of the natural conditions for lentils and a high productivity of the tested biological material. The highest productive genotypes in the three experimental years proved to be "Laird" and "Richlea" genotypes, with average yields of 14.27 q/ha and 13.54 q/ha, respectively.

3. Chemical composition of the lentils seeds was as follows: 22.18% proteins, 3.03% fats, 33.29% glucides, 4.00% ash, while the energetic value was 259.97 kcal.
4. Protein yields ranged between 2.48 q/ha and 3.26 q/ha, the average being 2.86 q protein/ha. The biggest protein yields, of more than 3.0 q protein/ha, was obtained from Laird and Richlea genotypes.
5. The results obtained in the three experimental years illustrate the favorability for lentils of the experimental area natural conditions, which offer favorable prerequisites for the achievement of successful crops and high quality production. Lentils is one of the alternative crops promoted by the organic agriculture system and can be a potential alternative crop for organic farms in the area.

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STUDIES REGARDING THE POSSIBILITY OF INTRODUCING BUCKWHEAT CROPS IN DOBROGEA, WITHIN THE CONTEXT OF SUSTAINABLE AGRICULTURE

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Keywords: *buckwheat*

Abstract

Buckwheat (Fagopyrum esculentum var. sagitattum), family Polygonaceae, is an old crop originated from Tibet, where a large variety of wild and cultivated forms can be encountered up to an altitude of 3,600 m or even more. It was brought in Europe much later and it spread in Denmark, Germany and France. Its importance diminished in the 19th century. The surface cultivated with this plant was considerably reduced after the First World War. From 3.9 million ha cultivated between 1922-1925, the surface was reduced to 3.1 million ha in 1940. The crops are concentrated especially in Europe (1.4 million ha, among which 0.87 million ha in the Russian Federation and 0.37 million ha in Ukraine) and China (1 million ha). Among the countries that cultivate buckwheat, the following can also be mentioned: The USA (65 thousand ha), Poland (74 thousand ha), Brazil (45 thousand ha), Japan (43 thousand ha), France (31 thousand ha), Belarus and Lithuania. The world trade sums up to 180 thousand tones yearly, the major exporters being China and the USA. The culture area extends up to 70 degrees northern latitude and an altitude of 800 m. In Romania, it could be extended in crop, especially in ecological farming. Buckwheat can be cultivated in Dobrogea as this region has the appropriate soil and climate conditions. This paper proposes possible technological versions that can be applied to this culture in order to extend it in Dobrogea.

INTRODUCTION

Buckwheat, a sweet-flavored food type, has recently been focused on again by the consumers, firstly because of the dietary qualities of the seeds (with a calorie count of only 128 kcal/100 g, compared to the average of 350 kcal/100g in the usual cereals). Buckwheat crop is promoted by those that practice ecological agriculture as an alternative to the basic crops, being frequently sold in shops specialized in ecological products. For these reasons, specialists have begun to pay attention to buckwheat lately, in what regards the improvement of the existing types. The farmers are also interested, but in terms of profitable alternative to the current structure of crops.

MATERIAL AND METHODS

For this paper, we studied the possibility of introducing buckwheat crops in the crop structure of Dobrogea by means of an opinion poll accomplished among the local farmers, who were interested in this culture. First there were meetings with the farmers, where the advantages of using this plant in alimentation and agriculture were presented to them. As a result of the poll, farmers were interested in this topic. The location of the experiments was a farm around the locality of Stupina, Constanta County. In this regard, a buckwheat crop was set up and it was followed during the vegetation period and the results are presented in this paper. The soil type on which the crop was placed was calcaric chernozem.

RESULTS AND DISCUSSION

Description of the experimental zone: Dobrogea is located in the south-east of the country (the town of Sulina, located on 29°41'24'' eastern longitude, is the easternmost locality of Romania), between the Danube and the Black Sea, surrounded from three sides by water. In spite if its Ponto-Danubian location, Dobrogea generally has a pronounced continental climate with hot and dry summers and winters with strong winds which influence the production. It can be said that the land of Dobrogea is a geological, morpho-hydrographic, climatic and biogeographical mosaic. It has a low potential for running waters, the region being dominated by natural lakes, but mostly anthropogenic lakes which are very important in modifying the structure of the hydrographic and physico-geographic landscape as a whole. Underground waters are found in differential hydrostructures, especially due to the lithological and tectonic elements, and they register a pH between 6.98 and 8.04. The fact that Dobrogea is framed by the Black Sea and the Danube on three sides determines the weakening of extreme values, especially thermal ones and the generation of local movements of air masses such as breezes. The annual precipitations, by the quantities registered (350-510 mm) locate Dobrogea between the regions with the lowest values in Romania. Regarding the soil, the loess and loess deposits have the widest distribution, covering practically the entire Dobrogea Plateau. This, at the level of the parent rock (the solification rock), gives the soil a high degree of homogeneity.

Description of the plant. Buckwheat is grouped, from the phytotechnical point of view, among cereals, because of its use. However, from a botanical point of view, it is a dicotyledonate plant, of the family Polygonaceae. The plant has a 20-40 cm tap root with numerous fibrous ramifications, distributed especially in the arable layer. The root hairs are very long, reaching 3-5 mm. This means that the root has a high capability to solubilize and absorb. The stem is erect, ramified from the basis, juicy and hollow inside. Its surface is slightly striated, green or reddish-green. Its height varies between 30-60 cm, but in good fertilization conditions, it can reach 130 m.

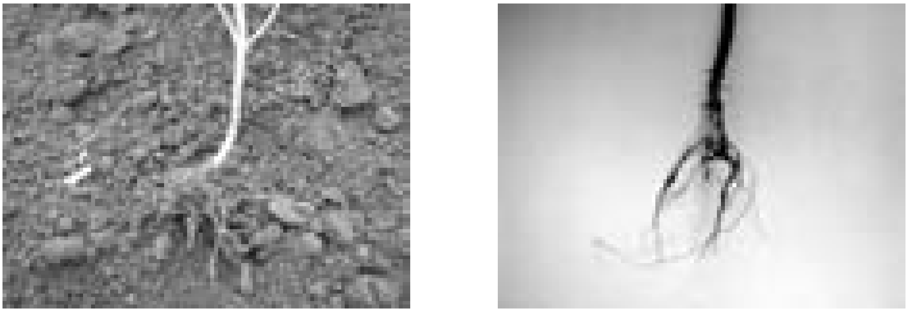
Fig. 1. Root of buckwheat

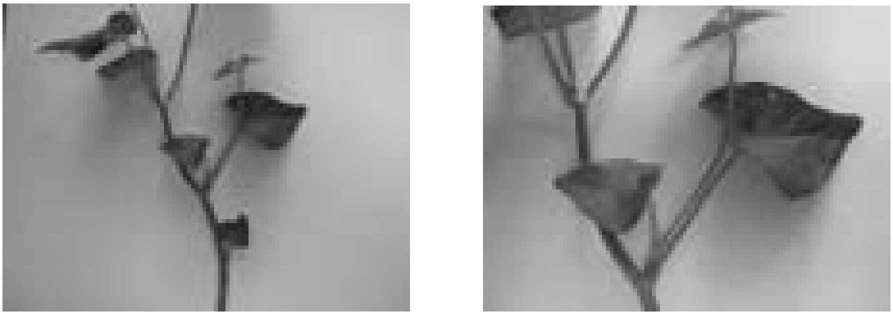
Fig. 2. Indefinite ramification in buckwheat

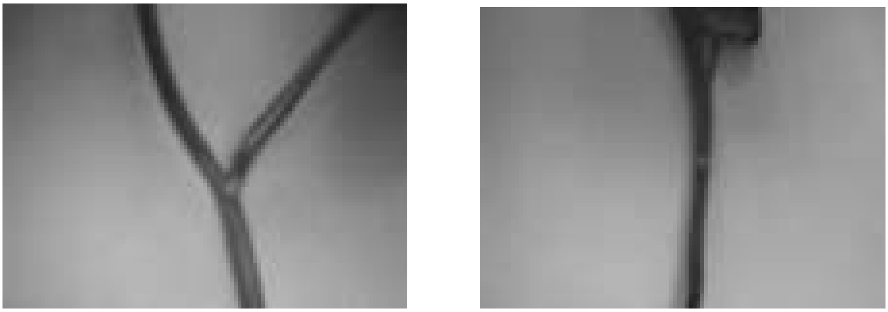
Fig. 3. Ramification and growth node in buckwheat

The leaves are triangular or sagittate-cordate, smooth and green; the ones from the base have long petioles, while those towards the top are almost sessile. The blade has a length of 2-5 cm and a width 1.5-5 cm, with slightly hairy nervures, green or reddish. The stipes are small and green. The stem and leaves juice is very acid; there are many calcium oxalate crystals in the cells. The flowers are frequently united in an inflorescence looking like an elongated raceme. The shapes of corymb and semiumbel are also encountered. The inflorescence has a long peduncle inserted at the pit of superior leaves and comprises a large number of flowers, sometimes 3000, but the average is approx 500. These are small (2-3 mm), made up of a perigone with 5 petal-like sepals, pinkish-white or red, with strong fragrance.


Fig. 4. The ventral and dorsal part of buckwheat leaf

There are eight stamens placed on two circles: five on the outside and three on the inside. Characteristic to the flowers is the sexual dimorphism studied by Darwin; some flowers have the style longer than the stamens, others, shorter. The ovary has a single chamber, one pistil and three stigmas (rarely two or four).

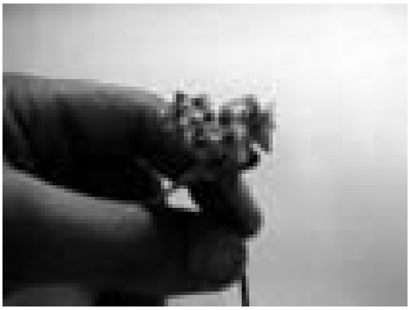


Fig. 5. The inflorescence of buckwheat

The fruit is a nut with three edges (length = 4-6 mm; width = 2.8-3.7 mm; thickness = 2.4-3.4 mm). Its color is chestnut-brown or silver-grey, glossy after harvesting and dull later. The MMB is 19-27 g, MH 55-70 kg. The springing is epigeous and the cotyledons emerge shrouded in the fruit covering, which it removes the following day. The little plant is pink or reddish when it springs, but turns green in the presence of light. For the entire vegetation period, buckwheat requires 60-160 days, depending on type and environment.

Cultivation technology. Rotation. The autumn barley was chosen as previous plant and after buckwheat followed mustard. *Fertilization.* For a production of 2000 kg/ha of seeds and 3400 kg/ha of straw, buckwheat extracts from the soil 64 kg N, 42.5 kg P_2O_5, 97 kg K_2O, (Bâlteanu, 2000), but it has a strong power of solubilization and use of the soil nutrients (in a form that is difficult to make soluble). Thus, only organic fertilizers were used, namely 20 tons/ha of manure. It was noticed that manure administered in autumn is very favorable on the seeds and straw production, but also on the production of nectar and thus honey. *Soil tilling*. Considering the high demands for humidity and warmth buckwheat has, soil tilling was accomplished by a good mobilization of soil, which contributed to the increased capacity for water and its warming. The plowing was done immediately after the harvesting of barley, at a depth of 25 cm. Until sowing, the ploughed field was tilled by cultivator and harrow for the breaking up of the soil and destruction of weeds. The first spring tilling was done as the weeds emerged while the second was accomplished at 6 cm, around sowing time. *Seed and sowing*. As the seeds harvest resulted after threshing contained impurities consisting of weed seeds and dry seeds, the seed was prepared carefully in order to increase purity to 97% and germination to 90%. Thus, the biggest seeds were chosen in order to ensure vigorous and productive plants. In order to increase the germinative capacity, especially the germinative energy, the air-thermal treatment was employed by exposing the seeds to open air and sunny weather for 2-3 days. The sowing date was established according to soil temperature, the danger of late frost and weather around lowering time. Sowing was begun when the soil temperature (10 m deep) was maintained at 9-10 degrees Celsius and the danger of frost passed. It was also considered that flowering time should occur in a wet period. The distance between the rows was chosen at 15 cm. The quantity of seeds per ha, calculated according to the useful value and MMB, with a target density of 400-500 germinable seeds/square meter, was 90 kg. The row orientation influences considerably the production in the forest zone, with more nebulosity and more fertile soils. In this regard, the row orientation was north-south. The sowing depth was 6 cm. *Maintenance works*. Flattening out the buckwheat culture is indicated on all the dry and light soils, as well as in dry springs. The capillarity resulted helps water rise to the seeds level which germinate faster. By advancing the growing plants, a harvest growth of 10-20% is ensured. In order to control crust and weeds, a light harrow was used. The weeds that were not destroyed by harrow were weeded so that the young plants should not bee suffocated during the early vegetation period. In order to facilitate pollination and fecundation, bee colonies were brought around the field (one hive/ha). *Harvesting*. Due to the long flowering period, buckwheat ripens very non-uniformly; on the other hand, the danger of shaking off is very high. This is why it is very important to choose the harvest day very carefully. If the threshing occurs too early, many seeds remain dry; if all the seeds are left to ripen, the most valuable ones are lost. Considering these aspects, threshing was begun when 90% of the fruits ripened, even though some plants still had a few flowers left. The losses by shaking off increase as threshing is delayed, reaching full ripening at 20-30% (Bâlteanu, 2000). The harvesting took place on September 6 (in the evening), by cereal combine, with specific modifications for buckwheat. The seeds must be deposited carefully as the high content in water at harvest in high, especially when there are many green seeds left. Immediately after harvesting, the seeds were scattered, spread in a thin layer on a concrete platform and then spaded several times a day. *Productions.* The production obtained was 1800 kg/ha.

CONCLUSIONS

1. The climatic conditions of Dobrogea are favorable to buckwheat crop.
2. Autumn barley is a good previous plant for buckwheat.
3. Ploughing performed immediately after the harvesting of barley, at 25 cm and a germinative bed at 6 cm around sowing time, fertilization only with organic fertilizers (20 tons/ha of manure), sowing at a distance of 15 cm between the rows, 90 kg of seeds per ha, row orientation on north-south, sowing at 6 cm, culture flattening out, all these provided favorable conditions for the development of buckwheat plants.
4. The bee colonies (one hive/ha) facilitate pollination and fecundation.
5. The production of buckwheat per ha (in the conditions of Stupina, Constanta County) was 1800 kg/ha.

ACKNOWLEDGEMENTS

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EXPERIMENTAL RESULTS CONCERNING THE YIELD OF *DACTYLIS GLOMERATA* SPECIES IN CONDITIONS OF ROMANIAN PLAIN

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Keywords: *botanical composition, mixtures, yield, density*

Abstract

The wide spreading of Dactylis glomerata in crop, as feeding crop, is explained by high productivity, great ecological and use plasticity, great vivacity and quality attributes approaching to the valuable fodder species.

An experiment was organized on Dactylis glomerata in sole crop and in mixture with Medicago sativa within Moara Domneasca Experimental Field. In the experiment there were studied two varieties of orchardgrass: Regent and Ambasador.

On the basis of the obtained results, we can observe that Dactylis glomerata species adapts excellent to the Romanian Plain conditions, ensuring in non-irrigated conditions both in sole crop and in mixture with Medicago sativa average yields of 4-5 t/ha D.M..

INTRODUCTION

From the species participating in the vegetal clover of temporary pastures from plain regions, it was studied the graminacea species with higher frequency in the botanical composition, respectively *Dactylis glomerata*.

Based on research effected in our country, it was found that *Dactylis glomerata* species has an excellent adaptabilityto the Romanian Plain conditions, achieving high an stable yields, both in irrigated and non-irrigated system.

In this paper there are presented the results obtained in 2009 within an experiment with *Dactylis glomerata* in sole crop and in mixture with *Medicago sativa*.

MATERIAL AND METHODS

Research was performed within the Moara Domneasca Experimental Didactic Farm, owned by University of Agronomic Sciences and Veterinary Medicine Bucharest.

Soil. The representative soil in the southern part of the country for the experimental field and for the oak area, belongs to the reddish preluvosoil type, presenting the following characteristics: loamy-clay texture; medium humus content in A horizon (2.77%) and relatively high in A/B horizon (about 1.2%); slight neutral-acid reaction in A horizon (pH 6.29-6.64); phosphorus content of 17 ppm P_{AL} (poorly-medium supplied); potassium content, of 184 ppm K_{AL} (well supplied).

Climate. As a multiannual average, in the area of the experimental field, precipitations sum up 556.1 mm. During the vegetation period (March and September), there was a waterfall of 380 mm in average. In comparison with the normal climate regime of the area where the experimental field is situated, the research year was a warmly one.

As far as rainfall is concerned, the vegetation period was characterized by lack of spring rainfall and normal rainfall during summer months (Figure 1).

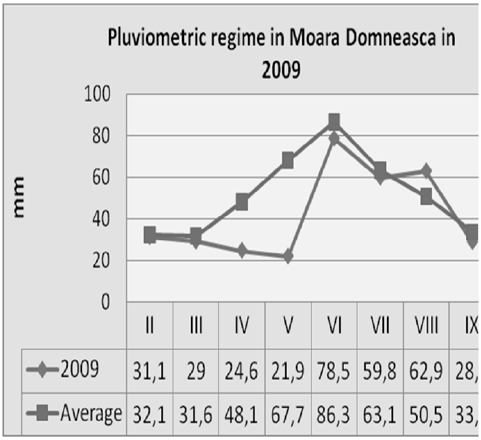


Fig. 1. Rainfall regime at Moara Domneasca, in 2009

Experimental factors: Factor A: Type of culture

a_1 – *Dactylis glomerata* in sole crop

a_2 – *Dactylis glomerata* 70% + *Medicago sativa* 30%

Factor B: Variety of *Dactylis glomerata*

b_1 – Regent (Romanian variety)

b_2 – Ambasador (English variety)

The experiment was established in 2008. Variants were placed in plots divided into four repetitions, with a plot area of 18 m^2. The experimental data refers to the second year of vegetation.

Measurement and analysis:

Shoots density - was determined for each variant, the surface of 400 cm^2 in 3 repetitions;

Leaf area index (LAI) - was determined by direct measurements only with *Dactylis glomerata* shoots;

Absolute growth rate (AGR) - was determined only with *Dactylis glomerata* species in sole crop, in the apex 10 cm level and after that, every 20 days at cycles I, II, III.

RESULTS AND DISCUSSION

***Dactylis glomerata* shoots density.** On the basis of the results presented in Table 1, it is estimated that the density of *Dactylis glomerata* shoots was higher in mixture with *Medicago sativa*.

Table 1

***Dactylis glomerata* shoots density**

Vegetation cycle	**Sole crop (shoots/m²)**		***Dactylis glomerata + Medicago sativa* (shoots/m²)**	
	Regent	Ambasador	Regent	Ambasador
Cycle I	2025	2025	2450	2275
Cycle II	500	338	563	400
Cycle III	450	388	400	425

As seen from the experimental data presented in both sole crop and in mixture with *Medicago sativa*, Regent variety had a better capacity of twinning than Ambasador variety, recording an equal or a greater density in all vegetation cycles.

The highest shoots densities were realised in the first vegetation cycle both in sole crop and in mixture with *Medicago sativa*, respectively 2025 shoots/m^2 and 2450 shoots/m^2.

Leaf area index (LAI). Table 2 shows that the highest LAI values were recorded in the variant mixed with alfalfa, resulting that leguminous in the mixture had a positive influence on the orchardgrass plant development.

Table 2

Leaf Area Index

Period	**LAI**			
	Sole crop		*Dactylis glomerata + Medicago sativa*	
	Regent	Ambasador	Regent	Ambasador
April 12	2.08	3.01	4.60	4.09
May 05	7.16	9.45	8.28	7.11
June 06	1.12	1.12	1.12	1.11
June 25	2.15	1.83	3.00	1.10
July 28	1.49	1.00	1.70	1.04
August 16	1.06	0.57	0.98	1.08

So, in sole crop, the highest value of LAI index was obtained on May 5^{th,} with Ambassador variety, namely 9.45, when the plants were in flower phase, with 2 active leaves. The lowest LAI value was obtained on August 16, on the third cycle of harvest in a dry period, with Ambasador variety, respectively 0.57.

From Table 2 it can be seen that the Ambasador variety registered higher LAI values in the first part of the growing season and, during the summer months (June to August) showed lower LAI values than Regent variety.

In mixture with *Medicago sativa*, Regent variety had a better reaction in terms of leaf area index, achieving the maximum LAI value on May 5th, respectively 8.28. The minimum LAI value was obtained with Regent variety on August 10, namely 0.98.

Absolute growth rate (AGR). Regarding the absolute growth rate, in Table 3 is showna clear difference between those two orchardgrass varieties tested.

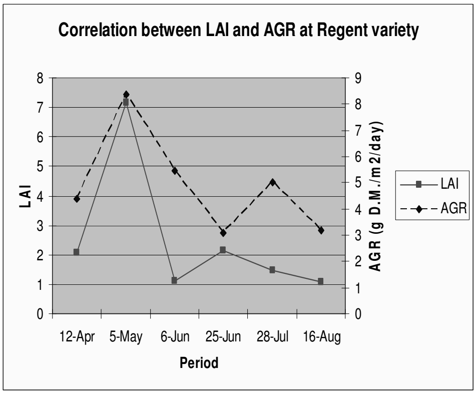
Table 3

Absolute growth rate

Period	**Absolute growth rate** (g/m^2/D.M./day)	
	Regent	Ambasador
April 12	4.37	6.02
May 05	8.36	5.67
June 06	5.48	4.35
June 25	3.11	3.23
July 28	5.00	4.64
August 16	3.18	2.27

Following the results presented in Table 3, it can be observed that the Regent variety had a faster absolute growth rate than the other variety of orchardgrass experienced.

At the same time, an almost perfect correlation between LAI and AGR (Figures 2 and 3) is registered with both varieties at the beginning of vegetation period (April 12 and May 5), as well as at the end of the vegetation period (August 16).



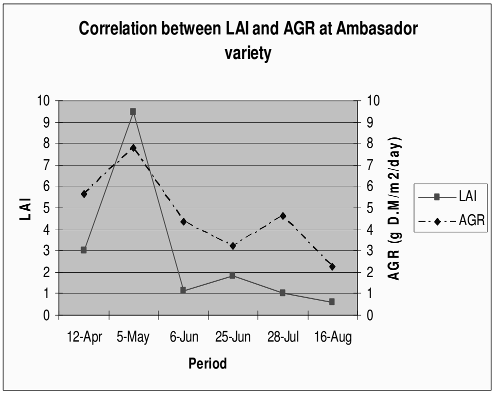


Fig. 2, 3. Correlations between LAI and AGR at Regent and Ambasador varieties

Dry matter yield per crop cycle. Regarding the dry matter yield, both in sole crop and in mixture, there were observed yield differences between those two orchard grass varieties that were tested.

Table 4

Dry matter yield

Cycle of harvest	**Dry matter yield** (t/ha)			
	Sole crop		Mixture	
	Regent	Ambasador	Regent + *Medicago sativa*	Ambasador + *Medicago sativa*
Cycle I	5.10	5.00	3.86	4.34
Cycle II	2.82	2.43	1.98	1.77
Cycle III	1.94	1.37	2.20	1.68
Total dry matter yield	**9.86**	**8.80**	**8.04**	**7.79**

Dl 5%=1.065 t/ha
Dl 1% = 1.700 t/ha
Dl 0.1% = 3.034 t/ha

From data presented in Table 4, we can observe that in mixture with *Medicago sativa*, the dry matter yields were relatively lower than those obtained in sole crop by *Dactylis glomerata* species.

In sole crop, the Regent variety achieved higher dry matter yields in all three crop cycles, compared with Ambasador variety. Thus, the maximum yield was obtained in the first harvest cycle, respectively 5.10 t/ha D.M. In the third harvest cycle there was obtained 1.94 t/ha D.M. In sole crop, Ambassador variety had a similar behaviour like Regent variety, the yields obtained from all three crop cycles being similar with those achieved by Regent variety.

In mixture, Regent variety assured higher yields than the other varieties tested, except the first harvest cycle, where a higher yield was obtained from Ambasador variety, respectively 4.34 t/ha D.M. The lowest yield in mixture was registered with Ambasador variety, respectively 1.68 t/ha D.M.

CONCLUSIONS

1. In the meteorological conditions of 2009, characterized by low rainfall regime during the growing season, and in Moara Domneasca Experimental Field, *Dactylis glomerata* species realised in average total yields of 7-10 t/ha D.M. in sole crop or in mixture with *Medicago sativa*.
2. *Dactylis glomerata* plant density, expressed as number shoots/m^2 ranged between 2000 and 2450, which means that leguminous species had a positive influence on the vegetation cover development.
3. *Dactylis glomerata* species adapts well enough to weather conditions from the Romanian Plain, ensures satisfactory yield increases both in sole crop and in mixture with *Medicago sativa,* in non-irrigate conditions.

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IMPROVING LONGITUDINAL SEED DISTRIBUTION FOR CONVENTIONAL GRAIN DRILLS

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Keywords: *conventional drills, seed distribution*

Abstract

The demand for uniform distribution into the soil of grain seeds and especially small grain seeds has increased during the last decade. Improvements had been made on the new metering devices, furrow openers and grain flow. The present research was focused on two major issues: a.) increasing grain flow uniformity out of the metering devices and b.) Improving seed distribution into the soil. Research was carried out in the Department of Mechanisation of the Faculty of Agriculture of the University of Agronomic Sciences and Veterinary Medicine of Bucharest and used a three row simulator of a conventional grain drill, made out of more than 90% of recycled components. The team comprised three students from Faculty of Agriculture in the final year, and this research was part of their final Diploma Project. All the research was supervised by Assoc.Prof. Dr. Cristian IACOMI, the Head of the Mechanization Department.

INTRODUCTION

Uniform soil seed distribution was, and is, a major target with all major manufacturers of conventional grain drills in the world. Usually, research was focused more on development of furrow openers and less on grain flow. The team of present research, three students in the final year of the Faculty of Agriculture, expressed their opinions to study both the flow of small grains (winter wheat) from the metering devices to the furrow opener and to study the changes of laying seeds into the soil. For this, the team decided to split the work into three major parts. One student manufactured the mini stand (simulator) of a conventional drill, one decided to study the flow of grains and the last one decided to change the application of grains into the soil. We must point out that the present research represented the quantification and contribution to the final Diploma Project of each of them.

MATERIAL AND METHODS

The simulator (Figure 1) was manufactured more than 90% of recycled components and coppied entirely a real drill, except the fact that the seed bulk was designed to supply seeds for three rows instead of 29 or more rows. To simulate the passing over the field, the team used a fabric belt soaked in oil so the seeds could be easily sticked. This was moved by an AC electric motor and covered two speeds (low speed and high speed). To simulate different seed rates, the metering device was actioned by a 12 V DC electric motor and through the help of various ratios obtained by a chain drive transmission it could be covered up to 6 different rates (Figure 2).

Fig. 1. Conventional three row drill simulator

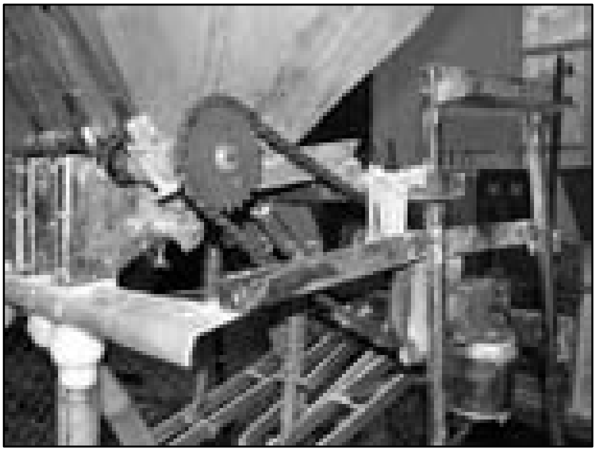

Fig. 2. Chain drive transmission

After each test, the sticked seeds were pictured and the team measured the quality of seed distribution on the belt and the number of seeds per meter. For each test there were used just two furrow openers, one classic opener and the second one modified according to the protocols (Figure 3).

In this research, the modified opener used an original design of a cone and tube device fixed in a classic opener wings, to narrow the channel of seeds but to properly keep the flow of seeds (Figure 3). The entire research used three different shapes of the tube, one vertical, one inclined and one under a narrow ***S*** shape.

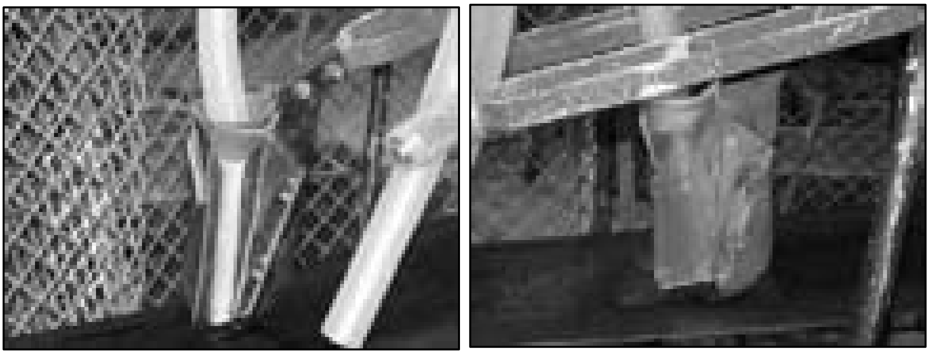

Fig. 3. Modified and classic opener

RESULTS AND DISCUSSION

The tests results for winter wheat seeds are shown briefly in table 1. After each test the sticked seeds were measured as they were spread over the belt (quality factor) and as number of seeds per meter (quantity factor).

Table 1

Longitudinal seed distribution specs

Trials	Band speed	Seed metering ratio	No. of seeds/ meter (classic/modified opener)	Quality factor (longitudinal distribution)	
				classic opener	modified opener
V1_1	Low	30/22	120/116	groups	improved
V1_2	High	30/22	95/89	groups	improved
V2_1	High	30/16	108/112	groups	improved
V2_2	Low	30/16	123/131	groups	improved
V3_1	Low	30/10	142/158	groups	improved
V3_2	High	30/10	134/126	groups	improved
V4_1	High	30/9	141/150	groups	improved
V4_2	Low	30/9	165/156	groups	improved

For each trial, a number of five tests were done. As shown in Figure 4 and Figure 5 the tests shown an improvement in the longitudinal seed distribution using various modified openers.

All tests showed that modified openers were keeping the seeds together and te gaps which appeared using the classical openers have had a trend to dissapear, performing an improved distribution of the seeds.

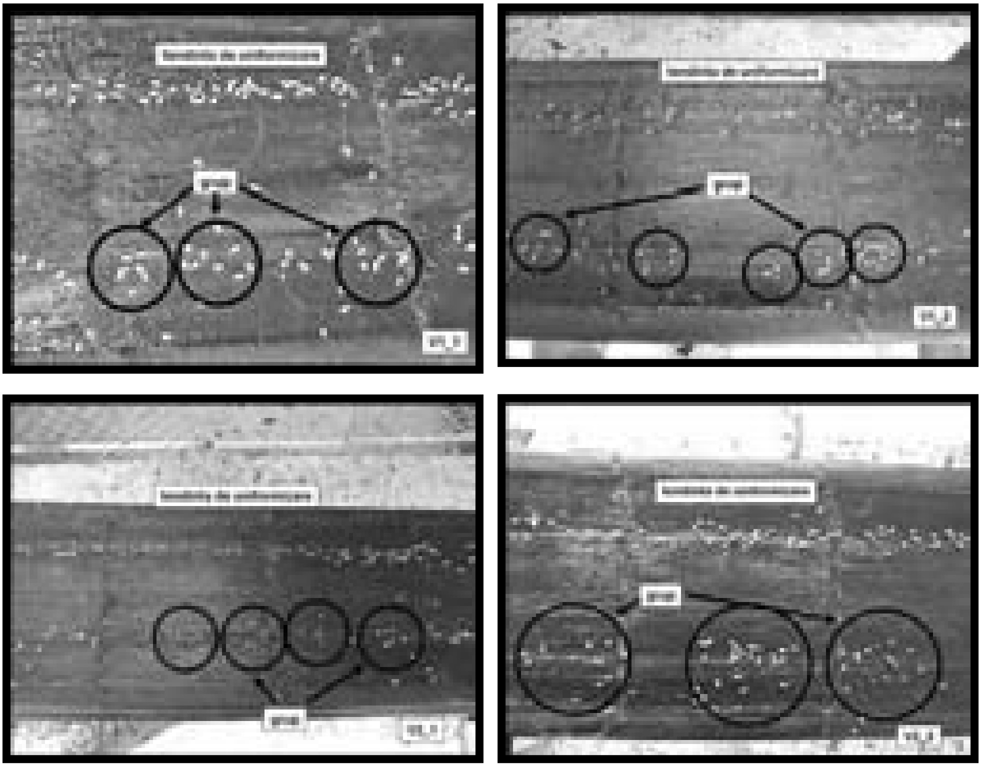

Fig. 4. Improvements in longitudinal seed distribution (trials V1_1, V1_2, V2_1, V2_2)

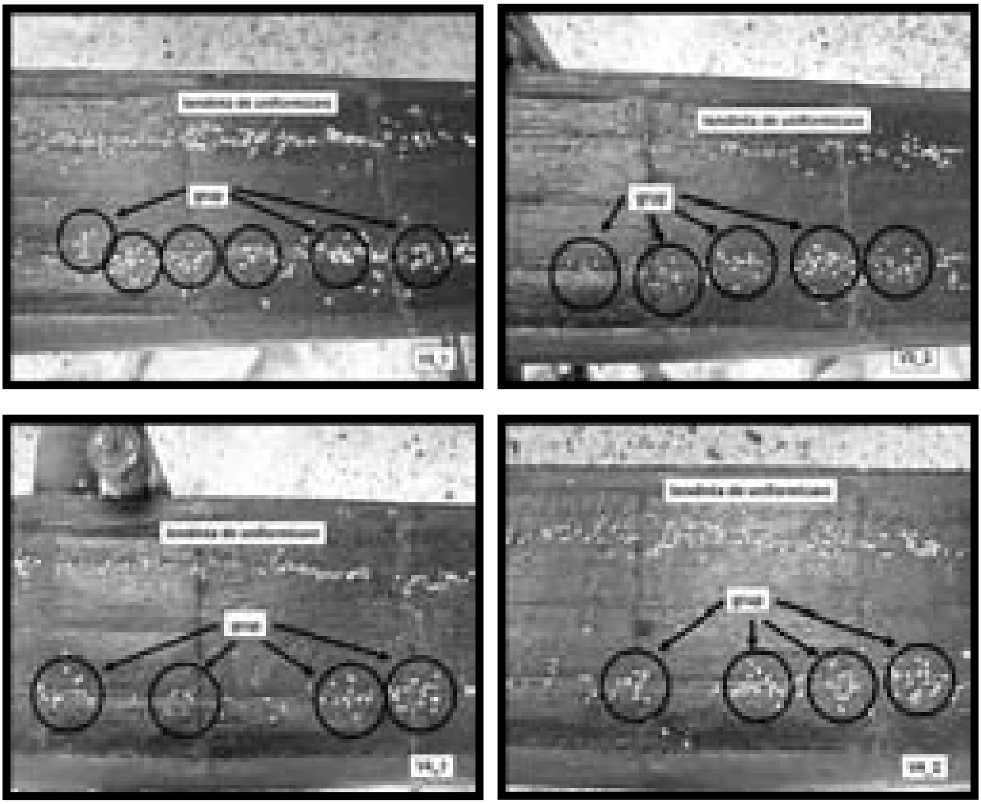

Fig. 5. Improvements in longitudinal seed distribution
(trials V3_1, V3_2, V4_1, V4_2)

CONCLUSIONS

1. Laboratory tests showed that it was possible to obtain a better longitudinal seed distribution into the soil for conventional grain drills, using modified openers.
2. No impediments and obstructions were observed in the seed flow from the mettering device to the furrow opener.
3. The seed rates in various tests were kept within resonable limits, without any exceptions.
4. Further tests will be done using different devices adapted for classical openers to show the influence of the shape of the narrowed channel on the longitudinal seed distribution.

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RESEARCH REGARDING INTERACTION OF MON810 BIOTECH CORN ON THE *HELICOVERPA ARMIGERA* IN ROMANIA

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Keywords: *Helicoverpa armigera, MON810 biotech corn, biology, damages*

Abstract

Corn earworm Helicoverpa or (Helicoverpa armigera Hb.) is considered by some to be the most important insect pest in corn after the stage of seventh collars (V7) together with the European corn borer (Ostrinia nubilalis Hb.). In Romania, the pest is spread all over the country but it seems to be very important in south part of the country, so along the Danube plain, during recent years, the damages were significantly and many farmers were afraid of it. In Europe, the species Helicoverpa armigera Hbn. has the status of "invasive foreign species". In the last years there has been significant damage in numerous crops both in Romania and in its neighboring countries (Hungary, Serbia, Bulgaria, Ukraine, etc.). Research carried out aimed at completing the knowledge of the biology and ecology of the species Helicoverpa armigera Hbn. in the conditions of our country, monitoring the appearance and flight of the adults, the appearance and succession of larvae generations in the maize crop in the year 2009, as well as the duration of parts of the development cycle in laboratory conditions.

INTRODUCTION

Corn earworm Helicoverpa or (*Helicoverpa armigera* Hb.) is considered by some to be the most important insect pest in corn after the stage of seventh collars (V7) together with European corn borer (*Ostrinia nubilalis* Hb.) [1].

