MINISTRY OF EDUCATION, RESEARCH, YOUTH AND SPORT

UNIVERSITY OF AGRONOMIC SCIENCES AND
VETERINARY MEDICINE
BUCHAREST

FACULTY OF AGRICULTURE

SCIENTIFIC PAPERS

SERIES A

LIV

2011

AGRONOMY

Scientific Papers UASVM Bucharest, Series A. Agronomy	Vol. LIV	1	p. 1 - 538	Bucharest	2011

ISSN 1222-5339

***

Editorial board and administration:
59 Mărăşti Blvd.
Bucharest
011464, Romania
Exchange of publications is done with institutions in Romania and abroad.

*

Rédaction et administration:
Blvd. Mărăşti n° 59
Bucarest -1
011464, Roumanie
Les publications de la faculté sont offertes en échange aux institutions similaires du Roumanie et de l'étranger.

*

Redaktion und Verwaltung:
B-dul Mărăşti nr. 59
Bukarest, Sektor 1
Cod 011464, Rumänien
Es wird Austausch von Veröffentlichungen mit ähnlichen Behörden vom in- und Auslande angeboten.

*

Redacția şi administrația:
B-dul Mărăşti nr. 59
Bucureşti, sectorul 1
Cod 011464, România
Se face schimb de publicații cu instituțiile similare din România şi străinătate.

***

CONTENTS

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

ADAPTIVE - LANDSCAPE MODEL OF AGRICULTURAL ECOLOGICAL BIOTECHNOLOGIES

GH. JIGĂU

State University of Moldova

Keywords: *agricultural ecological biotechnologies, landcape adaptation, agroecosystem biologization, pedogenetical processes renaturation*

Abstract

The adaptive lanscape model of agricultural ecological biotechnologies is based on the rules and mechanisms of steppe ecosystems that functioning in natural regime, which implies the insurance of a lower difference between local practiced agroecosystem and natural steppe ecosystems. Therefore, the basic principles of agricultural ecological biotechnologies are: agroecosystem adaptation to the landscape conditions, agroecosystem biologization,pedogenetical ambience conservation and renaturation of zonal pedogenetical process.

INTRODUCTION

In spite of the fact that ecological agriculture became an basic topic of the guvernamental programs, and also an UE priority, till nowadays on different decision levels and especially of production, the agricultural ecological practices are simplistic perceived. The views are reduced to the non using of fertilizers or synthetical plant protection products, manure aplication etc. In ambiental chapter, the ecological agriculture is reduced just to the soil amelioration and sustaining of the soil productive function, of biodiversity and soil structure etc. [3]. But in fact, the ecological agricultural practices presents complex systems not less sophisticated than agricultural industrialized systems.

MATERIAL AND METHODS

According to the law CE 834/2007, key subsystems of agricultural ecological technological systems remain characteristic components of intensive technologies: crop rotation; soil processing; fertilization; seed/planting material and sowing; management of fertility factors (production); protection against weed/pests/desease/; harvest.

According to the content of technological systems the main components of the regional ecological agricultural model are: landscape adaptation of agroecosystems; biologization of agroecosystems and biodiversity promotion of agricultural ecosystems; pedogenesis ambience conservation and renaturation of pedogenesis processes;

restoring of the volume/balance and biochemical circuit of substances; enlarged reproduction of the soil fertility; restoration of soil functions and their trend insurance of natural evolution [2].

Due to promoting the above named technological ecological systems, is basing on systems and ecological natural cycles. Hence the performance indices of technological ecological systems are: high degree of performance and intensity, according to the ecological agricultural principles; combining the ecological aims with the economical one; utilization at the maximum efficiency of the natural potential and reduction of the material and financial costs to obtain one production unit; reduction/avoidance of the soil degradation processes; ensure the integrity of the production process; emphasis placed on hygienic, ecological and biological production quality; promoting a new agricultural ethic.

In base of the above ideas, was developed the support of the agricultural ecological technologies (Figure 1).

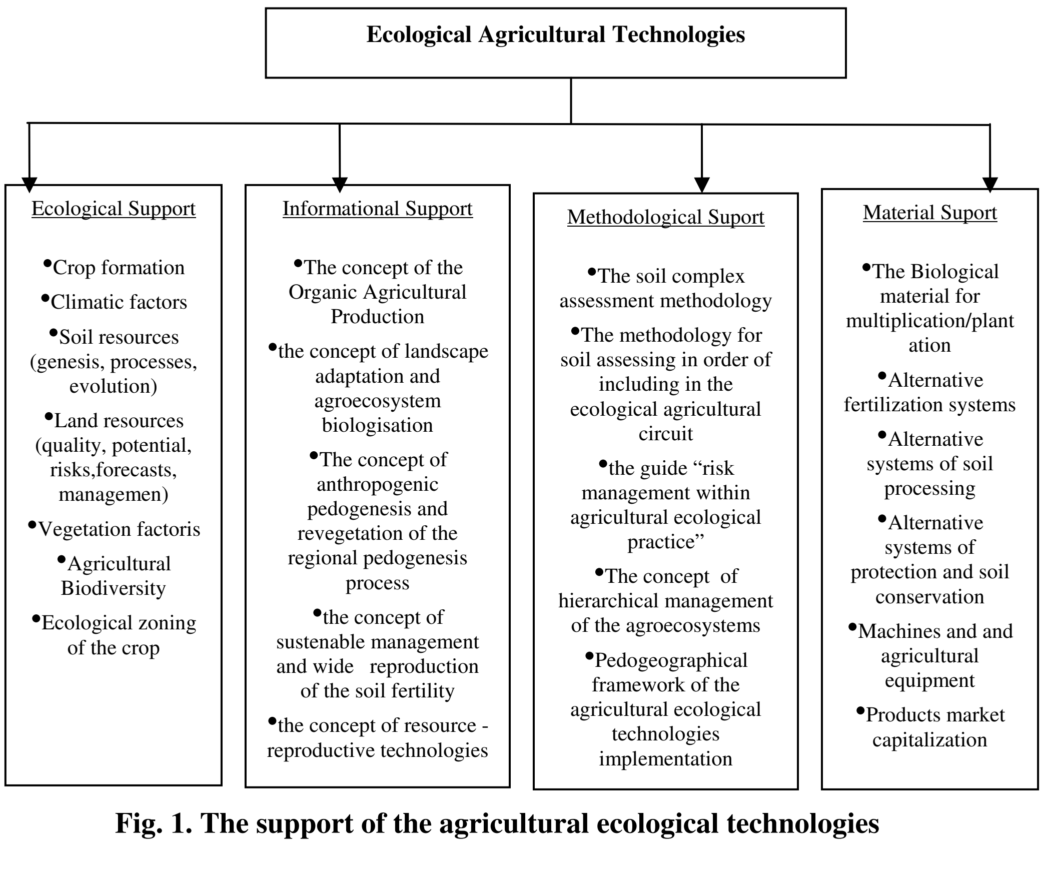


Fig. 1. The support of the agricultural ecological technologies

RESULTS AND DISCUSSION

At present in the world exist several models of agricultural ecological practices: biologic, including biodynamic, organic and organo-vegetal. These were developed in different periods in Europe, being conformed to the bio- and pedoclimatical framework of the region space. The achievements from naturalist pedology field, especially achievements registered at the compartment of pedogenesis theory and aplication of the soil physical principles for the pedogenesis process evaluation [1], created the conceptual-methodological framework of developing one special adaptive landscape model used for the carpato-danubiano-pontical region (Figure 2, Table 1).

CONCLUSIONS

1. The adaptive lanscape model of agricultural ecological biotechnologies is based on the rules and mechanisms of steppe ecosystems that functioning in natural regime, which implies the insurance of a lower difference between local practiced agroecosystem and natural steppe ecosystems. Therefore, the basic principles of agricultural ecological biotechnologies are: agroecosystem adaptation to the landscape conditions, agroecosystem biologization, pedogenetical ambience conservation and renaturation of zonal pedogenetical process.

REFERENCES

1. Jigău Gh., 2009. *Geneza şi fizica solului*. Chişinău, CEP USM.
2. Jigău Gh., 1998. *Însuşiri şi regimuri fizice, rolul ecopedologic*. Chişinău.
3. Jigău Gh., 2010. *Conceptual and metodological framework in the implementation of the resource-conservative tehnologies in the Carpatho-Danubian-Pontic area.* Prezent Environment an Sustainable Development, Ed. Univ. „Al.I. Cuza", Iaşi, V. 4 (pp. 25-38).

Table 1

Hierarchical levels of implementation of the ecological agricultural technologies

Hierarchical level	**The involved technogen factors**	**Landscape functions**	**Intrinsic factors**	**Evaluated parameters**
0 00	Biological characteristic of the plants. Physical traits which cause the biological potential use of the plant.	Soil – support for the plants. Soil – development environment for the root system. Soil – water/air/heat/nutrition provider.	Granulometric composition. Apparent density. Cohesion and penetration resistance.	Granulometric composition. Apparent density. Differential porosity.
1 10	Idem + solar radiation + temperature. Physical traits which favors the radiation potential exploitation.	Soil – surface receiving solar radiation, transformer and heat provider.	Termical adsorption capacity. Specific heat. Thermal conductivity.	Humus content and component. Granulometric composition. Differential porosity.
2 20	Idem + water resources (rainfall, irrigation) Physical trats determining water resource valorisation.	Soil – surface participating in water circuit within nature. Soil – water storage, reservoir and supplier.	Permeability for water. Hydraulic Conductivity. Water capacities (maximal – molecular, field, capilar, total).	Granulometric composition. Apparent density. Differential porosity.
3 30	Idem + transformation of substance and biogeochemical circuit constitution of substances. Physical traits which determine the sens and intensity of transformation processes of substances and the constitution conditions of biogeochemical substances circuits.	Soil – storage and transformation space of organic debris. Soil – space for the substances interaction from the big geological circuit with the small biological circuit.	Hydrothermal regime. Airhydrical regime. Oxido reduction regime.	Differential porosity
4 40 401 402 4021 4022 403 404	Idem + practiced technologies. Physical traits which determine practiced technologies. Irrigation. Fertilization. Mineral fertilization. Organic fertilization. Process system. Protection and conservation measures.	Soil – space of substances migration – accumulation. Soil – space of fertilizers / amendment administration – transformation. Soil – body of modeling thru agricultural processing.	Porous space (volume, size, stability, continuity).	Granulometric composition. Apparent density. Structure, hydro-stability.

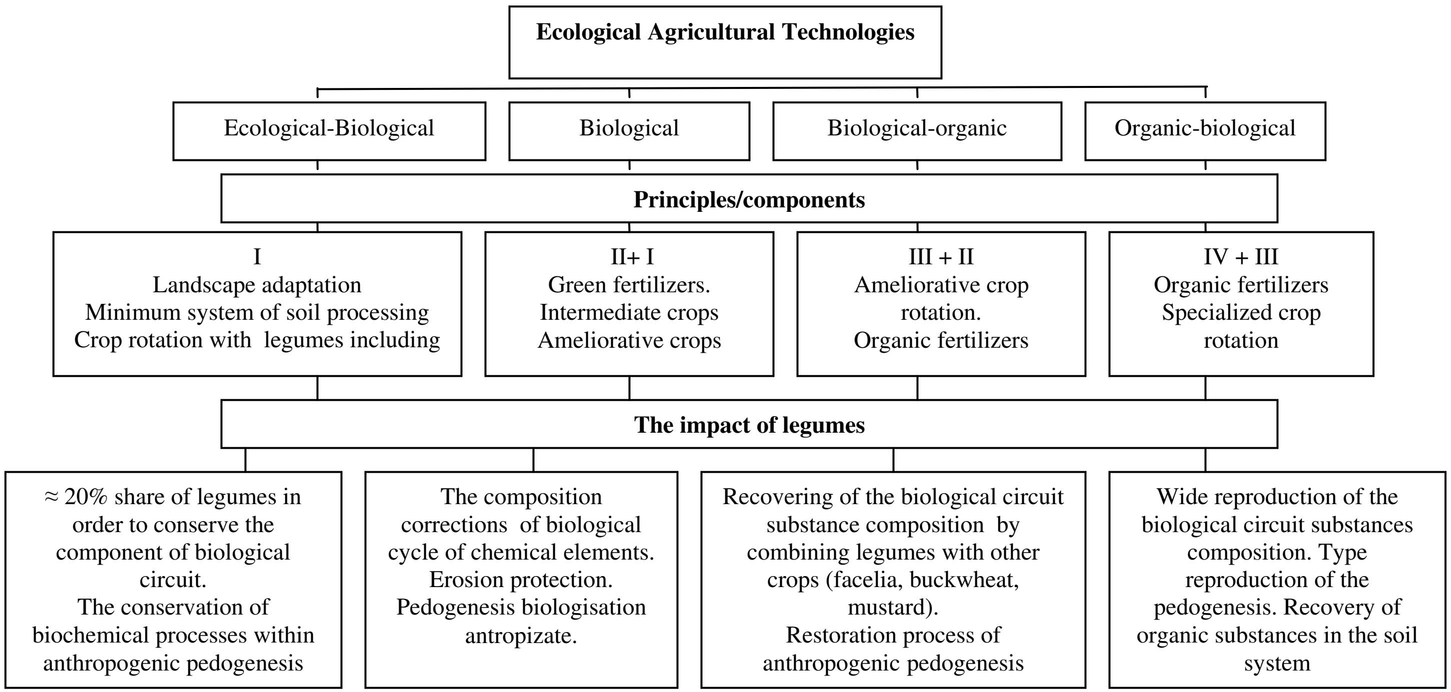


Fig. 2. Conceptual-methodological framework of the ecological agricultural technological resource implementation

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

STRUCTURAL - FUNCTIONAL LEVELS OF SOIL SYSTEM INTEGRATION, PROCESSES AND EVALUATION INDICES

GH. JIGĂU

State University of Moldova

Keywords: *system, soil, hierarchical subsystem, hierarchical levels, structural-functional organization*

Abstract

Pedogenesis process implies the formation of one complex system within which distinguish more several hierarchical subsystems. The last corresponds to certain structural – functional organizational levels: ionic-molecular level ↔ elementary particle ↔ aggregate ↔ horizon ↔ pedon. Due to this fact, both the soil constitution process as well its functioning implies hierarchical correlated processes, that ensure the self - reglation, self - managing and self - reproduction.