In Romania, the pest is spread all over the country but it seems to be very important in south part of the country, so along the Danube plain, during recent years, the damages were significantly and many farmers were afraid of it. Corn earworm has a wide host range (more than 120 host species), in addition to corn and tomato, perhaps its most favored vegetable hosts. Among field crops injured by corn earworm are: alfalfa, clover, cotton, flax, oat, millet, rice, sorghum (particularly favored), soybean, sugarcane, sunflower, tobacco, vetch, and wheat. Fruit and ornamental plants may be attacked [2, 3]. Pest is most abundant in the crops during silking of corn, when adults are mate female laid singly egg around the silks. Adults collect nectar or other plant exudates from a large number of plants, trees and shrub species are especially frequented. On corn, its most common host, young larvae tend to feed on silks initially, but eventually they usually gain access to the kernels. There are 6 larval stages, and the complete development larvae reach 35-40 mm long. Pupa is dark brown, 14-18 mm long, with smooth surface, rounded both anteriorly and posteriorly, with two tapering parallel spines at posterior tip.

In Romania losses are reported throughout the country, and pest cause attacks in some years, on certain sole, in the south of the country. Larvae chew leaves and tunnel down the silk channel of the cob. The presence of larvae and associated frass increase level of mycotoxins [4, 5, 6].

In Europe, the species *Helicoverpa armigera* Hbn. has the status of “invasive foreign species” [7]. Adults can migrate over long distances, borne by wind. In the last years there has been significant damage in numerous crops both in Romania and in its neighboring countries (Hungary, Serbia, Bulgaria, Ukraine, etc.), we thought it proper to choose this research topic referring to importance of pest for corn in southeastern part of Romania. Research carried out aimed at completing the knowledge of the biology and ecology of the species *Helicoverpa armigera* Hbn. in the conditions of our country [3, 8, 9], monitoring the appearance and flight of the adults, the appearance and succession of larvae generations in the maize crop in the year 2009.

MATERIAL AND METHODS

To establish a level for *Helicoverpa*, we proposed that, in south and east area of Romania, 10 corn field (having check Bt refugees or regular corn hybrid field with the same vegetation group) were inspected, and the presence of larvae and their number/ear was monitorised during the late vegetative stage and the silking stage. At the beginning we searched in different localities, with Bt. corn field, 1. Oltenita, CALARASI-field/farmer Dume; 2. Dalga, CALARASI -field/farmer Liviu Georgescu; 3. Dragos Voda, CALARASI - field/farmer Ildu; 4. Chiciu, CALARASI Soc. Transliberta - field/farmer Ciobanu; 5. Tudor Vladimirescu, BRAILA, Pietrosu S.A.- field/farmer Mihai Popa and regular corn hybrid field with approximately the same vegetation stage 6. Mihailesti, BUZAU demonstration field; 7. Berceni, PRAHOVA 8. Fundulea, CALARASI; 9. Moara Domneasca, ILFOV; 10. Dragos Voda, CALARASI – corn production field.

From this 10 field we chose 3 fields (1. Tudor Vladimirescu, BRAILA, Pietrosu S.A.- field/farmer Mihai Popa; 2. Dalga, CALARASI -field/farmer Liviu Georgescu; 3. 1. Oltenita, CALARASI-field/farmer Dume) with heavy attack which were monitored, (five adjacent plants in the row at six widely spaced positions in the crop, a total of 30 plants, and record pest as frequency and attack intensity).

Recording and estimation of the moth flight was registered visually [counting flying or resting moth], when we passed through field after the scale: 0=no moth; 1=1-2 moth at 100 m of corn row; 2=more than 3 moth at 100 m of corn row.

Readings were done from middle of June until the end of September when corn plants were dried.

Monitoring the pest's larvae populations was done by periodically visiting of fields biweekly during middle of June and late vegetative stage and once or twice per week during late vegetative stage (2 weeks before silking/flag leaf development) and silking when pest activity monitoring is critical, every two weeks until 30 September.

At the beginning, to establish a level for *Helicoverpa*, there were inspected, in 10 localities, 100 plants (25 plants in 4 replicateed) and noted the presence of larvae and their number/ear or plant. We count the number of pupae in Tudor Vladimirescu-BRAILA, Dalga-CALARASI and Oltenita, CALARASI by digging an area of 0.5 m^2 on the right size of row, in 10 replications/hybrid plot with higher larvae attack. At the same time, at Tudor Vladimirescu, BRAILA, we counted pupae from an area of 0.5 m^2 in 5 replications/hybrid plot (Bt and conventional). At the end of September, it was evaluated the *Helicoverpa* attack taking into consideration: percentage of plants attacked by *Helicoverpa armigera*, attack intensity of *Helicoverpa armigera* [Attack intensity of *Helicoverpa armigera* was noted on a scale from 1 to 3, where 1 means larvae attack only on the tip of the ear and on the silk, 2 means *Helicoverpa* spp, attacked ear was destroyed in tip (0.5-1.5 cm), 3 means that *Helicoverpa* spp. larvae have destroyed (by tunneling) till 1/3 from distal area of ear].

Establishing of quantity loses due to *Helicoverpa* attack was done by weighting 15 ears with attack level of 1, 2 and 3 together with unattacked ears. Establishing of quality loses due to *Helicoverpa* attack was done by establishing percentage of ears with pest attack and presence of fungi on attacked area.

RESULTS AND DISCUSSION

In southern Romania, there are two complete generations/year and a partial third, winter being passed in the pupae stage in the soil.

Monitoring *Helicoverpa armigera* Hbn. adult's (Table 1) supplies useful information we can see that butterflies in May and June are relatively small in number compared to the butterflies observed in July, August, and even in September, which shows that the butterfly generation emerging from hibernating pupae (G1) is smaller, while the larger number of butterflies in July, August, and September, i.e. adults from the generations G2 and G3 develop on maize crops and some of the captured butterflies might come from migration. Migration is, therefore, as mentioned in literature, more intense in summer, when the butterflies fly large distances in search for food.

Flight of *Helicoverpa* spp.

Table 1

Flight of *Helicoverpa* spp. observed in different corn fields

	Localities									
DATA	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
15-21 VI	ND	ND	ND	ND	ND	ND	1*	0*	0	1
29 VI-05 VII	ND	ND	ND	ND	ND	ND	1	0	1	1
06-12 VII	1	1	1	0	1	1	0	1	0	2*
13-19 VII	1	1	0	0	1	1	0	1	1	2
20-26 VII	0	1	0	ND	0	ND	0	0	0	0
27 VII-02 VIII	2	2	1	1	1	0	0	0	0	1
03-09 VIII	ND	ND	ND	ND	ND	ND	0	0	0	ND
10-16 VIII	1	2	0	0	2	1	0	1	0	1
17-23 VIII	ND	ND	ND	ND	ND	ND	0	1	1	ND
24-30 VIII	ND	ND	ND	ND	ND	ND	1	1	1	ND
31 VIII-06 IX	1	2	0	0	2	2	0	0	0	1
07-13 IX	0	1	ND	ND	1	ND	0	0	0	ND
14-20 IX	0	0	ND	ND	1	0	0	0	0	ND
21-27 IX	0	0	ND	ND	0	0	0	0	0	ND
28 IX-04 X	0	0	ND	ND	0	0	0	0	0	ND

*0=no moth; 1=1-2 moth at 100 m of corn row; 2=more than 3 moth at 100 m of corn row.
ND=not done

Localities: 1. Oltenita, CALARASI-field/farmer Dume; 2. Dalga, CALARASI -field/farmer Liviu Georgescu; 3. Dragos Voda, CALARASI - field/farmer Ildu; 4. Chiciu, CALARASI Soc. Transliberta - field/farmer Ciobanu; 5. Tudor Vladimirescu, BRAILA, Pietrosu S.A.- field/farmer Mihai Popa and regular corn hybrid field with approximately the same vegetation stage 6. Mihailesti, BUZAU demonstration field; 7. Berceni, PRAHOVA 8. Fundulea, CALARASI; 9. Moara Domneasca, ILFOV; 10. Dragos Voda, CALARASI – corn production field.

Analyzing results obtained in 2009, when we monitored the flight of the adults of *Helicoverpa armigera*, we can conclude that the emergence of the butterflies from pupae in spring takes place in May-June.

In corn, the appearance of larval populations of *Helicoverpa armigera* Hbn. from the second generation during the studied period of time took place starting with the second decade of June, with a peak between the second and third decades of July, the last appearances being in the last decade of July. In the third larval generation, the first signs were starting with the second decade of August, with a peak in the third decade of September, the last signs being in the first decade of September. We can consider that the periods in which larval populations appeared were determined largely by the climate conditions of each year, which could favor or not the early appearance of the butterflies and the development of the larval populations earlier or later on maize crops.

The second and third generations were the generations that cause damage on maize crops, the second generation being more important since it appeared the moment maize was in the milk stage. The climate conditions had a big impact not only on the pest's biology, but also on plant growth and development, both cultivated and spontaneous that represented a food source for the butterflies of the first generation and, thus, acted indirectly on the pest population growth and multiplication.

Monitoring the pest's larvae populations

Monitoring the pest's larvae populations was done by periodically visiting of fields. At the beginning, to establish a level for *Helicoverpa*, it was inspected, in 10 localities, 100 plants (25 plants in 4 replicates) and noted the presence of larvae and their number/ear or plant (Table 2), after 13 June, 3 fields (1. Tudor Vladimirescu, BRAILA; 2. Dalga, CALARASI; 3. Oltenita, CALARASI) with evident *Helicoverpa* attack have been monitorised, (five adjacent plants in six replicates widely spaced positions in the crop, a total of 30 plants, were noted for evolution of total alive larvae number/corn ears (no. larvae/ear or plant) (Fig. 1).

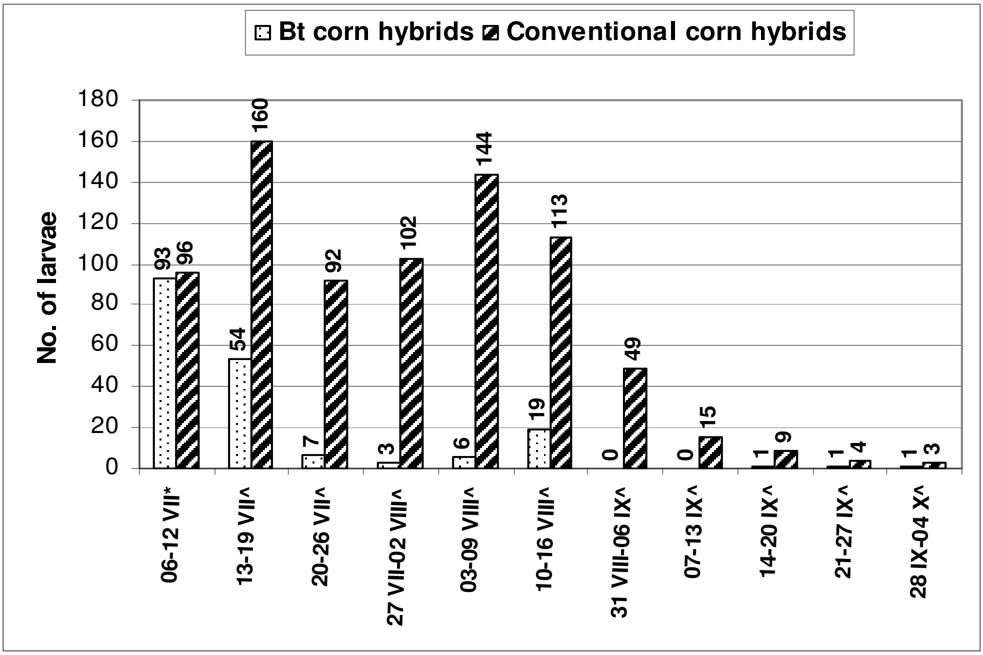

Fig. 1. Total *Helicoverpa* larvae number

Table 2

Presence of *Helicoverpa* spp. larvae*

	Localities									
DATA	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
15-21 VI	ND	ND	ND	ND	ND	ND	10*	5*	3*	14*
29 VI-05 VII	ND	ND	ND	ND	ND	ND	17*	5*	4*	21*
06-12 VII	9*	19*	5*	7*	25*	8*	6*	5*	4*	16*
13-19 VII	25^	30^	6	2^	46^	7^	3^	1^	0^	9^
20-26 VII	7^	6^	3^	0^	13^	ND	ND	ND	ND	8^
27 VII-02 VIII	11^	17^	ND	ND	26^	25^	ND	ND	ND	5^
03-09 VIII	12	17^	ND	ND	57^	ND	ND	ND	ND	ND
10-16 VIII	11	16^	ND	ND	33^	15^	10^	ND	ND	8^
17-23 VIII	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
24-30 VIII	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
31 VIII-06 IX	6^	7^	ND	ND	15^	10^	ND	ND	ND	2^
07-13 IX	5^	6^	ND	ND	7^	ND	ND	ND	ND	ND
14-20 IX	5^	5^	ND	ND	5^	ND	ND	ND	ND	ND
21-27 IX	ND	3^	ND	ND	2^	ND	1^	ND	ND	ND
28 IX-04 X	ND	2^	ND	ND	1^	ND	ND	ND	ND	ND

*=Number of larve/100 ears or plants (1-6, on most susceptible hybrids); ^= Number of larve/30 ears or plants (1-6, on most susceptible hybrids)
ND=not done
Localities: 1. Oltenita, CALARASI; 2. Dalga, CALARASI; 3. Dragos Voda, CALARASI; 4. Chiciu, CALARASI; 5. Tudor Vladimirescu, BRAILA and regular corn hybrid field with approximately the same vegetation stage 6. Mihailesti, BUZAU; 7. Berceni, PRAHOVA 8. Fundulea, CALARASI; 9. Moara Domneasca, ILFOV; 10. Dragos Voda, CALARASI.

Monitoring the *Helicoverpa* pupae populations

During the last week of July, we counted the number of pupae in Tudor Vladimirescu-BRAILA, Dalga-CALARASI and Oltenita, CALARASI by digging an area of 0.5 m^2 on the right size of row, in 10 replications/hybrid plot with higher larvae attack. At Oltenita, CALARASI it was registered, on hybrid DKC 5143, 0.4 pupae/m^2 (total 2 pupae), at Dalga-CALARASI it was registered, on hybrid DKC 4626, 0.6 pupae/m^2 (total 3 pupae), at Tudor Vladimirescu-BRAILA it was registered, on hybrid DKC 5276, 1.4 pupae/m^2 (total 7 pupae). At the beginning of August (the next week) at Tudor Vladimirescu, BRAILA, it was counted pupae from an area of 0.5 m^2 in 5 replications/hybrid plot. Of course there is a difference between number of pupae in soil due to larvae population on corn plants, DK 315, 0,4; DKC 3511, 0,8 ; DK 440, 0,4; DKC 4626, 0,4; DKC 4490, 0,8; DKC 5143, 1,2; DKC 5276, 2,4; DKC 5783, 1,6; **average on total conventional corn hybrids 1.1 pupae/m^2**.

Level and importance of NPV which contribute to decreasing population of *Helicoverpa*.

In Table 3, it is presented the situation at T. Vladimirescu, which shows that from 262 died larvae, 171 (65.27%).

Table 3

Importance of NPV to decreasing population of *Helicoverpa*

Hybrid	Number of observed died larvae	Number which seems to be died due to NPV
DK 315	26	20
DKC 3511	40	25
DK 440	24	17
DKC 4626	27	18
DKC 4490	29	17
DKC 5143	29	16
DKC 5276	41	28
DKC 5783	46	30
TOTAL Conventional corn hybrids	**262**	**171**

Mortality of *Helicoverpa* larvae was from total larvae observed (972) and from total died larvae observed (358), 79.6% seems to be died due to NPV infection.
There are more numerous died larvae which seems that were killed by NPV in conventional hybrids (83.4%) than in Bt. corn hybrids (16.6%).

Establishing the Helicoverpa importance for corn crop

At the end of September, it was evaluated *Helicoverpa* attack taking into consideration percentage and attack intensity of plants attacked by *Helicoverpa armigera*. The data presented in Table 4 underline that there was a difference between attack of *Helicoverpa* taking in consideration percentage an intensity of attack in different locality (attack is higher in T. Vladimirescu, followed by Dalga and Oltenita), Bt hybrids were significantly less attacked by pest.

Establishing of quantity loses due to *Helicoverpa* attack was done by weighting 15 ears (in kg.) with attack level of 1, 2 and 3 together with unattacked ears only at T. Vladimirescu taking into consideration conventional corn hybrids DK 315, DKC 4626 and DKC 5783. The results presented in Table 5 show that pest is possible to cause, at the level of 2009 in T. Vladimirescu, losses between 4.4 to 6.6%, depending on the hybrid and the level of attack.

Table 4

Importance of *Helicoverpa* attack on corn

	T. VLADIMIRESCU		DALGA		OLTENITA	
Hybrid	**% of ears attacked**	**Intensity of attack**	**% of ears attacked**	**Intensity of attack**	**% of ears attacked**	**Intensity of attack**
DK 315	18	2.3	12	1.6	7	3.0
DKC 3511	20	2.2	15	2.0	9	2.6
DK 440	30	2.3	21	2.6	14	2.3
DKC 4626	34	2.4	22	2.4	15	2.4
DKC 4490	32	2.3	19	2.7	11	2.0
DKC 5143	26	2.2	12	2.4	9	1.6
DKC 5276	21	2.0	-	-	-	-
DKC 5783	28	2.0	14	2.2	10	1.5

Table 5

Loses due to *Helicoverpa* attack

Hybrid	**Production/ 15 corn ears**				**Percentage of losses**		
	Attack level			Check			
	Note 1	Note 2	Note 3	Unattacked	Note 1	Note 2	Note 3
DK 315	2.229	2.200	2.130	2.228	+0.04	-1.26	-4.40
DKC 4626	2.335	2.280	2.195	2.351	-0.68	-3.02	-6.633
DKC 5783	2.540	2.485	2.395	2.545	-0.196	-2.35	-5.894

Establishing of quality loses due to *Helicoverpa* attack was done by establishing percentage of ears with pest attack and presence of fungi on attacked area. From this point of view almost 100% of the attacked area was covered with mold.

CONCLUSIONS

1. The results presented show that pest is possible to cause, at the level of 2009, percentage of ears attacked between 0-34% and losses between 4.4 to 6.6 %, depending on the hybrid and the level of attack.
2. The mortality of *Helicoverpa* larvae was from total larvae observed, 79.6% seems to be died due to NPV infection.
3. There is a significant difference between Bt. corn hybrids and conventional corn hybrids; the first category is not suitable for development of pest taking into consideration.

4. In southern Romania, there are two complete generations a year and a partial third, winter being passed in the pupae stage in the soil, but an important role seems to have immigrant moth population at the end of July, beginning of August observing that there is no a clear gap between the second and third moth flight or larval population level on corn ears.

ACKNOWLEDGEMENTS

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CONTRIBUTIONS TO THE STUDY OF WIRE WORMS (FAM. *ELATERIDAE*) POPULATION STRUCTURE AND BIOLOGY FROM BUCHAREST AND THE SURROUNDING AREA WITH PHEROMONE TRAPS

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Keywords: *Wire worms, Agriotes Esch., pheromones*

Abstract

The results broaden the spectrum of species and biology of wire worms (Coleopteran order, Elaterid family). It was made a complex study, applying pheromone traps, resulting in information about the structure and bioecology of the family Elaterid Leach, numerical values of species with economically importance from Bucharest and the surrounding area. There were used VARb3 type traps for species A. ustulatus Schaller and A. rufipalpis Brulé and YATLOR funnel for species A. lineatus Linnaeus, A. litigiosus Rossi, A. obscurus Linnaeus, A. sputator Linnaeus, A. sordidus Illiger and A. brevis Candèze. The results of the dynamics of adult species genus Agriotes Eschscholtz highlighted trapping equipped with synthetic sex pheromone that the species Agriotes sputator Linnaeus appears first from soil, followed by A. brevis Candèze and A. rufipalpis Brulé in a period of 10 days, adults of species A. ustulatus Schäller appear last from the soil (late June or early July) due to different biological cycle of other species of the genus Agriotes Eschscholtz that overwinters both as larva and as adult, this species winters only in the larva stage. Agriotes litigiosus Rossi species was not collected in pheromone traps, indicating its absence in the research area.

INTRODUCTION

Many scientists, both globally and in our country, made detailed and complex studies on the biology and ecology of wire worms, recent research in this area have been undertaken by Furlan [1, 2, 3, 4], Parker [5]. In our country, the results of research in this area were done by different the authors: Radu and Greeceanu Alexandrina [6, 7], Florica Manolache et al. [8], Perju et al. [9], Margarit and others. [10]. A modern method of limiting wire worms is using synthetic sex pheromones. Esterk et al. [11] communicate the results of monitoring Agriotes Eschscholtz species using pheromone traps in several crops in the Netherlands. The main species which were monitored *Agriotes obscurus* L., *Agriotes lineatus* L., *Agriotes sputator* L. and *Agriotes ustulatus* Schall. Pheromone trap method is a new strategy for monitoring and control of harmful wire worms in plants cultures. This method was described by different authors, Furlan et al. [1, 2, 3, 4], Tóth et al. [12, 13, 14, 15], and in Romania by Radescu et al. [16]. The use of pheromone traps is mainly aimed to determine pest and obtain information on their seasonal occurrence.

MATERIAL AND METHODS

To monitor the adult population we used the modern method of pheromone traps, described by Furlan et al. [1, 2, 3] and Tóth et al. [12, 15], which allowed us to capture a number of 2141 adult insects. We used specific pheromones for 8 species of the genus *Agriotes* Eschscholtz (*A. ustulatus* Schäller, *A. rufipalpis* Brullé, *A. lineatus* Linnaeus, *A. litigiosus* Rossi, *A. obscurus* Linnaeus, *A. sputator* Linnaeus, *A. sordidus* Illiger and *A. brevis* Candèze). We used traps type VARb3 [16], for the species *A. ustulatus* Schaller and *A. rufipalpis* Brulé and YATLOR funnel [16], for species *A. lineatus* Linnaeus, *A. litigiosus* Rossi, *A. obscurus* Linnaeus, *A. sputator* Linnaeus, *A. sordidus* Illiger şi *A. brevis* Candèze. We followed the dynamics of adult insects, the population and existing species in relation to climatic conditions of the studied area and selectivity of pheromone, which was high. We installed the traps on the ground in 2005, 2006, 2007, in sets, in a straight line at 20 m distance between traps in biotopes fruit orchards (USAMV-Bucharest) and alfalfa (Mogosoaia, farmer Gherlan Mihai) and pheromone lures were replaced from every 30 days. We controlled and noted traps weekly from date of installation in field (end of March) until traps could not have been catching for two weeks (end of August). Fauna collected was determined at level of genus and species, with identifying books of Dolina [17, 18, 19], Jagemann [20], Panin [21] and binocular magnifier MS XX.

RESULTS AND DISCUSSION

On the genus *Agriotes* Eschsch. adult collection using pheromone traps established their dynamics. The adults of *Agriotes lineatus* L. emerged from the soil in late April and early May until late July. The adults flight was reduced, flight distance rarely exceeding 100 meters. The maximum flight curve was recorded in the second decade of June (Figure 1).

The evolutionary cycle of the species *Agriotes obscurus* L. is 4-5 years, over winter in the soil as the larva of different ages and adults. Adults appear in August and remain in the soil, lodges stern until the following spring, coming from the soil surface from the third decade of May until the second decade of July. Maximum flight curve was recorded in the second decade of June (Figure 2).

The adults of species *Agriotes sputator* L. leave the soil surface in late March early April. The flight is spread over a long period (120 days). Maximum flight curve was recorded in the second half of June (Figure 3).

The evolutionary cycle of the species *Agriotes ustulatus* Schaller is 5 years. Unlike other species of the genus *Agriotes* Eschscholtz, this species over winters only in the larval stage at various ages. The active period of adults is short (50 days), maximum flight was recorded in the third decade of July (Figure 4).

The evolutionary cycle of *Agriotes sordidus* Illiger species takes place over 2-3 years, over winters in the soil as the larva of different ages and adults. In the last year of development, in May, the larvae turn into pupae in the ground inside the lodges built of particles of soil. Pupae stage takes on average 16 days at a temperature of 25^0C, after emerging adults who remain in the soil until the following spring when they come out at surface from May until the second half of July, with an average flight (80 days). In the area investigated, the maximum flight was recorded in the second decade of June (Figure 5).

The *Agriotes brevis* Candèze has a generation in 2-3 years as larva over winter in soil in different ages and as an adult. In the last year of development, in May, takes place pupal stage, stage lasting on average 15-20 days after emerging adults who remain in the soil until the following spring. Adult insects emerging from the ground from the second decade of April, their flight is till the end of July (110 days), maximum recorded flight into the second decade of June (Figure 6).

In the area studied, the adults of species *Agriotes rufipalpis* Brullé occur in soil from the second decade of April and until the second decade of August (130 days long period), with a maximum flight in the second decade of June (Figure 7). There are not captures of *A. litigiosus* Rossi on pheromone traps.

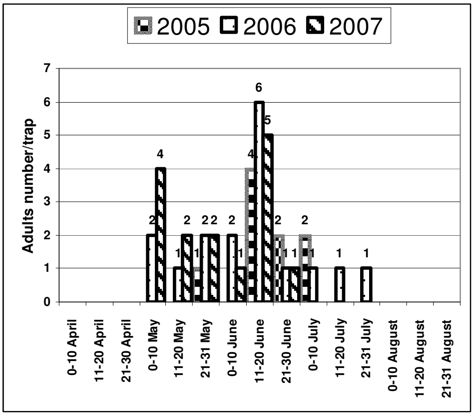

Fig. 1. Flight curve of adult species *A. lineatus* L.

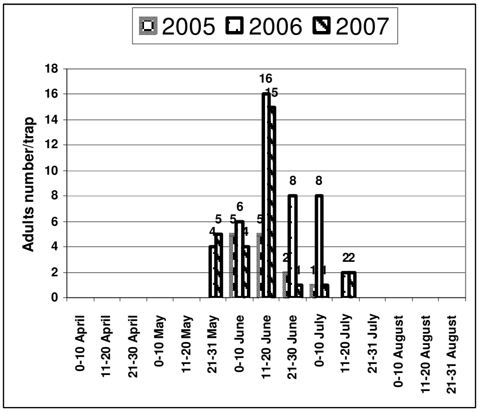

Fig. 2. Flight curve of adult species *A. obscurus* L.

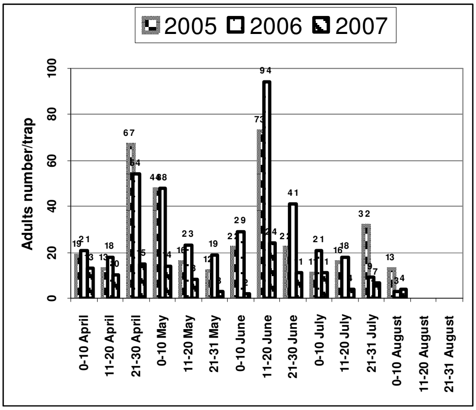

Fig. 3. Flight curve of adult species *A. sputator* L.

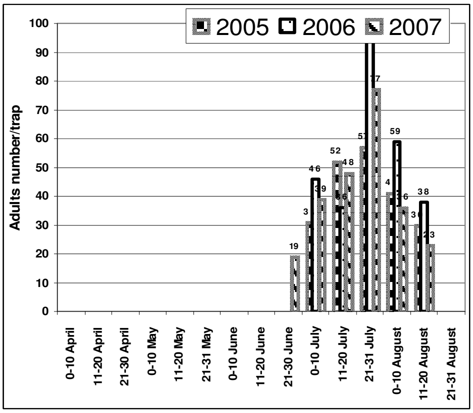

Fig. 4. Flight curve of adult species *A. ustulatus* Schäll.

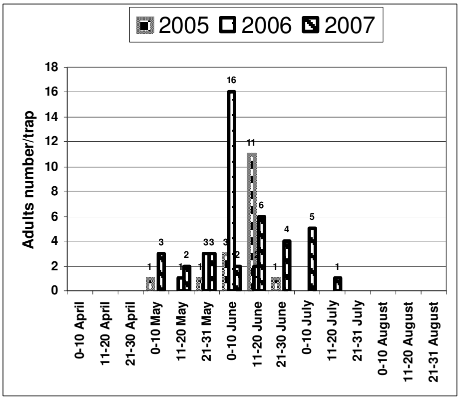

Fig. 5. Flight curve of adult species *A. sordidus* Illig.

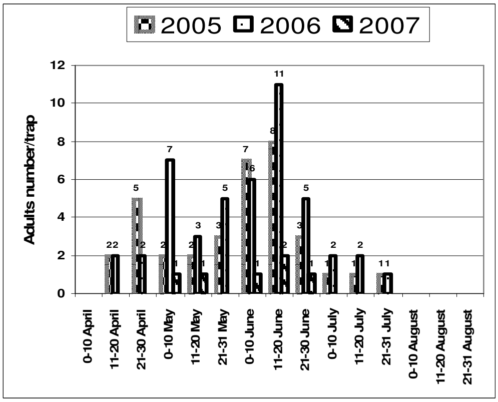

Fig. 6. Flight curve of adult species *A. brevis* Candèze

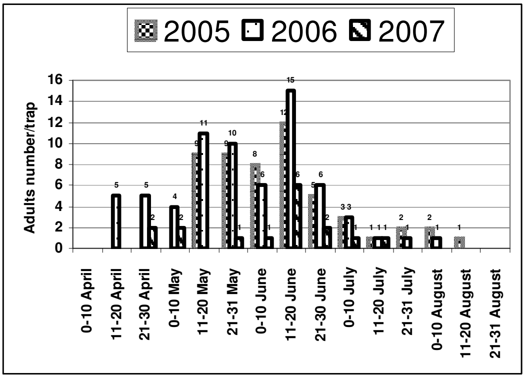

Fig. 7. Flight curve of adult species *A. rufipalpis* Brullé

The data presented on the dynamics of adult species genus *Agriotes* Eschscholtz highlighted by traps equipped with synthetic sex pheromone that *Agriotes sputator* L. appear first from soil, followed by *A. brevis* and *A. rufipalpis* Brulé Candle in a period of 10 days. Our data referring on the time when the adult insects emerge from the soil, existing species in studied area, the population level, maximum flight, provide the information necessary to improve methods of forecasting and warning for control of wire worms adults stage and confirm the effectiveness of sex pheromone traps equipped with synthesis as a method of studying bio ecology of these pests.

CONCLUSIONS

1. The use of synthetic sex pheromone is a new strategy for monitoring and control of wire worms and allowed studying their bio ecology providing accurate data on adult emergence from the soil, their dynamics, and population structure.
2. The results of the dynamics of adult species genus *Agriotes* Eschscholtz highlighted that trapping with synthetic sex pheromone results that *Agriotes sputator* L. appears first from soil, followed by *A. brevis* Candèze şi *A. rufipalpis* Brullé in a period of 10 days, adults of species *A. ustulatus* Schällér appear last from the soil (late June or early July) due to different biological cycle of the other species of the genus Agriotes Eschscholtz that winters both as larva and as adult, this species winters only in the larva stage.
3. The species *Agriotes litigiosus* Rossi was not collected in pheromone traps, indicating it's absence from the analyzed zone. Our research confirms data from literature concerning the area of spread of this species.

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RESEARCH REGARDING SPECIES OF SYRPHID FAUNA FROM MAIZE AGRO ECOSYSTEM

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Keywords: *maize, Syrphid fauna, biology*

Abstract

In the field, during the year 2009, in 4 variants with different hybrids of maize planted, specimens insects caught on yellow sticky traps were recorded taking into consideration specimens of Syrphid. Comparing proportion, it is noted that the most numerous are Coccinellidae, followed by Syrphid and finally Neuropterans. Analyzing data on time evolution of catches of Syrphid, it is noted that populations of Syrphid, develops digital in late July, when numbers reach a peak of development, then this reduces their agroecosistem easily (their continuing presence to be significant) and their number gradually reduce still registering a record growth towards the end of vegetation period of maize. Referring to specific composition, it is noted that the most common species in the maize agroecosistem are Sphaerophoria scripta and Syrphus ribesi, remarked the evolution of a population of each species depending on the analyzed period. There are no differences on the structure and quantity of wildlife Syrphid between different hybrids.

INTRODUCTION

Amazing evolution, from the last period of chemical treatments against pests and diseases, reflected through treated areas and quantity of used pesticides, together with interest of more people jointed in actions referring to protect environment conservation, aspect included in countries legislation, made to increase interest for study of effects of different technologies of control pests and diseases on useful fauna from different agrocoenoses. If a lot of studies were done, in Romania about biology, ecology and control of maize insect pest [1-6], there are few knowledge about useful fauna or "nontarget organisms" [nontarget organism = an organism which is affected by an interaction (for example, a pesticide application) for which it was not the intended recipient]. A large number of small creatures and micro-organisms live in the maize field. They form a species community and each has a place in the food chain. These organisms come into contact with the maize either directly by eating the plant, or indirectly, by eating or parasitizing prey that have eaten maize or plant parts. Beneficial organisms include various insects, mites, nematodes, fungi, bacteria, and other micro organisms that feed on or parasitize pest species. Some of these species are well-known and have been researched in Europe as in Romania and other locations; however, many more are lesser known species. The value of these organisms to agriculture and the environment are likely underestimated.

It is done a comparative study between Neuropteran fauna from different maize hybrids, and it is discussed role of these insects in maize agroecocenoses.
Romania, has a large area cultivated with maize (in average 3,000,000 ha/year), maize being most cultivated field cereal, easy to be cultivated for small farmers, being possible to be completely mechanized, offering to maize cultivators in generally good income and kernels are used for feeding animals, in industry and in human alimentation.

Based on experiences which were done during the last 8 years, in Romania, in different crops which have offered to us the possibility to observe if there are some influence on existing fauna captured in Yellow Sticky Traps (Pherocone AM traps) in field.

Family Syrphidae or flower flies or syrphid flies, sometimes called hoverflies, are common insect and they are often seen feeding with flower's nectar pollen, while the larvae eat a wide range of foods, especially insectivores maggots are important predators of pests, such as aphids, scales, thrips, other plant-sucking insects, and caterpillars, and are rivaled only by lady-bird beetles and lacewings as predators useful for biological control. Syrphids are being recognized as important natural enemies of pests, and potential agents for use in biological control. Their size ranges from 4 mm to over 25 mm and their coloration from bright yellow or orange to dull dark black or gray with a few iridescent forms. Some adult syrphid flies are important pollinators. There are about 6,000 species in 200 genera which have been described. The family Syrphidae is broken down into 3 subfamily and 15 tribes and contains more than 6,000 described species.

MATERIAL AND METHODS

The experiment was in Borovce, Slovakia, where were cultivated 4 reference hybrids in 2009 (NK Cisko, NK Fortius, PR 36D79 and KWS 1393) maize plots. Maize plots were 36/30 m, 75 cm inter-row spacing (46 rows approximately 150 plants/row). Foliar non-target arthropod abundance was assessed using yellow sticky traps, type Pherocone AM trap, 3/plot (on 18, 27 and 35 row, on each plot). Yellow sticky traps were installed, harvested and replaced, weekly or biweekly by Prof. Ludovit Cagan, (in 2009 on 2, 16, 30 June; 14, 21, 28 July; 11, 25 August and 7 September). Yellow sticky traps were maintained till transportation and analyzing at $+4^0$C, as soon was possible were analyzed by taking out (with glue) and counting Syrphid specimens which were glued on paper sheet and put together in an envelope in refrigerator.

As non target organisms were taking into consideration specimens of Syrphid, under stereomicroscope or with loupe were registered specimens of this group.

Determination of the species were done for Syrphid after identification keys [7-9] Under stereomicroscope or with loupe were registered and determined specimens of Syrphid and after that tacking out from glue specimens belonging to this group, were glued on paper sheet and put together in an envelope in refrigerator.

RESULTS AND DISCUSSION

Were identified 14 species of Syrphidae [*Chrystoxum cautum* Harris*, Dasysyrphus albostriatus* Fall.*, Episyrphus balteatus* De Geer*, Eristalis arbustorum* L.*, Eristalis tenax* L.*, Eupeodes corollae* Fab.*, Melangyna umbellatarum* Fab.*, Meligramma guttata* Fall.*, Metasyrphus* (Eupeodes) *latifasciatus* Macquart*, Neoascia podagrica* Fab.*, Sphaerophoria menthastri* L.*, Sphaerophoria scripta* L.*, Syritta pipiens* L.*, Syrphus ribesii* L.] 3 groups of species belonging to genera *Didea* sp., *Melanostoma* sp., *Platycheirus* sp., and a category which it was imposible to be recognised (identified) and were denoted as Syrphid species. In Table 1 it is presented evolution of captures of Syrphid species identified, on yellow sticky traps, in maize fields at different data. It is possible to underline that flight of most Syrphid species is during June-July.

There were identified 1183 specimens belonging to Syrphid fauna. In Figure 1 it is presented the structure of Syrphid species found in maize field. The most common is *Sphaerophoria scripta* L., 353 specimens (30%) (Figure 2)*,* followed by *Chrystoxum cautum* Harris*,* 218 specimens (18%) (Figure 3) and some common species, between 10 and 5% [*Melangyna umbellatarum* Fab. (10%)*, Episyrphus balteatus* De Geer (9%), species belonging to genera *Melanostoma* (8%)*, Eupeodes corollae* Fab. (7%) and *Syrphus ribesii* L. (6%)].

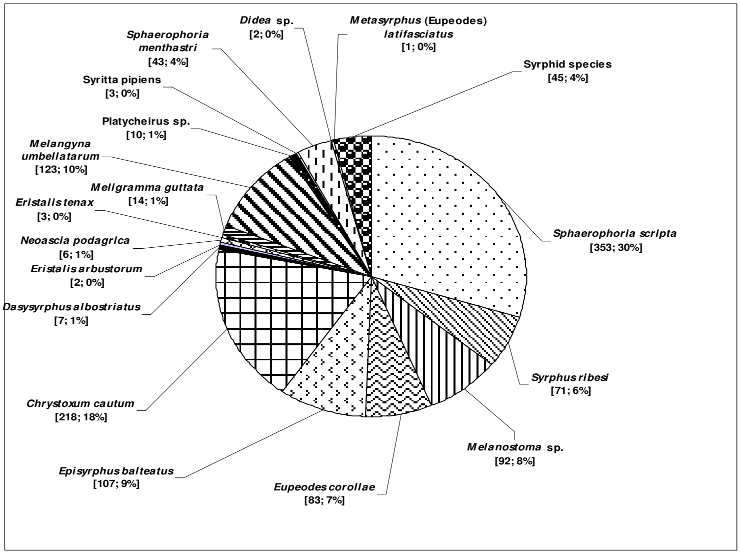

Fig. 1. Structure of *Syrphid* species found in maize field

Table 1

Syrphid species identified on yellow sticky traps in maize fields

	Sphaerophoria scripta	***Syrphus ribesii***	***Melanostoma* sp.**	***Eupeodes corollae***	***Episyrphus balteatus***	***Chrystoxum cautum***	***Dasysyrphus albostriatus***	***Eristalis arbustorum***	***Neoascia podagrica***	***Eristalis tenax***	***Meligramma guttata***	***Melangyna umbellatarum***	***Platycheirus* sp.**	***Syritta pipiens***	***Sphaerophoria menthastri***	***Didea* sp.**	***Metasyrphus* (Eupeodes) *latifasciatus***	***Syrphid* species**	**TOTAL**
2-VI	3	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	**4**
16 -VI	45	23	4	2	2	1	2	1	3	-	-	-	-	-	-	-	-	-	**83**
30 -VI	163	20	4	-	8	86	1	1	2	1	-	93	-	-	-	-	-	9	**388**
14 -VII	81	23	46	57	72	17	1	-	-	1	3	-	-	2	30	-	-	17	**350**
21-VII	30	-	18	13	5	72	1	-	-	1	-	25	2	-	-	-	-	7	**174**
28-VII	15	3	6	5	14	39	1	-	-	-	-	5	8	1	-	-	-	5	**102**
11-VIII	4	-	5	3	-	1	-	-	-	-	2	-	-	-	-	-	-	1	**16**
25-VIII	5	-	3	2	1	2	-	-	-	-	1	-	-	-	6	1	-	3	**24**
7-IX	7	2	6	1	5	-	1	-	-	-	8	-	-	-	7	1	1	3	**42**
TOTAL	**353**	**71**	**92**	**83**	**107**	**218**	**7**	**2**	**6**	**3**	**14**	**123**	**10**	**3**	**43**	**2**	**1**	**45**	***1183***

Fig. 2 ***Sphaerophoria scripta***
http://www.syrphidae.de

Fig. 3 ***Chrystoxum cautum***
http://www.syrphidae.de

In Table 2 it is presented evolution of captures at different data on different hybrids, of course it is possible to observe that there is no a significant difference between Syrphid species captures at a certain data and analyzed hybrids.

CONCLUSIONS

1. The most common is *Sphaerophoria scripta* L., 353 specimens (30%), followed by *Chrystoxum cautum* Harris, 218 specimens (18%) and some common species, between 10 and 5% [*Melangyna umbellatarum* Fab. (10%), *Episyrphus balteatus* De Geer (9%), species belonging to genera *Melanostoma* (8%), *Eupeodes corollae* Fab. (7%) and *Syrphus ribesii* L. (6%)].
2. There is no a significant differences between *Syrphid* captures at a certain data and analysed hybrids where were cultivated 4 hybrids (NK Cisko, NK Fortius, PR 36D79 and KWS 1393).
3. There is no a significant difference between *Syrphid* species captures at a certain data and analyzed hybrids.

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Table 2

Evolution of *Syrphid* species captures at different data on different hybrids

Date	Hybrid	*Sphaerophoria scripta*	*Syrphus ribesii*	*Melanostoma* sp.	*Eupeodes corollae*	*Episyrphus balteatus*	*Chrystoxum cautum*	*Dasysyrphus albostriatus*	*Eristalis arbustorum*	*Neoascia podagrica*	*Eristalis tenax*	*Meligramma guttata*	*Melangyna umbellatarum*	*Platycheirus* sp.	*Syritta pipiens*	*Sphaerophoria menthastri*	*Didea* sp.	*Metasyrphus* (Eupeodes) *latifasciatus*	Syrphid species
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
	PR36D79	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
	NK Fortius	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	KWS 1393	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NK CISKO	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-VI	**TOTAL**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	PR36D79	15	4	2	2	-	-	-	1	2	-	-	-	-	-	-	-	-	-
	NK Fortius	15	5	-	-	2	-	-	-	1	-	-	-	-	-	-	-	-	-
	KWS 1393	10	8	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
	NK CISKO	5	6	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
16-VI	**TOTAL**	**45**	**23**	**4**	**2**	**2**	**1**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	PR36D79	36	6	1	-	8	12	1	-	1	-	-	12	-	-	-	-	-	5
	NK Fortius	41	10	2	-	-	22	-	-	-	-	-	27	-	-	-	-	-	1
	KWS 1393	35	3	1	-	-	24	-	-	-	-	-	28	-	-	-	-	-	2
	NK CISKO	51	1	-	-	-	28	-	1	1	-	-	26	-	-	-	-	-	1
30-VI	**TOTAL**	**163**	**20**	**4**	**-**	**8**	**86**	**1**	**1**	**2**	**1**	-	93	-	-	-	-	-	9
	PR36D79	32	8	12	19	22	4	-	-	-	1	-	-	-	-	15	-	-	5
	NK Fortius	20	6	6	15	17	3	1	-	-	-	3	-	-	2	6	-	-	6
	KWS 1393	19	7	16	22	24	7	-	-	-	-	-	-	-	-	9	-	-	3
	NK CISKO	10	2	12	1	9	3	-	-	-	-	-	-	-	-	-	-	-	3
14-VII	**TOTAL**	**81**	**23**	**46**	**57**	**72**	**17**	**1**	**-**	**-**	**1**	3	-	-	2	30	-	-	17
	PR36D79	17	-	5	1	2	19	-	-	-	-	-	9	1	-	-	-	-	2
	NK Fortius	5	-	5	2	1	17	1	-	-	-	-	3	-	-	-	-	-	1
	KWS 1393	4	-	6	10	2	28	-	-	-	-	-	6	1	-	-	-	-	3
	NK CISKO	4	-	2	-	-	8	-	-	-	1	-	7	-	-	-	-	-	1
21-VII	**TOTAL**	**30**	**-**	**18**	**13**	**5**	**72**	**1**	**-**	**-**	**1**	-	25	2	-	-	-	-	7
	PR36D79	4	-	1	3	8	13	-	-	-	-	-	1	6	1	-	-	-	2
	NK Fortius	2	3	1	1	3	10	-	-	-	-	-	3	-	-	-	-	-	1
	KWS 1393	5	-	2	1	3	7	1	-	-	-	-	-	1	-	-	-	-	2
	NK CISKO	4	-	2	-	-	9	-	-	-	-	-	1	1	-	-	-	-	-
28-VII	**TOTAL**	**15**	**3**	**6**	**5**	**14**	**39**	**1**	-	-	-	**-**	**5**	**8**	**1**	**-**	**-**	**-**	5
	PR36D79	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NK Fortius	1	-	2	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-
	KWS 1393	2	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
	NK CISKO	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1
11 VIII	**TOTAL**	**4**	**-**	**5**	**3**	**-**	**1**	-	-	-	-	2	-	-	-	-	-	-	1

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	PR36D79	1	-	1	1	1	2	-	-	-	-	-	-	-	-	2	-	-	2
	NK Fortius	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	KWS 1393	-	-	1	-	-	-	-	-	-	-	-	-	-	-	3	1	-	-
	NK CISKO	1	-	1	1	-	-	-	-	-	-	1	-	-	-	1	-	-	-
25-VIII	**TOTAL**	**5**	**-**	**3**	**2**	**1**	**2**	-	-	-	-	1	-	-	-	6	1	-	3
	PR36D79	1	1	2	-	1	-	1	-	-	-	3	-	-	-	2	1	-	-
	NK Fortius	2	1	3	-	2	-	-	-	-	-	3	-	-	-	2	-	1	-
	KWS 1393	3	-	1	-	1	-	-	-	-	-	1	-	-	-	2	-	-	1
	NK CISKO	1	-	-	1	1	-	-	-	-	-	1	-	-	-	1	-	-	2
7-IX	**TOTAL**	**7**	**2**	**6**	**1**	**5**	**-**	**1**	**-**	**-**	**-**	8	-	-	-	7	1	1	3

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RESEARCH REGARDING SPECIES OF COCCINELLIDAE FAUNA FROM MAIZE AGRO ECOSYSTEM

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Keywords: *Maize, Coccinellidae fauna, biology*

Abstract

In the field, during the year 2009, in 4 variants with different hybrids of maize planted, specimens insects caught on yellow sticky traps were recorded taking into consideration specimens of Coccinellidae. Comparing the proportion, it is noted that the most numerous are Coccinellidae. It was found that the most widespread species of Ladybug is Propilea qatordecempunctata, followed by Coccinella septempunctata. Coccinellidae populations are developed in late June, when numbers reach a peak of development, then this reduces their agroecosistem easily (their presence will continue to be significant), to record a maximum in late July and the number gradually reduces in the late vegetation period of maize. There are no differences in the structure and quantity of wildlife Coccinellidae.

INTRODUCTION

Amazing evolution, from the last period of chemical treatments against pests and diseases, reflected in the treated areas and quantity of used pesticides, together with interest of more people jointed in actions referring to protect environmental conservation, an aspect included in the countries legislation, made to increase interest for study of effects of different technologies of control pests and diseases on useful fauna from different agrocoenoses. If a lot of studies were performed, in Romania about biology, ecology and control of maize insect pest [1-6], is litlle information about useful fauna or “nontarget organisms” [nontarget organism = an organism which is affected by an interaction (for example, a pesticide application) for which it was not the intended recipient]. A large number of small creatures and micro-organisms live in the maize field. They form a species community and each has a place in the food chain. These organisms come into contact with the maize either directly by eating the plant, or indirectly, by eating or parasitizing the prey that has eaten maize or plant parts. Beneficial organisms include various insects, mites, nematodes, fungi, bacteria, and other microorganisms that feed on or parasitize pest species. Some of these species are well-known and have been researched in Europe, as well as in Romania and other countries; however, many more are less known species. The value of these organisms to agriculture and the environment are likely underestimated.

A comparative study is performed between *Coccinellidae* fauna from different maize hybrids, and the role of these insects in maize agroecocenoses is discussed.
Romania has a large area cultivated with maize (in average 3,000,000 ha/year), maize being most cultivated field cereal, easy to be cultivated for small farmers, being possible to be completely mechanized, offering maize cultivators a general good income while kernels are used for feeding animals, in industry and human feeding.
The possible impact of pesticide and GMOs crops on the trophic chains in agrocoenosis is of concern to farmers, policy makers and organizations and societies interested in environmental conservation. Based on the experiments which were done during the last 8 years in Romania, in different crops which have offered us the possibility to observe if there are some influence on existing fauna captured in Yellow Sticky Traps (Pherocone AM traps) in field. Lady beetles, ladybugs, or ladybird beetles are among the most visible and best known beneficial predatory insects. Coccinellids are found worldwide, with over 5,000 species described [7]. Most lady beetles are beneficial as both adults and larvae, feeding primarily on aphids. They also feed on mites, small insects, and insect eggs. Lady beetles are voracious feeders and may be numerous where prey is plentiful and the broad-spectrum insecticide use is limited. Lady beetles need to eat many aphids per day so that they can lay eggs. The convergent lady beetle may eat aphids as much as its weight every day as a larva and consume as many as 50 aphids per day as an adult. Seven spotted lady beetle adults may consume several hundred aphids per day and each larva eats 200 to 300 aphids as it grows. Once the adults and larvae have eliminated an aphid colony, they will search additional food.

MATERIAL AND METHODS

The experiment was performed in Borovce, Slovakia, where there were cultivated 4 reference hybrids in 2009 (NK Cisko, NK Fortius, PR 36D79 and KWS 1393) maize plots. Maize plots were 36/30 m, 75 cm inter-row spacing (46 rows approximately 150 plants/row). Foliar non-target arthropod abundance was assessed using yellow sticky traps, type Pherocone AM trap, 3/plot (on 18, 27 and 35 row, on each plot). Yellow sticky traps were installed, harvested and replaced, weekly or biweekly by Prof. Ludovit Cagan, (in 2009 on 2, 16, 30 June; 14, 21, 28 July; 11, 25 August and 7 September). Yellow sticky traps were maintained till transportation and analyzing at +4^{0}C, as soon was possible were analyzed by taking out (with glue) and counting *Coccinellidae* specimens which were glued on paper sheet and put together in an envelope in the refrigerator.
As non-target organisms, there were taken into consideration specimens of *Coccinellidae*, under stereomicroscope or with magnifying glass were registered specimens of this group. Determination of the species was done for *Coccinellidae* after: http://www.coccinellidae.net [8, 9] and Fauna Romanian-*Coccinellidae* [10].

Under stereomicroscope or with loupe specimens of *Coccinellidae* were registered and determined and after that tacken out from glue, specimens belonging to groups *Coccinellidae* were glued on paper sheet and put together in an envelope in the refrigerator.

RESULTS AND DISCUSSION

The Coccinellidae species founded on yellow sticky traps were noted as shown in the following images (*http://www.coccinellidae.net):
1-*Propylea quattuordecimpunctata* L.; 2-*Psilobora vigintiduopunctata* = *Thea 22-punctata* L.; 3-*Coccinella septempunctata* L.; 4-*Adalia bipunctata* L. (figure 1).

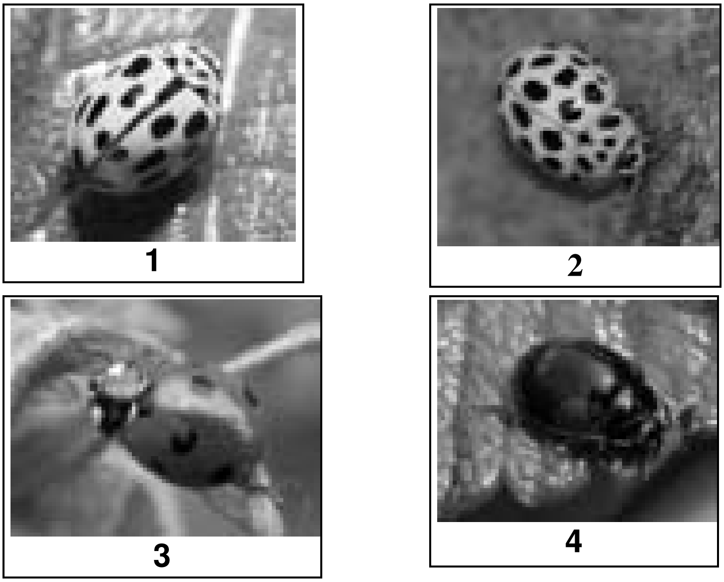

Fig. 1. *Coccinelidae* species

Table 1 presents the evolution of captures at different data on different hybrids, there are no significant differences between the captures at a certain data and the analysed hybrids.

Table 1

Evolution of captures at different data on different hybrids

Data	**Hybrid**	***Propilea qatordecempunctata***	***Psilobora vigintiduopunctata***	***Coccinella septempunctata***	***Adalia bipunctata***
1	**2**	**3**	**4**	**5**	**6**
2 June	PR36D79	0	0	0	0
	NK Fortius	0	0	0	0
	KWS 1393	0	0	0	0
	NK CISKO	0	0	0	0
	TOTAL	***0***	***0***	***0***	***0***
16 June	PR36D79	4	2	2	1
	NK Fortius	4	0	1	5
	KWS 1393	2	0	2	4
	NK CISKO	3	1	0	0
	TOTAL	***13***	***3***	***5***	***10***
30 June	PR36D79	4	1	2	7
	NK Fortius	6	0	1	7
	KWS 1393	6	1	1	4
	NK CISKO	6	1	0	1
	TOTAL	***22***	***3***	***4***	***19***
14 July	PR36D79	8	1	1	0
	NK Fortius	8	0	0	0
	KWS 1393	8	0	8	0
	NK CISKO	7	0	4	0
	TOTAL	***31***	***1***	***13***	***0***
21 July	PR36D79	34	0	3	0
	NK Fortius	17	0	3	0
	KWS 1393	36	0	2	0
	NK CISKO	17	1	3	0
	TOTAL	***104***	***1***	***11***	***0***
28 July	PR36D79	37	0	0	0
	NK Fortius	23	0	1	0
	KWS 1393	33	0	1	0
	NK CISKO	13	0	1	0
	TOTAL	***106***	***0***	***3***	***0***

11August	PR36D79	5	0	0	0
	NK Fortius	2	0	0	0
	KWS 1393	3	0	0	0
	NK CISKO	3	0	0	2
	TOTAL	***13***	***0***	***0***	***2***
25 August	PR36D79	6	0	0	0
	NK Fortius	6	0	0	0
	KWS 1393	6	0	0	0
	NK CISKO	4	0	0	0
	TOTAL	***22***	***0***	***0***	***0***
7 September	PR36D79	8	0	0	0
	NK Fortius	4	0	1	1
	KWS 1393	11	0	1	0
	NK CISKO	6	0	0	0
	TOTAL	***29***	***0***	***2***	***1***
Total general		**340**	**8**	**38**	**32**

Taking into consideration the number of specimens from the total of 418, the most spreaded species was *Propylea quattuordecimpunctata* L. [340 specimens (81%)]; folowed by *Coccinella septempunctata* L. [38 specimens (9%)]; *Adalia bipunctata* L. [32 specimens (8%)] and *Psilobora vigintiduopunctata* = *Thea 22-punctata* L. [8 specimens (2%)] (Figure 2).

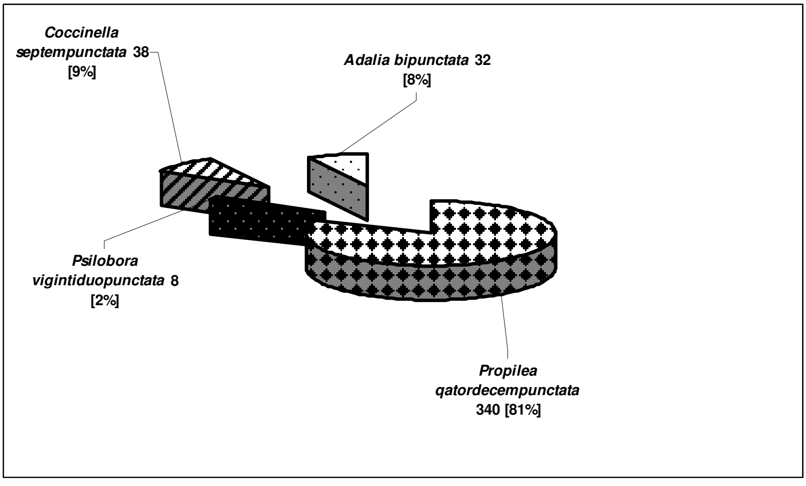

Fig. 2. Structure of *Coccinelidae* species captured in maize fields

The evolution of Coccinelidae species captured throughout the period in yellow sticky traps, in maize fields showed that *Propylea quattuordecimpunctata* L. and *Coccinella septempunctata* L. recorded the peak of captures in July, but *Adalia bipunctata* L. and *Psilobora vigintiduopunctata = Thea 22-punctata* L. had the largest number in June (Figure 3).

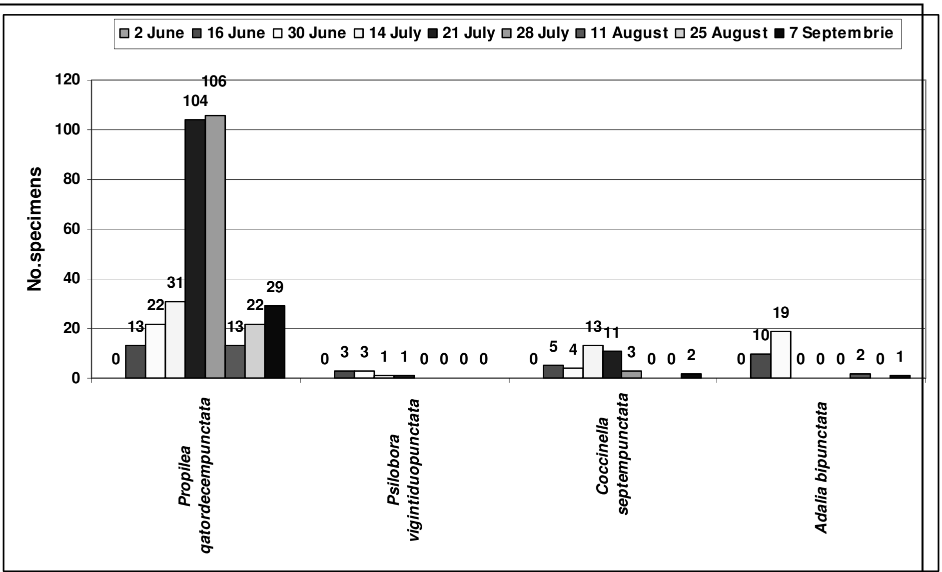

Fig. 3. Evolution of *Coccinelidae* species captured in maize fields

CONCLUSIONS

1. The most spreaded species wchich was found in yellow sticky traps in maize crops was *Propylea quattuordecimpunctata* L. folowed by *Coccinella septempunctata* L., *Adalia bipunctata* L. and *Psilobora vigintiduopunctata = Thea 22-punctata* L.
2. There are no significant differences between the captures at a certain data and the 4 hybrids grown and analysed (NK Cisko, NK Fortius, PR 36D79 and KWS 1393).
3. The evolution of Coccinelidae species captured throughout the period in yellow sticky traps, in maize fields showed that *Propylea quattuordecimpunctata* L. and *Coccinella septempunctata* L. recorded the peak of captures in July, but *Adalia bipunctata* L. and *Psilobora vigintiduopunctata = Thea 22-punctata* L. had the largest number in June.

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RESEARCH REGARDING SPECIES OF NEUROPTERA FAUNA FROM MAIZE AGRO ECOSYSTEM

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Keywords: M*aize, Neuropteran fauna, biology*

Abstract

In the field, during 2009, in 4 variants with different hybrids of maize planted, specimens insects caught on yellow sticky traps were recorded taking into consideration specimens of nontarget organims represented by Neuropterans. A lot of insect groups were captured on yellow sticky traps and comparison of proportion; it is noted that the most numerous are Coccinellidae, followed by Syrphid and finally Neuropterans. The most widespread neuropteran species is Chrysopa carnea, followed by Osmylus chrisops and only ont the third place is situated Drepanepteryx phalaenoides. Neuropteran populations are developed in late July, when numbers reach a peak of development, then this reduces their agroecosistem easily (their presence will continue to be significant) and their number gradually reduces towards the end of vegetation maize. There are no differences in the structure and quantity of wildlife Neuropterans between different hybrids.

INTRODUCTION

Amazing evolution, from the last period of chemical treatments against pests and diseases, reflected in the treated areas and quantity of used pesticides, together with interest of more people jointed in actions referring to protect environmental conservation, on aspect included in the countries legislation, made to increase interest for study of effects of different technologies of control pests and diseases on useful fauna from different agrocoenoses. If a lot of studies were done, in Romania about biology, ecology and control of maize insect pest [1-6], is litlle information about useful fauna or “nontarget organisms” [nontarget organism = an organism which is affected by an interaction (for example, a pesticide application) for which it was not the intended recipient]. A large number of small creatures and micro-organisms live in the maize field. They form a species community and each has a place in the food chain. These organisms come into contact with the maize either directly by eating the plant, or indirectly, by eating or parasitizing the prey that has eaten maize or plant parts. Beneficial organisms include various insects, mites, nematodes, fungi, bacteria, and other microorganisms that feed on or parasitize pest species. Some of these species are well-known and have been researched in Europe, as well as in Romania and other countries; however, many more are less known species. The value of these organisms to agriculture and the environment are likely underestimated.

A comparative study is done between Neuropteran fauna from different maize hybrids, and role of these insects in maize agroecocenoses is discussed.

Romania has a large area cultivated with maize (in average 3,000,000 ha/year), maize being most cultivated field cereal, easily cultivated for small farmers, being possible to be completely mechanized, offering maize cultivators a general good income and kernels are used for feeding animals, in industry and human alimentation.

Based on the experiments performed during the last 8 years in Romania, in different crops which have offered to us the possibility to observe if there are some influence on existing fauna captured in Yellow Sticky Traps (Pherocone AM traps) in field. The insect order Neuroptera, or net-winged insects, includes the lacewings, mantidflies, antlions, and their relatives. The order contains some 4,000 species. The common name lacewings is often used for the most widely known net-winges insects - the green lacewings (Chrysopidae) - but actually most members of the Neuroptera are referred to as some sort of "lacewing". Neuropterans are soft-bodied insects with relatively few specialised features. They have large lateral compound eyes, and may or may not also have ocelli. The larvae are specialised predators, with elongated mandibles adapted for piercing and the larvae of most families are predators. Many chrysopids eat aphids and other pest insects, and have been used for biological control (either from commercial distributors but also abundant and widespread in nature). Adults of many groups are also predatory, but some do not feed, or consume only nectar or polen (as *Chrysopa carnea*). The most interested groups of Neuroptera are superfamily Osmyloidea with family Osmylidae (osmylids), family Chrysopidae (green lacewings, stinkflies, formerly in Hemerobioidea) and superfamily Hemerobioidea with family Hemerobiidae (brown lacewings).

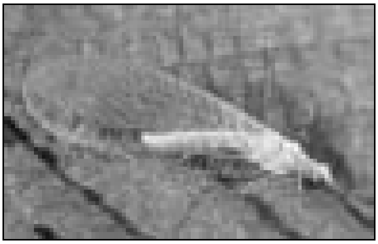
MATERIAL AND METHODS

The experiment was performed in Borovce, Slovakia, where were cultivated 4 reference hybrids in 2009 (NK Cisko, NK Fortius, PR 36D79 and KWS 1393) maize plots. Maize plots were 36/30 m, 75 cm inter-row spacing (46 rows approximately 150 plants/row). Foliar non-target arthropod abundance was assessed using yellow sticky traps, type Pherocone AM trap, 3/plot (on 18, 27 and 35 row, on each plot). Yellow sticky traps were installed, harvested and replaced, weekly or biweekly by Prof. Ludovit Cagan, (in 2009 on 2, 16, 30 June; 14, 21, 28 July; 11, 25 August and 7 September). Yellow sticky traps were maintained during transportation and analyzed at $+4^0$C, as soon as possible were analyzed by taking out (with glue) and counting Neuropteran specimens which were glued on paper sheet and put together in an envelope in the refrigerator.

As non-target organisms there were taken into consideration specimens of Neuropteran, under stereomicroscope or with magnifying glass were registered specimens of this group.
Determination of the species was done for Neuroptera after: www.hlasek.com/ [7-9] and Fauna Romanian-Neuroptera [10]. Under stereomicroscope or with loupe were registered and determined specimens of Neuroptera and after that taking out from glue specimens belonging to this group, were glued on paper sheet and put together in an envelope in the refrigerator.

RESULTS AND DISCUSSION

The Neuropteran species founded on yellow sticky traps were noted as shown in the following images (*http://www.hlasek.com *Chrysopa carnea* 359; *Osmylus chrisops* 366; *Drepanepteryx phalaenoides* 386): 1-*Chrysoperla carnea* (Stephens, 1836) or *Chrysopa carnea*; 2-*Osmylus fulvicephalus* (Scopoli, l763) or *Osmylus chrisops*; 3-*Drepanepteryx phalaenoides* (Linnaeus, l758) (Figure 1).



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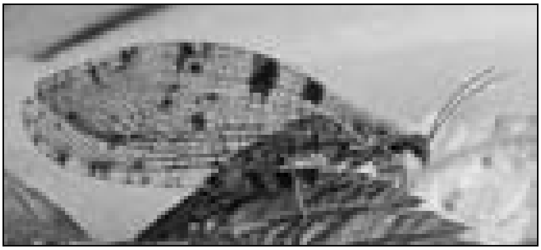

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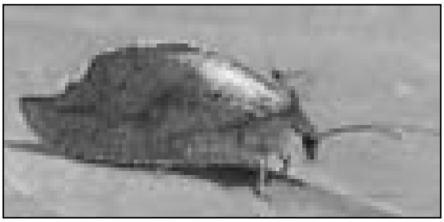

3*

Fig. 1. ***Neuropteran*** **species**

Table 1 presents the evolution of captures at different data on different hybrids, there are no significant differences between Neuropteran species captures at a certain data and analysed hybrids.

Table 1

Evolution of Neuropteran species captures at different data on different hybrids

Date	**Hybrid**	***Chrysopa carnea***	***Osmylus chrisops***	***Drepanepteryx phalaenoides***
1	**2**	**3**	**4**	**5**
2 June	PR36D79	0	0	0
	NK Fortius	0	0	0
	KWS 1393	0	0	0
	NK CISKO	0	0	0
	TOTAL	***0***	***0***	***0***
16 June	PR36D79	23	0	0
	NK Fortius	18	1	0
	KWS 1393	19	0	0
	NK CISKO	15	1	0
	TOTAL	***75***	***2***	***0***
30 June	PR36D79	11	0	0
	NK Fortius	16	0	0
	KWS 1393	9	1	0
	NK CISKO	18	1	0
	TOTAL	***54***	***2***	***0***
14 July	PR36D79	8	3	1
	NK Fortius	4	0	0
	KWS 1393	5	3	0
	NK CISKO	3	4	0
	TOTAL	***20***	***10***	***1***
21 July	PR36D79	37	1	0
	NK Fortius	22	0	2
	KWS 1393	39	3	0
	NK CISKO	31	3	0
	TOTAL	***129***	***7***	***2***

1	2	3	4	5
28 July	PR36D79	8	0	0
	NK Fortius	11	4	1
	KWS 1393	15	5	2
	NK CISKO	3	4	0
	TOTAL	***37***	***13***	***3***
11 August	PR36D79	1	0	2
	NK Fortius	5	4	4
	KWS 1393	1	1	2
	NK CISKO	1	5	0
	TOTAL	***8***	***10***	***8***
25 August	PR36D79	0	1	1
	NK Fortius	0	0	1
	KWS 1393	1	2	0
	NK CISKO	1	1	0
	TOTAL	***2***	***4***	***2***
7 Septembre	PR36D79	0	0	0
	NK Fortius	0	2	0
	KWS 1393	0	0	1
	NK CISKO	0	2	1
	TOTAL	***0***	***4***	***2***

Taking into consideration the number of specimens from the total of 395, the most spreaded species was *Chrysoperla carnea* (Stephens, 1836) or *Chrysopa carnea* [325 specimens (82%)]; folowed by *Osmylus fulvicephalus* (Scopoli, 1763) or *Osmylus chrisops* [52 specimens (13%)] and *Drepanepteryx phalaenoides* (Linnaeus, 1758) [18 specimens (5%)] (figure 2).

The evolution of Neuropteran species captured during all period in yellow sticky traps, in maize fields showed that the evolution of flight of *Chrysopa carnea* Steph. had two peaks, in the midle of June and in second half of July, but *Osmylus chrisops* Scop. and *Drepanepteryx phalaenoides* L. had the largest number in the middle of July until the first half of August (Figure 3).

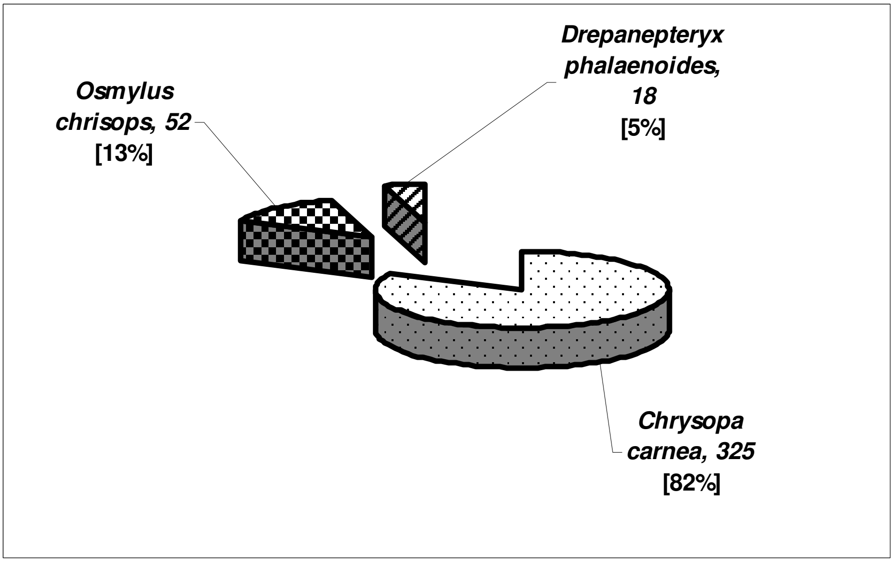

Fig. 2. Structure of Neuropteran species captured in maize fields

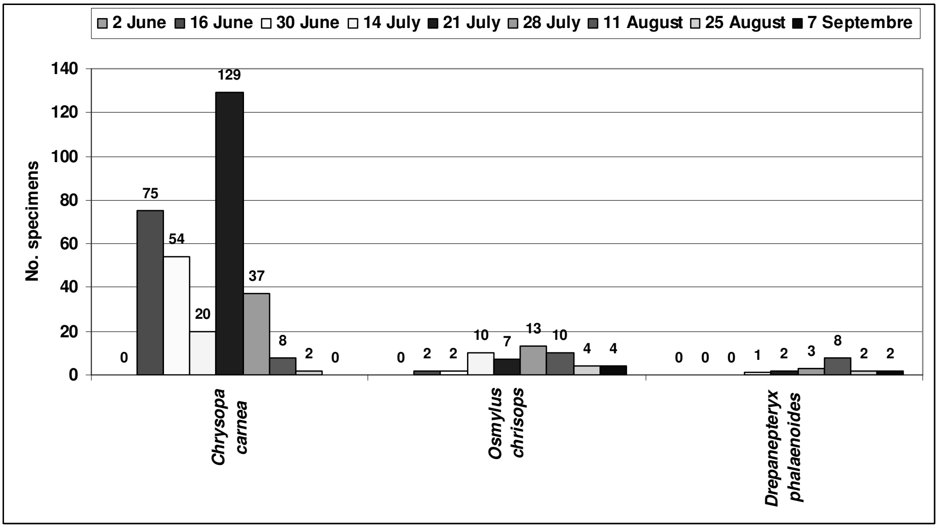

Fig. 3. Evolution of Neuropteran species captured in maize fields

CONCLUSIONS

1. The most common species found in yellow sticky traps in maize crops was *Chrysoperla carnea* (Stephens, 1836) or *Chrysopa carnea* followed by *Osmylus fulvicephalus* (Scopoli, 1763) or *Osmylus chrisops* and *Drepanepteryx phalaenoides* (Linnaeus, 1758).

2. There are no significant differences between the Neuropteran captures at a certain data and the 4 hybrids grown and analysed (NK Cisko, NK Fortius, PR 36D79 and KWS 1393).
3. The evolution of Neuropteran species captured during all period in yellow sticky traps, in maize fields showed that evolution of flight of *Chrysopa carnea* Steph. had two peaks, in the midle of June and in second half of July, but *Osmylus chrisops* Scop. and *Drepanepteryx phalaenoides* L. had the largest number in the middle of July until the first half of August.

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ANTIFUNGAL ACTIVITY OF MACROALGAE EXTRACTS

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Keywords: *algae, antifungal activity, plant pathogens*

Abstract

Macroalgae are ubiquitous organisms, they inhabit almost everywhere. They are a renewable living resources which are also used as food, feed, pharmaceuticals, wastewater treatment or for the industrial production of phycocolloids. Biostimulant properties of seaweeds are explored for use in agriculture (as fertilizer).

In our study, the biological activity of Alaria esculenta, Fucus vesiculosus, Fucus sp. *(Bioalgua®), Spirulina platensis, and Ecklonia maxima (as Kelpak®) was tested in vitro against Fusarium roseum, F. oxysporum, Alternaria alternata, A. dauci, A. longipes, Trichoderma viride, Botrytis cinerea, Aspergillus niger, Penicillium expansum. Their potential toxic effects were evaluated on mycelial growth. Results are presented as effective concentration which inhibits mycelial growth by 50% and 90%. Almost all the algal extracts tested showed an antifungal activity, as ethanol extracts.*

To our knowledge, this is the first report in Romania providing data on the antifungal activity of algal extracts. Macroalgae are an attractive and natural source of bioactive molecules. Such natural products may have potential for the management of fungal diseases in sustainable agriculture such as organic farming. Further research is needed regarding such alternative (seed treatment, foliar applications) in an integrated crop disease management program.

INTRODUCTION

Red and brown algae are mainly used as human healthy food sources, due to their high concentration in polysaccharides, natural richness in minerals, polyunsaturated fatty acids and vitamins. Macroalgae (seaweeds) are rich sources of structurally new and biologically active metabolites. In recent years, there have been many reports of macro algae derived compounds that have a broad range of biological activities, such as antibacterial, antiviral, antioxidant, anti-inflammatory, cytotoxic and antimitotic activities [2]. Special attention has been reported for antiviral, antibacterial and/or antifungal activities against human pathogens [8, 3, 6, 7, 10, and 11] and biostimulant properties of seaweeds are explored for use in agriculture.