INTRODUCTION

According to I.P. Ghermanov, the pedogenesis process is the interaction of three elementary groups of processes: a) decomposition - transformation and synthesis of mineral compounds; b) decomposition - transformation and synthesis of organic substances; c) migration and accumulation of the mineral and organic substances (Gherasimov, 1973,1975). Later, this aspects were developed in the scientific works of [5, 6, 7, 3, 1]. Within specified research, the elementary pedogenetic processes were systematized depending by pedogenetic effects, mechanisms, interactions etc. (Figure 1). A simple analisys of pedogenetic elementary processes suggests that these are characteristic also for other physical bodies (sludges, river deposits, etc.), their role consists in involving inside the parental layer some new traits. In the same time, these don't show the formation mechanisms of soil system, wich differs from other biorutinar systems by the distinct structural - functional organization.

MATERIAL AND METHODS

Starting from this, Gh. Jigău proposed the grouping of the elementary pedogenetic processes depending on the implication in the structural-functional organization of the soil: **a)** structural-accumulative; **b)** structural-organizational and **c)** structural-morphogenetic (Gh. Jigău 2009). The time sequence and the group interaction of mentioned processes, lead to soil constitution in one organized form wich involve both the certain arrangement of primary and secondary particle, as well as the space between these, and one certain differential vertical distribution in characteristic successive layers. Specialy this arrangement of particle and sequence of layers defines or characterize the soil itself or the pedon as natural body with special organization and morphology, features and qualities determined by both the mentioned constituents wich are in interaction and interconditioned as well their vertical distribution. All this ensemble integrates into the soil system wich is one structural-functional unit [1].

RESULTS AND DISCUSSION

The structural/functional integration and organization implies hierarchization of entire process of soil formation in succession on subsystems with diferent levels of organization more complex. Each level of organization has its own relationships and specific rules (Table 1, Figure 2).

Because of the structural/functional organization, the soil systems has integral, historical, informational and antientropic character, as also capacity for self-conservation, self-regeneration, self-regulation and self -development from simple to complex forms of organization. The antientropic character give them stability in the relation with the other systems from the environment.

Hieracly of the structural-functional integration processes of the soil system ant their evaluaton indices are presented in the table 2. In this context, we can consider that the pedogenesys, respectively, soil system formation and quality indices formation is the structural-functional integration of the pedogenetic effects achieved on various operating levels as followes: ionic-molecular level $\rightleftarrows$ elementary particle $\rightleftarrows$ aggregate $\rightleftarrows$ horizon $\rightleftarrows$ pedon.

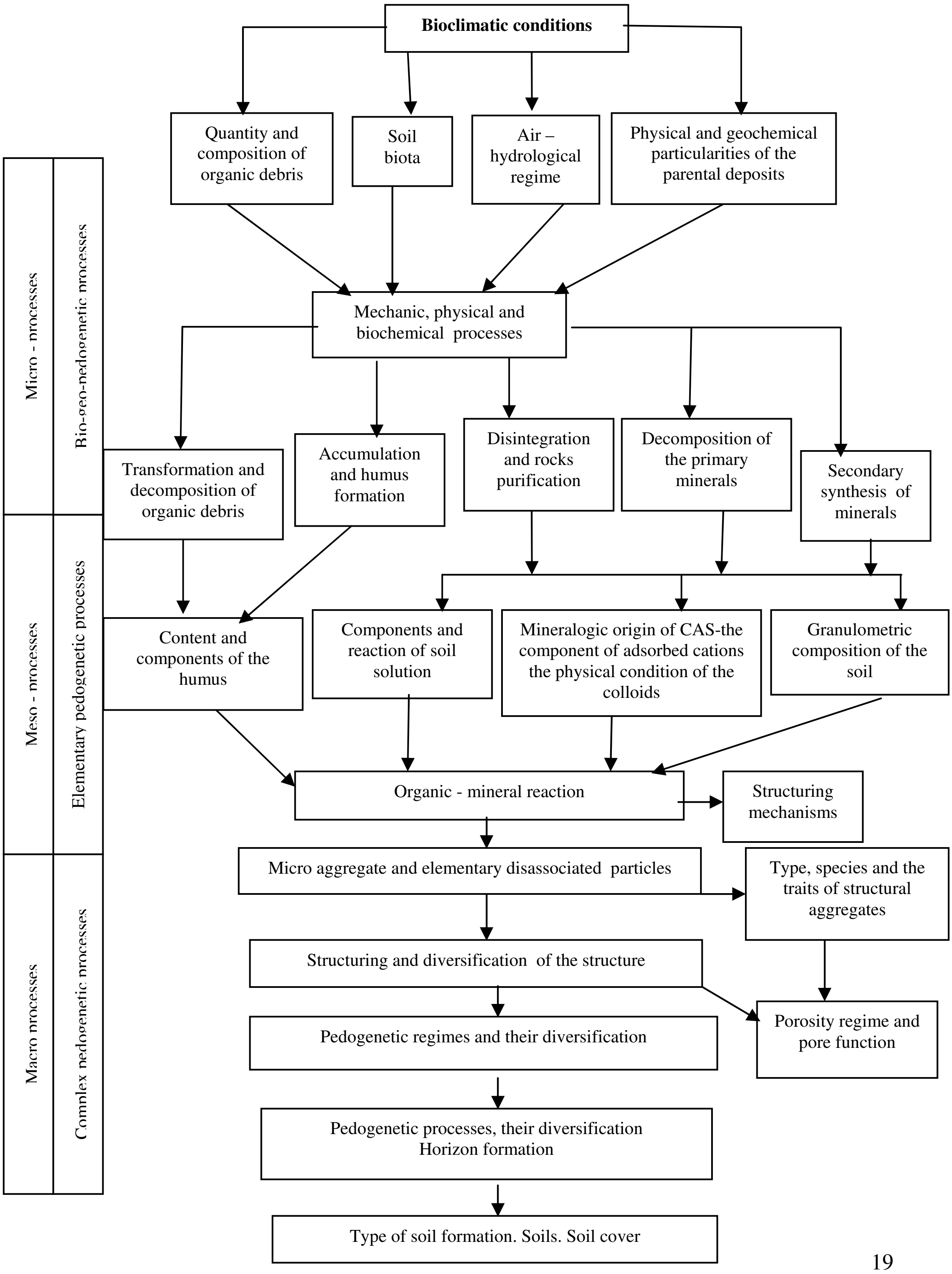
CONCLUSIONS

1. Pedogenesis implies the formation of one complex system within which distinguish more several hierarchical subsystems. The last corresponds to certain structural-functional organizational levels: ionic-molecular level ↔elementary particle↔aggregate↔horizon↔pedon.
2. Due to this fact, both the soil constitution process as well its functioning implies hierarchical correlated processes, that ensure the self-reglation, self-managing and self-reproduction.

REFERENCES

1. Jigău Gh., 2001. *Interacţiunea proceselor elementare în cadrul pedogenezei*. Solul şi viitorul, Chişinău (pp. 48-55).
2. Florea N., 1994. *Consideraţii asupra conceptului actual de pedogeneză*. Factori şi procese pedogenetice în zona temperată, Iaşi: Ed. Univ. "Al. I.Cuza", Vol. 1; (pp. 201-211).

3. Lupaşcu Gh., Gh. Jigău, M. Vârlan, 1998. *Pedologie generală*. Ed. Junimea, Iaşi (pp. 400).
4. Герасимов И.П., 1976. *Генетические, географические и исторические проблемы современного почвообразования*.Москва: Изд-во Наука (pp. 298).
5. Ковда В.А., 1973. *Основы учения о почвах. Кн.1. Общая теория почвообразовательного процесса*. Москва: Изд-во Наука (pp. 447).
6. Розанов Б.г., 1983. *Морфология почв*. Москва: Изд-во МГУ (pp. 320).
7. Florea N., L. Ilie, Daniela Răducu, 2005. *Morfologia şi geneza solului*. Bucureşti (pp. 276).



Bioclimatic conditions
Quantity and composition of organic debris
Soil biota
Air – hydrological regime
Physical and geochemical particularities of the parental deposits
Micro - processes
Bio-geo-pedogenetic processes
Mechanic, physical and biochemical processes
Transformation and decomposition of organic debris
Accumulation and humus formation
Disintegration and rocks purification
Decomposition of the primary minerals
Secondary synthesis of minerals
Meso - processes
Elementary pedogenetic processes
Content and components of the humus
Components and reaction of soil solution
Mineralogic origin of CAS-the component of adsorbed cations the physical condition of the colloids
Granulometric composition of the soil
Organic - mineral reaction
Structuring mechanisms
Micro aggregate and elementary disassociated particles
Type, species and the traits of structural aggregates
Macro processes
Complex pedogenetic processes
Structuring and diversification of the structure
Porosity regime and pore function
Pedogenetic regimes and their diversification
Pedogenetic processes, their diversification Horizon formation
Type of soil formation. Soils. Soil cover

Fig. 1. Hierarchy and interaction of the elementary soil formation processes and pedogenetic elementary processes

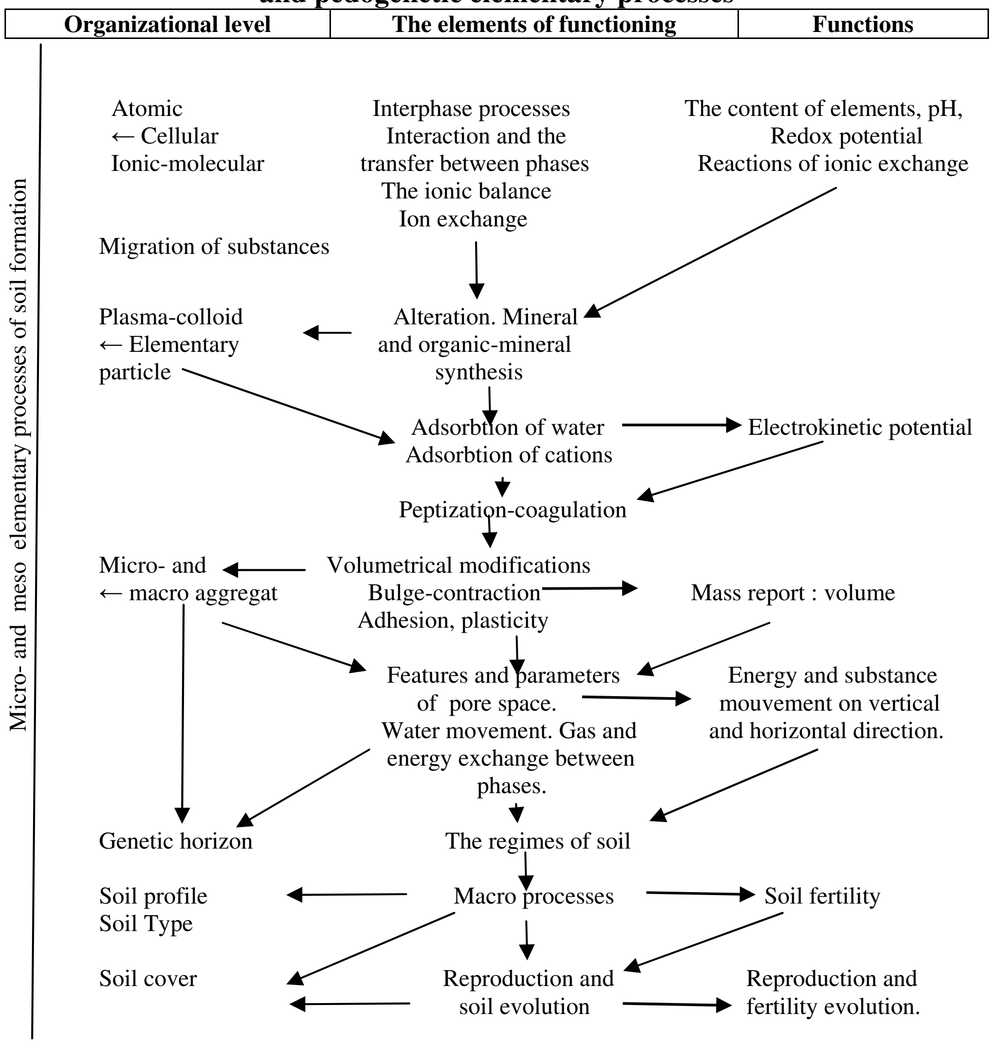


Fig. 2. Elements of functioning and pedon formation

Table 1

Structural - organizational levels of the soils and their main traits

Structural level	Structural elements	The particle size, mm	Specific processes	Specific changes and other features	Soil traits determined by the level
Atomic Ionic-molecular	Ions, stable radicals, mineral matrix (oxides, hydroxides, salts, carbonates, gypsum, aluminosilicates), organic matrix (protein, polysaccharides, nucleic acids, humic acids, fulvic acids)	$10^{-7} – 10^{-4}$	Chemical reactions	Formation of new chemical and mineral compounds	Physical-chemical, physical, permeability, pH, filtration, cationic exchange capacity, degree of substance mobility, of water mobility, mechanic, rheologic
Plasmatic - colloidal Elementary particle	Mineral matrix. humic - mineral, ferment - mineral, micro organism - mineral matrix, ultra mineral aggregate matrix	$10^{-4} – 10^{-3}$	Surface reactions (sorption and desorption) Participation to physical-chemical equilibrium establishment	The ion and molecules exchange between solid and fluid phase. Is influenced the ionic dynamic and its circuit between soil and plant	Hydro-physical, thermo-physical
Micro aggregate	The organic - mineral matrix	$10^{-3} – 0.5$	Water retention	Storage, water conservation and its circuit in the soil and between soil and plant	Thermo physical, the degree of water mobility and water accessibility
Aggregate	Micro aggregate, cutanes, manganese	0.5 – 2.0	Water retention inside aggregate, concomitant with air existence between aggregates Water and air permeability insurance. Activities combination of the aerobic and anaerobic micro-organisms (inside the aggregates)	Water and gas exchange between soil aggregates and gaps. Water adsorption (with nutrients) by the plants roots from aggregates. Capillary and gravity forces	Water and air permeability, hydraulic conductivity. Substances migration. Aeration porosity
Horizon	Morphon, neoformations, inclusions	-	Reversible and irreversible reaction, segregation processes. Humus, nutrients, water, air and salts accumulation, by addictions, transformations, migrations. Diffusion processes and local transport	Exchange of different compounds between horizons Morphologic characteristics and specific properties formation, including the neoformations	Morphologic traits. Geochemical barriers
Profile	Horizons	-	Translocations and accumulations in the soil (predominantly on vertical direction) Humus, nutrients and water reserves formation etc. The dynamics of temperature (regimes), water, nutrients and salts content	Substance, energy and information exchange between soil and environment. Biogeochemical cycles of the chemical elements Hydrologic cycles (wetting -drying) Flows of solutions: washing, accumulation	Ecosystems stability. Agroecosystems stability

***For the table elaboration were used the scientific works of N. Florea (2005) and T. Zubcova, L. Carpacevschi (2001)*

Table 2

Structural - functional integration processes of the soil material (pedomaterial) and indices of evaluation

Level of integration	**Integration processes**	**Indices of evaluation**
Atomar Celular Ionic – molecular	Biochemical reactions (anabolism, catabolism) Pedogeochemical reactions (synthesis – decomposition, acidification – alkalinization, oxidation – reduction, adsorbtion – desorption, solubilization – precipitation)	Reaction (pH) Adsorbtion capacity (cationic exchange capacity) Redox potential Transformation capacity Alkaliresistance
Plasmocolloidal Elementary particle	Processes and transformation reactions (alteration, mineral synthesis, decomposition, humification, clay formation, montmorillonitization, illization, salinization)	Garasoviț indices $K_i = SiO_2 : Al_2O_3$ $b_{a1} = K_2O + Na_2O + CaO + MgO: Al_2O_3$ $b_{a2} = CaO + MgO : Al_2O_3$ Deflocculant clay content in water Coagulated clay content Specific area Degree of dispersion The enriched index of organic matter The clay formation coefficient
Microaggregate Aggregate	Coagulation Association Agglutination Compression Compaction	Dispersion factor Structure factor Aggregation index Granulometric structuring index Aggregatical density Agregatical porosity Hydrostability The specific aggregate aria Average diameter weighted Structure crushing degree
Horizon	Spatial distribution	Total porosity Differential porosity Apparent density Density of solid phase Cohezion
Profile	Pedogenetical differentiation	Organic profile Profile of carbonates Profile of salts Hydrofizica profile Pedoaggregatical profile

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

PHYSICAL QUALITY INDICES OF THE GRAY TYPICAL SOILS IN ARABLE REGIME

ECATERINA CHISLARI, GH. JIGAU

State University of Moldova

Keywords: *gray soils, agrophysical indices,compactation, structural-functional differentiation*

Abstract

The pedogenesis of the typical gray soils located in the central Cordru forest, is determined by the elementary processes conditioned by the pedogenetical ambiance typical for the central forests. Their framing in the ecological agricultular cycle, implies the pedogenetical ambiance modification and respectively, changes the direction and intensity of several elementary processe. In arable regime, in the typical gray soils occurs the intercalation of the structural-functional-antropical stratification with the structural-functional primary differentiation, as a result of the initial pedogenesis type.

INTRODUCTION

The gray soils are pedogenetical formations with the genesis determined by the pedogenetical elementary processes conditioned by the pedogenetical ambiance typical for the central Codru Forests. Their framing in the ecological agricultural cycle, implies the pedogenetical ambiance modification and respectively, changes the direction and intensity of several elementary processes. As also, their framing within the agricultural circuit implies the substitution of the vegelal forest formations with the vegetal herby formations. In such substitution, occurs changes firstly in the soil hydrotermal regime. Increases the water amount as a result of consumption reduction on transpiration, increases the temperature as a result of shade degree reduction as well as aeolian factors intensification which lead to the evaporation increasing. The mentioned implications have direct impact on soil biota and respectively on the soil biological regime. On the other hand, the plowing works leads to the airhydrical regime modification, ie to the intensification of oxidation processes (mineralization).

As a result of framing the gray soils in the agricultural regime reacts firstly the content and humus composition. In literature we can also find information concerning the modification of soil solution reaction, degree of base saturation, nutrients provision etc. In the same time, practically there is no information concerning the soil physical traits evolution and physical quality indices evolution of the gray soils in agricultural regime, specialy in arable regime. The purpose of this paper is evaluation of the physical quality indices of the gray soils under arable regime.

MATERIAL AND METHODS

Research was conducted in an agricultural land belonging to the agricultural enterprise Ivancea, from Orhei district. Within specified land, were placed four profiles depending on the relief. The soil processing and crop multiannual structure is the same for the entire land.

Apparent density (ρb) were determined using the Kacinski compactimeter; solid phase density (ρs) - using accelerated Petinov method. Total porosity were calculated through relation Et = (1- ρb/ρs) x 100 when aeration porosity using relation Ea = Et – W [2]. Through the method the cone of Vasiliev was determined the plasticity, and using the relation I = Le – Li were calculated the plasticity index. The linear expansion coefficient were determined using the relation COLE =[(ρt - ρb)]/ρt x 100 [1].

RESULTS AND DISCUSSION

In the table below we notice that on the entire pedogenetic active segment the investigated soils are characterized with optimal ρ_b values. Even where the values exceed 1.3 g/cm^3, they does not exceed the critical threshold (1.45 g/cm^3).

The ρs values highlights homogeneous profiles, these increasing with the depth from 2.58 g/cm^3 (in the surface layer) till 2.70 g/cm^3 (in the inferior segment) of the pedogenetic active layer. Some signs of textural differentiation of the profile is not found, in the same time ρb highlights an slight but noticeable compaction in the 30-50 cm layer, here being the highest values of this parameter. This allows us to conclude that in the gray soils in arable regime occurs the structural\functional differentiation, ie within the agrophysical profile it distinguish arable and under arable layers [3]. This stratification is also proved by the total porosity values and aeration porosity values. In the compacted layer it noticed the lowest values of these parameters.

To note, profile distribution of ρb values and porosity indices, highlights some differential textural traits of the profile conditioned, probably, by the soft clay character of distribution on the profile.

CONCLUSIONS

1. In an arable regime, in the typical gray soils occurs the intercalation of the structural-functional-antropical stratification with the structural-functional primary differentiation, as a result of the initial pedogenesis type.

Table 1

Agrophysical indices of the gray soils

Depth, cm	ρ_b, g/cm^3	ρ_t, g/cm^3	ρ_s, g/cm^3	COLE, %	Porosity		Plasticity		
					E_t	E_a	Super. limit	Infer limit	Plasticity index
Profile 1									
0 – 10	1.16	1.30	2.58	12.10	55	42.9	27.1	22.4	4.7
10 – 20	1.14	1.30	2.58	14.63	56	42.1	25.5	21.1	4.4
20 – 30	1.18	1.34	2.63	13.64	55	41.2	37.8	25.2	12.6
30 – 40	1.26	1.44	2.63	14.36	52	37.3	23.6	21.0	2.6
40 – 50	1.32	1.54	2.65	16.58	50	33.0	29.6	26.3	3.3
50 – 60	1.28	1.47	2.68	14.50	52	37.4	25.0	24.0	1.0
60 – 70	1.29	1.48	2.70	14.94	52	37.4	31.5	25.8	5.7
Profile 2									
0 – 10	1.00	1.06	2.58	8.98	61	51.8	28.5	24.0	4.5
10 – 20	1.04	1.14	2.58	10.19	59	46.9	28.4	25.0	3.4
20 – 30	1.02	1.72	2.63	11.2	61	48.5	26.7	22.9	3.8
30 – 40	1.22	1.39	2.63	14.19	53	38.8	27.1	23.9	3.2
40 – 50	1.24	1.44	2.65	16.13	53	37.8	24.7	24.6	0.1
50 – 60	1.30	1.50	2.68	15.34	51	35.1	24.9	24.5	0.4
60 – 70	1.32	1.52	2.70	15.05	51	35.4	32.5	27.5	5.0
Profile 3									
0 – 10	1.04	1.09	2.58	5.03	59	50.1	26.7	23.9	2.8
10 – 20	1.14	1.14	2.58	-	56	44.1	24.0	18.0	6.0
20 – 30	1.14	1. 33	2.63	17.62	56	43.4	20.7	19.7	1.0
30 – 40	1.40	1.60	2.63	14.27	47	32.4	20.9	19.5	1.4
40 – 50	1.32	1.54	2.65	16.58	50	33.0	22.2	21.0	1.2
50 – 60	1.35	1.58	2.68	17.21	49	31.5	28.9	24.7	4.2
60 – 70	1. 30	1.54	2.70	18.37	52	34.1	27.7	26.4	1.3
Profile 4									
0 – 10	1.03	1.13	2.58	9.62	60	48.8	28.3	27.1	1.2
10 – 20	1.39	1.60	2.58	15.31	46	31.1	26.0	23.1	2.9
20 – 30	1.25	1.46	2.63	17.01	52	35.1	25.0	22.9	2.1
30 – 40	1. 32	1.57	2.63	19.10	50	31.3	28.9	25.1	3.8
40 – 50	1.14	1.39	2.65	22.25	57	34.2	25.7	24.7	1.0
50 – 60	1.27	1.54	2.68	21.45	52	30.5	32.2	29.2	3.0
60 – 70	1.26	1.52	2.70	20.63	53	32.2	30.1	24.8	5.3

REFERENCES

1. Jigău Gh., 2009. *Geneza şi fizica solului*. Chişinău, CEP USM.
2. Jigău Gh., Tatiana Nagacevschi, 2006. *Ghid al disciplinei Fizica solului*. Chişinău, CEP USM.
3. Jigău Gh., M. Motelica, I. Secrieru, E. Chişlari, 2010. *Indicii de calitate ai solului în cadrul asolamentelor tehnice*. Factori şi procese pedogenetice din ţara temperată, Iaşi.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

INTENSIVE AGRICULTURE INFLUENCE ON QUALITY OF TYPICAL CHERNOZEM FROM MOLDOVA

TAMARA LEAH, N. LEAH

„Nicolae Dimo" Institute of Soil Science, Agrochemistry and Soil Protection of Chisinau

Keywords: *chernozem, degradation, fertility, humus*

Abstract

In the paper comparative data are presented on change the characteristics of typical chernozem influenced by intensive agriculture for 130 years. Research results have shown that the properties of typical chernozem are satisfactory. Factors limiting productivity of typical chernozem are: strong compaction postarable layer, low content of organic matter and nutrients.