The present study was undertaken to investigate the antifungal activities of seven green and brown algae species. The tested algae were: *Spirulina platensis* - green algae (*Chlorophyta*); *Fucus vesiculosus* and other members of the *Fucaceae* family; *Alaria esculenta* and *Ecklonia maxima* as Kelpak® - brown algae (*Phaeophyta*).

MATERIAL AND METHODS

Algal extracts. Extracts of 5 algal species (listed in Table 1) were tested *in vitro* for their antifungal activities against 9 fungal isolates. Algal dried samples (*Alaria esculenta* and the mixture of *Fucaceae* family – as Bioalgua®) were cut into small pieces and ground in an electric coffee mill. The other algal species were formulated as powder, except *E. maxima* – as Kelpack® (liquid formulation). Ten grams of each algal powdered sample were submitted to lipid-soluble extraction with ethanol by soaking for overnight at room temperature. The extracts were filtered through bacterial filters (Millipore, 0.45µm). Stock solutions were prepared for each algal species at 10% concentration. **Fungal isolates.** *In vitro* tests were conducted using 9 fungal isolates belonging to the genera *Alternaria*, *Aspergillus*, *Botrytis*, *Fusarium*, *Penicillium* and *Trichoderma*. All fungal strains used in this study are listed in Table 2. All strains were purified by monospore isolation and maintained on malt agar (MA) medium (2% malt, 2% agar, w/v) at 4^0C. **Assay on mycelium.** The effect of algal hydro alcoholic extracts (HAE) on mycelial growth was tested *in vitro*. Growth of fungal isolates was scored after 7 days of incubation at 24°C. Agar disks were cut from the margin of a 7-day-old fungal colony and were transferred to MA medium supplemented with the algal extracts (aliquots of stock solutions were incorporated to medium at 45-50^0C to provide concentrations of 0.25, 0.5, 1.0 and 2.0%). Only for *E. maxima* the tested concentrations were 1% and 2%, recommended for Kelpak® application. Three replicates were used per treatment. For each algal extract and concentration, the percentage of growth inhibition in treated samples compared to the control was calculated. The results are expressed as the effective concentration EC_{50}/EC_{90} (the concentration which reduced mycelial growth by 50%/90%) determined by regressing the inhibition of radial growth values (% control) against the values of the algal extracts tested concentrations.

Table 1

Algal extracts

Algal extract	Algal type	Extract type	Origin
Alaria esculenta	*Phaeophyta* (brown algae)	HAE	Dried seawed, Naturalia
Fucus vesiculosus		HAE	Laboratoires Vitarmonyl
Fucus sp. (mixture)		HAE	Bioalgua®
Ecklonia maxima		-	Kelpak®
Spirulina platensis	*Chlorophyta* (green algae)	HAE	Hofigal

Table 2

Fungal species and isolates

No.	Fungal species	Isolate	Host	Geographic origin
1	*Alternaria dauci*	Ad P2	*Daucus carota/seeds*	France
2	*Alternaria longipes*	Al 2207	*Capsicum annuum/seeds*	Bulgaria
3	*Alternaria alternata*	Aa 100	*Trichocereus pachanoi/stem*	Romania
4	*Aspergillus niger*	As 205	*Allium cepa/onions*	Romania
5	*Botrytis cinerea*	Bc 2107	*Vitis vinifera/grapes*	Romania
6	*Fusarium oxysporum*	Fo 809	*Cucumis sativus/fruits*	Romania
7	*Fusarium roseum*	Fr 101	*Nerium oleander/seeds*	Romania
8	*Penicillium expansum*	Pe 2712	*Malus domestica/ fruits*	Romania
9	*Trichoderma viride*	Tv 65	*Malus domestica/fruits*	Romania

RESULTS AND DISCUSSION

The antifungal activities of five algal extracts were screened against important fungal species, 8 important plant pathogens and one well known antagonist. Variable response patterns to *Alaria esculenta* extracts were obtained (Figure 1a). For example, isolates An 205 (*Aspergillus niger*) and Aa 100 (*A. alternata*) appeared to be the least and the most sensitive isolates. All *Alternaria* tested isolates were sensitive (EC_{50} values ranging from 0.67 to 0.98%). The others isolates exhibited values of EC_{50} ranging from 1.27% (*F. oxysporum* Fo 809) to 1.54% (*P. expansum* 2712). Fungal mycelium growth was strongly inhibited at concentrations from 1.67% (*A. longipes* 2207) to 2.46% (A. *niger* 205).

The fungitoxic effects of *Fucus vesiculosus* extracts on the mycelial growth of fungal isolates are shown in Figure 1b. Like in the presence of *Alaria esculenta* extract, the most sensitive isolates were those belonging to *Alternaria* genus (mean EC_{50} values: 0.85% – *A. dauci* Ad P2, 0.81% *A. longipes* Al 2207; EC_{90} values below 2%). The other tested isolates exhibited similar sensitivity, EC_{50} values ranging from 5.66% - *B. cinerea* Bc 2107 and *T. viride* Tv65 to 6.33 – *P. expansum* Pe 2712; EC_{90} ranging from 6.46% - Bc 2107 and Tv 65 to 7.13% – Pe 2712. The less sensitive isolate was *Penicillium expansum* Pe 2712.

In vitro effects of *Fucaceae* sp. extracts (as Bioalgua®) on the mycelial growth of tested fungal isolates is presented in Figure 1c. The most sensitive isolate was *Botrytis cinerea* Bc 2107, the mycelial growth being 50% inhibited at 0.5% and 90% inhibited at 2.02%. The response of *Penicillium expansum* Pe 2107 isolate was different in the presence of Bioalgua®, compared to the two previously extracts, the mycelial growth being strongly inhibited at 2.20%. The response of the three *Alternaria* tested isolates was similar, with EC_{90} values ranging from 2.13% (*A. alternata* Aa 100) to 2.74% (*A. dauci* Ad P2). The least sensitive isolate was *Aspergillus niger* An 205 (mean $EC_{50/90}$ values 5.75 and 10.75, respectively).

The fungitoxic effects of *Spirulina platensis* extracts on the mycelial growth of fungal isolates are shown in Figure 1f. All the tested isolates were recorded as sensitive, the mycelial growth being strongly inhibited at concentrations below 2%. The most sensitive isolate was *F. roseum* Fr 101 (EC_{50} 0.5% and EC_{90} 1%). Less sensitive were *A. dauci* Ad P2, *P. expansum* Pe 2712 and *T. viride* Tv 65, with EC_{90} values of 1.95, 1.85 and 1.95% respectively.

No variation in response was obtained with the tested isolates towards Kelpak®, with no inhibition of mycelial growth, except *Alternaria longipes* Al 2207 isolate. In this later case, a slight inhibition of mycelial growth was recorded (13.5% at 1% and 21.6% at 2%). Previous reports have shown that seaweed extracts can reduce disease and promote plant growth. This lack of direct action of Kelpak®could be explained by the fact that, like other products (Iodus® and Vacciplant® - two plant activators with laminarine as bioactive molecule; SW product [5] based on *Ascophyllum nodosum*) is a well known plant growth stimulator, which improves general plant health and enhances plant resistance to nematodes, pests and fungal diseases.

Our results highlighted the strongly *in vitro* antifungal activity of the tested algal extracts, although in recent years, most of the compounds of marine algae were reported as antibacterial in human medecine. It is expected that the antifungal activity found by us to be done in the the presence of bioactive molecules, as phenolic compounds (phlorotannins, terpenes, alkaloids), polysaccharides or fatty acids, many of these structures being identified as antimicrobials [1].

Using organic solvents which are able to extract a large quantity of lipophilic compounds (glycolipid, phenolic-terpenoidsds, unsaturated-fatty acids and hydroxylated unsaturated-fatty acids), the higher antifungal activity found in ethanol extracts, compared to water extracts (data not shown) could be explained [9, 4]. Biochemical analysis are currently undertaken to determine the structure and nature of these compounds.

Current research is under different field cropping systems to assess the plant protective role of seaweed extract and impact on plant diseases. It will be interesting to study the potential elicitor and disease suppressive activities of the algal extracts.

These compounds could be an environmentally friendly means of plant disease control and could be utilized in organic farming and for vegetable cropping systems where application of synthetic fungicides or chemicals needs to be avoided.

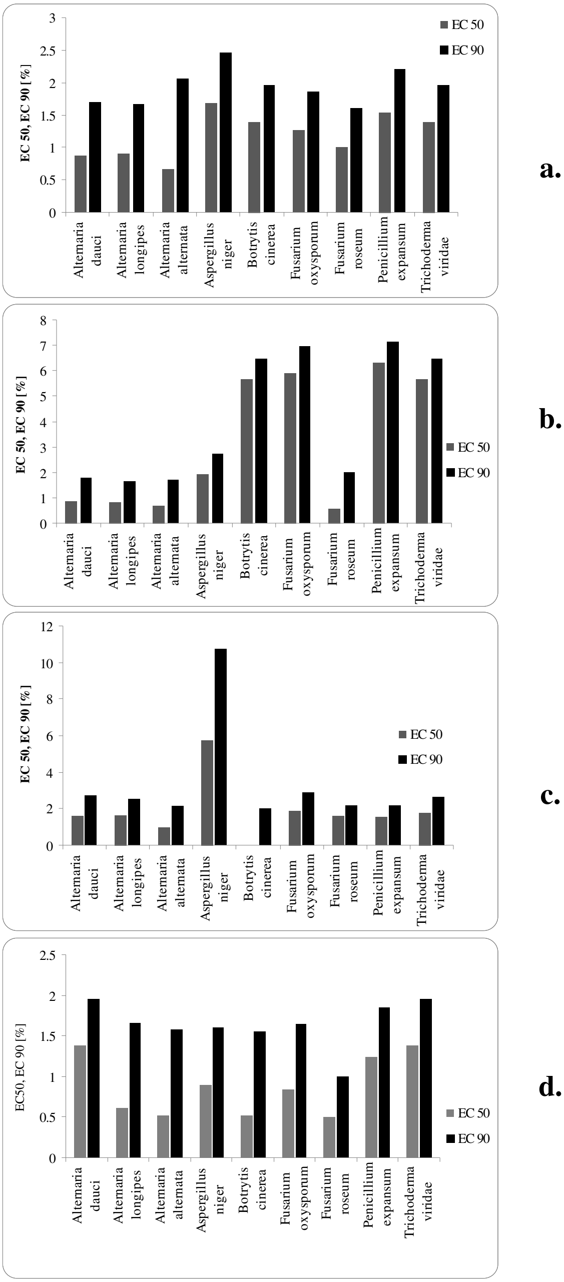

Fig. 1. ***In vitro*** **effects of algal extracts on fungal mycelial growth: a.** ***Alaria esculenta*****; b.** ***Fucus vesiculosus*****; c.** ***Fucus*** **sp. (Bioalgua®); d.*****Spirulina platensis***

CONCLUSIONS

1. In this study, we demonstrated that the tested ethanol macroalgal extracts exerted antifungal activity against different plant fungal species. Fungal mycelial growth was strongly inhibited generally below 2%. To our knowledge, this is the first report in Romania providing data on the antifungal activity of algal extracts against important pre-and postharvest or seed borne pathogens.
2. Further work is required to identify the bioactive molecules that are responsible for the antifungal activity (phenolic compounds, polysaccharides or fatty acids) and to assess the plant protective role of seaweed extract (as foliar or seed treatment).

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FUNGI ASSOCIATED WITH ESCA DECLINE AND THEIR *IN VITRO* CONTROL BY CHITOSAN

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Keywords: *grapevine, esca decline, fungal pathogens, chitosan*

Abstract

Esca is a devastating and insidious disease that affects vineyards in major grape-producing areas worldwide. Several esca characteristics make the effectiveness of control strategies still difficult (types of microorganisms involved, correlation of foliar symptoms with wood deterioration).

The aims of our research were to identify fungal pathogens associated with esca decline and to evaluate their in vitro control by chitosan. Research was carried out in Bucharest (N $44^0 25'$, E $26^0 6'$) in 2009, in a plantation founded in 1994 of Feteasca regala cultivar grafted on Kobber 5 BB. The type of vine training system can be a favourable factor for esca decline. Both, the mild and the severe form of esca were observed. Samples obtained from vines with characteristic esca symptoms were examined for the presence of pathogenic fungi. The fungi isolated from the wood were included in the genera: Phaeoacremonium, Phaeomoniella, Phomopsis, Fomitiporia, Fusarium, Alternaria, Cladosporium, Aspergillus and Botryosphaeria.

In vitro assays investigated the influence of chitosan on the mycelial growth of esca pathogens. The effective concentrations which inhibit mycelia growth by 90% were calculated. Our results highlighted the potential of chitosan to control esca pathogens. Further investigation is needed to set an integrated management program in which chitosan could be used as wound dressing.

INTRODUCTION

Esca is a devastating and insidious disease that affects vineyards in major grape-producing areas worldwide. The esca diagnosis is based on external symptoms on leaves, and internal degradation of wood tissues. Several esca characteristics make the effectiveness of control strategies still more difficult: a) several fungi have been associated with the disease; b) in most cases, foliar symptoms shows up when wood discoloration and decay inside the vine are already extensive; c) foliar symptoms vary on the same vine from year to year - it appears to be some relationship between fungal development in the host plant and climatic parameters as air temperature, rainfall [5].

With no chemical control available for treatment of grapevine trunk diseases, management options are largely preventive and limited to minimizing infection risk by pruning in dry weather whenever possible.

The aims of our research were to identify fungal pathogens associated with esca decline and to evaluate their *in vitro* control by chitosan (poly b-(1-4)N-acetyl-d-glucosamine), a deacetylated form of chitin, and known as a natural antimicrobial compound.

MATERIAL AND METHODS

Research was carried out in Bucharest (N 44^0 25', E $26^0$6') in 2009, in a plantation founded in 1994 of Feteasca regala cultivar grafted on Kobber 5 BB. Vines were spaced 2.20 x 1.20 m by using three pruning systems (Guyot on demi-high trunk, Cazenave cordon and spur-pruned cordon).

Plant material. Samples obtained from vines (Feteasca regala cultivar) with characteristic esca symptoms were examined for the presence of pathogenic fungi. Samples were composed by canes (vine shoots), larger branches (arms) and trunks of vines of Feteasca regala cultivars with variable symptoms of disease.

Fungal isolation. Plant materials were surface sterilized (soaked in 10% bleach for five seconds), dipped in sterile distilled water, and dried on sterile filter paper. The samples were cut and cultured on Malt-Agar (MA) plates (2% + 2% w/v) for the recovery of the pathogens. Cultures were incubated at 25ºC in the dark. Fungal colonies were transferred to MA plates, incubated at room temperature and identified according to their morphological characteristics (morphology of colonies, the microscopic characteristics of mycelium, conidiophores, and conidia).

Antifungal activity. Antifungal activity of chitosan (Sigma Chemicals) on 6 esca fungal isolates was tested *in vitro*. Mycelial discs (8 mm in diameter) were cut from the margin of colonies and placed, mycelium downwards, in Petri dishes containing MA and chitosan (0.0625 - 10.125 - 0.25 - 0.5 - 1 - 2%). Chitosan stock solutions were prepared [2]. All plates were incubated at 25^0C in the dark. Colony diameters were measured and the percentage of inhibition of radial growth (values are the means of three replicates) was calculated. Results are expressed as effective concentration EC50 (the concentration which reduced mycelial growth by 50%).

RESULTS AND DISCUSSION

Esca decline was typically identified in the mild form, as symptoms on leaves: interveinal regions of chlorotic and yellowish tissue that turns yellow-brown or red-brown (Figure 1a). The severe form (dieback of one or more shoots, leaf drop, shriveling and drying of fruit clusters - Figure 1b) was also observed. Both form of esca were observed on 5% of the Feteasca regala cultivar. In cross sections, the most common dieback symptoms were: a) internal wood decay: white rot in the centre of the trunk, soft, friable wood mass; b) central necrosis, brown wood (Figure 2); c) wedge-shaped lesions were the least common.

The type of vine training system can be a favourable factor - the mode of pruning can favor disease spread. Esca decline was found in only 2.4% of vines trained by Cazenave cordon, in 3.7% of vines trained by Guyot on demi-high trunk but in 13.58% vines trained by Spur-pruned cordon. In vines trained by multiple Guyot and Guyot with periodically replaced arms, esca decline was found in 6.79, respectively 7.4% (Figure 3).

Fungal pathogens associated with esca decline. Nine fungal species were isolated from the wood of the grapevines with esca decline symptoms. The isolates were identified according to their morphological characteristics on potato dextrose agar. The fungi isolated from the wood were included in the genera: *Phaeoacremonium, Phaeomoniella, Phomopsis, Fomitiporia, Fusarium*, *Alternaria, Cladosporium, Aspergillus* and *Botryosphaeria*.

The fungal species detected in trunks with esca decline, and the frequencies at which they occurred are shown in Figure 4. *Phaeomoniella chlamydospora* and *Phaeoacremonium aleophilum* are recognized as the primary colonizing agents in the development of esca in older vines [3, 4]. An infection involving the *Phaeoacremonium* and *Phaeomoniella* species predisposes the vines to wood rots caused by basidiomycete fungi such as *Fomitiporia punctata.* In the last stage of wood degradation, the two fungi are frequently associated with other pathogens, in particular *Fomitiporia* sp. isolated from the white-rotted wood.

In vitro effect of chitosan on mycelial growth of esca fungal pathogens. Chitosan, a deacetylated form of chitin, is a natural biodegradable compound derived from crustaceous shells. *In vitro* assays investigated the toxic effects of chitosan on the mycelial growth of esca pathogens. The effective concentrations which inhibit mycelia growth by 90% were calculated. For all tested isolates, the mycelial growth was strongly affected by chitosan, with complete inhibition starting to 0.25% (Table 1). Our results highlighted the potential of chitosan to control esca pathogens.

Chitosan has been proven to control numerous pre- and postharvest diseases on various horticultural commodities [1]. In addition to its direct microbial activity, it is strongly suggest that chitosan induces a series of defense reactions.

Due to its ability to form a semi permeable coating, could be use as wound dressing. Further investigation is needed to set an integrated management program in which chitosan could be used as wound dressing.

Table 1

Sensitivity of esca isolates to chitosan

Isolate	Code	EC50 [%]
Phaeoacremonium chlamydosporum	Pc 1205	0.20
Phaeomoniella aleophilum	Pa 809	0.12
Fusarium sp.	F 205	0.10
Aspergillus niger	An 305	0.20
Alternaria alternata	Aa 1704	0.10
Cladosporium sp.	C 542	0.15
Botryosphaeria dothidea	Bd 2320	0.20

a. **b.**

Fig. 1. Esca foliar and symptoms (a); shriveling and drying of fruit clusters (b)

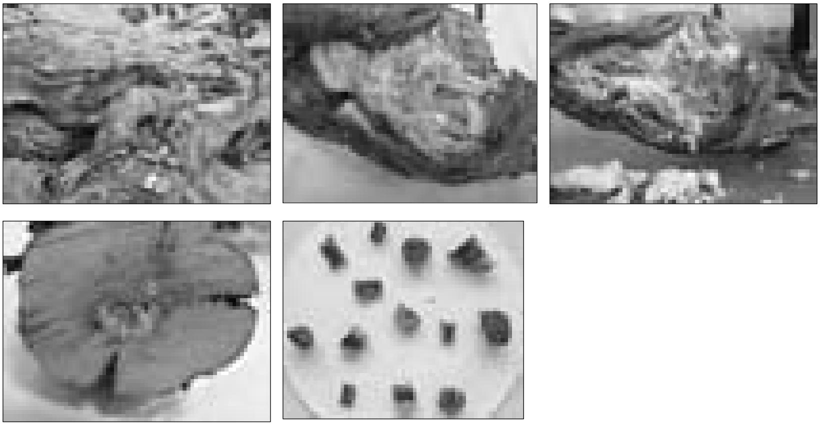

Fig. 2. Cracking of a grapevine trunk. Internal wood decay
(white rot, friable mass; central necrosis, brown wood)

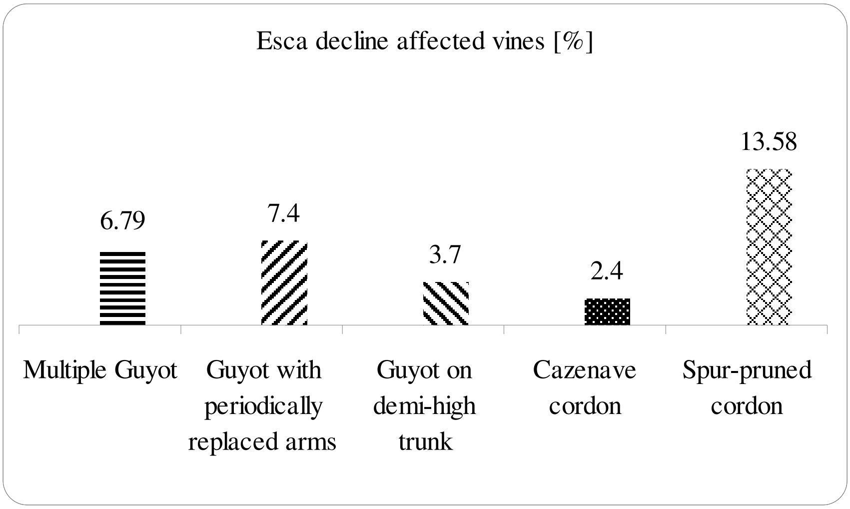

Fig. 3. Type of vines training and frequency of esca decline

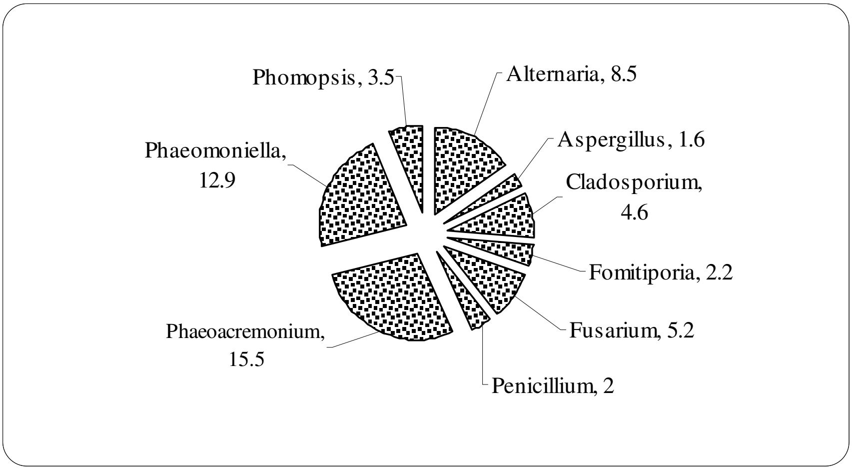

Fig. 4. Frequency of fungal species associated with esca decline

CONCLUSIONS

1. Our survey confirmed the presence of esca decline, typically identified in the mild and the severe form on vines of the Feteasca regala cultivar. The type of vine training system can be a favourable factor. Esca decline was found in only 2.4% of vines trained by Cazenave cordon but in 13.58% vines trained by Spur-pruned cordon.
2. In symptomatic vines, nine fungal species were isolated from the wood of the grapevines with esca decline symptoms. The fungi isolated from the wood were included in the genera: *Phaeoacremonium, Phaeomoniella, Phomopsis, Fomitiporia, Fusarium*, *Alternaria, Aspergillus, Cladosporium* and *Botryosphaeria*.
3. Our results highlighted the potential of chitosan to control esca pathogens. Further investigation is needed to set an integrated management program in which chitosan could be used as wound dressing.

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PATHOGEN FUNGUSES OF THE SUNFLOWER SEED *(HELIANTHUS ANNUUS L.)* AND THEIR IMPACT UPON GERMINATION

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Keywords: *fungus, seed, germination*

Abstract

The Central Laboratory for the Quality Control of the Seeds and of the Seeding Material Bucharest (LCCCSM) carries into effect all the analyses for the seed lots which are comercialized outside the country. In market year 2009, the Central Laboratory has made a number of 9503 analyses, assigned this way: 1030 purity analyses; 3005 germination analyses; 970 humidity analyses; 3020 of sanitary state; 949 determinations of T.G.W. (1000 seeds weight); 515 cold test; 14 different analyses. In the Central Laboratory for the Seeds and Seeded Material Quality Control, the work for the elaboration of the present study has been done, during this time, on all the sunflower samples picked up by the accredited people who could fathom them, from the economical agents.

INTRODUCTION

Sunflower is one of the most important oil-containing plants from Europe, France, Spain, Russia, Ukraine, Romania, etc. Worldwide, its seed is produced in order to ensure and cover an over 16 milion ha surface.

In Romania, quality control for the seeds is fulfilled by the Ministry of Agriculture, through the National Inspection of Seeds Quality and through the Inspectorates of the Territorial Counties (INCS).

During the stockpile, a series of funguses appear on the seeds' surface, which, generally, do not produce damages to the crop, whereas at the moment of the tilling, they disappear due to the inauspicious soil conditions. However, certain situations have been encountered, in which the storage funguses have had a major influence while keeping the seeds in deposits. It can ultimately get to the germination diminution, so much that it can drop under the limit allowed by law (specifically for seeding), and, in this case, the lot is entirely compromised and the loss is total. Also, the storage funguses negatively influence seeds in process of germination on the field, leading, in first phase, to weakling plants which afterwards recover and then, in the following phases, get to develop as good as normal plants. Fungus species which have been identified as belonging to the following genres: *Rhizopus*, *Penicillium*, *Aspergillus* and *Alternaria*.

MATERIAL AND METHODS

The investigation of the existent lots on economical operators, was made according to the ISTA method, and the number of sacks explored was ascertained congruous to the legislation table. From the compund sample, the following probes were extracted: humidity sample, laboratory sample, witness sample.

The sample's minimum size, in order to determine humidity is of 50 g, and for the accomplishment of all the other analyses of 1 kg.

The seeds' sanitary state determination by using the macroscopic analysys seeks the determination of the *Sclerotinia sclerotiorum* sclerots. The obtained information is wrote down in the analysys data sheet by the analyst, which must be dated and signed. If *Sclerotinia sclerotiorum* sclerots are more than 10 pieces in a 1000 g sample, the lot is rejected and does not receive a quality certificate. The seed's owner can take clearance measures and then the lot can be reanalysed, and if everything is ok, the quality certificate can be awarded, and the owner has the possibility to trade.

In order to identify the pathogen agents, from the pure seed, 4 groups-each of 100 g of seed - can be taken randomly, and then arranged as uniform as possible on a paper sheet's wet surface. The wrinkled shreds of paper must be wrapped in another wet shred of paper, in order to ensure uniform humidity. These scrolls must be introduced in a plastic bag, to maintain constant humidity. The bags are introduced in the germination room, at 25ºC temperature, for a period of maximum 10 days, in the dark. In the germination room, a permanent ventilation system must be secured, and also a constant temperature, which should be computer verified. After this phase, the results can be read, by analyzing each and every seed, in order to determine the funguses found in the leafs and in the layer. Another purpose is also to determine the total bacterial count. For the results' confirmation, microscopic preparations are made, if necessary. The results are written down on the working sheet.

RESULTS AND DISCUSSION

In the present project, the results obtained after analysing 28 samples derived from 4 different crop years, and on which germination, normal germs presence, and alive and dead germs, was closely examined, and the results obtained are presented here (Table 1). From Table 2 we can observe the contamination degree with pathogen agents of the same hybrids.

Table 1

Germinative values of some maize hybrids netween years 2006-2009

No.	Sheet Code	Hybrid	Production Year	Germination (%)	G. abnormal (%)	G. dead (%)
1	3000	Zoltan	2006	49	28	23
2	3001	Valentino	2006	53	25	22
3	2347	LG5665M	2006	80	17	3
4	2936	PR64A83	2006	91	8	1
5	3002	Zoltan	2007	48	22	30
6	3057	PR64A83	2007	93	4	3
7	3059	PR64A83	2007	88	8	4
8	3060	PR64A89	2007	97	3	0
9	3058	PR64A83	2007	86	12	2
10	3003	NK Dolbi	2008	80	13	7
11	3007	Oxana	2008	80	16	4
12	3005	Valentino	2008	74	19	7
13	3074	PR63A86	2008	90	8	2
14	2943	PR64A89	2008	94	5	1
15	2910	PR63A86	2008	94	4	2
16	2909	PR63A86	2008	92	5	3
17	2944	PR64E83	2008	90	8	2
18	2942	PR64E83	2008	94	5	1
19	3061	PR63A62	2008	92	7	1
20	3055	PR64A89	2008	89	8	3
21	3043	PR64A71	2009	96	3	1
22	3044	PR64A71	2009	98	2	0
23	3071	PR64B24	2009	86	6	8
24	3017	Inigen	2009	85	7	8
25	2947	PR63A90	2009	93	4	3
26	2948	PR63A90	2009	93	4	3
27	2946	PR63A90	2009	88	4	8
28	3230	PR64B24	2009	81 + *	6	8

*Fresh not germinated seeds - in repose

Table 2

The seeds' contamination degree with pathogen agents of maize hybrids in years 2006-2009

No.	**Sheet Code**	***Alternaria* (%)**	***Aspergillus* (%)**	***Penecillium* (%)**	***Rhizopus* (%)**	***Sclerotinia* Sclerots (pieces/kg sem.)**
1	3000	58	12	8	15	3
2	3001	49	8	3	9	2
3	2347	24	5	1	5	0
4	2936	12	3	2	2	0
5	3002	51	8	3	7	4
6	3057	23	5	0	0	0
7	3059	18	3	0	2	0
8	3060	10	1	0	0	0
9	3058	14	2	0	1	2
10	3003	29	3	0	0	1
11	3007	34	4	1	4	1
12	3005	45	7	2	5	5
13	3074	12	4	1	3	0
14	2943	5	0	0	0	0
15	2910	7	0	0	0	0
16	2909	11	5	2	3	0
17	2944	5	0	0	0	0
18	2942	6	0	0	0	0
19	3061	12	3	0	0	0
20	3055	14	2	1	2	4
21	3043	3	2	0	0	0
22	3044	4	0	0	0	0
23	3071	9	4	0	0	4
24	3017	20	5	1	5	3
25	2947	5	0	0	0	0
26	2948	4	0	0	0	0
27	2946	3	0	0	0	2
28	3230	25	3	3	2	0

From Table 1 we can observe that the seed lots with code numbers 3000 and 3001 have a germination which is very close to 50%, while lots with 2347 and 2936 codes have an equal or bigger germination than 80%, although they are produced in the same crop year, meaning in 2006. It can also be seen the fact that there exists a direct correlation between the germinative value and the dead and abnormal germs' presence. The higher the value of the germination is, the lower the number of germs with problems is.

On the 2007 year level, the 3002 lot has a 48%, germination, while lots 3058 and 3059 have an over 80% value, and 3057 and 3060 have over 90%. On PR64A89 hybrid, which has 97% germination, it can be ascertained that only 3% of the germs have an abnormal development, dead germs not being encountered.

On the seed produced in year 2008 there are lots with a lower germination: 3005 with 74%, lot on which the biggest number of abnormal germs was registered. (17%) and dead germs (7%), 3007 and 3003 with 80%, 3055 with 89% but there are also lots with germination values higher than 90%, such as: 3074, 2943, 2910, 2909, 3061, 2942.

On the seed produced in year 2009 there are lots with germination under 90%: 3071, 3017, 2946 and 3230, but also lots with values of 90%: 3043, 3044, 2947 and 2948.

We can observe that the deposit phase has a negative influence upon preserving the germination, however there are other factors which influence quite greatly the seeds' and germs' (the ones wich result from these seeds) quality.

If we analyse the fungus presence upon seeds (Table 2), we can observe that the number of seeds with smaller germination is directly tied to the big number of seeds infected with *Alternaria* spp. and with a longer storage phase.

Also, lower values of germination on different lots are connected to higher values of other funguses, such as: *Aspergillus*, *Penicillium* and *Rhizopus*.

Regarding these pathogens' incidence on the sunflower seeds' level, it can be observed that the highest percentage belong to species of the *Alternaria* genre and then these decrease to *Aspergillus, Rhizopus*, and the lowest values are registered at *Penicillium*.

The sclerots *(Sclerotinia sclerotiorum)* presence in some seeds lots, has a negative influence upon the seeds' quality.

The presence of the relatively high number of abnormal germs in seeds lots is closely connected to the presence of funguses on seeds.

CONCLUSIONS

1. The germinative values on analysed hybrids varied between 48% (on hybrid Zoltan from 2007) and 98% on hybrid PR64A71, from 2009.

2. On the analysed seeds, a number of five pathogen agents were identified, belonging to genres: *Alternaria*, *Aspergillus*, *Rhizopus*, *Penicillium* and *Sclerotinia.*
3. The older the seed is, the bigger the attack's incidence with pathogen agents can be.
4. Funguses of the *Alternaria* genre have the highest percentage values, in what the seeds' contamination degree is concerned, while funguses belonging to *Penicillium* genre have made a very light presence.
5. Both the deposit phase and the funguses presence on seeds influence greatly the seeds and germs' quality, and the germs which result from these seeds.
6. A certain technology is recommended on the field, which should consider the purpose of reducing as much as possible the pathogen agents' presence on seeds.

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THE INFLUENCE OF TREATMENTS WITH SOME FUNGAL EXTRACTS ON PLANTS OF SOYBEAN GROWN UNDER GREENHOUSE CONDITIONS

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Keywords: *soybean, extract, Botrytis cinerea*

Abstract

The study was carried out in the greenhouse from the Department of Vegetable and Ornamental Plants, USAMV Bucharest during 2008-2009. In this study we used the soybean as biological material, variety PR 91M 10. The experimental variants consisted in treatments with chemicals and fungal extracts applied on plants and soil. After inoculation with pathogen we found that plants in variants treated with fungal extracts showed increased resistance to Botrytis cinerea as compared with the untreated control.

All fungal extracts induced resistance to Botrytis cinerea in soybean plants more efficiently when administrated on leaves. They can be use for plants protection in the context of sustainable agriculture.

INTRODUCTION

By applying friendly products we can help to reduce environmental and plants pollution. Identifying products that induce plant resistance to reduce chemical treatments costs, in this way we contribute to a sustainable agriculture.

The aim of the study was testing the influence of fungal extracts on improving the resistance of soybean plants to pathogen *Botrytis cinerea*.

Research has been carried out to find biocontrol products of microbial origin that increase plant resistance or inhibit pathogen development (Legard et al., 2002; Namdeo, 2007). Studies on the use of fungi with origin into the soil carried out by Ushamalini et al. (2008) proved that these fungi induced defend responses in plant against various pathogens.

MATERIAL AND METHODS

The study carried out during 2008-2009 in the greenhouse from USAMV Bucharest. The biological material was PR 91 M 10 soybean cultivar, sensible to grey mould.

The experimental variants were: V1 - control; V2 - chemical treatment; V3 - treatment with Extract 1; V4 - treatment with Extract 2; V5 - treatment with Extract 3. Biological control treatments were derived from pathogenic (E1), antagonistic (E2) and both mixed (E3) fungi. The chemical fungicides and fungal extracts were applied on plant (leaves) and on soil. All vegetative factors (light, temperature and humidity) were daily monitored. The chemical and biological treatments and doses administrated are presented in Tables 1 and 2.

Table 1

The chemical treatments was applied spraying on leaves and on soil

The days	Products - spraying on leaves	Dose ml/plant	Products applied on soil	Dose ml/pot
Day 1st	Captan +Teldor	10 ml	Topsin +Rovral	10 ml
Day 4th	Captan +Teldor	10 ml	Topsin +Rovral	10 ml
Day 6th	Captan + Batron	10 ml	Topsin	10 ml
Day 8th	Captan + Batron	10 ml	Topsin	10 ml

Table 2

The fungal extract applied by spraying on leaves

The days	Extracts - spraying on leaves	Dose ml/plant	Products Applied on soil	Dose ml/pot
Day 1st	1,2 and 3	10 ml	1,2 and 3	10 ml
Day 4th	1,2 and 3	10 ml	1,2 and 3	10 ml
Day 6th	1,2 and 3	10 ml	1,2 and 3	10 ml
Day 8th	1,2 and 3	10 ml	1,2 and 3	10 ml

After three days of treatments with chemical products and biological extracts, the plants were experimentally infected with the pathogen *Botrytis cinerea*.

The observations and determinations made: the dynamic of height plant; number of leaves; the growth rhythm; the evolution of attack after 24, 48, 72 and 168 hours after inoculation with pathogen; foliar surface; number of affected leaves; percent of affected leaves. The data were compared by means of statistical analysis of variance.

RESULTS AND DISCUSSION

After examining the effect of treatment, we found that the percentage of affected leaves was lower at the variants treated on plant and soil with chemical products and extracts as compared with control. The treatment made with fungal extract E2 (in V4) on plant and soil showed the best resistance of plants at *Botrytis cinerea* (Table 3).

Table 3

Total leaves, total leaves affected and the percent of leaves affected from total leaves

Experimental variants	Treatments applied on:	Total number of leaves per plant	% to control	Signif.	Leaves affected	% of leaves affected from total leaves
V1 - Control	V1 Mt	7.33	100.00	Mt	3	40.93
V2 – Treatment	V2 - Plant	10.00	136.43	*	1	10.00
	V2 - Soil	11.00	150.07	*	1	9.09
V3 - Extract 1	V3 - Plant	10.33	140.93	*	1	9.68
	V3 - Soil	8.00	109.14	N	1	12.50
V4 - Extract 2	V4 - Plant	10.33	140.93	*	0	0.00
	V4- Soil	11.00	150.07	*	0	0.00
V5 - Extract 3	V5 - Plant	10.67	145.57	*	1	9.37
	V5 - Soil	7.00	95.50	N	1	14.29

DL5% = 2.540 DL5% in % = 34.6521
DL1% = 3.700 DL1% in % = 50.4775
DL01% =5.550 DL01% in %=75.7162

Based on observations we noticed that all variants treated with Extracts on the leaves were not significantly affected after 48 hours respectively 72 hours after inoculation with the pathogen at variants 3, 4 and 5. In control variant, percentage of attack to total leaf area was highest after 48 hours (1.19%) respectively after 168 hours (23.51%). In V4 leaves have not been affected (Table 4).