INTRODUCTION

In order to assess the anthropogenic impact on the quality status of the typical chernozems from North-East part of Moldova under the influence of agriculture's conditions, in Napadova, Floresti was founded regular monitoring polygon for comment on changes over time of physical and chemical indices of these soils. The object of study is interesting in that fact, the typical chernozem on the fallow field was studied in 1877 by genetic fonder of Pedology V.V. Dokuceaev [1]. Later in 1960 these soils has been studied by I. Krupenikov, A. Ursu, in 2003 by Institute of Geography, in 2007 by the "Nicolae Dimo" Institute of Soil Science, Agrochemistry and Soil Protection [2].

MATERIAL AND METHODS

The studied soil cover is composed by typical chernozems with whole clay-loam profile. Chernozem profiles are characterized as: Ahp1-Ahp2-Ahk-Bhk1-Bhk2-BCk1-BCk2-Ck. Effervescence at the depth of 70 cm. Pseudomycelia carbonates within the 80-200 cm of profile. In the horizon BCk2 is highlighted rarely de mesh of bieloglasca carbonates. The lower part of profile (BCk) is considerable modified by krotovines.

The natural factors of soil degradation are not highlighted. Anthropogenic factors of soil degradation are: dehumification, de-structuring and strong secondary compaction of the soil postarable layer as a result of intensive agricultural exploitation, unreasonable, insufficient of soil nutrients which ensure the soil fertility.

RESULTS AND DISCUSSION

Mechanical composition of the studied soil is typical for formation of loess deposit under the common influence of the global and local process of wind deposits accumulation. The percentage of fine sand and dust in the soil is high, because these particles were made by local winds on the sand banks formed by deposits with easily texture of alluvial ancient meadow. High content of fine sand and dust of investigated chernozem is a factor both positively and negatively. Due to lower cohesion between the particles of dust and sand at the humidity of physical maturity these soils are worked comparatively easily, even if their natural structure is damaged. But loamy clays are very susceptible to compaction. Being compacted, they have big retention capacity of plant available water and lower permeability, poor aeration and less mechanical properties, in special the resistance for tillage.

The Ah subarable horizon unchanged by plowing kept natural grain-granulometric structure at good to very good quality level. This soil structure described 130 years ago V.V. Docuceaev. But this structure had a layer thickness of 60 cm. Now, as a result of agricultural use the arable and postarable layers of researched typical chernozem lost practically their natural structure.

Generally, typical chernozem is characterized by satisfactory values of physical properties, except for postarable stratum 22-36 cm, which is compacted. The state of physical quality of this layer is unsatisfactory and has a negative affect on all soil regimes. Periodic mechanical destruction of practically monolithic structure of this layer by plowing to a depth of 35 cm (depth of prevision plowing) or through polishing is absolutely necessary.

The researched soil is characterized by lightly acid reaction in Ah (pH 6.5-6.7) and weakly alkaline in carbonatic horizon (pH 7.7-8.1). These pH values can be considered as optimal for plant growth and development of culture. Distribution of carbonates in the studied soil profile is typical for chernozems. Depth of carbonates occurrence, in dependence of soil humidity regime, may be within 50-70 cm from the surface of the soil. The carbonate content varies from 5-7% in the horizon Bh2 to 13-20% in BC and C horizons (Table 1).

Mobile forms of nitrogen is contained in medium quantities in Ahp1 horizon (1.22 ± 0.42 mg/100g soil) and low in underlying horizons. Total phosphorus content of studied arable soil layer is small (0.11 ± 0.01%), the degree of assurance with mobile forms of phosphorus is low (1.2 ± 0.4 mg/100g soil). The soil studied is relatively assured in optimal mobile potassium (23 ± 1.3 mg/100g soil).

Cations exchange amount is comparatively small and consists 26-27 me/100 g in humus horizons containing more than 1.00% and 22-24 me for parental rock. Values ratio Ca^{++} : Mg^{++} are within 7-8. Hydrolytic acidity is 2.6-2.3 in Ah and 1.7-1.1 me in Bhk (Table 2).

Statistical average data of humus content in the investigated soil humus layer varies from 3.25 ± 0.14% in the horizon Ahp1 up to 1.35 ± 0.28% in horizon Bh2. The comparatively low humus content for typical chernozem from Napadova commune is caused by inadequate use of intensive agriculture and sand-dust texture of soil.

Table 1

Average statistical parameters (X ± s) of physic-chemical indexes of soil

Horizon and depth, cm	pH	$CaCO_3$, %	Humus, %	Mobile forms, mg/100 g soil		
				$N\text{-}NO_3$	P_2O_5	K_2O
Ahp1 0-22	6.5±0.1	0	3.25±0.14	1.22±0.42	1.2±0.4	23±1.3
Ahp2 22-36	6.6±0.1	0	2.97±0.13	0.69±0.32	0.7±0.3	19±2.0
Ah 36-49	6.7±0.1	0	2.60±0.13	0.48±0.14	0.5±0.1	14±0.5
Bhk1 49-70	7.0±0.3	0	2.13±0.29	-	-	-
Bhk2 70-96	7.7±0.2	5.4±2.2	1.35±0.28	-	-	-
BCk1 96-111	8.0±0,2	13.0±3.8	0.86±0.08	-	-	-
BCk2 121-130	8.1±0.1	15.0±3.5	0.68±0.01	-	-	-

Table 2

Average statistical parameters (X ± s) of physical-chemical indexes of soil

Horizon and depth, cm	Ca^{++}	Mg^{++}	Suma	Hydrolytical acidity
	me/100g sol			
Ahp1 0-22	22.9±1.7	2.9±0.4	25.8±2.1	2.6±0.2
Ahp2 22-36	23.4±2.0	2.9±0.5	26.3±1.7	2.3±0.2
Ah 36-49	23.9±1.4	3.1±0.6	27.1±0.5	1.7±0.1
Bhk1 49-70	24.1±1.1	3.1±0.8	27.2±0.8	1.1±0.1
Bhk2 70-96	22.6±2.7	2.7±0.6	25.3±2.2	-
BCk1 96-111	21.0±2.0	2.7±0.8	23.7±1.4	-
BCk2 121-130	19.7±1.7	2.4±0.6	22.0±6.8	-

Research conducted by Dokuceaev in 1877 determined that the humus content of this soil was 5.718%. In 1960, as a result of repeated study by A. Ursu and I. Krupenikov established that the content of humus decreased to 3.675%, the losses accounted for 2.04% or 36% of initial content of humus (Table 3).

The comparison of typical chernozem humus content in the clay-loamy (almost loamy) sand-dust typical chernozem initially fallow near the commune Napadova investigated in the years 1877, 1960 and 2007 showed that the thickness of horizon A decreased in 130 years with 15 cm (from 61 cm in 1877 up to 46 cm in 2007).

During the 130 years (1877-2007) humus content in arable layer of typical chernozem in result of agriculture use fell by 2.47% or 43 percent of the initial content of fallow soil (1877), speed humus reduction was 0.019% annually.

Table 3

Morphological indexes and humus content of typical chernozems

Indexes		1877-steppe Docuceaev	1960-arable Krupenikov, Ursu	2003-arable Institute of Geography	2007-arable Institute of Pedology
Horizon, cm	**A**	0-61	0-44	0-50	0-48
	B	62-91	45-92	51-98	49-95
	C	92	93	99	96
	Effervescence		65	70	70
Humus, %	**A 0-61**	**5.718%**	-	-	-
	Ahp1 0-22		3.60	3.32	3.25±0.14
	Ahp2 22-36		3.30	3.15	2.97±0.13
	Ah 36-49		-	-	2.60±0.13
	Bhk1 49-70		2.73	1.94	2.13±0.29
	Bhk2 70-96		1.57	1.68	1.35±0.28

During the years 1960-2007 (47 years), humus content was reduced under the influence of intensive agriculture in this chernozem by 0.54% or 34 percent, reduction rate - 0.016% of humus annually. Humus content in the soil samples collected in 2003 and 2007 is about the same, with some minor changes.

CONCLUSIONS

1. Comparing the characteristics of the past fallow soil, studied in 1877, with the arable soil characteristics studied on the same field in 2007 gives opportunity to assess the degree of recent degradation of typical chernozem as a result of long use in agriculture. Factors limiting productivity of these chernozems are compaction of postarable layer, low content of humus and nutrients.
2. Changing the technological process of growing plants should be directed towards increasing the content of organic matter and nutrients in soil and implement a rational system of tillage would conduct in loosening of compacted soil layer. Keeping highlighted annual reduction rates of the humus content has a significant economic and ecological danger.

REFERENCES

1. Крупеников И., 1967. *Черноземы Молдавии.* Картя молдовеняскэ, Кишинев, (pp. 194-204).
2. Ursu A., A. Overcenco, I. Marcov, 2003. *Cernoziomul de la Soroca - 125 de ani după Docuceaev.* Buletinul AŞM, 2 (291), Chişinău (pp. 120-123).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

SYSTEMATIZATION AND ADMINISTRATION MODALITIES OF DATA CONCERNING ECOLOGICAL IMBALANCE BETWEEN NATURAL AND ANTHROPICAL SYSTEMS

TAMARA LEAH

„Nicolae Dimo” Institute of Soil Science, Agrochemistry and Soil Protection of Chisinau

Keywords: *data base, soils, ecological imbalance, natural system*

Abstract

The paper presents the characterization of ecological imbalance between natural and antropical systems. The identification and presentation of collection data methods, the systematization and generalization of data of ecological imbalance will contribute to create the Information System (Banc Data for soils) for the quality of soil cover in the Republic of Moldova.

INTRODUCTION

Moldova’s ecosystems are grouped in *natural* (forest, steppe, meadow, aquatic and marsh) and anthropogenic or *agriculture* (land occupied by grain crop, vegetables, orchards, vineyards, fallow lands, etc.). Ecological imbalance of these systems can be avoided as anthropogenic factors, as well as natural ones. However, it is necessary to detect ecological imbalance as a result of unfavorable co-report between natural and anthropogenic ecosystems and result of destabilization natural or concrete anthropogenic ecosystem.

The first type of ecological imbalance has arisen with the agriculture appearance. The more are involved in agricultural areas of agricultural land; ecosystems occupy larger areas; ecological imbalance of these ecosystems is more pronounced. So, the concept of ecological imbalance between natural and anthropogenic ecosystems is a relative concept and therefore, it is estimated quite approximately, by the ratio between natural and anthropogenic ecosystems.

MATERIAL AND METHODS

Extension and reckless exploitation of agricultural land have been caused by acceleration of degradation processes; have increased considerably the area of fallow land and temporarily tillage land. In recent years, after implementation of the land reform the balance of fallow soils, pastures and the intensive agricultural use has changed dramatically: with increasing areas of grassland and fallow land decreased perennial plantation surface. The materials collected on the ecological balance in the outcome of general cadastral land records, current records of annual changes taking place, are generalized and presented in the Land Register, developed and published annually. Materials with present ecological balance are required to implementation the land monitoring, environmental monitoring, to assess the environmental situation of each administrative territorial unit.

Collecting information on fallow land areas, eroded, salinized, alkalized soils occupied as forest plantations, swamps, rivers, etc. is made in accordance with contents of recommendation of the Land Cadastre.

To appreciate the ecological imbalance between natural and anthropogenic ecosystems is necessary to consider changes in areas of different ecosystems in a specific period and within each system separate. This makes it possible to highlight and assess the positive and negative trends in the evolution of ecosystems.

RESULTS AND DISCUSSION

The most affected today are past anthropogenic steppe, meadow, marsh and aquatic (pond). Their area decreased by 80% over the past 40 years. A very intentness situation was created between the natural and agricultural ecosystems, and within these systems due to high revaluation of the republic territory. Agricultural terrenes occupies 2498280 ha (73.8%), including: arable - 1812730 ha (72.6%), plantations - 298780 ha (12%), pastures - 352550 ha (14.1%), fallows - 34210 ha (1.4%).

In total, relatively natural ecosystems (grasslands, forests, wetlands, water) is only 917500 ha or 27.3% of the total area. Grasslands in Moldova are ecosystems with the natural vegetation, however, very anthropogenic transformed. The forests can be considered natural ecosystems. Other forest land holding of 426600 ha or 12.6%, marshes - 21500 ha or 0.6%, water - 87300 ha or 2.6% of the total. The forestation degree of the Moldova's territory is the lowest in Europe, which affects negatively the ecological status of the country.