Table 4

Foliar surface and the percent of surface affected from total foliar surface

Experimental variants Treatments applied on plant	Foliar surface	Surface affected of pathogen from the total foliar surface (%)		
		48 hours	72 hours	168 hours (7 days)
V1 - Control	923	1.19	18.09	23.51
V2 - Chemical treatment - plant	1115	0.81	6.01	10.58
V3 - Extract 1 - plant	1050	0.10	0.48	2.10
V4 - Extract 2 - plant	986	0	0	0
V5. Extract 3 - plant	988	0	0.10	2.83

We remarked that when applying the treatments on soil all variants treated with fungal extract have provided a better protection of plants, but less efficient than treatment on plant (Table 5).

The surface of affected leaves was about ten fold reduced in variants treated with extracts E1 and E3 as compared with control, but the chemical fungicides applied, reduced the surface affected by pathogen to about half from that registered in control variant.

Table 5

Foliar surface and the percent of surface affected from total foliar surface

Experimental variants Treatments applied on soil	**Foliar surface**	**% attack regarding the total foliar surface**		
		48 hours	**72 hours**	**168 hours (7 days)**
V1 - Control	923	1.19	18.09	23.51
V2 –Chemical treatment -soil	1023.11	0.49	8.60	10.95
V3 - Extract 1 – soil	956.37	0.10	0.63	3.24
V4 - Extract 2 - soil	893.67	0	0	0
V5. Extract 3 – soil	886.33	0	0.11	4.06

CONCLUSIONS

1. Biological control agents represented by fungal extracts had beneficial effects on soybean plants that were better protected against infection with *Botrytis cinerea* than non-treated plants or treated with chemical fungicides
2. The effect of biological agents for pathogen control was the best when applied by spraying on plant leaves than on soil
3. In the case of the treatment applied on plant and soil the best protection was observed at variant 4, where there were no signs of attack
4. The efficiency of pathogen control treatments in the experiment was: Extract 2>Extract 1>Extract 3>Chemical fungicides.

ACKNOWLEDGEMENTS

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DIPLOID AND TETRAPLOID VARIETIES OF THE *LOLIUM PERENNE* BEHAVIOR, UNDER THE INFLUENCE OF STORAGE YEARS AND STORAGE CONDITIONS

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Keywords: *germination, field emergency, seed, quality, diploid, tetraploid, varieties*

Abstract

The value of the Lolium perenne seeds' quality parameters are influenced by a large number of internal and external factors. The analyzed factors are: the variety, storage conditions and storage period of the varieties analyzed. Most of these factors can be influenced and controlled by humans. A great importance regarding maintaining the seed quality of the varieties of Lolium perenne seeds, during the storage period, is represented by the storage condition and genetic information (diploid or tetraploid varieties). For the diploid varieties, the final count- germination decreases with seeds aging in uncontrolled environment, and for tetraploid varieties increases in the same conditions. The influence of the storage conditions upon the final -count germination, soil germination and field emergency for the diploid varieties is stronger than upon the tetraploid varieties. The soil germination and field emergency decreases with seeds aging for the diploid varieties and stays constant for tetraploid varieties

INTRODUCTION

The germination in the laboratory (soil and paper tests) and field emergency of the *Lolium perenne* seeds is represented by the totality of processes happening in the embryo while it passes from latent life to active life. It is known that only with a good quality seed, the result expected from this important forage plant can be obtained. In this project, I have deepened the study of this quality parameter for diploid and tetraploid varieties.

MATERIAL AND METHODS

For the study 8, varieties of *Lolium perenne* were used: Mara, Calibra, Kaiser, Lorenz, Marta, Mãgura, Summit and Tove. The seed of all the varieties studied was obtained from the year's 2005 production and the samples used were extracted from certified biological category seed lots.

A material as homogeneous as possible regarding the quality indexes was used, so that the biological purity had values higher than 96%, the percentage of foreign seeds was situated between the legal limits (less than 1.5%), and the initial humidity of the lots was situated between 11.6%-12.8%. The 8 varieties were considered 8 variants. In the year 2005, laboratory tests were made to determine the initial germination (energy and germination capacity). Both the ensured conditions in the seeds growing period, and their evaluation were made according to the ISTA rules.

After making the tests in the vintage year, the samples were mixed and divided resulting two homogeneous sub-samples with the same weight, for each of the varieties studied. A set of sub-samples was kept in controlled environment (temperature under 10 ^{0}C, and relative air humidity under 50%), and the other set of sub-samples was kept in uncontrolled environment, in a space in which the temperature and relative air humidity were changing depending on the season. On both sets of sub-samples germination was determined (energy and germination capacity) for 3 years (2006, 2007, 2008).

When determining the germination for each variant, the laboratory test was made on 4 repeats of 100 seeds. The germination layer used, was filter paper TP (paper layer), in temperature and light conditions of 20 ^{0}C. The evaluation of the seeds was made in 5 days (first-count germination) and 11 days (final-count germination). For soil germination was used the same condition for growing but the paper was changed with a mixture soil and sand (1:1). The field emergency was tested in small plots 25 x 25 cm in the field and the evaluation was performed at 11 days after planting.

RESULTS AND DISCUSSION

Concerning the first count germination, for the diploid varieties in comparison with the tetraploid varieties, through the same interaction: storage conditions x storage period various aspects are highlighted, such as (Figure 1):

- The first count germination of diploid varieties in controlled environment has higher values than the tetraploid varieties.
- Both regression lines, for the tetraploid and diploid varieties have the same gradient descent, which means that the first count germination decreases as the seed ages and the storage environment is no longer controlled.
- The influence of the storage years and storage conditions upon the first count germination is more powerful for diploid varieties, where the determination coefficient has a value of 66.8% towards 41.9% for tetraploid varieties.
- For diploid varieties, for each increase of the "x" with one unit (storage conditions x years of storage interaction) the first count germination decreases by 18.27% for diploid varieties and for tetraploid varieties by

4.20%. This leads to the conclusion that the diploid varieties lose their first count germination more than tetraploid varieties, in the studied varieties.

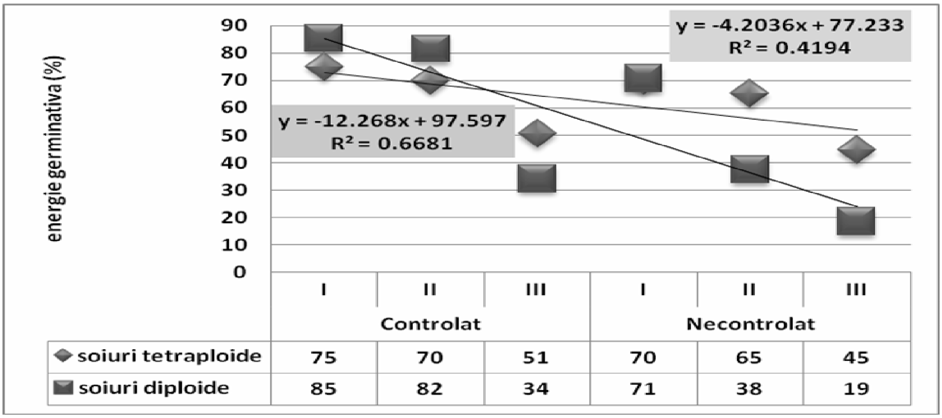

Fig. 1. Influence of the storage conditions x storage years interaction upon the first-count germination of diploid and tetraploid varieties

From the chart of storage conditions x years of storage interaction, for the final count germination comparing the diploid and tetraploid varieties, there are some aspects to be noted (Figure 2):

- Final count germination, for diploid varieties in controlled environment, has higher values than for the tetraploid varieties. In uncontrolled environment it has lower values than for the same tetraploid varieties.
- The regression line for diploid varieties has a gradient descent, while the line of the tetraploid varieties is descending. This leads to the conclusion that the final count germination decreases as the seed ages and the environment is no longer controlled for the diploid varieties, but it decreases in the same conditions for the tetraploid varieties.
- The influence of storage years upon the final count germination is more powerful for diploid varieties where the determination coefficient has a value of 74% towards 62% for tetraploid varieties.
- For diploid varieties, for each increase of the “x” with one unit (storage conditions x years of storage) the final count germination decreases by 6.31% but it increases by 8.8% for the tetraploid varieties.

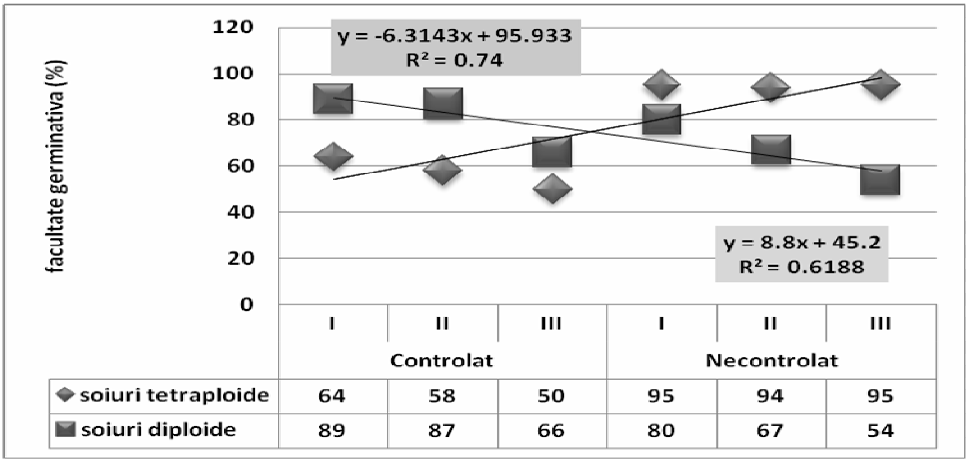

Fig. 2. Influence of the storage conditions x storage years interaction upon the final- count germination of diploid and tetraploid varieties

Soil germination, comparing the diploid and tetraploid varieties is characterized as following (Figure 3):

- Soil germination for diploid varieties, in controlled environment has higher values than for the tetraploid varieties.
- The regression line for the diploid varieties has a gradient descent, while for the tetraploid varieties the descent is linear, which leads to the conclusion that the soil germination for the first variety categories decreases as the seed ages and the storage environment is no longer controlled. For the tetraploid varieties it is almost constant, the amplitude being of 9% (the highest value - 75% in controlled environment in the first storage year, the lowest value - 66% in uncontrolled environment, in the third year of storage).
- The storage conditions and storage years' influence upon the soil germination is approximately equal for the two varieties, the determination coefficient being of 71.9% for the diploid varieties and of 70.7% for the tetraploid varieties;
- For the diploid varieties, for each increase of the "x" with one unit (storage conditions x years of storage interaction) the soil germination decreases by 6.68% for diploid varieties, while for the tetraploid varieties it decreases by 1.64%.

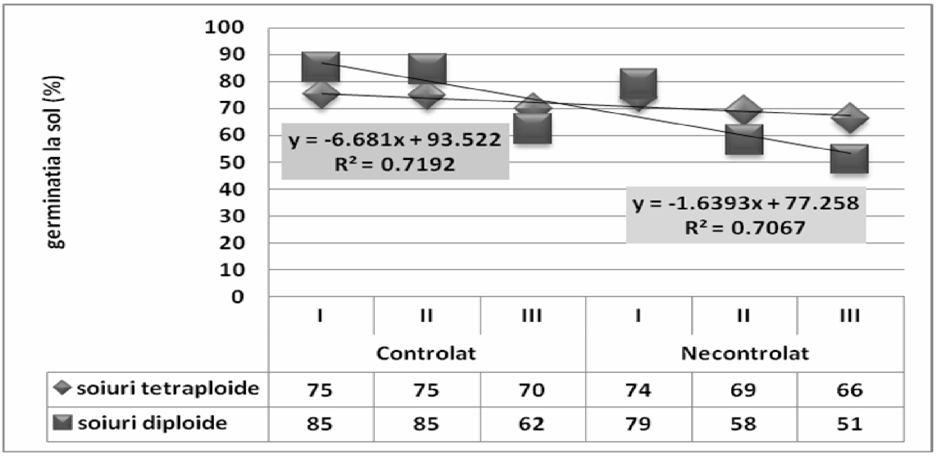

Fig. 3. Influence of the storage conditions x storage years interaction upon the soil germination of diploid and tetraploid varieties

From the chart of the storage conditions x years of storage interaction, for field emergency, comparing the diploid and tetraploid varieties there are some aspects to be noted (Figure 4):

- Field emergency for diploid varieties, in controlled environment, generally has values higher than for the tetraploid varieties and in uncontrolled environment has lower values towards the same tetraploid varieties.
- The regression line for the diploid varieties has a gradient descent, while for the tetraploid varieties the descent is almost linear, which indicates that the filed emergency decreases as the seed ages, and the storage environment is no longer controlled for the diploid varieties, but it is almost constant, regardless of the storage conditions and years of storage for the tetraploid varieties.
- The influence of the storage conditions and years of storage upon the field emergency, is more powerful for the diploid varieties, where the determination coefficient is of 72% towards 48% for the tetraploid varieties.
- For the diploid varieties, for each increase of the "x" with one unit (storage conditions x years of storage interaction) field emergency decreases by 6.40% and for the tetraploid varieties it decreases by 1.2%.

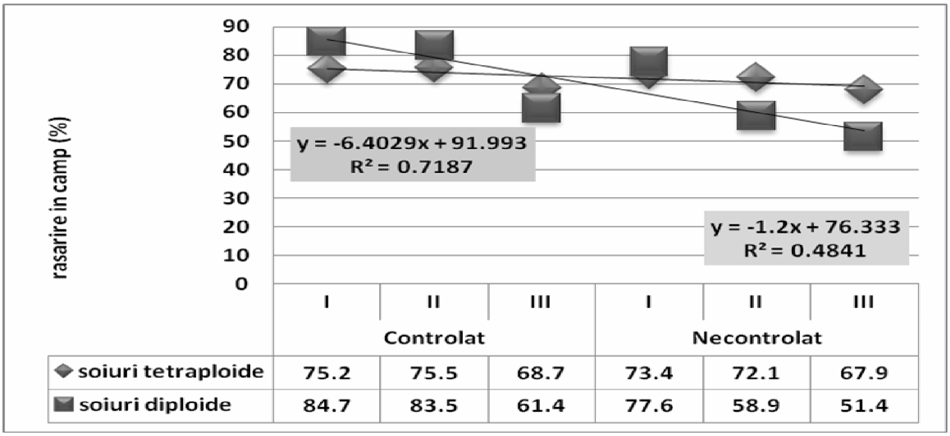

Fig. 4. Influence of the storage conditions x storage years interaction upon the field emergency of diploid and tetraploid varieties

CONCLUSIONS

1. The first count germination, the final count germination, soil germination and field emergency for diploid varieties register higher values in controlled environment, but in uncontrolled environment there are lower values registered towards tetraploid varieties.
2. For diploid varieties, the final count germination decreases as the seed ages and the environment is not controlled. For the tetraploid varieties it increases in the same conditions.
3. The soil germination for diploid varieties decreases as the seed ages and the environment is no longer controlled, while for the tetraploid varieties it is almost constant, the amplitude being of 9% (the higher value, 75% in controlled environment in the first year of storage; the lowest value, 66% in uncontrolled environment in the third year of storage).
4. The field emergency decreases as the seed ages for the diploid varieties and it stays almost constant for tetraploid varieties.
5. The influence of conditions and years of storage upon the soil germination is approximately equal for the two varieties, the determination coefficient being of 71.9% for the diploid varieties and of 70.7% for the tetraploid varieties.

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VARIABILITY PHENOPHASE OF APRICOT BLOSSOM IN DIFFERENT PHENOTYPES IN THE ROMANIAN PLAIN

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Keywords: *apricot, phenotype, blooming*

Abstract

Observations and determinations performed over the past years have highlighted the potential genitors attributes great importance to the objectives of genetic improvement programs.
Some of these genitors are already created the new Romanian varieties other selections included in the current study and others are reserved for future germplasm varieties.

INTRODUCTION

Flowering phenophase takes place every year, in a certain sequence, always the same, regardless of weather developments since the beginning of vegetation. Thus, depending on the year (very early or very late spring) there was a block away in the early flowering throughout the time from March to April. In different years, the same species (the earliest) bloomed first, and the same species (the late) flourished last. On the onset of flowering, different varieties need different amounts of active degrees of temperature, which confirms the genetic determinism of these phenophase. For practical fruit growing, late flowering varies with particular interest. These bloom later than 2-4 days, which is the average time for a group, avoiding the negative influence of frost later and eliminating the risk of loss in fruit production, due to this effect.

Another important feature related to the flowering period is the duration of flowering which is influenced by climatic factors and genetic determinism. It appears in different periods of time between the beginning and end of flowering to the same variety and in different years. Flowering occurs later, and has a shorter duration. One can appreciate that the longer persistence of flowers on the tree is a positive attribute, adapting to conditions unfavorable for pollination varieties whereas a longer duration of flowering, includes, of course, a greater number of sunny days, bees and ensures proper flight pollination.

MATERIAL AND METHODS

Biological material is represented by a total of 33 apricot phenotypes and 3 control varieties with different fruit maturation periods: extra early, early, middle and late. Experimental plot with a competitive culture destination was planted in spring 1998 on an area of 1.21 hectares. Setting system is linear block, 4 repetitions in each block with 5 trees in each repetition. At the end of the row 1 tree was used as isolation. Trees were grafted in 1996 on apricot rootstock Franc (Poroschia local selection) with branch graft ELISA tested, harvested from the microculture where was selected the most valuable phenotypes. After planting, the axis was shortened to 60 cm from ground level. In May and June cuts of crown formation were performed. The crown shape was chosen as vessel improved. Between 2 and 3 correction angles were made at planting, mechanical cultivation 3-4. Intervals between rows alternating with grass husbandry were black. During the first 3 years irrigation 3-4 and 4-5 treatments were applied in the furrow, which allowed organic chemicals with diseases and pests. The research methods used on this purpose were the following: observations and determinations of flowering stages (begining flowering, the end, durata and intensitatea), and the need for active temperature to browse the flowering phenophase.

The calculation of the assets above the threshold temperature of 6.5^0C was obtained biologically by adding the average temperature at the exit of obligatory rest (biological) and early December until the beginning of the flowering time.

In this paper I referred to phenophase flowering (early, late, intensity and duration), and the amount of active degrees of temperature at the end of biological recovery by early flowering, which may be conclusive to differentiate genotypes. The data were recorded in 2001-2005. For an interpretation as objective research results, the data were statistically processed phenotypes are grouped by age of fruit ripening.

RESULTS AND DISCUSSION

In the 36 studied phenotypes, flowering time was different, ranging from 5.8 days at Atractive phenotypes (late maturing) and Bucovina (maturation medium) to 6.6 days at phenotypes Valeria, Rares (extra early) and Viorica, Carmela, 82.12.2 BIV and 82.12.91 BIV (early maturing) (Figure 1). The Adina phenotype is observed with late maturation has a thriving period of 6.4 days earlier phenotypes identical to Dacia, Siret, 82.28.62 BIV and those environments (Excelsior). Also placing another apparent phenotype late 82.16.7 BIV (6.2 days) with medium maturing phenotypes, in response to better adapt to climate conditions specific to the new apricot varieties obtained.

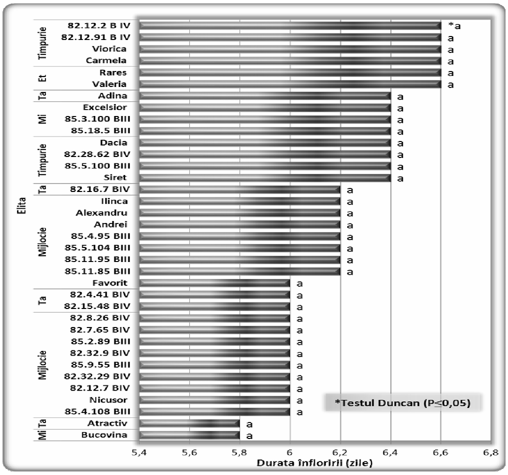

Fig.1. Genotype influence on flowering time depending on age group of elites after fruit maturation

In the 36 apricot phenotypes studied in 2001-2005, the highest average duration of flowering was in 2002 when it recorded 8.8 days, average 2003-2005 was between 5.2 (2003) and 5.5 days (2004 and 2005) (Figure 2). An intermediate duration of flowering was recorded in 2001 to 6.6 days. It follows that, when the trigger earlier flowering and climatic conditions are favorable, the acceptable minimum and maximum temperatures not too high, the duration of flowering may be higher.

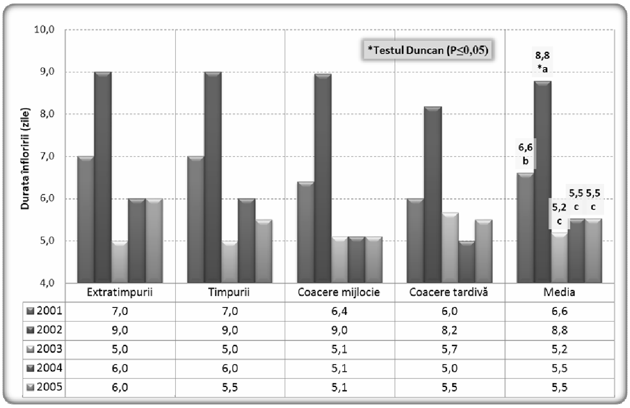

Fig. 2. Influence on duration of study group according flowering apricot phenotypes after fruit maturation period

Grouping phenotypes after fruit maturation times show that the aging phenotypes are most extra early period of blooming, in correlation with specific climatic conditions each year. One can say that during the flowering period decreased proportionally with aging, such as average maturing phenotypes have shorter days. It noted, however, that phenotypes with late maturation can have a flowering period of at least equal to the average maturing phenotypes (Figure 3). The mean period is 2003-2005, when it started flowering in mid-February. This is explained by obtaining phenotypes with late blooming as with longer duration of flowering, due to better adapt to environmental conditions and varieties for pollination.

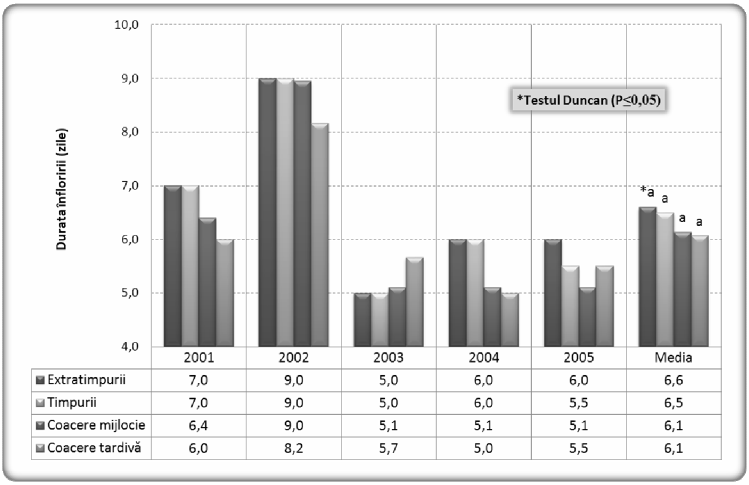

Fig. 3. Influence of fruit ripening period on flowering time in the year of study

It was found that between phenophases: early flowering, late flowering and flowering intensity, the correlation coefficients are 0.377** and 0.412** respectively, which evokes a strong connection between the two biological indicators. There is a significant correlation at a level of 0.05% between the early, late, flowering duration and amounts of active degrees of temperature above the biological threshold. Positive correlation coefficient is 0.100, 0.154* and 0.136 (Table 1, Figure 4).

Flowering duration shows significant negative correlation to the beginning and end of flowering, with correlation coefficients -0.921** and -0.883**. Flowering intensity also shows a negative correlation (-0.038) than the sum of active temperatures above the biological threshold (Table 1, Figure 4).

Table 1

Simple correlation coefficient values between various phenophases of flowering

Biological indicator	Blooming start	Blooming end	Flowering time (days)	Flowering intensity (notes 1-5)	∑° temp. until the beginning of blooming
Blooming start	1	0.996**	-0.921**	0.377**	0.100
Blooming end	0.996**	1	-0.883**	0.412**	0.154*
Flowering time (days)	-0.921**	-0.883**	1	-0.192*	0.136
Flowering intensity (notes 1-5)	0.377**	0.412**	-0.192*	1	-0.038
∑° temp. until the beginning of blooming	0.100	0.154*	0.136	-0.038	1

** correlation is significant at the 0.01 level
* correlation is significant at the 0.05 level

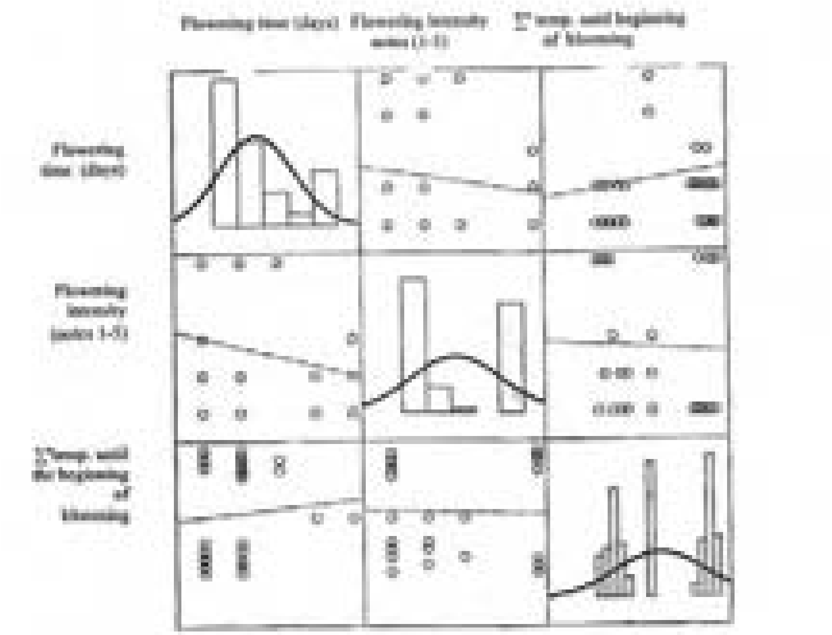

Fig. 4. Simple correlation coefficient values between various phenophases of flowering

CONCLUSIONS

1. The influence of genotype in terms of the later flowering varies earlier than 2-4 days, with the same period of flowering with extra early and early varieties (Adina).
2. Significant correlation was established between phenophases: early flowering and flowering intensity (0.377**) and between late flowering and flowering intensity (0.412**).
3. There are significant negative correlation between flowering time and its beginning (-0.921**), and between duration of flowering and late flowering (-0.883**).

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RESEARCH INVOLVING IMPROVEMENT OF APRICOT ASSORTMENT IN THE SOUTH AREA OF ROMANIA

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Keywords: *apricot, phenotype, early, ripening*

Abstract

The modern concept of culture and superintensive apricot requires a variety of plant architecture enabling small distances without diminishing opportunities for complex mechanization, unrestricted illumination of the crown, with the normal course of the application process and other photorespiration physiological and biochemical processes, reflected in the synthetic, regular and quality production. Research and character traits of each constituent of complex systems, which are known and new biological forms obtained in the improvement of apricot, require specific methods for data collecting, processing and interpretation.

INTRODUCTION

The creation of varieties with different fruit maturation periods, especially extra early and maturation, has been a priority since 1980 to improve the program in Romania.

The market demand for extra early apricots, until recently satisfied by importing them from the Mediterranean countries like Italy, France, Spain, Turkey is a strong argument for the scientists involved in the improvement of this species.

It aims to obtain new varieties with particular organoleptic qualities, resistance to diseases so stable apricot: *Monilinia laxa* (Aderh et Ruhl) Honey, *Stigmina carpophilla* (LEV) and *Cytospora cincta* Sacc and *Plum-pox* virus, better ecological plasticity, the tree for small force allow the crop intensivization of early fruit-bearing with high productive potential.

The increase in apricot production will be achieved by creating varieties able to use better environmental conditions; between these two elements is there a direct relationship.

In this context, there arises the need to establish itself strategies for achieving specific variety and technological links, to overcome current barriers: lack of adaptation to larger areas, susceptibility to diseases, frost and winter, still productive at low, alternating fructification, poor quality fruit.

MATERIAL AND METHODS

The biological material is represented by a total of 33 phenotypes of apricot and 3 control varieties with different fruit maturation periods: extra early, early, middle and late. Experimental plot with a competitive culture destination was planted in spring 1998 on an area of 1.21 hectares. The setting system is linear block, 4 repetitions in each block with 5 trees in each repetition. At the end of the row 1 tree was used as isolation. Trees were grafted in 1996 on apricot rootstock Franc (Poroschia local selection) with branch graft ELISA tested, harvested from microculture where was selected the most valuable phenotypes. After planting, the axis was shortened to 60 cm from ground level. In May in June have made cuts of crown formation. Crown shape was chosen vessel improved. Between 2 and 3 were made at planting correction angles, mechanical cultivation 3-4. Intervals between rows alternating with grass husbandry were black. During the first 3 there years were applied in furrow irrigation 3-4 and 4-5 treatments allowed organic chemicals with diseases and pests. The research methods used on this purpose were the following: observations and determinations of vegetative growth (increase in thickness of the trunk, crown volume), observations and determinations of fructification stages (early flowering, fruit ripening, the need for active temperature to browse fructification phenophases), methods of study of the factors limiting production (resistance to pests and diseases), methods for determining fruit quality (weight and size, content of ascorbic acid, acid content, the percentages of pulp and stone). Calculation of the assets above the threshold temperature of 6.5^{0}C was obtained biologically by adding the average temperature at the exit of obligatory rest (biological) and early December until the beginning of the end of flowering and flowering to fruit maturation. Resistance to disease was made by noting the degree of attack. Increase in thickness was calculated by multiplying the trunk diameter greater than the diameter of the trunk, resulting in the trunk section area Based on measurements made with the calliper on the three dimensions of a fruit: large diameter, small diameter and height, shape index was calculated. Shape index, synthetic data in some years may vary depending on weather conditions, particularly rainfall. When index values are as close to 1, or less than supraunitar subunit, the fruits are almost round or flat. When the result is well above 1, the fruit is elongated and can be appreciated oblong or elliptical shape.

RESULTS AND DISCUSSION

From the 33 phenotypes studied were selected the most valuable in terms of very early aging phenotypes (Valeria and Rares) and very late aging phenotypes (Adina); these results represent a high achievement for the enriching the assortment and markets for the sale of indigenous fruits, often superior to those imported in terms of taste quality.

In terms of the genetic traits specific to each variety of mature fruit sooner or later, the apricot varieties were divided into age of maturation as follows: extra early maturing varieties, early maturing varieties; middle maturing varieties, late maturing varieties.

Regarding the need for active temperature to trigger flowering phenophase was found that the differences between maturity groups are 22 and 33 degrees, which corresponds to a total of 3 days with temperatures above the biological threshold for the earliest blooming and that 5 days later for the blooming (Table 1).

For fruit ripening, the amounts are different temperatures after the aging group. Thus, extra early phenotypes need temperatures between 888-1000 degrees, the earliest between 916-1457, the middle between 1280-1874 and the late between 1584-1998. One year earlier, the number of days from bloom to ripening is between 32 days and a year later, phasing fruit maturation takes place over 43 days (Table 1).

Table 1

Amounts of active temperatures 6.5 ^{0}C above the biological phenophases at the beginning of flowering and fruit ripening

Ripening group	**Flowering period (limits)**	**∑° until beginning of flowering - limits-**	**Ripening period -limits-**	**∑° temp. from blooming to ripening -limits-**	**Nr. of days from bloom to ripening**
Extra early	25.03-16.04	144-317	4.06-14.06	888-1000	57-71
Early	25.03-18.04	144-334	14.06-1.07	916-457	64-100
Middle	27.03-19.04	155-350	4.07-20.07	1280-1874	79-110
Late	28.03-19.04	166-350	15.07-28.07	1584-1998	89-114

Productivity index varies in direct proportion to the amount of fruit on the tree done. While the core area values can be from one year to the next higher or stagnant production and also fluctuate downwards. It is noted that during the 3 years studied, the trees aged 4-6 years, productivity index ranged from 0.05-0.07 to extra early phenotypes between 0.06 to 0.10 on average compared with phenotypes Excelsior control of 0.06-0.07 and between 0.05 -0.08 at late phenotypes compared with Favorit control 0.03-0.09.

In our country, although there are quoted more fungi that can contribute to the decline of apricot, the highest frequency of attack are: *Monilinia laxa* (Aderh et Ruhl) Honey, *Stigmina carpophilla* (LEV) and *Cytospora cincta* Sacc., which cause significant damage in all apricot-growing areas.

Table 2

Changes in productivity index of most valuable apricot phenotypes with different maturation periods

Phenotype	Productivity index (kg/cm^2)		Sectional area of trunk (cm^2)	
	(average 3 years)	limits	(average 3 years)	limits
V1 Valeria	0.07	0.07	185.16	66.16-345.0
V2 Rares	0.06	0.05– 0.07	193.61	59.9-351.3
V3 Carmela	0.07	0.06– 0.08	213.53	70.9- 383.91
V4 Viorica	0.09	0.07– 0.10	222.76	70.8 - 415.61
Dacia - Control	0.09	0.08– 0.10	212.12	66.4-383.4
V31 Andrei	0.06	0.06– 0.07	181.85	66.3– 342.8
V17 Nicusor	0.07	0.06– 0.09	241.18	90.6– 471.6
V26 Ilinca	0.06	0.05– 0.07	252.56	105.8– 464.4
Excelsior - Control	0.07	0.06– 0.07	255.10	105.8– 478.0
V30 Adina	0.07	0.05– 0.08	256.34	109.6 – 468.1
Favorit - Control	0.05	0.03– 0.09	251.77	108.5 – 502.0

Notaries were performed in conditions of natural infection treatment plant in the background making the smallest number with organic substances allowed.

Table 3

Reaction to major diseases and Plum-pox virus, the most valuable of apricot phenotypes with different maturation periods

Phenotype	***Stigmina carpophilla*** **(Lev) M.B.Ellis G.A%**	***Cytospora cincta*** **Sacc. G.A%**	***Monilinia laxa*** **(Aderh et Ruhl) G.A%**	***Plum-pox*** **G.A%**
V1 Valeria	0.6	0	0	0
V2 Rares	0.13	0.48	0	0
V3 Carmela	0	0.18	0.8	0
V4 Viorica	0.3	0.08	0.9	0
Dacia - Control	0	0	0	0
V31 Andrei	0	0	0	0
V17 Nicusor	0	0	0	0
V26 Ilinca	0	0	0	0
Excelsior Control	0	0	0	0
V30 Adina	0	0	0	0
Favorit - Control	0	0	7,0	0

All phenotypes, except Favorit control, show degrees of attack less than 1%, which is resistant on the notaries scale (R).

Phenotypes: Valeria, Rares, Carmela, Viorica, Andrew Nicusor, Ilinca, Adina, fruit weight between 56 g (Rares) and 93 g (Viorica), shape index 0.99 (Viorica) and 1.02 (Nicusor), which corresponds to a spherical shape, flat and spherical. All these phenotypes shows large percentages of pulp (Table 4).

Tabel 4

Quality elements as the most valuable fruit of apricot phenotypes with different maturation periods

Phenotype	Average fruit weight - gr.	Shape index	% stone	% flesh
V1 Valeria	60.67	1.15	5.98	94.02
V2 Rares	56.33	1.16	6.34	93.66
V3 Carmela	89.67	1.26	4.54	95.46
V4 Viorica	93.67	0.99	4.41	95.59
Dacia - Control	78.0	1.01	4.78	95.22
V31 Andrei	75.33	1.08	5.31	94.69
V17 Nicusor	79.33	1.02	5.04	94.96
V26 Ilinca	80.67	1.1	4.96	95.04
Excelsior Control	78.67	1.11	5.34	94.66
V30 Adina	64.33	1.1	4.97	95.03
Favorit - Control	68.0	1.21	5.44	94.56

The dry matter content is high, ranging between 15.47% and 21.33% from variety Valeria to variety Viiorica. Genetic gain due to heredity and that is transgressively type of vitamin C level, which is much higher compared to conventional varieties, ranging from 13.8 mg/100 g (Ilinca) and 21 mg/100 g (Carmela). The titratable acidity level is balanced, with between 1.17 mg/100 ml (Nicusor) and 1.43 mg/100 ml (Carmela). Firmness had values between 1.14 (Valeria) and 3.07 (Andrei) (Table 5).