The cadastral register of land includes quantitative and qualitative information on all land in the communes and rayon's boundaries. Land plan is the graphical representation of the territory, containing data about the location, boundaries and numbers of the sectors of land cadastre and other data. Number of land cadastre sector is an individual number, unique within the country, which is awarded in accordance with the procedure established by law. Module preparation and updating of cadastral plans shall be determined by an instruction, approved by the Agency. Cadastral register of land (cadastral summary sheet) shall be made at the 1 January and contains information on all lands.

Assessments of the land areas *destroyed by ravines, affected by landslides and damaged as a result of human economic activity* is carried out from making land cadastre, and record analog as agricultural land areas. Gullies, landslides, excavation work out of set-aside land with fertile soils, destroying cultural and social objects, houses, roads network.

The first inventory of gullies was carried out in 1911. Adapting the data to geographical division the most affected by ravines were hilly region of Central and South Moldova Plateau. The following inventory conducted in 1965 and 1982 gave the opportunity to make a comparative analysis of desolation formations of deep erosion over 90 years. Materials about the damage and intensity of growth in recent gullies on agricultural land during 90 years have highlighted the changes and spatial dynamics of gullies. If, in 1911 the number of gullies consisted 9543 and surface 14434.2 ha, then in 1965 it increased on average 3.5 times, in the Southern regions more than 10 times.

Annual average growth of gullies varies in large ranges from 0.53 m to 1.48 m on the Nistru Plateau to the South Moldavian Plain. Following the active development of linear erosion the total area of gullies annually increases to 300 ha and total area of land destroyed is 450-500 ha. At present, according to the latest land surveying, affected land area is 12200 ha of ravines, or 0.4 % of total land area.

The documentary evidence of land *areas affected by landslides* after the 1970 was not performed. The data is approximate, which slopes disorder characterized by relatively selective investigation results. After 1970 began to appear the balance of land ravines and land sliding, which meant the annual inter communes cadastral plans.

According to the research since 1990 in Moldova there were 55500 ha of farmland destroyed by active landslides, 350000 ha affected by ancient landslides. Most are affected by landslide processes the forests, which has occurred most important geotectonic movements. Activation of landslides occurs especially during winter-spring; they held high rainfall, with ranges of 3.7 to 9 years. Monitoring of landslides wearing a very specific and methodical he has developed special, which does not into existing monitoring methodology. According to the 2010 land cadastre the area completely destroyed by ravines consist 29800 ha or 0.9%.

The land areas *damaged as a result of human economic activity* is comparatively high. Destruction of soil cover of quarries excavation process is carried out. In Moldova until 1990 career exploration work is performed without re-cultivation of land development projects destroyed. As a result, are now recorded 5000 hectares of land damaged by excavation soil cover, which can be called "industrial deserts". Currently, as a result of human economic activity, is partially or totally destroyed the soil cover an area of 45300 ha or 1.3% of total land area.

Restoration of destroyed land by landslides, ravines, damaged by various activities is necessary a costly improvement. Therefore, surveys in frame of monitoring processes and prevent the development opportunities that may occur are of quite significant. The initial information on the area of ravines, landslides, damaged land can be obtained in the execution of works on pedological or topographical surveys, they are highlighted in the wild, can be measured and drawn on the map. The collection of data and training on land damaged databases include: initial data, generalization data, statistical process, graphic presentation.

The database on land fallow areas, eroded, alkalized, salinized soils, under forest plantations, swamps, rivers, destroyed by ravines, affected by landslides and damaged as a result of human economic activity is necessary for rational distribution of land within the national economy, creating an optimal balance between agricultural and natural ecosystems, making measures to combat landslides, stopping the growth surface gullies, other land re-cultivation damaged.

Information on the use of soil cover and land surfaces damaged by various negative processes account for the basic documentation for establishing protective measures, improvement and sustainable use of land and increase agricultural production. This information is scientific basis to substantiate the optimal use of land for development projects to improve land and regional planning, to implement the most appropriate technologies to conserve and improve soil fertility. Most information on land use and land areas damaged as a result of natural disasters and economic activity is presented in the Land Register of Moldova. However, this information is incomplete and not always meets the requirements of monitoring of land. These data are difficult to use in the preparation of forecasts for development of ecology negative processes of natural and anthropogenic ecosystems. To create a base of precision data on areas show destroyed land area is necessary to create an Information system of Land Monitoring.

CONCLUSIONS

1. The database on the quality status of the soil cover in the Republic of Moldova give information about the state land, agrarian reform impact, pedogenesis factors and average parameters of the statistics characteristics of the soils, soil erosion and damage caused to the national economy, quality of ameliorative land fund, humus content and soil agrochemical indices.
2. The database will contribute to the right of the citizens to access of information and transparency concerning the quality of the soil cover to promote prevention and control of processes of soil degradation and deterioration, pollution caused by natural phenomena or human activities, for maintaining for the long term agricultural and forestry production capacity of the soil cover, the establishment the quality land monitoring.

REFERENCES

1. xxx, 2011. *Land Cadastre of Republic of Moldova on 1 January 2011* (Informative note). Chisinau.
2. xxx, 1996. *Ecopedological Monitoring Bulletin*. Chisinau.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

ASPECTS CONCERNING SOIL EROSION IN THE BARLAD RIVER BASIN

M. PARICHI, ANCA-LUIZA STĂNILĂ, GH. HERIŞANU

„Spiru Haret" University of Bucharest

Keywords: *soils, Barladului basin, erosion, texture*

Abstract

Through its relief variety coefficient, the Barladului Highlands is booked as a standard territory, pointing a hilly region of which soil cover presents a pronounced diversity.

Considering all this, it has two main corresponding pedogenetic areas: cernisoils and luvisoils. The first characterize mostly Colinele Tutovei, while the luvosoils appear dominantly in the Central Moldavian Highlands.

Their physical, hydro-physical and chemical characteristics, as the relief conditions, to which is added the brainless usage mode have increased considerably the vulnerability to erosion. At present on big surfaces of land, erosion has even carried off the B horizon of the soils, coming to work even in C horizon.

INTRODUCTION

At present, a big part of the Earth's soils are more or less modified through human activity, but mostly the ones in the agroecosystems. Consequently, man must not be considered a simple factor or exterior agent, but as a component of the agrosystem itself, considering that he is often the origin of soil degradation or amelioration. Humans' attitude towards the soil must reflect human-soil partnerships, relations that assure the preservation of soil resources inside the durable development of the rural economy.

In our country, nowadays a lot of soils appear more or less eroded or affected by other degradation phenomena. They are found on extended areas in the Barladului basin, hydro graphic unit with a large extension inside the Highlands with the same name.

MATERIAL AND METHODS

The soil cover of the Barlad basin was charted in several stages: Sc. Mateescu, A. Miloşovici, Fl. Predel, C. Tutunea, C. Sorocinski (1961), C. Tutunea (1963), M. Parichi (1963, 1984), OJSPA Vaslui (1980), on scales varying 1:50,000 and 1:200,000. The material used for writing the present paper is based on the research in the 1961-1984 periods. Mapping was made on a 1:50,000 scale by the complex study method. Analytical used data were obtained after the analysis effectuated on the soil samples in the Pedologic Service inside the Geologic Prospecting Enterprise of Research Institute for Soil Science, Agrochemistry and Environmental Protection of Bucharest laboratories.

On the basis of these materials were brought definitions concerning the soil cover of the Barlad basin and concerning the preservation state of the soils in the actual conditions.

RESULTS AND DISCUSSION

The Barladului Highlands constitute the most extended subunit of the Moldavian Highlands. Through its geomorphologic un-uniformity, it is booked as a standard territory, indicating the presence of a typical hilly relief. The maximum altitude of the Barladului Highlands is reached in the Dorosanu Hill (568 m) and the lowest north to Mastacani (under 15 m). Most of its area (35%) is found at an altitude of about 100-200 m, and the smallest part (14%) between 300-500 m.

Through its physiognomy, the Barladului Highlands, especially the Northern part looks alike somehow with the Sucevei Highlands being frequently spread the structural relief represented through the structural surfaces or spine-shaped interfluves, consequent and subsequent valleys.

Under a geologic report, the Northern part of the Barladului Highlands belongs to the superior sharmatian made out of clay marnes, sands, sandstone and limestone, and South to Vaslui appears the pliocen represented especially through sands and clay that are loessidiesed.

The parental material of the soils is varied, being constituted of eluves and loess deposits on big areas, from the deluves on versants and colucvions on their basis, to which adds recent sediments of alluvial nature from terraces and meadows.

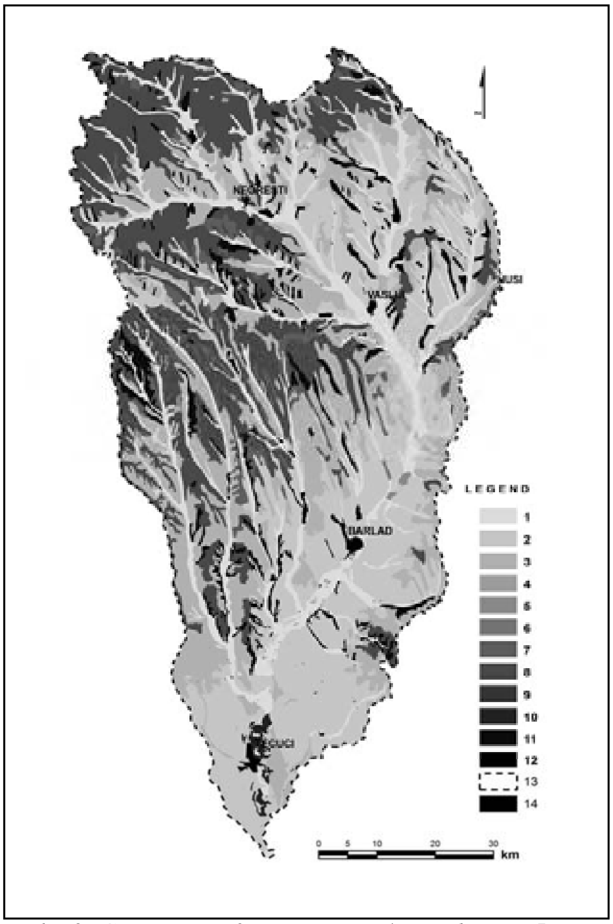
Climatically, the Barladului basin belongs to severs agroclimatic areas: hot drain area, subzone 4, moderate thermal sub-humid area, subzone 1 and 4 and humid cold area, subzone 3.

The first area is characterized through high thermal resources (T^0 annual average temperature of $10.5\text{-}11.5^0$ C, sum of temperatures over 0^0C between $3900\text{-}4300^0C$ and low water resources (400-600 mm annual rainfal).

The moderate sub-humid thermal area has low thermal resources (T^0 annual medium of $9.0\text{-}10.5^0C$; the sum of temperatures higher than 0^0C is between 3600-3900, and the water resources are medium (450-800 mm).

In the humid cold area, thermal resources begin to recede. So, the annual medium temperature is between $8.0\text{-}9.5^0C$, the sum of temperatures over 0^0C lowers up to 3400, and the water resources are between 500-600 mm.

A following of the pedogenetic conditions presented above, the soil cover of the Barlad basin is characterized through sort of diversity. Considering all that, it has two main pedogenetic areas: cernisoils and luvisoils. These intimately intermission, so the separation limit becomes sinuous, the luvisoils maintain inside the higher interfluves and in the cernisoils area, as they deepen, especially along the valleys in the luvisoils area (Figure 1).



1. Aluviosoils; 2. Cernozems; 3. Faeozems; 4. Rendzinas; 5. Eutricambosols; 6. Districambosols; 7. Preluvosols; 8. Luvosols; 9. Stagnosols; 10. Solonetz; 11. Erodosols; 12. Lakes and slops; 13. Basin limit; 14. Cities

The soil cover of the Barlad basin compasses luvisoils (46.7%) and cernisoils (40.9%). To them adds in small and very small percents some protisoils (11.7%), cambisoils, hidrisoils and salsodisoils associated with protisoils. To these add a series of erodosoils.

Luvisoils appear predominantly in the Central Moldavian Highlands as in the superior Colinele Tutovei. Their existence inside these units is correlated with the loam-clay deposits mostly loessidised situated on the highest areas of the land.

They are represented through typical luvosoils, most of them under the forest and white luvosoils, the last occupy surfaces of land less watered and forested. **Cernisoils** are represented mostly through greic soils (39%). These make the transition towards the lower parts of the relief in the direction of the inferior Colinele Tutovei and the north of the Vaslui Depression (Colinele Viisoarei).

The other chernisoils like chernosioms, including the cambic and argic complete the soil landscape in the north of the Vaslui Depression, Colinele Viişoarei and Colinele Tutovei.