Tabel 5

Biochemical features and fruit firmness in the most valuable apricot phenotypes with different maturation periods

Phenotype	Solubile dry matter content %	Titrable acidity malic acid g%	Content ascorbic acid C vit. mg/%	Firmness kg force/cm^2
V1 Valeria	15.47	1.25	14.2	1.14
V2 Rares	17.27	1.25	16	1.64
V3 Carmela	20.4	1.43	21	2.11
V4 Viorica	21.33	1.39	16.67	2.43
Dacia - Control	18.47	1.14	18.33	1.8
V31 Andrei	18.13	1.19	14.13	3.07
V17 Nicusor	19.2	1.17	15.53	1.21
V26 Ilinca	18.27	1.83	13.8	2,41
Excelsior Control	19.63	1.87	16.8	1.75
V30 Adina	18.2	1.82	17.33	3.0
Favorit - Control	17.8	1.93	15.2	2.64

CONCLUSIONS

1. In terms of genetic traits specific to each variety of mature fruit sooner or later, apricot varieties were divided into ages of maturation as follows: extra early maturing varieties (4.06 -14.06), early maturing varieties (14.06-1.07), middle maturing varieties (4.07-20.07), late maturing varieties (15.07-28.07).
2. From the 33 phenotypes studied were selected the most valuable in terms of very early aging phenotypes (Valeria and Rares) and very late aging phenotypes (Adina); these results represent a high achievement for the enriching the assortment and markets for the sale of indigenous fruits, often superior to those imported in terms of taste quality.
3. They complement the assortment of varieties with different maturation periods, with particular organoleptic qualities, high productivity; they are suitable for crop intensivization (intensive crops and superintensive crops) and also they have resistance to specific diseases: *Monilinia laxa* (Aderh et Ruhl) Honey, *Stigmina carpophilla* (LEV), *Cytospora cincta* Sacc and *Plum-pox* virus.

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MULTIDISCIPLINARY RESEARCH ON PILOT AGROECOSYSTEMS UNDER CONDITIONS OF CLIMATE CHANGE

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Keywords: *partnership, agroecosystem, conversion, European standards*

Abstract

In correlation with the research activity promoted by the EU Framework Programme 7 concerning "Promoting sustainable agriculture, increasing food safety and security", an inter-institutional partnership has been initiated between the Agronomic University of Bucharest and three research institutes specialized in fruit-tree growing, biology and natural history, and environmental study and management.

The results of the interdisciplinary and multidisciplinary research performed in the areas of the Vlăsia Plain (southern Romania) and the Dobrudja Plate (nearby the Black Sea Coast) consist in leading an agroecosystem aimed at preserving the environment, natural habitats, wildlife and grown flora and fauna, biocenoses (agricultural crops, pathogens, bioantagonists, useful and harmful entomofauna, soil macro and microorganisms, spontaneous flora, water), biotypes (the changing climatic, edaphic and orographic components), as well as the agrophytotechnical and socio-economic subsystems that affect the lower intensity of the anthropogenic factors and global warming.

INTRODUCTION

This paper is aimed at proposing a synthesis of the interdisciplinary and interinstitutional research results performed between 2007 and 2010, under the project titled „Agroecosystems influenced by anthropogenic risk factors and their piloting sequences", financed by the Ministry of Education and Research.

MATERIAL AND METHODS

Starting from the basic ecological principle of alternative agriculture, i.e. the interrelation between 'living', 'eating', and 'making food for other living organisms', interdisciplinary research was developed in order to find solutions for ecosystem leading.

The methods used in activities in the paper refer to:

Studies, determinations and analyses on the variation of the environmental factors up- and downstream the agroecosystems Moara Domnească, Vlăsiei Plain and Valul lui Traian, Dobrudja [2]; Methodological study on the evaluation of species biodiversity and substantiation in the agroecosystems in two regions [3]; Analyses and determinations on nutrients concentrations (N, P, S), oxygen level (dissolved oxygen concentration, oxygen saturation, chemical and biochemical oxygen consumption, primary production), phytoplankton (biomass, chlorophyll "a"), and microorganism, macroinvertebrate and fish populations in the water sources existing agroecosystems [1.5]; Evaluation of microflora and microfauna biodiversity under the impact of intensive chemical fertilisation by the time of the study [6]; Biological study of the useful and damaging entomofauna, pathogenic and antagonistic agents under the impact of the risk anthropogenic factors [4]; Study on the behaviour of the newly patented varieties belonging to agricultural, fruit-tree and vegetable species resistant to diseases and changing climate factors [2].

RESULTS AND DISCUSSIONS

Study on climate change within the Moara Domnească agroecosystem by typical meteorological year-TMY and cluster analysis

The objectives were: to build a typical meteorological year-TMY for the ecosystem existent at the Moara Domnească experimental field.

Our research used a statistical weather method introduced by J.M. Finkelstein, R.E. Schäfer (1971). For discrete distributions, the Finkelstein-Schäfer statistics gives better results than the statistics used in accordance with the Kolmogorov-Smirnov tests. This type of statistics was used in the USA Sandia Laboratories to determine the typical meteorological year (TMY), i.e. the mathematical model using the American standard and ISO 15927-4/2005.

The sample contains observations for 23 years, with complete for the ecosystem the periods 1977-1983 and 1991-2006 at Moara Domnească. He was eliminated on the date of February 29th in the leap years was eliminated, therefore the total number of observation days was 9,395. Comparisons were made with the meteorological year 2007 as standard.

The typical months for the period under analysis are shown in Table 1.

Table 1

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1982	1994	1992	1979	2005	1982	1992	1977	1995	1999	2005	1978

The overall mean temperature was 11.31 ± 9.1^{0}C for typical normal TMY, and 11.33 ± 10.51^{0}C for 2007; the variability coefficient for that year was high, i.e. 93%.

Four types of typical days were defined – two for the hot season and two for the cold season, as follows 1) summer days with maximum temperature ≥ 25^{0}C, 2) hot days, maximum temperature was ≥ 30^{0}C, 3) days of frost with minimum temperature ≤ 0^{0}C and 4) frosty days - minimum temperature was ≤ -10^{0}C.

A very significant difference was determined in the frequency of the characteristic days (Test Z) in TMY to 2007 (205 days characteristic in TMY, and 254 in 2007).

In the end, we used a nonlinear model of cluster analysis to compare the months of 2007 in order to highlight the idea of climate change occurring in the examined ecosystem. The climatic characteristics used were: mean temperature, relative humidity, rainfall, solar radiation and temperature amplitude. Through a non-linear projection model we show three clusters (Figure 1) (possible three seasons). In 2007, a cold season - months of November, December, January and February; a hot season - April, May, June, July, August; and finally, a transient season - March, September and October. The cold season in 2008 includes the same months: a warm season (March, April, May and September) and a very hot season (June, July and August).

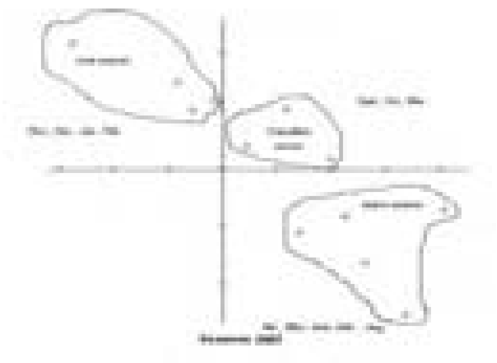

Fig. 1. Cluster diagrams (years 2007 and 2008)

Characterisation of biotic and enzymatic red preluvosoil grown with fruit tree species in the agroecosystem provided by Moara Domnească

Changes in the biotic (breathing and celuloliza) and enzyme (catalase, urease, phosphatase and sucrase) characteristics have been highlighted, according to the methodology developed by Ştefanic (1999). Also, changes have been recorded in the red preluvosoil cultivated with fruit-tree species within the Moara Domnească agroecosystem (depths of 0-0-20 cm and 40 cm during the full growing season and its termination). Statistically, in the vegetation period, the vital activity of the soil records no differences in the planting of apricot and peach (year II – hollow and fruiting) and cherry and sour cherry.

The most intense biological activity was recorded in the hair planting apple and pear plantations, whereas the lowest in apricot and peach - Year II (ground level).

The slow phase of metabolism in the first 20 cm, the soil vital activity expressed by IPAV% ranges between 29.39 and 37.09, and the 20-40 cm layer between 23.12 to 33.23. The highest enzyme activity of the soil, expressed by IPAE%, was recorded for apricot and peach in year 2 (hollow) in the first 20 cm. In 20-40 cm depth, the most intense enzyme activity occurred in the plum and apple grown variants. Analyzing the biological soil activity at the end of the fruit-tree vegetation cycle, and considering the average of the two depths of soil sampling, there may be variations in 4 separate groups (descending order): Group 1 - apple, Group 2 - apricot and peach - second year (hollow), Group 3 – walnut, and Group 4 - apricot and peach - second year (level ground), apricot and peach, plum, cherry and cherry.

The results are mainly due to the different technology applied to the species of fruit trees.

Investigations of specific composition, taxa and systematic group number, biomass density, bio-volume, abundance, sensitive taxa, ecological status and diversity index in the aquatic ecosystem of Lake Moara Domnească

According to the Water Framework Directive 60/2000 EC, the definition of the ecological status of water bodies involves the full knowledge of the characteristic biocenoses and species. The group of primary producers in an aquatic ecosystem is represented mainly by all green plants (i.e., phytoplankton and macrophytes).

Phytoplankton biomass showed high values, ranging from 11.9 to 17.6 mg/l, which suggest hypertrophy in Lake Moara Domnească 75 algal taxa were inventoried, belonging to the groups: *Cyanobacteria, Bacillariophyta, Pyrrophyta, Euglenophyta* and *Chlorophyta*.

The analysis of the qualitative composition of the phytobenthotic association indicates a numerical abundance of the algae diatom group: 32.86% of the association, followed by other groups: chloforphiceae - 31.42%, cyanobacteria - 22.86 %, euglenopyceae - 10%, pyrrophyceae - 2.86%.

Based on the phytonethone analysis, we can state that the environmental status of Lake Moara Domnească is low to moderate.

Bacteriologically, Lake Moara Domnească was identified as an aquatic ecosystem with relatively clean water, corresponding to a moderate level of bacterial pollution. The bacteriological quality indicators were within the limits prescribed by the Order 161/2006, referring to GD 567/2006, the quality class II (> 5000 bacteria/100 ml water, for total coliform bacteria).

Lake Moara Domnească is directly affected by anthropogenic impact upstream. It is a lake with high trophic potential considering the nutrient concentrations in water. An excesses of quality standards is observed for both Pb and for Ni. The three drin-class compounds under analysis (aldrin, endrin, dieldrin) are not present in any of the sections. Moreover, heptachlor is not present.

Study of useful and harmful entomofauna biology, of agrowcosystem pathogens and antagonists under the impact of anthropogenic risk factors

The biological study of the pathogens and pests present in the period 2007-2009 was developed under the Moara Domnească fruit-tree agroecosystem, as well as in the peach and apricot plantations, as dominant species in the Valu lui Traian basin.

In the Moara Domnească fruit-tree agroecosystem, pathogenes and sarophites were identified macroscopically and microscopically, in association with peach shoots, while separate species of the useful microflora were dissociated. Micoflora was highlighted by the agar plate method (average PDA - Potato dextrose agar, Sigma Biochemicals, 39 g/l).

The micoflora associated the peach shoots belonged to the species: *Alternaria alternata, Aureobasidium pullulans, Cladosporium carpophilum, Botrytis cinerea, Mucor racemosus, Penicillium* spp., *Rhizopus stolonifer*. Also, species with antagonist resources were identified: *Epicoccum purpurascens*, *Trichothecium roseum*, *Cheatomium globosum* and *Trichoderma viride*.

There have also been isolated filamentous yeast species belonging to the genera *Aureobasidium*, *Rhodotorula* and *Cryptococcus*. *Aureobasidium pullulans* was the most common of the yeasts, followed by *Cryptococcus*. Some of *Cryptococcus* and *Rhodotorula* yeasts have a recognised antagonist activity, particularly those of the genus *Rhodotorula* and *Aureobasidium* - used to control the *Botrytis cinerea* and *Penicillium expansum* fungi in the pear-tree species.

The interrelations between the species vary in vitro. Thus, the *Alternaria alternata* species can occupy the substrate faster (which explains its high prevalence-Figure 2).

The study of pathogens-antagonists interrelations show a strong antagonistic action of the *Trichoderma viride* species against the various species of pathogenic isolates tested, restricting their development space almost completely after 7 days (Figure 3).

The *Epicoccum* species and *Trichothecium* isolates showed antagonistic action, compared with the species mean test.

The useful fauna was represented by the species of Coccinellidae (*Coccinella septempunctata, Adalia bipunctata*) and Chrisopidae (*Chrysoperla* meat) in the plantation grown with the following apple varieties: Florina, Generous, Idared, Goldspur, Starkrimson, Sirprise, Jonathan, Granny Smith, Mutzu, Liberty, Elstar, Royal Galla, Delbard, Prima.

In the Valu lui Traian agroecosystem, the contribution of the useful fauna was evident in the peach and apricot plantations.

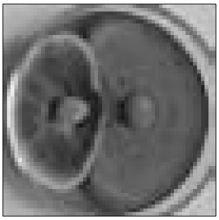

Fig. 2. ***Epicoccum / Alternaria***

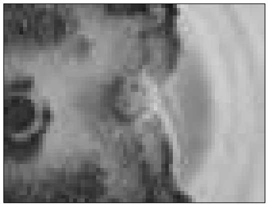

Fig. 3. ***Trichoderma / Botrytis***

In the case of the *Anarsia lineatella*, which frequently attacks the larval stage of the peach and apricot buds and shoots, there were identified 6 species of primary parasitoids that limits its populations, such as: the Fam. Braconidae: *Apanteles anarsiae* Faure et Alaba and *Apanteles longicauda* Wesn; Enczrtidae family: *Paralitomastix varicornis* Nees.

For *Laspeyresia molesta,* which attacks the larva stage of the peach, apricot, plum, quince, almond shoots and fruit - and, less frequently, the apple, cherry plum, quince, almond shoots - there have been identified eight species of primary parazitods belonging to the Ichneumonidae family: *Itoplectis alternans* Grav, *Coccygomimus turionella* L., *Lissonota paralella* Grav.; the Braconidae family: *Apanteles anarsiae* Faure et Alaba, *Macrocentrus linearis* HEES; the Pteromalidae family: *Dibrachyus cavus* Walk; and the Trichogrammatidae family: *Trichogramma cacoeciae* March.

The primary parasitoid complex was able to reduce the *Laspeyres* populations by 40-65%.

However, its action was limited by the intervention of some secondary parasitoids, as indicated in the food chain under study.

To limit the *Anarsia lineatella* and *Laspeyres molesta* moth attack in expanding the study of the useful wilfdlife, there were tested bioproducts posed by biological extracts from wormwood, celandine, garlic and ladybug. All the four biopreparates provided a very effective protection of the peach shoot and fruit against the moth larvaeattack. Their control efficiency was over 90%.

Fauna diversity in the Moara Domnească agroecosystems

The fauna identified is composed of 147 species, of which 126 are invertebrates: 7 species of arachnids belonging to 5 families and 119 species of insects belonging to 9 orders and 56 families. The vertebrate fauna includes 21 species, of which: 13 species of fish (belonging to 2 families), 3 amphibians, one reptile species and 4 species of mammals. Fish are the dominant species: *Scardinius erythrophthalmus, Rutilus rutilus, Carassius auratus, Lepomis gibbosus.*

Biodiversity in the agricultural ecosystems of Moara Domnească is very low, representing approximately 9.36% of the biodiversity of natural habitats (the Cernica-Pustnicul forest complex). Many of the collected species have high adaptation capacity and are pests generally specific to crop plants (Ord. Othoptera, Heteroptera, Coleoptera).

Impact of meteorological factors on fruit-tree phenology and production

The last nine years out of the 19, located in the decade 2000-2009, were crucial for drawing conclusions about the damage caused by rising temperatures in winter and their sudden drop binding during flowering or fruiting periods.

The low temperatures in the spring of 2008 were strongly felt on the apricot varieties with very early and early ripening and, to a lesser extent, the late ripening varieties such as Commander, Favorite, Augustine, Histria. In 2009 the lowest temperatures were within the normal until 23.04, when the absolute temperature was recorded in the early morning -1.4 ºC, associated with white frost, and followed the very next day by positive temperature of 0.8 ºC, which surprised the apricot and nectarine species in phase fruit 1 cm followed by early-fruit fall, and nut species in full bloom, causing the total damage in the apricot, peach, and nectarine production.

In the years 2000-2009, the higher temperatures after fruit formation resulted in changes in the biochemical and physiological processes of fruit growth and development, accelerating fruit ripening fruits in all species.

CONCLUSIONS

1. The paper highlights three clusters as a result of climate change, representing three possible seasons: a cold season in November, December, January and February, a hot season in April, May, June, July, August and a transitional season in March, September and October.
2. The changes in the biotic (breathing and celulolysis) and enzyme characteristics (catalase, urease, phosphatase and sucrase) of the Moara Domnească preluvosoil grown with fruit-tree species are due to the applied technology rather than the specific biology of the species and varieties.
3. Lake Moara Domnească has a low-to-moderate ecological status due to the presence of phytobenthone; water is relatively bacteriologically clean,

affected by the anthropogenic impact directly upstream hypertrophy. It is a lake with high trophic resources, considering the nutrient concentrations in water. It exceeded the quality standards for both Pb and Ni, and had neither heptachlor nor drin compounds (aldrin, endrin, dieldrin).

4. In the Moara Domnească fruit-tree agroecosystem, the macroscopic and microscopic analyses identified pathogenic and saprophyte species associated with peach shoots; also, species of useful entomofauna (*Coccinella septempunctata*, *Adalia bipunctata*) and chrisopidae (*Chrysoperla* meat) were identified and isolated.
5. At Valu lui Traian, the primary parasitoid complex managed to reduce Laspeyres the populations by 40-65%. The bioproducts represented by organic extracts of wormwood, celandine, garlic and ladybugs provided very efficient (over 90%) protection of the peach shoots and fruit against the moth larvae attack.
6. Biodiversity in the Moara Domnească agricultural ecosystems is very low, i.e. approximately 9.36% of the natural habitats biodiversity (the Cernica-Pustnicul forest complex).
7. Any degree of negative temperature (very short hours, not days), which was recorded in the springs of 2008 and 2009, and the intrusion of arctic temperatures affected the floral organs of the fruit-tree species, the apricot being the most sensitive of all.

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RESEARCH ABOUT SEXUAL REPRODUCTION CYCLE OF CANADIAN THISTLE (*CIRSIUM ARVENSE*) WEED

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Keywords: *Cirsium arvense, female clones, male clones, seed-set, variation*

Abstract

Although the efficiency of the sexed reproduction of the species Cirsium arvense is situated at well-balanced to low levels despite its spread and gaining in light of new habitats, it is constantly growing. It is possible that the seed-set flower head (S-S FH), able to spread, may succeed in doing this if it has got a large range of information, as a result of an outcrossing and by the seedling' stamina which derives from morphologically well-selected seeds, that is bigger, fuller and heavier. Morphological variability of the S-S FH from the female capitula provides information over the possibility of their formation on the one hand, numerically speaking and their setting up or not of seed-set from male capitula which shows the structure of the clones' type by their number on the other hand. In the present study, the morphological variability of the S-S FH from the female capitula is analyzed according to their prolific location within the big inflorescence. The big and heavy seeds were formed on the first ramifications. Between the number of formed seed and their total weight, a negative correlation was found. The obtained data proved that only small seed-sets had an absolutely big absolutely weight. In this correlation, one might find an explanation in favor of natural and genetic formation of less but heavier seeds as a guarantee for the seedling's success in various habitats.

INTRODUCTION

Canadian thistle - *Cirsium arvense* L./Scop. is a widespread species in the Temperate Zone. Being a perennial plant, it insures its reproduction through vegetative propagation and sexual one. Its spreading takes place on the micro-level through its under-ground roots and on the macro-level through its seeds of type achene [2]. The seeds are being formed within a complex sexual system (Figure 1). The system is of dioecious mating type [5]. This requires the existence of female and male plants. The respective plants form offshoot stems named clones. Female clones are pollinated compulsory by the male ones [6, 7, 3]. This pollen carries out important genetic information and varied. Seed-sets from FH of female clones are variable and generally speaking reduced because of multiple causes. Among the most important factors which adjust the seed-sets, one can mention: genetic factor and pollination agents' mobility = insects. Important factors are: sexual differences they can be enclosed or remoted, the seed-predators and the degree of filling up with endosperm. The less important factor is sexual rate, which can be equal, of 3 to 1 or more [8]. The male clones are genetically varied [5].

<table>
<tr><td colspan="5">THE MATING DIOECIOUS SYSTEM</td></tr>
<tr><td rowspan="4">THE FEMALE PART</td><td>Female plants</td><td><u>Pollination</u></td><td>Male plants</td><td rowspan="4">THE MALE PART</td></tr>
<tr><td>Morphologically hermaphrodites</td><td></td><td>Morphologically hermaphrodites</td></tr>
<tr><td>Female clones</td><td><u>Pollen</u></td><td>Male clones</td></tr>
<tr><td>little seed-set number</td><td></td><td>little seed-set number</td></tr>
<tr><td colspan="3">Female ecological conditions:</td><td colspan="2">Male possible way:
initial gynodioecious population</td></tr>
<tr><td>a.Very important</td><td>b.Important</td><td>c.Less important</td><td rowspan="2">a-male clones with pollen no seed,
b-subhermaphrodites with pollen and 1-10 seed-sets</td><td rowspan="2">c-hermaphrodites with pollen, over 10 seed-sets</td></tr>
<tr><td>i)genetic factor,
ii)pollinator mobility</td><td>i)distance & sexes,
ii)seed predators,
iii)% endosperm,</td><td>i)sexual rate</td></tr>
<tr><td colspan="5">Large outcrossing</td></tr>
<tr><td colspan="2">GENETIC VARIABILITY</td><td>&</td><td colspan="2">REDUCED SEED-SET NUMBER</td></tr>
<tr><td colspan="2">Genetic diversity</td><td>&</td><td colspan="2">Adapted plants</td></tr>
<tr><td colspan="5">NEW HABITATS</td></tr>
</table>

Fig. 1. Sexual cycle structure of *Cirsium arvense* weed (original)

The male clones also form seed-sets and according to their number per set they can be defined as: hermaphrodites with sets of over 10 seeds a FH, subhermaphrodites with reduced sets, 1-10 per FH and clone only with pollen, that is without seeds. Among various types of clones, there are also large hybridizytions outcrossing. As a result of the female flower fecundation, seed-sets should contain genetic information as varied as possible. The question one would ask is: which of the formed seeds and spread, are successful in forming viable seedlings? The answer may be found in studies regarding variability of seed-sets formed in a couple of diverse populations of *Cirsium arvense*. In the present study, variability was obtained from the diversity of populations, diversity of sex-differences, diversity of FH depending on their location on floriferous branches.

MATERIAL AND METHODS

In order to determine the seed-production of *Cirsium arvense,* a few populations from extended specific spreading area from Arges county were chosen.

a) <u>Selecting ecotypes</u>: every population registered a good growth on a large area, measuring over 100 sq.m. each, with high densities of stems/clones. Both female and male plant populations developed in tilled fields.

b) Taking samples: they went in a zigzag direction that crossed the respective population, without trying a stationing-positioning right in front of a certain plant. A stationing was done at every 2 steps and FH were harvested out of the clone. Every referred clone was planned to be well grown and developed with big inflorescence. The FH were harvested separately from every 3 different levels, out of the first 1-3 floriferous branches, then from 4-6th branch and the third category out of 7-11th branch. This procedure was repeated 50 times, separately on the 3 types of floriferous branches.

c) The analysis of seed-sets: the flower-head (FH), one by one, according to ramifications' category and clone FH were harvested after stems within 12 days after its full flourishing on July. They considered that achenes were already formed and developed accordingly [1]. The samples were put to dry in lab conditions for 4-5 days. The FH were weighed according to categories of floriferous ramifications, seed-sets from every FH have been counted separately and also weighed. The sterile FH had been recorded separately. Estimation was made with the help of ordinary methods: Anova test, correlations and regressions by Excel program.

RESULTS AND DISCUSSION

The analysis of *Cirsium arvense*' population emphasized a specific variability.

i) The variability of seed-sets and of sterility. In the case of female clones, achene-sets varied both as interval (min to max) but also as location in inflorescence. On the harvested capitula from 1st-3rd branch, seed-sets were between 1-62 (F_3) and 1-74 (F_1). On the 4th to 6th branch, sees-sets varied between 1-63 (F_1) and 1-75 (F_2), and on the 7-11th branch between 1-54 (F_1) and 2-76 (F_2) (table 1). On the male clones, the M_1 ecotype had no seed-set; M_2 ecotype formed 6 achenes in only one FH on the 1-3 branch and 1-7 achenes in 2 FH on the 4-6th branch. The 3rd ecotype, M_3 formed achenes, only in 2 capitula with 1-6 seeds on the 1st-3rd branch. The FH' sterility has been extremely different. On the female clones the 1st-3rd branch had 9-34 percent sterility; the 4-6th branch had 17-51 sterility, and 7-11th branch between 40-73 percent without seeds. On the male clones, the sterility was between 84-100 %, which shows the prevalence of the pollen type versus subhermaphrodites type (1-7 seed-sets). As for sexual differences, the seed-sets were between 1-84, 1-71 and 1-67 on a middling-average distance from the male clones : between 2-83, 1-78 and 2-87 on the enclosed clones and in between 1-62, 1-58 and 1-72 at a great distance from the pollination agent. At first sight, one couldnot clearly divide any influence of the capitulum's branch location and of the sexual differences over seed-production. It was emphasized the growth of sterility percentage towards the base branches and through distance increase versus pollination agent.

Table 1

Seed-set number limits and sterile flowers in female and male clones of *Cirsium arvense*

Ecotype*	Seed-set number limits			Sterile flowers, %		
	branch no.			branch no.		
	1-3	4-6	7-11	1-3	4-6	7-11
F_1	1-74	1-63	1-54	33	51	73
F_2	2-69	1-75	2-76	9	17	40
F_3	1-62	1-68	1-72	34	30	44
M_1	0	0	0	100	100	100
M_2	6	1-7	0	88	84	100
M_3	1-6	0	0	86	100	100

*F-female, M-male

ii) The variability of capitula' morphology and seed-sets per FH. The female clones formed different fertile flower heads (FFH) according to their location on the floral branches (Table 2). The average degree of fertility registered higher value on the 1st-3rd branch, particularly 77%; the 4-6th ramifications had FFH of about 67% and on the 7-11th of only 45% fertility. The conclusion is that the analyzed Canadian thistle populations, 3/4 of the capitula from the 1st-3rd branch form seed-sets; 2/3 of middle capitula are fertile but those from the base form only 1/2 of capitula, seeds. The FH' weight was considerably equal, as well the populations' variability and its shows a good ecotypes' constancy. As for absolute values the FH' weight was in between 0.21- 0.22 gr. The average number of seeds showed values in between 26.3 on the 1st-3rd level; 24.8 seeds/FH on the 4-6th level and 25.5 seeds/FH on the 7-11th level. Achenes-set had an average total weight in between 0.0195 gr. on the first ramifications, 0.0150 gr. on the middle and 0.0149 gr. on the ground ramifications. The one thousand grains weight (TGW) was between in 0.76 gr. from 1st-3rd branch; 0.60 gr. on the 4-6th branch and 0.59 gr. on the 7-11th branch.

iii) Correlation between various morphologic characters. According to the increase of the FFH' percentage seed-sets production was positive. The estimation showed a growing rate of 2.7 seed at every 10% fertility growth. The correlation showed a favorable tendency of *Cirsium arvense* population to form more seeds by increasing the number of FFH (Figure 2). The correlation between FFH-% and TGW seemed to be initially almost null or close to 0 value. The estimation established a light increase, although recording a low correlation coefficient and therefore non-significant. The function showed that at every 10% rise of fertility percentage, TGW increased with 0.01 grams.

Table 2

Fertile female flower head and seed-set per capitulum variability

Branch position	FFH	FFH weight	Seed-set	Seed-set weight	TGW
	%	g.	no.	g.	g.
1-3	77	0.22	26.3	0.0195	0.76
4-6	67	0.22	24.8	0.0150	0.60
7-11	45	0.21	25.5	0.0149	0.59

The formed seeds had absolute weight a little influenced by the degree of FH' fertility. The correlation between number of seeds and their total weight (TGW) was negative and statistically not insured.

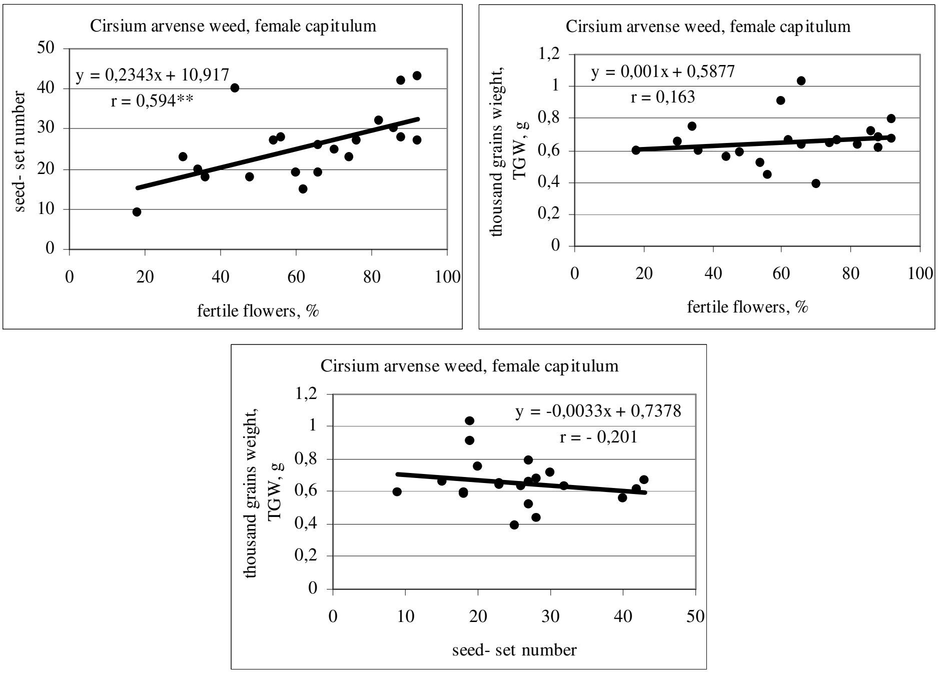

Fig. 2. Correlations between *C. arvense* fertile female flowers and morphological seed-sets characteristics

Out of the antagonism of the two morphologic characters resulted in a diminished value of TGW at every 10 achenes additionally formed. A smaller number of seeds brought about the increase of their absolute weight. The correlation might explain the inefficiency of sexed reproduction on *Cirsium arvense* through a smaller number of seeds as they were heavier.

CONCLUSIONS

1. The analysis of the seed-sets that the plant produces brings in some momentary information over the morphological diversity of populations within a specific zone. As part of female ecotypes, sterility recorded 9-73% and within FFH the seed-set was up to 1-76 pieces, with less obvious variations among the group of female plants. The reference material shows a great diversity in estimating FFH [6, 4, 8] but it displayed no variability according to location on the floriferous branches.
2. The seeds were formed either into the female clones' flowers or into the male ones. The sets in a reduced number proved a more advenced and evolutionary stage.
3. Achene-set per FH and TGW showed a very important negative connection that was the tendency of forming less numbered achene-sets but having a bigger weight.

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STEM STRUCTURE FROM WINTER GENERATION INDIVIDUALS OF 3 EPHEMERAL SPECIES

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Keywords: *ephemeral species, stem anatomy, floriferous stem*

Abstract

Observations on the anatomical structure of the stem were made on individuals hibernate generation individuals of 3 species considered to have an ephemeral life cycle: Stellaria media, Veronica persica, V. hederifolia. At the time of flowering, produced very early (from March to April) the structure of the Stellaria media stem was the primary origin. Neither in the cortex nor at the vascular bundles level was observed tissue of secondary origin. In the Veronica species, secondary tissues were observed only in the central cylinder where they worked for a short period: a vascular cambium, consumed entirely, so, at the time of flowering, it was no longer present.

INTRODUCTION

Morphological and anatomical peculiarities of the plant are the material background for the performance of the physiological processes. They support the lives of the plants and influence their biology and specific behavior of the environmental factors, thus ensuring a successful survival in the natural communities of plants [7].

The three species studied - *Stellaria media* (L.) Villa, *Veronica hederifolia* L., *V. persica* Poiret, are fast-growing weeds, considered ephemeral because of short development cycle, having several generations per year [6]. Results of the various research in the biology, ecology, morphology or internal structure of these species have revealed features that permitted them the development and behavior in their specific environment. The observations contained in the paper complements a previous study [5] trying to establish a link between anatomical structure of the flowering stem and the rapid growth‘s rate, specific to these plants.

MATERIAL AND METHODS

This study was based on morphological and anatomical observations conducted on plants from the Botanical garden and the park of UASVM Bucharest.

For the microscopic examination, cross sections were used obtained from floriferous stem. They were stained by alaun-carmine and jod-grun for study with a light microscope (BA 2500 with phase contrast); photos were taken with a digital camera (Panasonic DMC-LZ7).

RESULTS AND DISCUSSION

Stellaria media (L.) Villa.

Propagation occurs primarily by seed, one plant producing between 600 - 1500 seeds whose germination capacity can be preserved for 50-60 years. Germination may take place between 2 ^{0}C and 30 ^{0}C, allowing it to spread over a long period [3]. Plants can multiply vegetatively too [9, 10] forming numerous branches; they can reach 31 cm in length and may root at nodes; an accidental separation from the parent plant permits the occurring of the new individuals. This character and the intense growth rate (about 300 cm in 3 months) [3] allows plants to grow at the expense of other species [9, 10]. The species is sensitive to drought; the seed germination is inhibited at temperatures above 30 ^{0}C [9, 10].

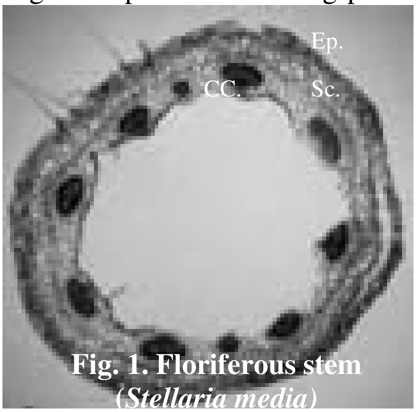

Fig. 1. Floriferous stem (*Stellaria media*)

In the cross-sections of the stem, made up at the flowering/fructification moment, a primary body was observed (the secondary meristems - the vascular cambium and the phellogen, fall in activity).

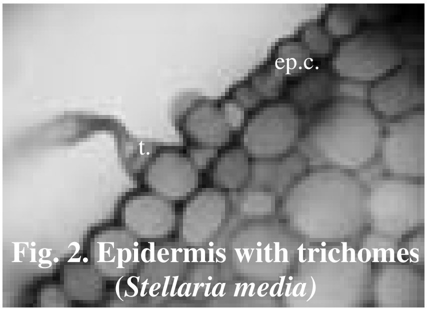

Fig. 2. Epidermis with trichomes (*Stellaria media*)

The section contour is approximately circular, slightly flattened on one side. On this side, the epidermis has multicellular trichomes (Figure 1).

In the section, 3 important zones are distinguished (Figure 1): epidermis (Ep.), cortex (Sc.), the central cylinder (CC.).

Epidermis (Figure 2) consists of a continuous layer of tabular cells (ep.c.); the outer and the inner cellulosic walls are thicker than the radial ones. The trichomes (t.), formed on one side of the section, are multicellular (made up of 5-6 cells), uniseriate and unbranched (simple), without living constituents.

The cortex (Figure 3) (Sc.) is parenchymatous, 4-5 layered, with a subepidermal, continuous layer, a photosynthetic parenchyma, and the endodermis, indistinct from the rest of the cortex cells.

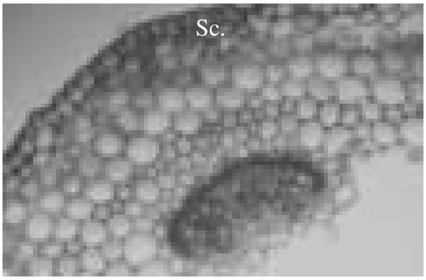

Fig. 3. The cortex (*Stellaria media)*

The stele (Figure 4) has an outer boundary - a sclerenchymatous pericycle (P); the lignin is uniformly deposed in a thin layer in their cell walls.
The collateral type of vascular bundles (VB) is arranged on a single circle, divided by areas of parenchyma tissue; they are bounded by 2 sclerenchymatous arches; under the outer arch there is the primary phloem, consisting of vessels (protophloem, metaphloem) and companion cells; under it, there is the primary xylem, consisting of vessels (metaxilem, protoxilem) and uniseriate rays of parenchyma cells.

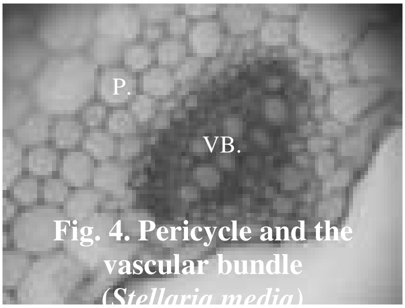

Fig. 4. Pericycle and the vascular bundle (*Stellaria media*)

Between the primary phloem and the primary xylem the vascular cambium does not activate, so the primary body is conserved all plant life.
The pith is represented by a parenchymatous tissue, partially destroyed, the center of the section revealing an aeriferous cavity with nearly circular shape; sometimes, part of the interfascicular parenchyma is destroyed too.

Veronica hederifolia L.

Species with medium temperature requirements [3] for growth; it can germinate in cold weather. Encountered especially in cereal crops, on light soils [1], it produces a similar number of seeds like grains (200-300) [3].

The primary vascular tissue form an almost continuous vascular cylinder in the internodes (the interfascicular regions are very narrow), and the secondary vascular tissues do the same [4], like the structure seen in *Tilia* [2].

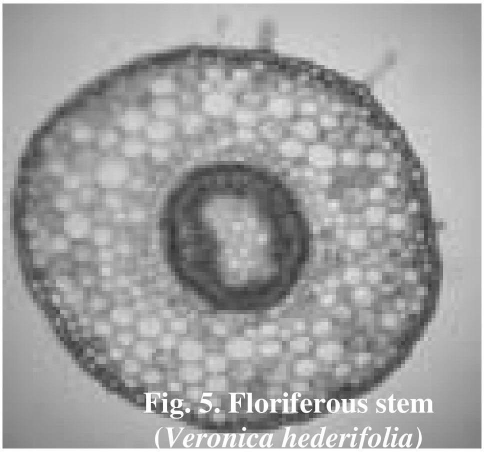

Fig. 5. Floriferous stem (*Veronica hederifolia*)

The general contour of cross section through the floriferous stem is $\pm$ circular (Figure 5).

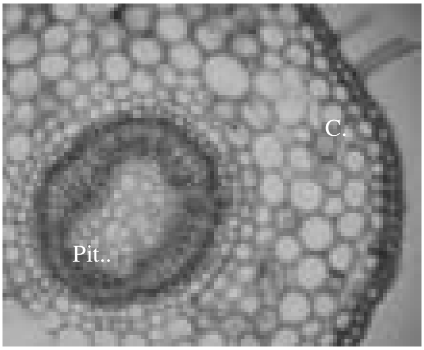

Fig. 6. Chlorenchyma in floriferous stem (*Veronica hederifolia)*

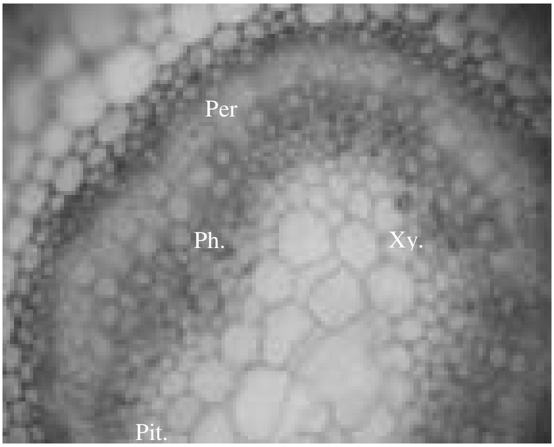

Fig. 7. The inner part of the floriferous stem internal structure (*Veronica hederifolia)*

Unilayered epidermis is composed of cellulosic cells with thick tangential walls. There are also multicellular protective trichomes. The primary cortex is made entirely of a chlorenchyma (Figure 6) (C) with isodiametric cells, larger in the middle layers, with air spaces between them. The stele is bounded, on the outside of a collenchymatic pericycle (Per.) (Figure 7). The phloem (Ph.) (Figure 7) forms an external ring, consisting of vessels and companion cells. The xylem (Xy) has a concentric, $\pm$ regular development (Figure 7). Below the phloem there are the secondary xylem elements, represented by vessels arranged in radial rows and by fibers. To the pith primary xylem vessels can be observed, surrounded by angular collenchymas.

The pith (Pit.) (Figure 7) consists of a thin-walled, aeriferous parenchyma. Although at the xylem level it can see elements of secondary body, between phloem and xylem the vascular cambium is unable to be identified. The vascular cambium has a short seasonal activity.

Veronica persica Poiret

Similar to previous species in terms of internal structure [4], *V. persica* is found mainly in the hoed crops [1]. Plants have a large capacity to produce seeds (up to 1000 seeds) [3]. Germination and plant growth is positively influenced by the wheat presence [3].

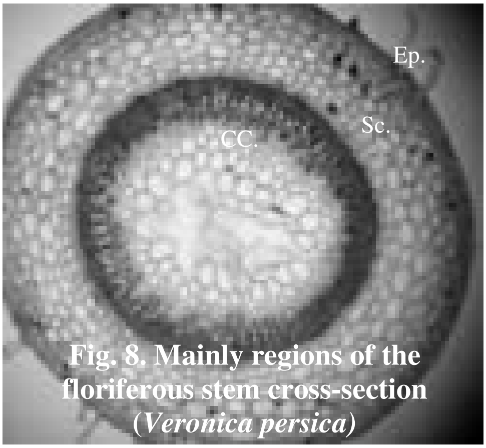

Fig. 8. Mainly regions of the floriferous stem cross-section (*Veronica persica*)

The stem in cross-section has a circular shape, with mainly regions: the epidermis (Ep), cortex (Sc.), and stele (CC) distinct one from the others (Figure 8). The unilayered epidermis presents uniseriate, multicellular trichomes (Figure 8). The cortex is composed of a parenchyma with chloroplast distribute in the subepidermal layers. The endodermis is distinct from the rest of the cortex cells. A pericycle ring, consisting of 2-3 cellulosic cell layers, bounded the stele on the outside of this. Bundles in the central cylinder are made of secondary phloem (Ph.) and xylem elements (Xy.), generated by a vascular cambium (figure 9). This one has a short period of seasonal activity.

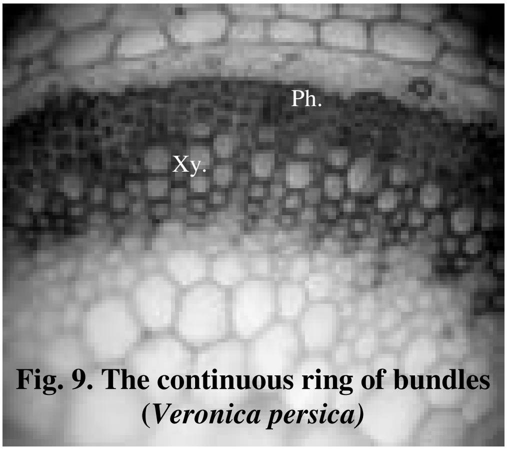

Fig. 9. The continuous ring of bundles (*Veronica persica*)

In the winter generation individuals, the internal structure of the flowering stem consisted mainly of primary body tissues, for each of the three observed species.

The parenchymatous tissue, consisting of thin-walled cells is predominant. Lignin is found only in the stele elements - pericycle and xylem vessels. Elements of secondary origin are encountered only in the *Veronica* species, at the xylem and phloem level, produced in small quantity by a vascular cambium. The primary body is maintained in *Stellaria media* stem the entire life, like in monocotyledonous plants. The absence of secondary structure elements or their formation in small quantity, due to a reduced activity of the vascular cambium, is a characteristic of the flowering stems and may account for the senescence and plant death that will be installed after the reproductive phase [7].

The internal structure of the three species is closely related to the short life cycle and it represent a feature of ephemeral plants.

CONCLUSIONS

1. In the internal structure of the flowering stem of the three observed species, primary body tissues are predominant.
2. In *Veronica hederifolia* and *V. persica*, secondary body tissues are products of a vascular cambium converted entirely to xylem and phloem elements.
3. In *Stellaria media* stems, the primary structure persisted in all life stages.
4. Short life cycle of the 3 ephemeral species is reflected by the internal stem structure.

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DYNAMIC BLADE COMPONENTS REGISTERED ON SOYBEAN PLANTS FOLLOWING TREATMENTS APPLIED TO SOIL AND PLANT, IN RELATION TO RESISTANCE TO ATTACK OF THE FUNGUS *BOTRYTIS CINEREA*

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Keywords: *Soybean plants, Botrytis cinerea, mesophyll and epidermal cells, stomata*

Abstract

Soybean plants, belonging to the PR line (Botrytis sensible), grown in fields and greenhouse, were subjected to treatments with fungicides and elicitors, applied on soil or plants, to test their behavior to the attack of the fungus Botrytis cinerea. Plants of each variant showed a different reaction in relation with the control variants. At the blade level, changes have been observed in the size of mesophyll and epidermal cells, and in the number of stomata encountered on the upper epidermis.

INTRODUCTION

The paper work includes research performed on leaves belonging to soybean plants to reveal changes occurring in the leaf structure, following the application of treatments to boost resistance to the fungus Botrytis; the research, conducted during 2009, continue the research carried out in 2008 whose results were published previously [1].

MATERIAL AND METHODS

The plant material was consisted of leaves drawing from one line of soybean plants – M10 (*Botrytis* sensible), on which were applied these treatments:

- contact fungicides – Captan+Teldor, Captan+Batron (fine sprayings on plants);
- systemic fungicides – Topsin M+Rovral, Topsin M (introduced in soil);
- 4 extracts types – 1, 2, 3 (applied on leaves or on soil);
- pathogen inoculation – *Botrytis* (applied on leaves or on soil).

Variants are made of plants grown in the greenhouse and in the field.

For the microscopic observations and measurements there were made cross sections in the middle blade zones or in parts of leaf with pathogen attack symptoms. These were stained by alaun-carmine and jod-grun for study with a light microscope (BA 2500 with phase contrast); photos were taken with a digital camera (Panasonic DMC-LZ7).

RESULTS AND DISCUSSION

The results presented the anatomical measurements made at epidermis and mesophyll levels and the number of stomata located on the upper epidermis (Figure 1).

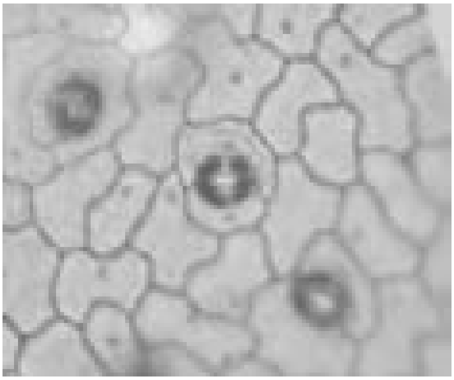

Fig. 1. Stomata on the upper epidermis

Comparing the results of biometric measurements made at mesophyll level for the chemical treatment and extracts 1, 3 variants (plant treatments; field crops, after treatments), with those obtained for control variant, it appears the same size, higher than the control variant, for the chemical treatment and for the extract 1 and a decrease in size for the extract 3 (Table 1).

When treatments were applied on the soil, mesophyll sizes have been increased from those of the control variant unless chemical treatments, while for both types of extracts, mesophyll sizes were smaller than those of the control variant (Table 1).

Number of stoma formed on each leaf is dependent on abiotic factors such as light or carbon dioxide [2, 3]. Regarding the stomata numbers formed on the upper epidermis, the treatment variants, regardless of their mode of application (on the soil or on the plant) show a lower level than that observed in control variant (Table 1).

The same treatments on plants grown in greenhouse have led to different results on the mesophyll sizes: there are higher than that of the control variant for chemical treatments on soil, extract 1 on plants and soil, and extract 3 on plants variants (Table 2). The mesophyll sizes are reduced to the control variant for the following variants: chemical treatments on plants, extract 2 on plants and soil, extract 3 on soil (Table 2). The stomata number is reduced for all variants compared with the control variant (Table 2).

Table 1

Results of biometric measurements made in soybean leaves - M10 (field crops; after treatments)

Variants	Blade biometric measurements (μ)			Stomata number/100 μ^2
	Upper epidermis	Mesophyll	Lower epidermis	
Control	17.60	196.00	14.40	40
Chemical treatments on plants	16.80	211.20	17.60	32
Chemical treatments on soil	14.00	217.60	16.00	24
Extract 1 on plants	16.80	211.20	17.60	28
Extract 1 on soil	18.40	188.80	16.00	24
Extract 3 on plants	14.40	189.60	16.00	20
Extract 3 on soil	16.80	132.80	17.60	20

Table 2

Results of biometric measurements made in soybean leaves - M10 (greenhouse crops; after treatments)

Variants	Blade biometric measurements (μ)			Stomata number/100 μ^2
	Upper epidermis	Mesophyll	Lower epidermis	
Control	15.20	150.40	16.80	36
Chemical treatments on plants	16.80	139.20	16.00	20
Chemical treatments on soil	16.00	178.40	16.80	24
Extract 1 on plants	18.40	179.20	18.40	16
Extract 1 on soil	16.80	152.00	16.00	28
Extract 2 on plants	19.20	133.60	16.30	16
Extract 2 on soil	18.40	148.80	15.20	20
Extract 3 on plants	15.20	156.80	16.80	28
Extract 3 on soil	18.40	132.80	17.60	20

After pathogen inoculation in all variants applied on field crops, there was a decrease in size of the mesophyll to the control variant (Table 3). Again, the stomata number is reduced for all variants compared with the control variant (Table 3).

Table 3

Results of biometric measurements made in soybean leaves - M10 (field crops; after pathogen inoculation)

Variants	Blade biometric measurements (μ)			Stomata number/100 μ^2
	Upper epidermis	Mesophyll	Lower epidermis	
Control	16.00	228.00	15.20	32
Chemical treatments on plants	14.40	171.20	16.00	24
Chemical treatments on soil	14.40	171.20	16.00	28
Extract 1 on plants	12.80	182,40	16.00	28
Extract 1 on soil	15.20	133.60	13.60	16
Extract 3 on plants	12.00	171.20	12.00	32
Extract 3 on soil	15,60	211.00	18.40	28

The results from biometric measurements from greenhouse crop show an increase in size of the mesophyll for all the variants except the chemical treatments on soil variant (Table 4).

In terms of stomata number, it varies; for the first time appear stomata equals or higher in numbers than those recorded in controls, respectively chemical treatments on plant, extract 1 on plants, extract 2 on plants and on soil, extract 3 on soil variants (Table 4).

Table 4

Results of biometric measurements made in soybean leaves - M10 (greenhouse crops; after pathogen inoculation)

Variants	Blade biometric measurements (μ)			Stomata number/100 μ^2
	Upper epidermis	Mesophyll	Lower epidermis	
Control	14,40	91,20	13,60	20
Chemical treatments on plants	14,40	163,20	16,00	24
Chemical treatments on soil	15,00	80,00	14,00	12
Extract 1 on plants	14,40	120,00	16,00	32
Extract 1 on soil	15,20	133,60	13,60	16
Extract 2 on plants	18,00	133,60	16,00	20
Extract 2 on soil	14,40	162,40	16,00	24
Extract 3 on plants	14,40	117,60	16,00	12
Extract 3 on soil	15,20	130,40	15,20	20

CONCLUSIONS

1. The treatments led by spraying plants usually increase the mesophyll in size compared with the control variant.
2. The number of stoma formed on the upper epidermis remained lower than the control variant, in all treatment options, except the variants of greenhouse crops, after the pathogen inoculation.

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ADAPTATIONS OF OVERGROUND VEGETATIVE ORGANS IN SOME SEMPERVIRENT PLANTS

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Keywords: *sempervirent plants, adaptation, leaves*

Abstract

Two plant species from the Pinaceae family (Abies alba, Pinus nigra) with evergreen leaves were analyzed in this paper. The material was collected in autumn and winter, in order to emphasize some changes which could occur depending on the vegetation season.

At the same time, histo-anatomical features correlated with the evergreen phenomenon were highlighted.

Differences were observed in the sizes of different parts of the leaf anatomical structure in the two species considered for the study, reflecting differences in their mode of adaptation to the environmental conditions. Thus, there was a significant increase in the size of most tissues belonging to the structure of Abies alba leaves collected in winter, less the diameter of endoderm; and in the Pinus nigra, there was observed a considerable increase in the epidermis, hypodermis and resin canals in the leaves collected in winter, compared with leaves collected in autumn.

INTRODUCTION

In the existing literature, in the country and worldwide, the issues of ecological anatomy, and the relationship between organ structure and function become increasingly important.

Some authors have noted that the same species, depending on the original habitat, leaf structure may undergo significant adaptive changes, suggesting the possibility of some degree of freedom in the enhancing phenotype, depending on the environmental conditions.

Also, there occur differences in the anatomical structure of some organs, reflecting differences in the plants' mode of adaptation to environmental conditions.

MATERIAL AND METHODS

For the anatomical study, fresh material (leaves) of fir (*Abies alba*) and black pine (*Pinus nigra*) was used.

Cross-sections of fir leaves and black pine were made, which were clarified in chlorine hydrate for 24 hours; color was achieved by using the Geneva reactive, subsequently mounted in Canada balsam [2].

Measurements have been performed using the ocular micrometer, in a microscope ML-4M IOR found in the equipment of the Botanical Laboratory, University of Agronomic Sciences and Veterinary Medicine, Bucharest, specialization Biology.

RESULTS AND DISCUSSION

The study of *Abies alba* adaptations, performed by micrometric measurements in the different leaf tissues collected in autumn and winter, revealed significant and new issues elated to the transformations occurring at that level (Figure 1).

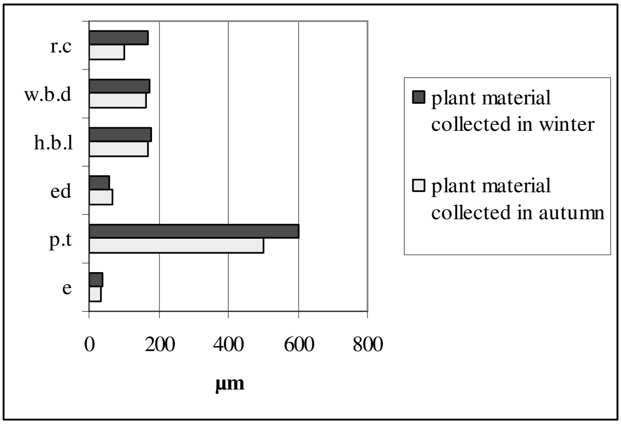

Fig. 1. Anatomical characteristics of *Abies alba* leaf

Most tissues (epidermis - ed, palisade tissue - p.t, beam driver - h.b.l = beam height leader, w.b.d = beam width driver, resin canals - rc) of the sections made in the fir leaves collected in winter, recorded an increase in size (except the endoderm - ed), compared with the tissue sections of the leaves collected in autumn.

Pinus nigra leaves are acicular [3] and the section has a semicircular shape, flat on the upper face and convex on the lower.

The micrometric comparative measurements of different tissues of leaves collected in autumn and winter allowed to highlight the adaptation of the black pine - *Pinus nigra* to the environmental conditions (Figure 2).

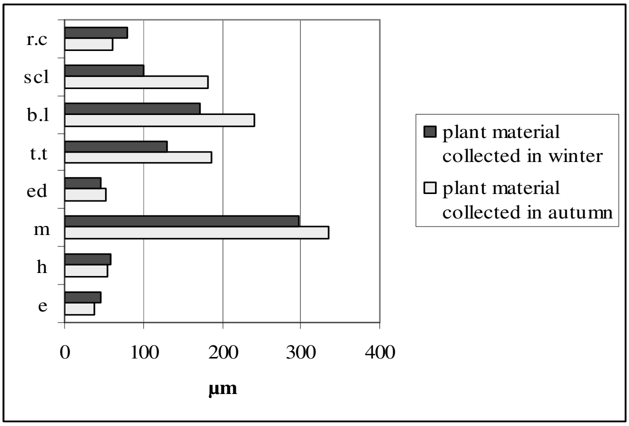

Fig. 2. Anatomical characteristics of *Pinus nigra* leaf
(e = epidermis; h = hypodermis; m = mesophyll; ed = endodermis; t.t = transfusion tissue; b.l = beam leader; scl = sclerenchyma; r.c = resin canal)

Epidermis, hypodermis and resin canal had increased in size, while the other tissues recorded decreases in their diameter.

CONCLUSIONS

1. Several anatomical traits were analyzed by original micrometric measurements in the leaves of *Abies alba* (fir) and *Pinus nigra* (black pine).
2. There were differences in the sizes of different parts of the leaf anatomical structure in the two species considered for the study, based on their harvest in two seasons (autumn and winter), reflecting differences in their mode of adaptation to the environmental conditions.
3. Thus, there was a significant increase in the size of most tissues in the *Abies alba* leaf structure (leaves collected in winter), less in the endodermis diameter.
4. In the leaves of *Pinus nigra*, there was observed a considerable increase in the epidermis, hypodermis and resin canals of the leaves collected in winter, compared with the leaves collected in autumn.

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RESEARCH REGARDING THE USE OF A FAR-INFRARED HEATING TECHNOLOGY OVER THE ENVIRONMENT (II)

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Keywords: *far-infrared heating, growth of plants*

Abstract

The paper presents the results obtained in the frame of an applicative research contract upon the use of ecological, biogenetic heating technology of far-infrared kind, with the purpose of using it in Romania in different domains of activity.

In the climatic conditions of our country, we proposed and performed a measurement program in the following fields: electric expenditure, the adaptability to the climatic specifics, microbial loading of air, effects over plants, effects over pets, prolusions over general health and comfort status of human being. In this article we present the results above the greenhouse, the micro-climate measurements, and effects over plants and over microbial loading of air from the space in which we used this type of heating system (during 2007-2009).

In the rely of this research, we are in right to affirm that this type of heating technology has benefic effects in preserving the homogeneity of the micro-climate conditions, in the growth of plants and assures an easily growth of hygiene of the environment in which it acts.

INTRODUCTION

Nowadays, most of infrared sources are using short wave lengths (type A infrared), outputting high temperatures and having the specific that the brown to red color radiation is observable only near the sources of output.

As a benefit of the actual improvement of technology, there have been developed panels with wide length infrared radiations of 10.000 nm (type C infrared) that fulfill European laws and standards. The distance where these radiations can be observed is 3.5-4.5 m, with generated temperatures of 150°C. The exterior surface of these panels can have different colors, with different esthetic properties related to owner preferences and can also be placed in different positions, according to the specific of the room that is being heated.

The implementation of wide length infrared generator panels in glasshouses has been done after a literature research study. The glass materials are retaining ultraviolet and infrared radiations. The plastic materials are less transparent for infrared radiation and far red radiation. Polyethylene films and PVC films have a poor capacity of thermal isolation compared with glass materials.

The results applied on practical conditions reveal that this technology can be successfully implemented in different activity domains like agriculture (greenhouses and animal husbandry farms), industry (constructions, wood manufacture, food industry) commercial spaces heating systems, houses heating systems, all mentioned above applications are at the beginning of implementation and in a continuous development.

MATERIAL AND METHODS

By its purposes, the research activity intends to reveal the vegetable crop efficiency under the influence of artificial generated wide length infrared radiations. The results will serve for further practical perfection of the technology in the general term of modern agriculture and also to determine the entire effect caused by the long term use of the new technology on all levels: soil composition, seeding process, plant development and air composition.

The vegetable crops where cultivated in pots, with the notification that the experimental plot was emplaced in classic „Prinz-Dokkum" glasshouses from Baia Mare, Romania. Each of the mentioned above experimental factors where emplaced in a 36 m^2 surface variant.

The following observations where made:

- On-line monitoring of microclimate for the following parameters: temperature - about 22 °C, and relative air humidity - about 55%;
- Seedling and monitoring of 7 vegetable species (tomatoes, sweet peppers, egg plants, cucumbers, cabbage, turnip cabbage and onion) and 4 flower species (salvia, nemesia, primula, amaryllis);
- Phenological and biometrical measurements have been taken periodically;
- General monitoring of the greenhouse regarded as artificial ecosystem;
- Photographic recordings of growth and development stages;
- Prevailing and editing a data base with different electronic devices;
- Daily monitoring of the process executed by qualified personal (engineers and overseers specializes in horticulture and agriculture).

RESULTS AND DISCUSSION

Presented as images and graphics, we have obtained results during 2009, February - July period, from the glasshouse.

As we can see in the graphics below, the temperature is about 22°C and the highest temperatures inside the greenhouse where recorded at noon time. The relative air humidity inside the greenhouse is about 55% and it is negatively related with the inside temperature, also the highest percentage has been observed in the morning time. Once with the increase of temperature during the day time the relative air humidity decreased.

The seeds of tomatoes were planted on the 10th of February, and the first harvest has been recorded on the 16th of June from the new area. There has been registered a maximum of 10 flower- levels in this area, while, at the same time, in control area have been recorded only 5 flower-levels. The first harvest in control area has been on the 1st of July, while, at the same time, in new area there has been picked the fourth harvest and also there has been noticed a mass ripening of the fruits.

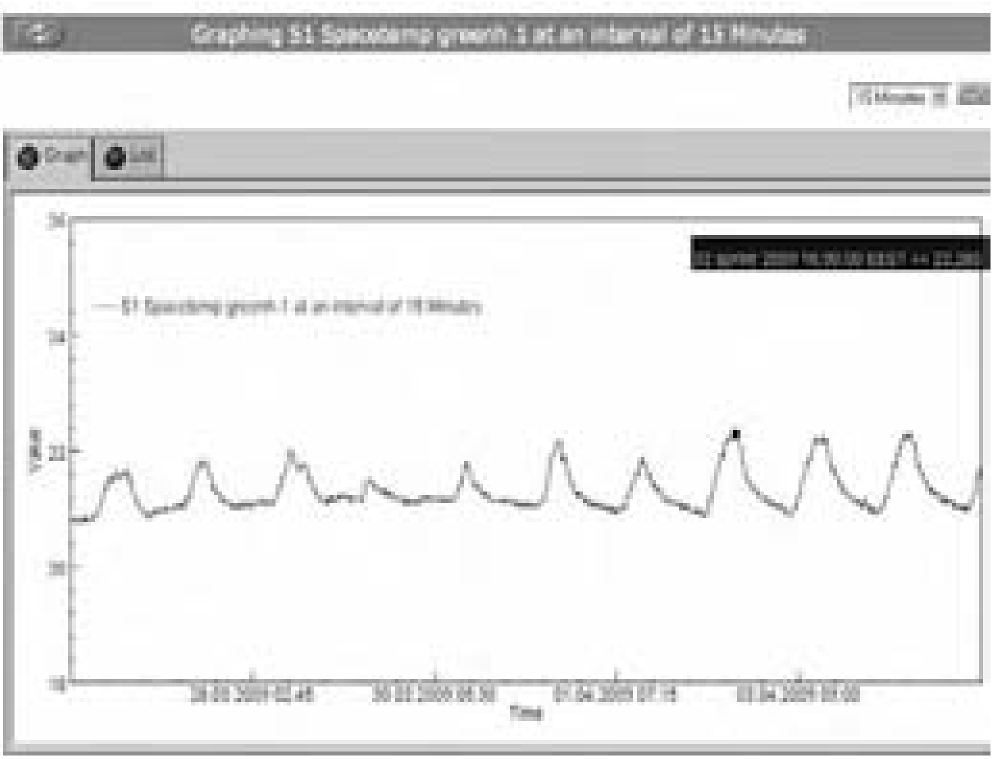

Fig. 1. Automatic graph example created by the computer

Fig. 2. Working method

Fig. 3. Tomatoes – *Lycopersicum esculentum*

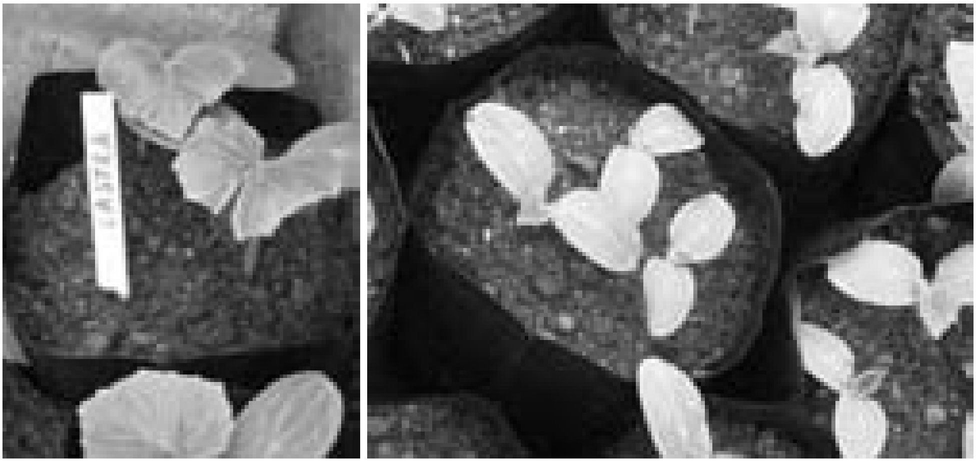

Fig. 4. Cucumbers - *Cucumis sativus*

Fig. 5. Measurements in the greenhouse

CONCLUSIONS

In actual conditions, considering the European strategy in the energy and gas emissions domains, the research results show that long-waved infrared technology:

1. is clean, efficient, non polluting emission technology;
2. can be used in a very large scale of domains;

3. is just at the beginning of the research when being used in the agro-industrial applications;
4. has benefic effects over the organisms (human, animal and vegetal), effects that can be fragmental quantified for the moment;
5. it can be successfully implemented in Romania.

Research in this domain is to be continued because of the multitude of the less known phenomenon and the limits that appear when using a new technology. Also time is a factor that is not to be neglected.

ACKNOWLEDGEMENTS

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ENVIRONMENTAL ASPECTS OF MINING AREA OCNA ŞUGATAG

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Keywords: *Ocna Şugatag, salt mining, salt lakes, anthropic impact*

Abstract

The paper presents some results of research done on the salt mines area from Ocna Şugatag, an evolution of mining in the region correlated with environmental aspects.

The salt mines were abandoned in 1950, since then a lot of major changes happened in the area with negative impact over the environment. By abandoning the salt mines and destroying their infrastructure, some crumbling appeared and served as places to collect rainwater. The result was a number of 45 lakes. The paper presents a detailed analysis of the implied processes and a detailed description of these lakes and their surroundings with special particularities.

From an environmental protection point of view, the most serious problem that was identified is the stability of the old salt mines which still stands and soil fertility.

INTRODUCTION

Mining in the Maramures region saw a flowering and a major importance over time as one of the most important industrial activities in the county. However, the mining activity, with its various aspects, has produced a varied, mostly negative impact on the environment. Although mining activity ceased, the impact of mining are felt far and it seems that it will feel a long time to come.

Mining in Maramures is known because of the famous ore mines rich in precious metals (gold, silver, copper, etc.) and salt mining is forgotten although it was particularly flourishing in the early XIX century. Former salt mines from Costiui and Ocna Şugatag were transformed into bathing areas of local interest without knowing the history of this places, the origin of salted water or the risks to health and safety of people from these areas. The mines from Ocna Sugatag entered into oblivion, although their presence is felt, after more than 50 years since their closure, by a significant environmental impact.

BRIEF HISTORY OF THE OCNA ŞUGATAG MINING REGION

Located on the interfluves between the rivers Mara and Cosău at a distance of 19 km from Sighetu Marmației city, near the border with Ukraine, we can say that Ocna Şugatag is located in the central area of Maramureş County (Figure 1). This village is first attested in 1355, by a document referring to the existence in the area of a very large salt mining region and a road of salt passing near Giuleşti, a well known location nearby.

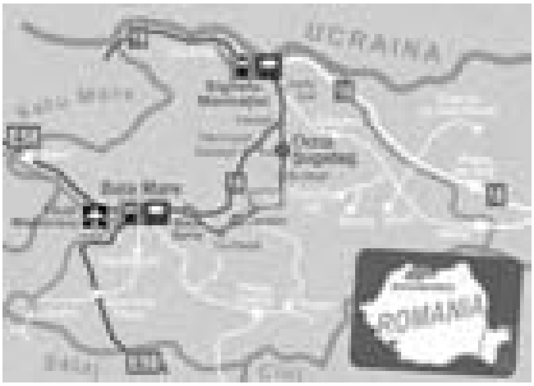

Fig. 1. Location of Ocna Şugatag in Maramureş county

Over time, this village earned several names being mentioned in 1360 by Radu Popa in an official document as "near Giuleşti, Sărata Valley, a tributary of the Mara river, <<Zalatina>> in the top six <<villas nostras Olachales>> from the Mara valley strengthened in 1360 by Dragoş son of Giulea from Giuleşti. Zalatina was the first officially mentioned name of the locality.

In another document from the year 1419, the locality is named Şugatag and in 1828 is called Akna Sugatagh (Ocna Şugatag), as we know, the actual name. The history of this village is continuously related with the mining activity, the main concern of the inhabitants.

In 1950, due to massive infiltration of different kind of water in the active mines, it was decided to abandon them in the same year. So, with some haste, the mines were closed and flooded. Gradually, because of salt dissolution by fresh water, the mines stability decreased, resulting in massive collapse. In the cavities formed in this way, water has accumulated, leading to the formation of 45 lakes of different sizes, shapes and salinity.

IMPACT OVER THE SOIL

In the Ocna Şugatag area, under the influence of specific climate, vegetation, geomorphology and petrography substrate, developed several soil types, as follows:

- In the lowest forms of meadow of the Mara valley and of the more important tributaries, on alluvial deposits under the influence of shallow groundwater, often completely flooded, the soils are represented by weakly gleyed luvisols, mostly carbonated or saline.

- In the narrow side valleys, between the slopes, in the highest area, where water stream flow or creep through the skeletal material on which the soil cannot form, we meet the rock on the surface.
- In the area immediately adjacent to the valleys, that of the lower terraces, such as the Mara river terraces, or high terraces as those of Ocna the strongly pseudogleyed podzolic soils predominate. This type of soil is found also on the old salt mining site.
- In the higher regions, the genetic diversity of soil increases without the proper soil units to grow a lot, this diversification is expressed more on subtypes and varieties of soils. Here, over an acid parent material, generally represented by sandstones, clays, rolling piedmont and less zeolites yellowish acid brown soils are present. This type of soil contains a lot of skeletal material and is weakly varied by texture.

Soils encountered in this area generally have low fertility potential, due to reduced nutrient content and especially due to their faulty maintenance, including poor fertilizing and irrational exploitation.

Fig. 2. Soils destroyed by salt excess

In the former mining area, soil fertility is lower due to an excessive quantity of salt present in the soil, but the area has a tendency to become a swamp.

Due to the accumulation of salt on these soils grow and develop only salinity-loving plants such as *Cochlearia officinalis* or *Juncus gerardi*. These plants are accompanied by large *Eleocharis palustris* plant associations, plant characteristic to wetlands. All these plants have a low nutrient content and are avoided by grazing livestock. Also, this area is highly degraded due to frequent changes in the subsurface. As a result, land in the area is unsuitable in terms of agriculture, with the appearance of an abandoned field (Figure 2).

IMPACT ON THE POPULATION

Village settlement and the existence of underground reserves of natural resources, lead to the conclusion that the area of the village of Ocna Şugatag was populated since ancient times. This is confirmed by archaeological findings which indicate human presence in this area since the Stone Age.

In the Maramures county official Almanac from 1901 is mentioned that the number of the residents of Ocna Şugatag numbered 1748 and in 1920 already had 1858 inhabitants, the largest number of people that the locality ever had. This is due to the fact that during that period to work the salt mines reached its peak, the mines were modern, with facilities and advanced equipment and the locality took advantage from exploitation, its development is supported and somehow forced by the salt mines.

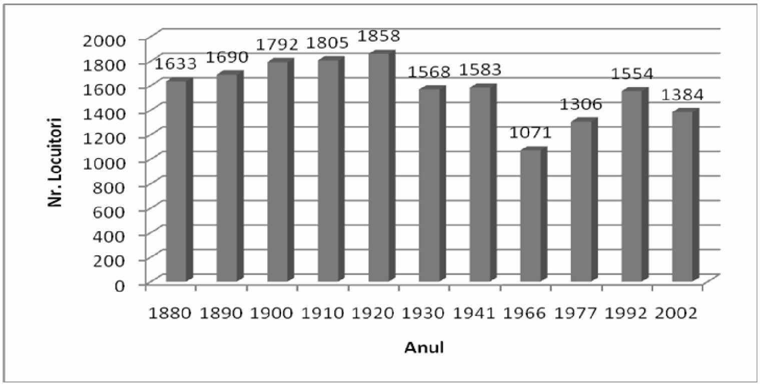

Fig. 3. The evolution of the population between 1880 – 2002

From the analysis of population development between 1880 and 2002 (Figure 3) we can observe a strong correlation of the evolution with the history of the region.

Thus, in 1919 the number of inhabitants decreased to 1696 due to losses of First World War and the early demise of Habsburg Empire under whose direct management the Ocna Şugatag mines were at.

By 1930, the population increase is insignificant, being only 12 inhabitants/year.

Between 1941-1966, was happens a dramatic decrease in population due to several causes, including the loss of life in the Second World War, low birth index due to poverty post Second World War and the official end on 1950 of the salt extraction activity. In that time, some people migrated to other mining centers such as Praid, Dej or remain closer in the Baia Mare mining basin, respectively in mining cities like Baia Mare, Baia Sprie, Cavnic, or to other towns close which offered good jobs in the field of mining.

Today, Ocna Şugatag includes 4 villages with a total of 4,500 inhabitants, respectively Ocna Şugatag with 1600 inhabitants, Sat Şugatag with 1200 inhabitants, Breb with 1300 inhabitants and Hoteni with only 400 people. The population consists mostly of Hungarian and Romanian, but living together in harmony with gypsies, Russians, Ukrainians, Germans, etc. The socio-economic situation from the past 20 years, in Ocna Sugatag developed tourism and agro-tourism. As a result, the number of inhabitants is increasing; the number of residences inhabited temporarily, also, but the quality of the provided services is in retreat. Rising demands for healthy food, bio-food, areas for recreation and season sports areas are still far from the goals proposed by the Local Council.

CONCLUSIONS

1. The salt mining from Ocna Şugatag had a major impact on the environmental factors in the region. After closing the mines major changes took place in the area concluded in great collapses of the old mines. Land use has changed. Soils near the former mines were used in the past for grazing domestic animals. Now, by changing the surface, this function cannot be met. Soils were turned into swamps, vegetation, consisting predominantly of salt water-loving plants doesn't offer a favorite food for animals.
2. As regards population, it is well known that man has a great capacity to adapt, transforming nature in his favor. When the mines closed, has been a massive migration of people specialized in mining, this migration had a major impact on the area. Today, the population is increasing due to massive development of spa tourism, salty waters of area providing treatment for a wide range of diseases and transformed a former mining area into a tourist area.
3. Determining risk areas and take measures for their delimitation are required. Former mines, flooded today are not totally collapsed, these events are inevitable in the future. Through advanced engineering processes such breakdowns are unavoidable, but can be controlled. Priority actions are the delimitation of these areas and protection of population against possible accidents.
4. Further maintaining the village character requires a punctual evaluation of bio-productive capacity of the area and a long-term strategy aimed at the welfare of the whole community.