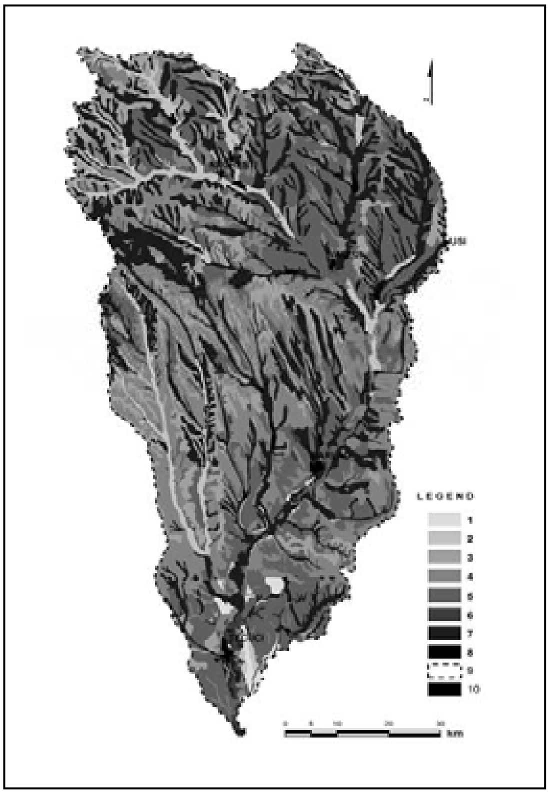


Fig. 2. Barladului basin - soil texture map (in the upper horizon)
1. Sandy; 2. Sandy loam; 3. Loam sandy; 4. Loam; 5. Loam-clay; 6. Clay;
7. Variated texture; 8. Lakes and slops; 9. Basin limit; 10. Cities

Protisoils are represented through aluviosoils and regosoils. The first are distinctive to Barladului, Vasluiului, Tutovei, Zeletinului fields and other tributaries of the Barlad, while regosoils appear frequently on versants.

Under a grainmetric composition report (texture) in the Barladului basin prevail clay, loamy and clay-sandy soils. On the meadows, the dominant texture is the sandy one, and on the versants most of the soils have a varied texture (Figure 2).

The soil preservation state

The vulnerability to erosion of the soils from Barladului basin depends mostly of their grainmetric structure, relief (shape, pitch, slope length, versants), vegetation cover degree and climate. so, the soils with a fine texture, clay-loamy containing a big quantity of colloidal clay, through humidification they enlarge their volume, abridging porosity and infiltration, while the soils with a light texture (sand-clay) and medium (sand-clay-loam) during rain with high intensity produce faster leaks than the clay ones (Figure 3).

Fig. 3. Barladului basin - soil erosion map

1. Lands with unappreciable erosion, in which under 5% of the A horizon of the soils was affected and with a clogging danger; 2. Slightly eroded lands, with an A horizon of the soils affected between 5-25%; 3. Moderate eroded lands, with an A or E horizon of soils affected 25-50%; 4. Highly eroded lands, with an A or E horizon of soils affected 50-75% and even a part of the transition horizon; 5. Intense eroded lands, where the erosion went over the transition horizon, B horizon, at some soils even C horizon; 6. Lakes and slops; 7. Basin limit; 8. Cities

As a consequence of the physical and hydrophysical soil characteristics, the way they are used, the crop structure and applied agrotechnique, to which adds their forestation degree, currently the soil cover of the Barlad basin is in a relatively medium erosion stage.

These soils have a high rate in Colinele Tutovei, as in the west of the Central Moldavian Highlands in the north of the basin.

CONCLUSIONS

1. In the mentioned pedogenetic conditions, the North and South-East part of Barlad basin (Central Moldavian Highlands, Colinele Viisoarei) present themselves unappreciable or weakly affected by erosion.
2. High and intense erosion are characteristic to the superior Colinele Tutovei where affects 50-75% of the territory. Big surfaces of land (versants) from the Barladului basin are affected by numerous slides, solifluxions and tumbling.

ACKNOWLEDGEMENTS

This work was supported by CNCSIS-UEFISCSU, project number PNII - IDEI 631/2008.

REFERENCES

1. Hârjoabă I., 1968. *Relieful Colinelor Tutovei*. Ed. Academiei Române, Bucureşti.
2. Parichi M., Anca-Luiza Stănilă, Filuța Staicu, Irina Moise, 1998. *Contribuții la cunoaşterea solurilor din Colinele Joase ale Tutovei*. Analele Univ. Spiru Haret, Seria Geografie, nr. 1, Ed. Fundației România de Mâine, Bucureşti.
3. Parichi M., 2007. *Eroziunea şi combaterea eroziunii solurilor*. Ediția a II-a revăzută şi adăugită. Ed. Fundației România de Mâine, Bucureşti.
4. Stănescu I., P. Poghirc, 1992. *Podişul Bârladului.* Geografia României, Vol. IV, Ed. Academiei Române, Bucureşti.
5. Tutunea C., N. Muică, M. Parichi, 1964. *Raport asupra prospecțiunilor pedologice în Podişul Bârladului*. Arhiva I.C.P.A., Bucureşti.
6. xxx, 1998. *Harta solurilor României.* Scara 1:200.000, foaia Bârlad.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

SOIL BACKGROUND OF ILFOV COUNTY

ANCA-LUIZA STĂNILĂ, M. PARICHI

„Spiru Haret" University of Bucharest

Keywords: *pedogenetic parameters, soils, the Vlasiei Plain*

Abstract

Ilfov County is situated in the Vlasiei Plain and it entirely overlaps on the Maia, Snagov, Superior Mostistea, Otopeni-Cernica, Cotroceni-Berceni and Calnau fields, which have common geomorphologic characters, but with important differences concerning the soil cover.

The diversity of pedogenetic factors, especially the relief, the water table and the stagnation water have imprinted the soil cover a complex character.

As a consequence, in the territory we wild find protisoils represented through aluviosoils, cernisoils with cambic, argic chernozems and greic faeosioms, luvisoils with preluvosoils and luvosoils with eutric hydric soils and stagnosoils and antrisoils represented through erodosoils.

In the territory, preluvosoils, argic and cambic chernozems are prevalent.

INTRODUCTION

The soil cover of Ilfov County reflects abundantly the un-uniformity of the pedogenetic factors and especially the relief, water table and parental material ones, which have imprinted a complex character. This results from the simple fact that the limits of the 245,000 ha on which the county is stretched presently, have been defined over 130 types, subtypes and soil associations belonging to the protisoils, cernisoils, luvisoils, hidrisoils and antrisoils classes.

MATERIAL AND METHODS

Over the soil cover of Ilfov County have been attempted pedologic research in several stages: Ana Conea, C. Tutunea (1954); N. Florea, Ana Conea, C. Oancea, T. Gogoaşă (1964); M. Parichi and collab. (1982-1988); Anca-Luiza Stănilă, M. Parichi (1988) - Pedogeografic observations in the west side of Snagov Plain (1988); Pedogeografic study of Snagov Plain (2000).

The mapping was made at big scales (1:5,000-1:10,000) by the complex pedologic study method (having as purpose the watering arrangement and stopping excessive humidity) and at medium scales (1:50,000) for mapping all the soils of the former Ilfov County.

The material used for editing the present paper is mainly based on the research performed in the 1982-2000 periods.

The analytic data were collected in the Soil Service laboratories of the Geologic Prospections Institute of Research Institute for Soil Science, Agrochemistry and Environmental Protection of Bucharest.

Based on these materials were carried out the soil map, the relief, parental material, water table maps and a series of interpretable maps concerning the arrangement for watering and stopping the excessive humidity.

RESULTS AND DISCUSSION

Situated in the South of the country, in the Romanian Plain, Ilfov County has varied natural conditions which are clearey reflected in its soil cover.

As defined, this county overlaps on six subunits of the Vlasiei Plain, which is a unit of the Romanian Plain, such as: Maia Field, Snagov, Superior Mostistea, Otopeni-Cernica Field, Colentina Field, Cotroceni-Berceni and Calnaului Field.

The Maia Field is partially deployed in the North-East extremity of the county, to the north of Ialomita. It is made out of gravels and sands covered by a thick horizon of loess of about 3-4 m in which a lot of croves have deepened. Its medium height is between 75 and 90 m.

The Snagovului Field. It is covered with forests in a percentage of about 40% and it corresponds to the geographic space between Ialomita-Cociovaliste and Caldarusani Lake. On its structure there are sediments that belong to the upper Pleistocene, represented sands, gravels, clay and clay loessoid deposits, mostly proluvial.

The relief is mostly flat, with absolute altitudes between 86-119 m, moderately fragmented by the Snagov, Vlasiei and Ciocovalistea Valleys in interfluves wide up to 5-6 km and relatively well sewed.

As characteristic morphologic elements, except the versants, we must add numerous croves, from which some are much deepened.

The Superior Mostistea Field is defined by Cociovalistea Valley in the north and Pasarea Valley in the south. It is developed on the NW-SE direction, from altitudes of 95-100 m (Corbeanca-Otopeni) to 75-80 m (Branesti). It is made out of sands with frequent areas of clay, covered by a layer of loess thick of 6-8 m. In the west, where sewing is bad, the water table is at 3-5 m depth, in the east, the microdepression areas (padins), as corves, they appear abundantly on the surface of the interfluves which separate the Cociovalistea-Mostistea-Pasarea, Sindrilita and Colceag Valleys.

The Otopeni-Cernica Field. It corresponds in the western half to a depression surface, weakly sewed (the water table is about 2-3 m). As a result, the field here is crossed by numerous drainage channels for eliminating the excessive water table, under 5 m. There are numerous croves left with depth, of 0.5-1.5 m under the reference level of the field.

Concerning the parent material of the soils, it is represented this by clay and loam loessoid deposits in the west and loess clay in the rest.

The Colentina Field is between the Dambovita and Colentina, oriented NW-SE, and reaches a length of almost 30 km and width of 3-6 km. The absolute altitude is of about 80-95 m in the west and it comes down to under 60 m in the East. Croves and old water beds are there, too. It is hard to track the three terraces of the Dambovita. On the surface, the field is made out of a complex of sands and gravels from Colentina, over which there are loess deposits with a general thickness of 7-8 m.

The Calnaului Field represents the South Eastern part of the county from the right of Dambovita and it is drained by the Calnaului Valley and numerous small valleys. It is situated at a height of 65-70 m, well sewed. The loessoid deposits have a thickness of 8-10 m, favor the development of croves.

The Arges-Sabar meadow occupies inside the county, a surface of about 2%, at an altitude of about 55-80 m and a width of about 5-6 km. There is a meadow terrace and a low meadow well developed in the Arges area.

In a climatic report, the Ilfov County is situated in a hot draught area, sub-area 4 (INMH, 1987), characterized high thermal resources, modest water resources and high stress parameters. The medium annual temperature is between 10.5-11.5ºC, the maximum absolute temperature is about 44ºC, and the minimum temperature doesn't go under -35ºC. The annual medium throughfall varies between 450-550 mm, to which the humidity deficit represents about 230 mm.

In the soil conditions mentioned above, the soil cover of the Ilfov County is characterize through a wide range of types, subtypes and varieties of soils, which, in the Romanian Soil Taxonomy System (2003) reunites five classes of soils: protisoils, cernisoils, luvisoils, hidrisoils and antrisoils, with physic, hydrophysic, chemic and agroproductive specific characteristics. From all of these, the biggest preponderance have the cernissoils, followed by luvisoils (80%) (Figure 1).

PROTISOILS

They are considered to be the youngest soils of the county, represented only through entic and gleic aluviosoils. They are made out of fluvic parental material on at least 50 cm thickness and A horizon (Am, Ao). They can be found on the river valleys, and on wider areas in the Arges and Dambovita meadows, where they crop successfully corn, wheat and vegetables.

CERNISOILS

In this class are included the soils that have an A molic horizon (Am), followed by intermediary Bv and Bt horizons. The accumulation of carbons horizon can be present in the first 125 cm or lower.

To this class belongs the cernosiom represented through the following subtypes: cambic chernozem, argic chernozem and the faeosiom with the greic subtype.

Cambic chernozems are spread on small surfaces in the Eastern half of the county, mostly in the Mostistei Field and are characterized through a well developed *Am-AB-Bv-Cca* profile. They have a midst or midst delicate texture. The structure is glomerular, well developed giving this soil a good permeability for water and air and also medium values of hydro-physic subscripts.