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OPTIMAL MEDIUM FOR GROWTH OF CERTAIN SPECIES OF ALGAE DOMINATING WITHIN THE PHYTOPLANKTON OF THE AQUATIC ECOSYSTEMS OF THE REPUBLIC OF MOLDOVA

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Keywords: *phytoplankton, dominant species, mineral medium, aquatic ecosystems*

Abstract

This study prezents research on cultivation conditions dominated by the phytoplankton species in Moldova. Thus it is established that Oscillatoria Amphibia Ag. develops intensely in mineral environment Gromov 6, Navicula cryptocephala Kutz- mineral environment Rixter, Scenedesmus apiculatus (W. et GS West) Chod. var indicus (Hgrtob) - Gromov 6 and Prat.

INTRODUCTION

The study of alga cultures contributes to settle many theoretical and practical problems of the modern algology. The use of algae bodies as biological models contributes to the development of algology, hydrobiology and microbiology [9, 10].

Algae are a relatively common, classic object research of the most various biological processes. This is due mainly to a series of advantages in comparison with other organisms: small size, high coefficient of reproduction, capacity to accumulate solar energy in the photosynthesis process, possibilities of growth in laboratory conditions [4, 2]. The integration of data obtained as a result of the scientific research on algae will allow to develop their potential in different fields of human activity.

An important stage on which depends the correctness of the experimental data represents the selection process of pure cultures and their maintenance. At present a series of growth methods are used: in phytobioreactor and race way; however in laboratory conditions the classical growth method was used [2, 3, 5].

MATERIAL AND METHODS

The investigations were conducted in the Laboratory of Hydrobiology and Ecotoxicology of Institute of Zoology of the Academy of Sciences. In view to fulfil the proposed objectives, there were used usual methods of pure cultures selection and their growth [6, 9].

The process of algae growth consists of several stages. The first is the takeoff of water assays that contain the alga species we are interested in. The second stage is to obtain assays of a large variety and biomass of algae. And the last stage is to obtain a pure culture that is carried out via the reinsemination method on agar-agar jelly environments. From the Petri boxes with the help of an ansa a cell or a cell culture and are reinseminated on liquid environments. This procedure is carried out several times till the pure culture is obtained.

The study involved three stains of algae: *Oscillatoria amphibia Ag., Navicula cryptocephala Kütz şi Scenedesmus apiculatus (W. Et G.S. West) Chod. var indicus (Hgrtob).*

The strain *Oscillatoria amphibia Ag* was collected from a drainage canal in the village Criva, Briceni and separated in the pure culture of Hydrobiology and Ecotoxicology Laboratory of the Institute of Zoology of the ASM, using agarose mediu Gromov. The filaments of *Oscillatoria amphibia Ag* are just wthit color blue-green in colour. The cells have ranging sizes is 4-8.5 μ and in length from 2 to 4 μ.

Terminal cells have rounded ends. They represented a typical, commonly encountered in aquatic ecosystems is the filumului Bacilariophyta *Navicula cryptocephala Kutz*, shell form of spear length and width 20-40 μ μ 5-8.5. These species were collected from the fish ponds in the village Nemoreni and separated in the pure culture, using agarose medium Gromov.

The stain of *Scenedesmus apiculatus (W. Et G.S. West) Chod. var indicus (Hgrtob)* (division Chlorophyta) was collected from the lake Cuciurgan-Bender/Tighina. Filaments of *Scenedesmus apiculatus* consists of 2, 4, 8 oval cells with thickening dished ends, ranging sizes is 9-10.5 μ and in length from 5 to 6.4 μ.

In order to select the optimal nourishing environments of these species there have been used the medium proposed in the Register of the Cultures of Microalgae of the URSS Collection [5].

Cultivation was performed in laboratory conditions, the balloon Erlenmayer (250 ml) with 100 ml of medium for 12 days. The experiments were conducted at a temperature of 27 to 32 °C and 18-20 °C.

As for growing strain of *Oscillatoria amphibia Ag.* were used medium Gromov 6, Schlosser and Elenkin. Quantity biomass inoculate was 2 ml.

RESULTS AND DISCUSSION

As a result of the experiments with the strain of *Oscillatoria amphibia Ag.* it was established that the largest amount (6 g/l) of algal suspension was obtained on growth in an Gromov 6 environment. Gromov 6 medium contained supplementary $NaHCO_3$ (0.2 g/l), but it lacked Fe_3Cl_6 in comparison with the Elenkina environment. As for mineral medium Schlosser was more complex in chemical substances.

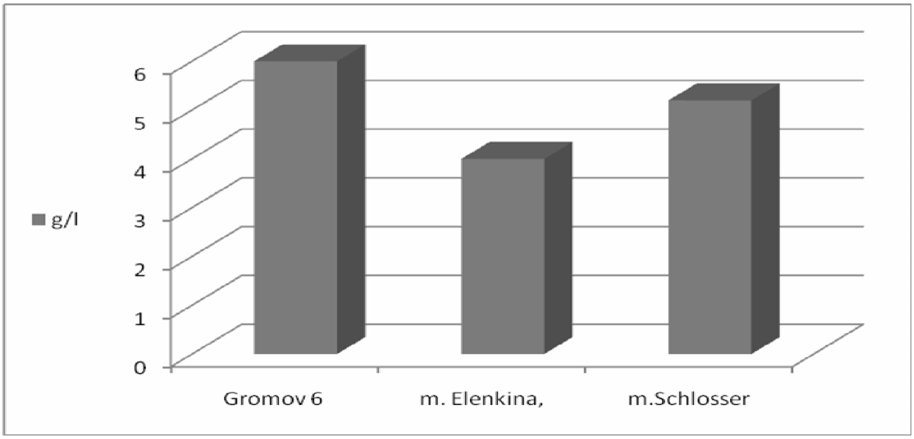


Fig. 1. Quantity of algal biomass of *Oscillatoria amphibia*, grown on different nutrient mediums in the 12th day

In the experiments with *Navicula cryptocephala Kütz* strain there were used the nourishing mediums Rixter and Beneke, that had in their composition the substance Na_2SiO_3, necessary to the shell. The productivity of *Navicula cryptocephala* strain indicated an abundent development in Rixter environment (170 mii cel/ml) (Figure 2.). This was probably due to the larger content of Na_2HPO_4 - 0.5 g/l in comparison with 0.1 g/l from the Rixter medium.

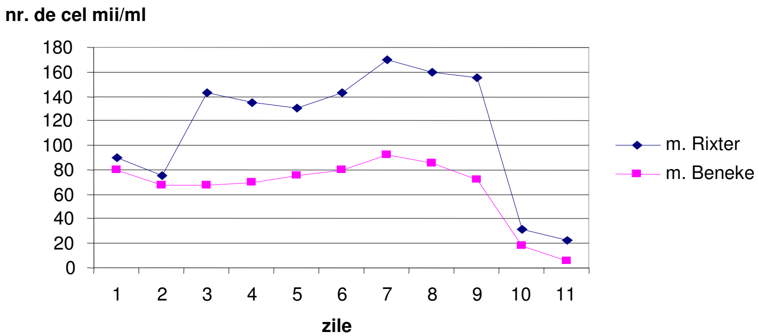
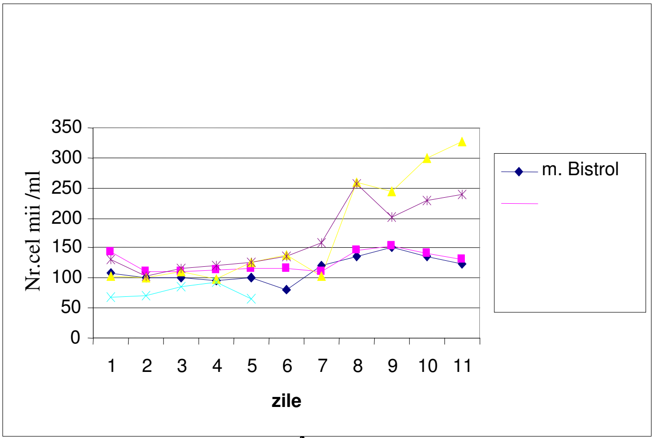
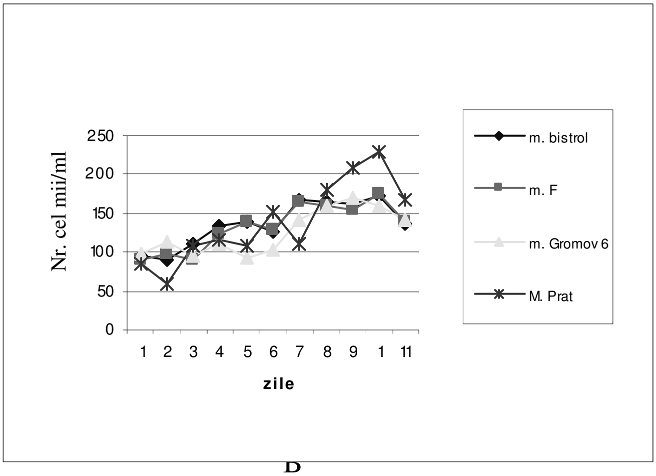


Fig. 2. Development of *Navicula cryptocephala Kütz* species in different nourishing mediums

Figure 3 A, B highlights the development of *Scenedesmus apiculatus (W. Et G.S. West) Chod. var indicus (Hgrtob)* species in different nourishing mediums. For this culture there were tested 2 temperature modes: I- 27-32 °C; II- 18-20 °C. The obtained results indicate that, at the temperature of 27- 32 °C, the culture developed well in Prat medium, the productivity being of 230 thousand of sells/ml. And at a lower temperature of 18-20 °C, the cells of *Sc. apiculatus* grow and multiplied intensively in Gromov 6 medium.



A



B

Figure 2. The development of *Scenedesmus apiculatus (W. Et G.S.West) Chod. var indicus (Hgrtob)* species in different mineral mediums and at different temperatures (A- 18-20°C and B at 27- 32°C).

This confirms the data from the bibliography which state that the green algae, Chlorophyta phylum, develops intensively, generating even the waters efflorescence during the summer period at a high temperature of the water. In spite of the lower concentration of nourishing substances in Prat medium (KNO_3-0.1 mg/l; K_2HPO_4-0.01 mg/l; $MgSO_4$-0.01 mg/l; $FeCl_3$-0.001 mg/l) in comparison with Gromov 6 medium, the said strain developd intensively.

CONCLUSIONS

1. As a result of the performed research, it was stated that the selected strains are subject to growth in laboratory conditions and can be used in different experimental research. The optimal nourishing mediums for the development and reproduction of the strains are: Gromov 6 for *Oscillatoria amphibia Ag*., Rixter for *Navicula cryptocephala Kütz.* For *Scenedesmus apiculatus (W. Et G.S. West) Chod. var indicus (Hgrtob)* - Gromov 6 at low temperatures (18-20 °C) and Prat at higher temperatures (27- 32 °C). The obtained results indicate that each species has its physiological and biochemical specific that influences a specific developments. The experiments carried out demonstrate that the selected mediums can be proposed for strain growth and biotechnological tests.

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PRELIMINARY DATA CONCERNING SOME INVERTEBRATE BIODIVERSITY COMPONENT FOR PREDELUȚ- BRAN REGION - AN EXAMPLE OF INTERDISCIPLINARY TEAM IN BIOLOGICAL PRACTICE

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Keywords: *invertebrates, biological practice, Predeluț-Bran, team*

Abstract

During the biological practice developed in Predeluț-Bran region (Brasov County) in the summer of 2009 by second-year students of Faculty of Agriculture, Biology Specialization from UASVM Bucharest, were collected specimens of terrestrial and aquatic invertebrates, belonging to the macro-taxa: Gastropoda, Arachnida, Crustacea, Myriapoda and Insecta.

Some of the samples were sorted and identified directly in the Predeluț Practice Centre, the rest of the material being properly preserved and transported to laboratories in Bucharest in order to examine it. Collection, preservation and identification of invertebrates species, were due to sustained work of a team composed of 23 students, three teachers and three researchers with experience. At some stages of future practice, we whole picture on local invertebrate biodiversity potential, completing concomitantly the collections of invertebrate zoology laboratories from UASVM Bucharest.

INTRODUCTION

At 25 km West of Braşov, on the road that goes through the old neighborhood Bartolomeu and links for centuries the great city at the foot of Mount Tâmpa with Câmpulung Muscel, where Piatra Craiului separates by Bucegi Massif, the villages of Bran lines up. They were born together with Bran old legend, the one who had several sons and gave them to the eternal possession the 15 villages and hamlets of today, namely: Poarta, Sohodol, Predeluț, Simon, Moieciul De Jos, Moieciul De Sus, Cheia, Peştera, Coacăza, Măgura, Drumul Carului, Şirnea, Fundata, Fundățica. They are placed at an altitude between 750 and 1200 m, are scattered along the old ways of connection between Transylvania and Wallachia, the Bran Pass [1].

Since the summer of 2009, second-year students of the Biology specialization, performs work practices within the Practice Center in Food Services and

Agroturism from Predeluț village, provided by the Faculty of Management, Economic Engineering in Agriculture and Sustainable Development in Bucharest.

Professional practice is a compulsory discipline in the curricula of biologist students, to main aim followed being the assimilation of knowledge gained in the field, and also setting concepts previously taught in school (Figure 1).

The objectives set during practice were identifying and describing the family taxa character for various specimens from endemic flora and collecting of a significant number of local macro invertebrates, for study. Some animal samples have been preserved in alcohol and brought to Bucharest for the expanding collection of invertebrate zoology laboratory.

Fig. 1. Second-year Biology students in Predeluț (July 2009)

MATERIAL AND METHODS

Each student has noted daily in the field books, theoretical concepts and actions carried on. The categories of collected invertebrates were systematic described using keys determinants [14], in parallel with some microscopy sessions.

Fig. 2. Sampling of aquatic insect larvae in a brook of Predeluț

The required equipment for research activities in the field or in laboratory, included: binocular microscopes, kidney dishes, Petri dishes, Eppendorf micro tubes, other sterile containers, disposable bags, tweezers, entomology needles, paper tracing, graph paper, calipers, surgical gloves, medical alcohol, alcohol 70%, 5% formaldehyde, adhesive labels, writing tools.

In order to sampling, were undertaken field trips in the Predeluț neighborhood, near Bran Castle, and also in the Râşnoava Keys. The biotopes of interest were both terrestrial (myriapods, insects, araneids, isopods, gastropods), and aquatic (insects) (Figure 2).

Fig. 3. Student Iulia Crețu identifying invertebrates in Predeluț Practice Center

A part of biological material was sorted out and determined even in Predeluț Practice Center (Figure 3). The remaining samples were properly preserved and transported for study in laboratories from Bucharest, to the specialists of the Agriculture Faculty (Minodora Gutue, insects), "Emil Racoviță" Institute of Speology Bucharest (Andrei Giurgincă, isopods and myriapods), but also in the National Museum of Natural History "Grigore Antipa" Bucharest (Oana Paula Popa, gastropods, Costică Adam, spiders).

RESULTS AND DISCUSSION

Examination the collected invertebrates from the perimeter of Predeluț-Bran region, led to the identification of the following macro taxa categories: *Mollusca* (*Gastropoda*) [4, 5, 6], *Arachnida* (*Araneae*) [2, 3, 7, 12, 15], *Crustacea* (*Isopoda*) *Myriapoda* (*Diplopoda, Chilopoda*), *Insecta* [11] (Table 1).

Table 1

Invertebrate list identified so far, showing the biodiversity potential in Predeluț-Bran region

Mollusca (Gastropoda)	**Arachnida** (Araneae)	**Crustacea** (Isopoda)	**Myriapoda** (Diplopoda/Chilopoda)	**Insecta**
Chilostoma faustina Rossmässler, 1835 *Cochlodina laminata* Montagu, 1803	*Enoplognatha ovata* Clerck, 1757 *Tetragnatha pinicola* L. Koch, 1870 *Pardosa amentata* Clerck, 1757 *Tegenaria domestica* Clerck, 1757	*Porcellio scaber* Latreille, 1804	*Cylindroiulus luridus* C. L. Koch, 1847 *Dorypetalum degenerans* Latzel, 1884 *Lithobius nodulipes* Latzel, 1880 *Strigamia crassipes* C. L. Koch, 1835	*Baetis* sp. *Dociostaurus maroccanus* Thunb., 1815 *Philaenus spumarius* L. *Andrena* sp. *Formica rufa* L., 1758 *Carabus violaceus* L., 1758 *Philonthus politus* L., 1758 *Amphimallon solstitialis* L., 1758 *Pentodon idiota* Hrbst., 1789 *Arpedum* sp. *Harmonia 4-punctata* Pontop. *Halyzia 16-guttata* (L.) Mulsant, 1846 *Altica tamaricis* Schrank., 1785

The *Oniscidea* are represented by only one species, *Porcellio scaber*, a common and widespread species not only in Europe but also introduced to many parts of the world [13]. The *Diplopoda* are represented by *Cylindroiulus luridus* and *Dorypetalum degenerans*, the first species was found in Central and East Europe (from Germany and Switzerland to Romania, Italy and Poland but also Serbia, Slovenia, Bulgaria and the Republic of Macedonia), the second species being found in Romania, Sebia, Bosnia and Herzegovina, the Republic of Macedonia and

Hungary [8]. Like the *Diplopoda*, the *Chilopoda* are represented by only two species, namely *Lithobius nodulipes* (a species found in Central Europe and the north-western part of the Balkans) and *Strigamia crassipes* (a species spread in the entire Europe) [10].

ACKNOWLEDGEMENTS

We would like to thank Cosmin Vîlcu (Faculty of Management, UASVM Bucharest), who was a useful guide in our field trips, during the summer of 2009.

CONCLUSIONS

1. The present paper presents some preliminary data concerning the estimating of biodiversity invertebrate component in Predeluț-Bran region.
2. The main macro invertebrate categories, collected during the biological practice with second-year student of Faculty of Agriculture in the summer of 2009, are: *Mollusca, Arachnida, Crustacea, Myriapoda, Insecta*.
3. Collection, preservation and identification of biological material were possible due to some laboratory and field activities carried out by an interdisciplinary team consisting of students, teachers and researchers with experience.
4. A more complete picture of the invertebrate biodiversity of Predeluț area will be made during the future practice stages.

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PRINCIPLES OF DESIGN AND LAYOUT OF A JAPANESE STYLE GARDEN

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Keywords: *design,cha niwa, nature, symbolism, structure*

Abstract

Based on this theme, we have created a perspective of a private Japanese tea garden (Cha niwa), taking into account the characteristics of area of origin influences, as well as the area in which to be located (Snagov, Ilfov County).

The art of Japanese gardens is led by certain principles and rules, being practiced since ancient times by certain types of gardeners (Soseki Muso, Sen no Rikyu) and becoming an artistic profession.

The present paper is an attempt of precise and original integration of the vegetation in the landscape, by using species predominantly used in arranging such gardens.

Thus, there were introduced tree species and shrubs related to the Japanese religious cult, and species of flowering plants belonging to the traditional setting.

Into the spatial arrangement there were introduced shrubs shaped by the old tradition of „bonsai", and rocks of certain colors and sizes, which bring some kind of symbolism by their forms and types of association.

Within the garden, we can also meet original elements, such as traditional Japanese lamps, a tea house that links the ground by a curved bridge, and a pond, always present in these arrangements.

INTRODUCTION

Japanese gardens derive their beauty from a mixing and blending of different elements such as sand, rocks, water, ornaments (lanterns, water basins also named tsukubai and bamboo fences), natural plants and surroundings.

The main object of a Japanese garden is to copy the beauty of nature and to bring it home by adapting it through different techniques, most obvious in the art of Bonsai, and its design is based on three basic principles: reduced scale, symbolization, and borrowed view.

This garden's objectives are to bring a small part of the Japanese culture to the location by using the tea garden principles to embellish the surroundings and to create a place for relaxation and contemplation.

Traditional Japanese landscape gardens can be broadly categorized into three types:

Tsukiyama Gardens (hill gardens). Ponds, streams, hills, stones, trees, flowers, bridges and paths are used to create a miniature reproduction of natural scenery. The name Tsukiyama refers to the creation of artificial hills.

Karesansui gardens (dry gardens). Reproduce natural landscapes in a more abstract way by using stones, gravel, sand and sometimes a few patches of moss for representing mountains, islands, boats, seas and rivers.

Cha niwa gardens (tea gardens). Are built for the tea ceremony and they contain a tea house where the actual ceremony is held and are designed in aesthetic simplicity according to the concepts of sado (tea ceremony).

The actual garden was created according to the cha niwa principles.

MATERIAL AND METHODS

The Japanese garden fundamentals that make the object of this work are guided by several conventional designs and symbols.

This garden has been modelled as miniature representations of a popular scene by strictly observing the arrangement of pathways and led by the rules of the appropriate proportions.

Flowers, lawns and hedges are of no significance in a Japanese garden and that is why they were potted and placed carefully in an appropriate position.

The farther-most mountains are generally higher, lightly drawn and represented by trees and distinct vegetation.

The distant line of the pond is set at a lower level with narrow lines broadening as they approach the center.

Coniferous trees were displayed on the slopes of hills in sideways, creating a background for the flowering shrubs used in the foreground making the landscape suggest greater depth and detail compared to the original.

The garden design was made in such a way that the existing scenery becomes part of the total design.

Raked sand or gravel symbolizes rivers and groupings of stones and rock can represent islands. Shakkei or borrowed view is the use of existing scenery and plants to supplement the garden.

RESULTS AND DISCUSSION

Taking into acount all of the japanese design criteria, have created a tea garden, representing a miniature perspective of a natural landscape and a relaxing garden for reflection and meditation, by introducing the most used and beautiful elements of the cha niwa garden type.

Displaying of certain plant species (Figure 1)

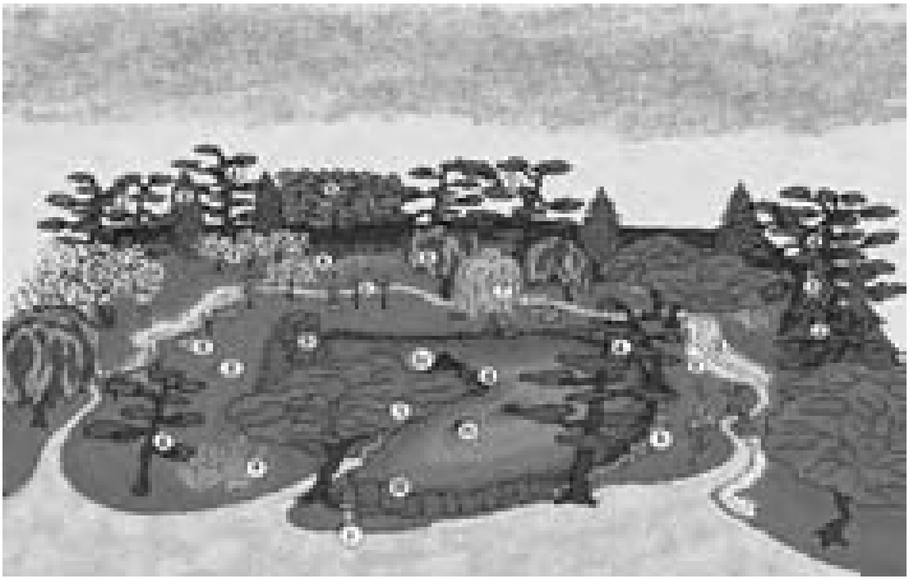

Fig. 1. Main view of the garden

1. *Acer palmatum* (Japanese maple tree); 2. *Pinus sylvestris* (common pine);
3. *Abies concolor* (silver fir); 4. *Pinus nigra* (black pine);
5. *Bambusa vulgaris* (bamboo); 6. *Sophora japonica* var.pendula (Japanese acacia);
7. *Salix alba* (white willow); 8. *Tuja orientalis* (Emerald green);
9. Picea pungens var.glauca (biting spruce);
10. *Magnolia soulangiana* (saucer magnolia); a. *Forsythia intermedia* (forsythia);
b. *Amaryllis* (belladonna lily); c. *Syringa vulgaris* (lilac);
d. *Chaenomeles japonica* (Japanese quince); e. *Cerasus vulgaris* (cherry tree);
f. *Hydragea schizophragma* (oak leaf hydrangeas);
g. *Kerria japonica* (Japanese rose); h. *Nimphaea alba* (water lily).
I. Stone lantern; II. Siting place; III. Rocks; IV. Tea house.

The plants introduced follow the Japanese tradition in which the color tones must be pale in a season passing to bright tones in the next one.

Plants were carefully selected for not only flowering beauty or attractive foliage but their architectural structure as well.

Many plants are indigenous to Japan, though some sacrifice has been made to account for the differentiating climates.

Each plant in the Japanese garden has a beauty on several levels. For example, the Japanese maple (*Acer palmatum*) has beautiful foliage that is often slightly colorful in the growing season and vibrant in autumn, but the branch structure and silhouette is also highly ornamental and eye-catching.

Exhibition of unusual rocks (Figure 2)

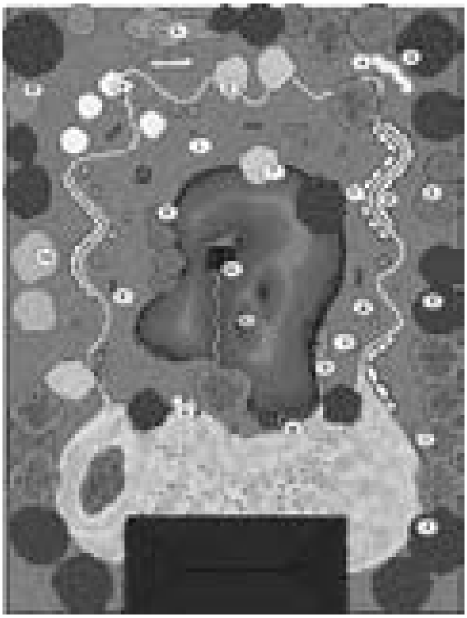

Fig. 2. Exhibition of unusual rocks

I. Stone lantern; II. Siting place; III. Rocks; IV. Tea house.

In the background of the design and rock arrangements of the Japanese garden there is a respect for the nature and abstract representations of the utopian world of the time which were derived from the religion and philosophy.

Therefore, there were used natural stones, only without any artificial processing and arranged on the pond edges and in other central locations, to show many expressions of sometimes dynamic forms and other times extremely subtle and sensitive forms.

Stones were also used to construct the garden paths and walkways.

Rocks, both large and small were used to symbolize land as well as permanence and can actually tell a story in the garden.

Each element has been carefully placed to draw the eye and add to the beauty (too much becomes garish and overdone).

Design elements (Figure 3)

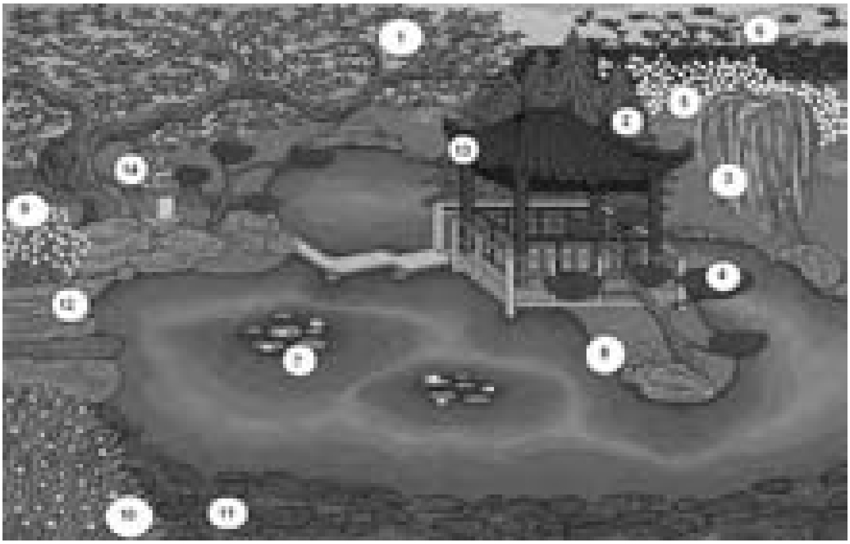

Fig. 3. View over the pond

1. *Acer palmatum* (Japanese maple tree);

2. *Picea pungens* var. glauca (biting spruce); 3. *Salix alba* (white willow);

4. *Pinus nigra* (black pine); 5. *Cerasus vulgaris* (cherry tree);

6. *Pinus sylvestris* (common pine); 7. *Nimphaea alba* (water lily);

8. *Iris germanica* (iris); 9. *Allium moly* (golden garlic);

10. *Amaryllis* (belladonna lily); 11. Water rocks; 12. Surface rocks;

13. Tea house; 14. Stone lantern.

The water source was created in such way that it appear to be part of the natural surroundings and includes the tea house (the sitting area where the visual and aural interest can be best enjoyed), placed on the island from the center of the pond,wich was designed so that complies with the cha niwa garden principles, as well as the lanterns located beside the main alley.

The Japanese garden will be beautiful in any season because it has a carefully constructed structure that never changes and because there are elements of the garden that are attractive at any given time.

Every feature of the Japanese garden has a special significance, place, status and title.

“The first place to seek God is in a garden” and this is very true with the basic spirit of the traditional Japanese design.

CONCLUSIONS

1. The Snagov's Japanese garden have simple, clean lines and reflect nature symbolically.
2. The main four planted species (*Acer palmatum*, *Pinus sylvestris*, *Cerasus vulgaris, Bambusa vulgaris*) are very impotant and representative for the Japanese garden thanks to their shape, size, colour and symbolism.
3. The rocks are strictly related to the japanese cult by their powerfull symbolic signification, and are used to embellish and to bring more originality to the japanese tea garden type.
4. The design elements (lanterns, tea house, bridge) and the pond are part of the cha niwa japanese garden and are used for contemplation and relaxation.

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AN INVESTIGATION INTO HOW DIESEL FUEL ADDITVES AFFECT EXHAUST GAS EMISSIONS, POWER, TORQUE AND FUEL CONSUMPTION

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Keywords: *Diesel, fuel additives, power, torque, temperature, emissions*

Abstract

The report aims to show how horsepower, torque, emissions, temperature and fuel consumption are affected by the addition of aftermarket fuel additives, which are claimed to improve exhaust emissions, engine performance and fuel economy. Four different diesel fuel additives and one blend of "super diesel" were critically evaluated and compared with the data obtained from conventional low sulphur road diesel used as the bench mark. Using a Fendt 415 fitted with a four cylinder, sixteen valve turbo charged common rail, tier III, diesel engine and a Fromet Sigma 5 power take off (PTO) dynamometer a series of controlled tests were carried out to determine the effects of fuel additives.

INTRODUCTION

Global warming and climate change is a world wide issue, the latest G8 Conference (7^{th}-18^{th} December 2009), representing the richest nations, also agreed for the first time that it should collectively cut emissions by 80% by 2050, and that the world should be able to cut its emissions by 50% by the same date. It is alleged that burning fossil fuels (coal, oil, gas) produces carbon dioxide (CO_2); CO_2 acts as a blanket, which traps more of the sun's energy and warms the earth's surface and modern day power and transport needs contribute to the increased levels of CO_2 in the atmosphere[1].

The reason why fuel additives are becoming more noticed in industry is because manufacturers both of the vehicles and the fuel companies are being enforced by the government to reduce the carbon footprint in accordance with the European emission laws. Fuel additives are one way in which the manufacturers can achieve this. (Emission standards, 1997)[2].

The range of additives selected was based on price[3], availability and alleged reputation[4]. It was important that these additives were related to the power output of the engine, the specific fuel consumption and exhaust gas emissions.

MATERIAL AND METHODS

Test Equipment

Dynamometer: A Fromet Sigma 5 PTO dynamometer fitted with an on board computer, programmed to carry out a test cycle which could be replicated for each fuel sample under test[5].

Emissions Analyser: The emissions analyser was a Testo 350XL hired in for the duration of the test. The Testo 350XL is capable of reading the following exhaust gases; Nitrogen Oxide (NO), Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), Carbon Dioxide (CO_2), Oxygen (O_2) and the exhaust temperature[6].

Method: Fuel for testing was accurately made up into 10 litre samples following the fuel additive manufacturer's recommendations for concentration; the tractor fuel system (Fendt 415)[7] was adapted to use the fuel directly from the containers, a separate sample of the fuel was run through the fuel system prior to commencing the test. Three test runs were made for each fuel sample and an average reading calculated. The fuel samples consisted of four commercially available additives and a super diesel, which all manufacturers claim to improve economy, performance and reduce emissions.

Test results were bench marked against low sulphur diesel EN 590[8].

The dynamometer was programmed to load the tractor engine from maximum revolutions per minute to engine stall; power and toque data was automatically recorded at 30 second intervals. The exhaust gas was monitored in the exit point of the exhaust pipe on the tractor, the data being collected at regular intervals throughout the cycle. The collected data was analysed and compared to the data collected when standard low sulphur diesel fuel was used.

It was difficult to identify the chemical content of the additives used; however, extensive research identified the use of the chemical cerium oxide as one of the additives and according to G. Wakefield and M. Gardener[9] the addition of cerium oxide at a concentration of 5-8 ppm has the effect of improving fuel economy between 5-8%

RESULTS AND DISCUSSIONS

All tests were carried out without any problems occurring and the data collected proved an interesting comparison to claimed performance.
From the available data not one of the fuel samples provided an overall improvement on economy, power and torque; for the emission additive "A" provides the most significant improvement.

All additives provided an increased economy with very little change to power and torque figures and the cost effectiveness of using additives for economy need to be compared to litres of fuel used per hour or in the case of road going vehicles litres used per 100km.

Additive "A" reduced the impact of CO_2, whereas additives "B" and "E" increased the levels.

Table 1

The maximum PTO horse power produced from test samples

	Power outputs (HP)			
	Test 1	**Test 2**	**Test3**	**Average pto/hp**
Additive A	150.4	150.9	151.2	150.86
Additive B	150.9	151.6	151.6	151.36
Additive C	150.6	151.4	151.1	151.03
Additive D	150.9	151.5	151.9	**151.43**
Additive E	150.9	151.7	151.2	151.26
EN509 Diesel	150.7	151.5	151.3	151.16

Table 2

The maximum torque produced from test samples

	Power outputs (Torque Nm)			
	Test 1	**Test 2**	**Test 3**	**Average**
Additive A	1282.60	1279.89	1277.18	1279.89
Additive B	1281.25	1288.03	1285.32	1285.32
Additive C	1279.89	1281.25	1279.89	1279.89
Additive D	1286.67	1281.25	1290.74	**1286.67**
Additive E	1288.03	1281.25	1281.25	**1286.67**
EN509 Diesel	1282.60	1283.96	1281.25	1282.60

Table 3

The amount of fuel used during each test run

	Fuel consumed during each specific test (litres)
Additive A	5.4
Additive B	5.15
Additive C	**5.05**
Additive D	5.25
Additive E	5.2
EN509 Diesel	5.5

Table 4

Exhaust gas emissions and temperature

Average emissions and temperature during each test						
	O_2%	**CO ppm**	**CO_2%**	**NO ppm**	**NO_2 ppm**	**FT ºC**
Additive A	11.07	**55.33**	**5.88**	**521.76**	40.11	**309.29**
Additive B	10.77	65.52	6.14	537.76	**38.39**	322.74
Additive C	10.79	60.76	5.97	547.33	39.23	318.94
Additive D	**10.70**	67.86	6.01	542.43	40.00	317.6
Additive E	10.99	55.71	6.94	535.00	39.93	314.38
EN509 Diesel	10.91	58.71	5.92	530.24	38.26	316.82

Table 5

Analysis of available data

Analysis of test results: percentage change									
	Econom y	**Power**	**Torqu e**	**O_2%**	**CO ppm**	**CO_2%**	**NO ppm**	**NO_2 ppm**	**FT ºC**
	%	%	%	%	%	%	%	%	%
Additive A	*+1.81*	*-0.20*	*-0.21*	*+1.57*	**-5.76**	**-0.68**	**-1.6**	*+4.83*	**-2.38**
Additive B	*+6.36*	*+0.13*	*+0.21*	*-1.28*	*+11.60*	*+3.7*	*+1.42*	**+0.34**	*+1.97*
Additive C	**+8.18**	*-0.09*	*-0.21*	*-1.09*	*+3.49*	*+0.84*	*+3.22*	*+2.54*	*+0.67*
Additive D	+4.55	**+0.18**	**+0.32**	**-1.92**	*+15.58*	*+1.52*	*+2.30*	*+4.55*	*+0.25*
Additive E	+5.55	+0.07	**+0.32**	*+0.73*	*-5.10*	*+17.23*	*+0.90*	*+4.36*	*-0.77*
EN509 Diesel	100	100	100	100	100	100	100	100	100

CONCLUSIONS

1. The improved economy, which is in line with Wakefield and Gardner's research, is of a significant impact to consider using an additive, providing it is cost effective
2. The effect on power and torque is unlikely to be noticed by the operative.
3. The effect on emissions is negative in all but two examples.
4. The tractor engine is a current tier III, future legislation is for tier IV and V to be introduced into the agricultural sector. Future research needs to focus on the effects of fuel additives on the more sophisticated engines

5. The format of the test may need to be revised, the current test measured the results from a programmed power/torque test, it is suggested that a series of programmed working cycles would give a more accurate data profile.

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