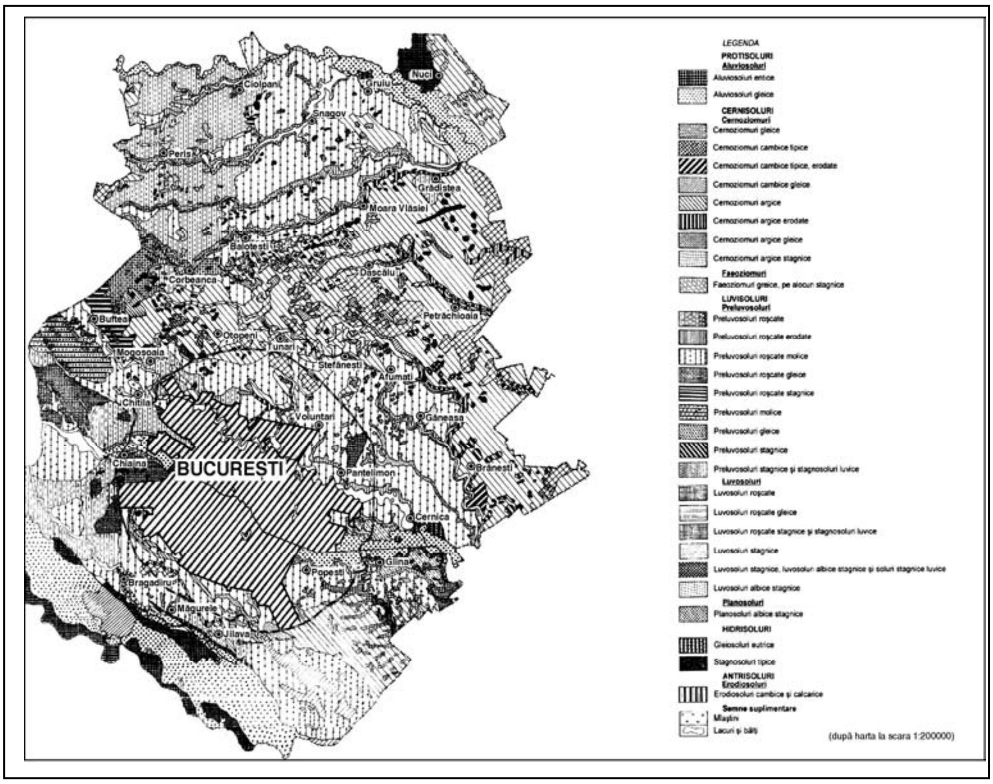


Fig. 1. Soil cover of Ilfov County

Argic chernozems are also very spread in the Mostistei Field. In the case of these soils the humification processes are a little more spread, and the ones of the free coloiz migration are more accentuated than at the cambic chernozems. They have a type *Am-AB-Bt-Cca* profile, differenced texturally (1.2), low-middle humus content (3.7-3.8%), weak acid reaction (6.4) and a saturation degree with bases under 86.0%. The nutrient supplying is good (N, 0.185%; P, 53 ppm and K, 260 ppm), (Table 1).

Table 1

Physical and chemical data concerning argic chernozems

Horizon	Depth (cm)	Granulometric composition				Humus (%)	pH (H_2O)	Ntotal (%)	P (ppm)	K (ppm)
		<0.002 mm	0.002-0.02 mm	0.02-0.2 mm	0.2-2.0 mm					
Ap	0-16	34.0	29.1	32.2	0.4	3.7	6.4	0.185	53	260
Am	22-40	37.0	26.5	31.8	0.32	3.8	6.4	0.199	35	194
A/B	50-61	37.9	26.1	31.1	0.3	1.8	6.7	0.099	12	176
Bt_1	70-90	40.0	26.1	30.9	0.3	1.6	6.8	89.7	0.091	-
Bt_2	110-130	36.5	28.4	33.0	0.3	1.1	7.0	89.6	-	-
Bt_3	140-160	34.5	28.4	35.3	0.3	-	-	-	-	-
Cca	185-205	27.2	25.0	32.0	0.3	-	-	-	-	-

LUVISOILS

In this class are included the preluvosoil, luvosoil and planosoil types.

Preluvosoils are morphologically characterized through: the presence of the A ocric or molic horizon (Ao, Am), followed by the argic horizon (Bt), having colors with values of over 3.5 in a humid state and a saturation degree in bases (V%) over 5.3%. They are represented through molic preluvosoils, stagnic preluvosoils, sometimes associated with luvic stagnosoils, red preluvosoils including eroded, molic, gleic and stagnic red preluvosoils. From all these the most spread are red and molic preluvosoils. They appear in Snagovului, Colentinei, Berceni and Calnau Fields.

Red preluvosoils have a well developed *Ao-Bt-C* profile. They are weakly texturally diferenciated (Idt=1.3), slightly tamped, poor in humus (2.3-2.5%) and not well supplied with nutrients (Table 2).

Table 2

Physic and chemic data concerning reddish preluvosoils

Horizon	Depth (cm)	Grainmetric composition				Humus %	pH (H_2O)	N total %	P ppm	K ppm
		< 0.002 mm	0.002-0.02 mm	0.02-0.2 mm	0.2-2.0 mm					
Ap	0-14	26.8	28.1	36.2	5.2	2.5	6.2	0.131	16	185
Ao	14-27	29.4	27.7	34.6	5.1	2.3	6.3	0.125	11	150
A/B	27-41	33.5	27.7	33.1	4.2	2.0	6.5	0.106	9	-
Bt_1	41-57	36.7	26.9	31.1	4.1	1.0	6.4	0.089	-	-
Bt_2	95-115	34.1	28.5	33.7	3.8	-	-	-	-	-
Bt_2	135-155	28.1	26.7	35.2	.0	-	-	-	-	-

Luvosoils are morphologically characterized through the presence of the A ocric horizon (Ao) followed by an E eluvial (El) or E albic (Ea) horizon and a B argilic (Bt) horizon, with a saturation degree (V) over 53%, or at least in a horizon in the superior part. It has no textural abrupt transit (between E and Bt on less than 7.5 mm).
Representative in the Ilfov County are red luvosoils and typical luvosoils, both in varied scope at a subtype level or varied because of the local relief conditions and drainage - gleic and stagnogleic.
Planosoils appear in the stagnic albic variant and are morphologically characterized through the presence of the A ocric (Ao) horizon followed by an eluvial E albic (Ea) horizon and a B argic (Bt) horizon, the transit between E and B horizons is made through a sudden textural change, on a thickness smaller than 7.5 cm. They appear locally in the Colentina Field and in some micro-depression crove areas.

HIDRISOILS

The soils in this class are represented through the subtypes of eutric gleiosoils and typical stagnisoils, formed under the influence of humidity excess.
Eutric gleiosoils are found locally in Ialomita's meadow, north from Gruiu and as in the Dambovita's meadow in Cernica. They are watery hydromorph soils defined through an A ocric (Ao) horizon and gleic properties (Gr horizon) which appear in the upper part of the profile starting with the depth of 0-50 cm.
Typical stagnosoils have an island appearance and are spread in the Snagov and Mostistea Fields, they are characteristic to the crove microrelief.

ANTRISOILS

In this class are the soils that have their upper horizons removed through erosion, on the surface they have B or C horizon. This is the way ***erodosoils*** are. They appear on the versants of most of the valleys that pass the Ilfov County.
Usually, on the surface they have an Ap horizon from the change of the B or C horizon, having under 20 cm.

CONCLUSIONS

1. Through its geographic positioning in the Southern part of the country, Ilfov County has natural conditions that are relatively varied and that reflect through its soil cover. The most predominant are preluvosoils (red and molic) and chernozems (argic and cambic). With a certain frequency, in the territory appear locally red stagnic luvosoils, albic luvosoils, including stagnic, gleiosoils and stagnosoils, but also erodosoils with limestone, and on the main valleys (Ialomita, Arges-Sabar, Dambovita) can be found entic and gleic aluviosoils.
2. The good chemic and physic characteristics enlarge the scope of crops, of vegetables for grains and oil plants.

REFERENCES

1. Parichi M. şi colab., 1986. *Caracterizarea resurselor de sol ale Sectorului Agricol Ilfov*. Arhiva I.C.P.A., Bucureşti.
2. Parichi M., 1996. *Revizuirea hărţii solurilor din zona Bucureşti*. Arhiva I.C.P.A., Bucureşti.
3. Stănilă Anca-Luiza, M. Parichi, 1998. *Observaţii pedogeografice în partea de vest a Câmpiei Snagovului*. Analele Univ. Spiru Haret, Seria Geografie, nr. 1, Bucureşti.
4. Stănilă Anca-Luiza, 2003. *Câmpia Snagovului-studiu de pedogeografie*. Ed. Carol Davila, Bucureşti (pp. 164).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

PEDOLOGYCAL RESOURCES OF ROMANIA

ANCA-LUIZA STĂNILĂ, M. PARICHI, F. VARTOLOMEI

„Spiru Haret" University of Bucharest

Keywords: *soils, classification, pedogenetical factors, distribution*

Abstract

Due to the landscape and hydrographic conditions, also specific climate and vegetation of our country territory, on a relatively small area (238 391 square km), most global soils can be found.

Romania presents such a variety of soils from those of the specific semiarid areas to those found in wetlands and cold, but associated with the soil caused by local conditions of landscape, hydrogeology and rock.

The vast majority of soils in Romania are found distributed in a horizontal scale, especially in the plain and plateau area, and also in a vertical scale in mountain regions.

There are 32 types of soil who are grouped in 12 classes.

A quarter of the country is occupied by Cernisoils class (26.7%), followed by soil from Luvisoils class (25%), then Cambisoils and Spodisoils addition to Umbrisoils, all these three classes summarize a considerable area, about 60 000 square km (25%).

Except Aluviosoils class, spread in the form of a strip of both sides of the river (9% area) and Psamosoils (1%), the remaining 13.3% of the country is occupied by soils with local distribution (intrazonals) among which we mention: Hidrisoils (3.2%), Salsodisoils (0.8%), Protisoils (3.9%), Histisoils (1.1%) and Pelisoils (1.6%).

INTRODUCTION

Romania has an important agricultural area with soil and climatic conditions that allow the practice of intensive agriculture.

Following the intensive development of pedology knowledge and international and national progress, in 1980 a unique classification system (S.R.C.S.) was developed which focuses on the intrinsec characteristics, quantified for soil.

Recently there was a improvement in the ratings, especially following the FAO/UNESCO (1988) reviewed legend and world soils, also dissemination of improved edition of several American classification and French Pedology Referential Issue (1990).

Thus, in 2003, a definitive form of classification was reached called "Romanian System of Soil Taxonomy". It comprises two main levels, an upper and a lower level of four categories, namely: variety, species, family and soil variant. Keeping the tradition of the Romanian school of pedology, the basic unit of system is the genetic type of soil.

Some classes were introduced: Andisols Pelisols, Protisols and Antrisols, thus leading to a total of 12 classes, the last two by splitting the previous class, unevoluted soils, truncated or sloppy. There appeared new types of soil as pelosols, lymnosols and anthrosols and were elevated to some kind of soil other subtypes as alosols, cryptopodzols and foliosols.

MATERIAL AND METHODS

Since 2003, in Romania has been used a final form of a classification called "The Romanian Soil Taxonomy System". It is considered a multicategory system with two main levels, an upper level with three categories: class, type and subtype and at an inferior level with four categories: species, family, variety, soil type. The different elements between categories are those soil properties which can't be observed in the field.

Andisoils, pelisoils, protisoils, antrisoils have been introduced, and the name molisoils has been changed into cernisoils.

On a genetic soil level limnosoil, alosoil and pelosoil have been introduced. Cernosioms, cambic cernosioms have been united under the name of cernizom, and then, the argiloiluvial cernosiom, the cernoziomoid soil and pseudorendzine - under the name of preluvosoils, and brown-red luvic soil and brown luvic soil have been reunited under the name of luvosoil.

An uniformization of names has been made through applying some rules. So, at the soil class level the name is a noun used in plural, ended in soils, of which part shows the essential character of the soil types, which compiles the class: for example, cernisoils, luvisoils, salsodisoils, pelisoils, protisoils, etc. At all names is pointed out the presence of the vocal "I" as a connection element to the "soil" suffix.

At a soil genetic level was shown that names represented through a single word (which doesn't have anything in common with the name of the soil class), and as a connection vowel with some exceptions is "o" (cernoziom, luvosoil, gleiosoil, aluviosoil, regosoil, vertosoil, pelosoil).

RESULTS AND DISCUSSION

Relief

Romania is composed of very diverse landforms, proportionately distributed and fairly symmetrical and concentrically arranged. Mountains, hills, plateaus and plains succeed from the inside edge of the country around a central plateau - Transylvania Plateau.

Mountains stage is the centerpiece of the dominant relief techtonic-erozive and extends the 31% of the country.

The hills and plateaus stage is 35% of the country, with highly variable absolute altitude. Morphometrical indices still indicate the existence of two types of forms: a - the-hills of the plateau, b - Carpathian hills.

Hills of the plateau have altitudes ranging from 300-1000 having moderate to severely fragmented interfluves, sometimes they have the appearance of narrow peaks.

The subcarpathian hills generally achieved greater heights than the hills of the plateau, occurring with chain forms in the outside of the Southern Carpathians.

Plains stage includes the forms of relief flat plains with low relief energy and fragmentation, with absolute altitudes ranging from 0-300 m, they occupy about 34% of the country. Plain relief is represented by Danube Delta and river systems major corridors, the Romanian Plain and the Western Plain (Tisa).

Climate

Being situated on the one hand, halfway between the equator and pole, and on the other, at a considerable distance from the ocean, Romania is located in the temperate continental climate, maritime influences are felt only slightly.

Romania's climate is not uniform but are outstanding issues from one region to another, and on that basis, the country, it is creating some climatic regions which correspond to certain provinces (regions soil).

Medium values of annual temperature varies with latitude, longitude and altitude in particular. Thus, between south and north of the country there is a temperature difference of 3°C, and between west and east of about 1°C.

The largest quantities of precipitation fall in mountain areas (1200-1400 mm). As the altitude decreases, the amount of precipitation is reduced, so 700 mm izohieta surrounding high mountains and hills in their vicinity.

Rock

The geological structure of Romania consist in rocks of different ages from the Protherozoic-Paleozoic, Mesozoic, Cenozoic and Quaternary which, by genesis, are divided in eruptive, metamorphic and sedimentary rocks.

The role of rocks in soil formation is less important compared to that of the climate and vegetation, although from transformation of rocks is resulting mineral part of soil, which is often over 80-90% of its total mass.

Soil cover

According to the actual Romanian Soil Taxonomy System (SRTS, 2003) on our country's territory appear about 32 soil types grouped in to 12 classes. A quarter of the country is occupied by mollisols (25.4%). They are spread mostly in the plain and highland regions represented through kastanozems**,** chernozems, phaeozems and rendzinas, the last ones can be found locally in hills and more frequently in some mountain areas on limestone rocks. From these the most spread are chernozems and phaeozems (24.9%) (Figure 1).

MOLLISOLS have as a diagnostic an Amolic horizon (Am), dark colored (chromes and values <3.5 in a humid state and <5.5 in dry state) and a sub-acent horizon, with a little molic horizon character in the superior part.

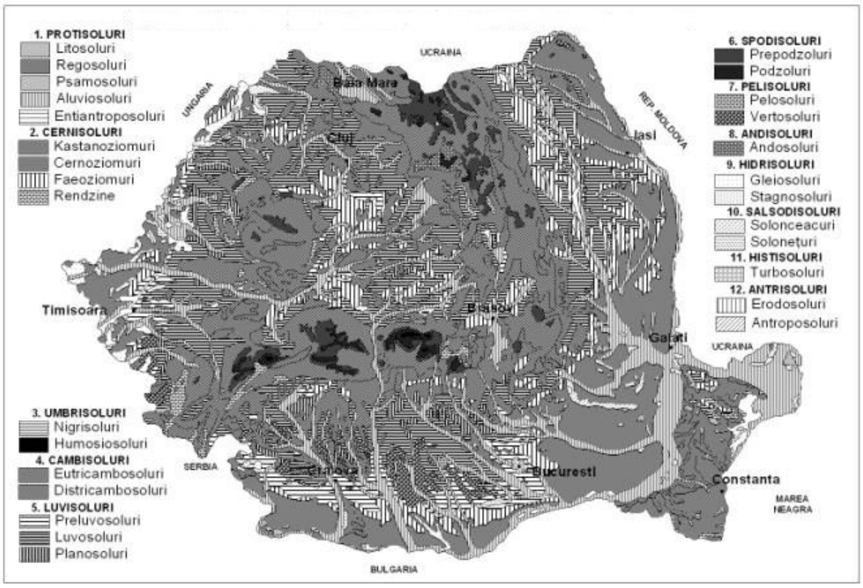


Fig. 1. Soils of Romania in Romanian Soil Taxonomy System from 2003

The grain composition of the mollisols is maintained relatively uniform on the profile. It contains about 19-23% clay (under 0.002 mm), around 26-27% dust and u to 53% sand. The nutrient supplying is medium with nitrogen (0.146-0.160%), good with phosphorus (41-62 ppm) and very good with potassium (150-219 ppm).

Another quarter of the country is occupied by ***LUVISOLS*** (25.5%) represented through *preluvosols, luvosols, planosols* and *alisols* and are spread in the plains and highlands, mostly in the hill and highlands regions. Dominant are typical *luvosols* which participate with about 15%.

LUVISOLS includes those soils which don't have as a diagnosis a rich migrated clay BT horizon. They can have or not an eluvial horizon (El or Ea). There are soils with an acid reaction (pH=5.4-5.7), weakly moderated humifere, with a mezobazic character and a supplying with fertilizing elements that is unsatisfying (N, 0.100-0.130%; P, 20-36 ppm and 100-110 ppm).

CAMBISOLS and ***SPODISOLS*** at which are added ***UMBRISOLS*** and ***ANDISOLS*** represent together a quarter (25.5%) and are characteristic to mountain regions.

CAMBISOLS group soils at which the essential diagnostic element is the presence in the profile of the B cambic (Bv) horizon, like *eutricambosols* and *districambosols*. They appear in the Subcarpatic areas, Transylvania Highlands, Getic Highlands and Western Piedmont Hills.

SPODISOLS unite the soils in which the main diagnostic element which constitutes the presence of a spodic B horizon can be Bs or Bhs type. They are specific to the boreal mountain level (corresponds to conifers) and under the sub-alpine level. The inferior limit is situated at 1300-1450 m and goes up to approximately 2000 m. From the spodisols class there are prepodzols and podzol. *Prepodzols* represent a type Au-Bs-R profile, have a sandy-clay or clay-sandy texture, high permeability (25-39 mm/h), high acid reaction (5.0-5.5) and are well supplied with nitrogen (0.09-0.39%).

Podzols are described through the presence of Bhs or Bs and Es horizons and occupy extended areas in a mountain area (4.6%). In general they have a type Aou-Es-Bhs-Bs-R morphology, have a varied texture on profile (sandy-clay, clay-sandy), low clay content (under 25%) and are acid (3.6-4.6).

UMBRISOLS include soils having as diagnosis an A umbric horizon like nigrisols and humosiosols.

Nigrisols are defined by an Au horizon, with chromes under 2 at humid material and a Bv horizon, having V under 55%. They are spread in the mountain areas with the same areas as the brown acid soils.

Humosiosols. This kind of soils are defined by an Au horizon with chromes smaller than 2 at the humid material, containing humified organic matter separable from the silicate mineral part and A/C, A/R or Bv horizon, having at least in the upper part colors with values and chromes under 3.5 at the humid state material.

ANDISOLS are represented just by the *andosol* type defined through the presence of an A (Au, Ao, Am) horizon, followed by an intermediary horizon A/C, A/R, Bv to which amlic properties are associated. They can be found at altitudes between 1000-1800 m in volcanic mountains.

PELISOLS. They have as a diagnostic horizon the presence of a pellic or vertic horizon, of which higher limits are situated in the 0-20 cm interval and include among vertisoils also very clay soils which don't have vertic characters.

HYDRISOLS refer to soils formed in permanent or periodic high humidity conditions watery or stagnant. Included in this class are gleiosols and stagnosols (3.3%).

Gleiosols are watery hidromorf soils defined through an A horizon (mollic-Am, ochric-Ao, umbric-Au and a gleyic horizon-Gr). In Romania they are spread locally in plain areas, hill regions and inner-mountain highlands.

Stagnosols, considered hydromorphed pluvial soils are defined through a stagnic diagnostic horizon (W) with an upper limit up to the depth of 50 cm, grafted on the A horizon and/or E and B.

They are spread in plains, piedmonts, highlands, terraces on plane horizontal surfaces imperfectly watered made out of fine sediments, hard permeable. Usually they are moderated acid soils (pH, 5.0-5.8).

SALSODISOLS concern soils with a salic horizon (sa) or a nitric horizon (na) in the superior part like the solonchaks and solonetz (0.9%).

Solonchaks are soils with an A ochric or mollic (Ao, Am) horizon and an intermediary horizon to which is associated a salic horizon (sa) in the first 50 cm, they are spread on extended areas in the plain areas, on terraces and meadows.

Solonetz were defines as soils that have an A ochric or A mollic horizon (Ao,Am) followed by an intermediary natric (na) horizon from the surface or in the first 50 cm, they are spread in the same areas as the solonchaks, they have a clay texture, extremely low permeability, moderated neutral alkaline reaction (6.7-8.9).

PROFILES OR UNEVALUATED SOILS. These were formed on recent sediments, with a wind or alluvial nature which have different textures, sandy up to clay. In this class the most popular are *regosols, arenosols (psamosols)* and *aluviosols*. To these are added *lithosols and entiantrosols* (11.0%).

HISTISOLS. They are made out of organic hidromorphic horizons, the minimum thickness of the peatfull horizon (T) is at least 40-50 cm, they can be found in small spots in intracarpatic depressions, in some swamp areas, meadows, former lakes etc (1.8%) having a low fertility they are used as grasses.

ANTHRISOLS. Recently introduced in the soil classification worldwide and in our country, they refer to soils that have on the surface an intense modified atrophic horizon of at least 50cm thickness of which A and E horizon were excluded through erosion. In this class we can find erodosols and anthrosols (3.5%).

CONCLUSIONS

1. The Romanian System of Soil Taxonomy-2003 includes a total of 12 classes of soils and 32 soil types. As it stands now, is an attempt to systematize and order latest progress in the light soils ever made in nationally and internationally scale.

2. Without changing the basic structure and entities of the system since 1980, provides a better system of soils classification, a consistent application of diagnostic criteria, increased awareness of practical application and also a uniform soil terminology.

REFERENCES

1. Florea N., Munteanu I., 2003. *Sistemul Român de Taxonomie a Solurilor.* Ed. Estfalia, Bucureşti.
2. Parichi M., Anca-Luiza Stănilă, N. Cruceru, 2006. *Solurile principalelor unități de relief din România*. Ed. Fundației România de Mâine. Bucureşti (pp. 179).
3. Parichi M., Fl. Vartolomei, Anca-Luiza Stănilă, 2006. *Harta solurilor României în Sistemul Român de Clasificare-2003*. Analele Univ. Spiru Haret, Seria Geografie, nr. 9, Ed. Fundației România de Mâine, Bucureşti (pp. 121-124).
4. Stănilă Anca-Luiza, M. Parichi, 2001. *Cartografierea solurilor.* Ed. Fundației România de Mâine, Bucureşti.
5. Stănilă Anca-Luiza, M. Parichi, 2003. *Solurile României*. Ed. Fundației România de Mâine, Bucureşti (pp. 191).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

SUITABILITY OPPORTUNITIES IN LANDS OF ROMANIA ESTABLISHED BY SOIL EVALUATION AND AGROECONOMIC CRITERIA

A. BASARABA*, JULIETA CRISTINA POPA, N. ANDREIASI**, CRISTINA NEDIANU**, GABRIELA CORFU****

*University of Agronomic Sciences and Veterinary Medicine of Bucharest
**"Bioterra" University of Bucharest

Keywords: *edaphic resources, soil evaluation, soil taxonomy, cadastre unit*

Abstract

Agricultural land favorability from Romania, although known a long time ago, was practically neglected at the same time with the land property changes. The actual legislation does not include direct references to the opportunity of the market value of a land establish according to the categories and grades of land classification.

Our target was to remind to specialists and not only, the criteria according to which land classification has to be done, the obligation to any agronomical space evaluation, in order to negotiate or another opportunity, to have as principle the land classification.

INTRODUCTION

Soil evaluation, as a soil science component, represents the reference in terms of natural qualities, both technological aspects of an agricultural area. Agricultural territory, wherever they are location parameters and transposed cartographically defined at different scales. It thus finds new destination in various agronomic utility.

Mutations in the categories of land resources spent in the last decades, and indirectly led to disruption of several components of eco-homogeneous "territories". Distribution of major land units suffered many changes, reflected in the land registers.

Soil map legends, previously developed, were converted after the 2003 SRTS and cadastral maps, the same scale, were subordinated to the land resources landmark new law (Law 18), while classes of soil evaluation were grouped by two (five instead of ten, twenty points range).

RESULTS AND DISCUSSION

Suitability for a specialist refers to natural ability or potency of a ground application of agricultural technologies in order to obtain stable and high quality productions.

For investors, the agronomic suitability means to achieve the profit opportunity.

Knowledge is the first condition of land resources in developing a profitable investment. If the necessity for an agricultural specialist is no stranger to training and his concerns, for people with ambitions for agriculture, but no knowledge in the field, soil resource must be the first opportunity. Based on the resource will be able to appreciate the land's production capacity, need and nature of investment, and expected to finally profit per hectare.

Opportunities, at present, on the production capacity of agricultural land in Romania, established by researchers in the field, have been grouped as follows:

1. At the national level, cartographic maps reconsideration of soil evaluation suitability to small scales (1/1,000,000), legends and the necessary annexes;
2. In the counties, maps of soil information is the (printed sheets 1/200,000), and also the work of zoning agricultural production (Sc. 1/50,000) counties:
3. Zoning on agro-ecosystems (23 total), includes reference to soil characterization, ameliorative systems and classes of soil evaluation for the most representative of the culture and uses.
4. In the commune, the default profile companies with agricultural production, private associations and manufacturers, the opportunity is correct inventory level of favorability (1/10,000 scale detail and sometimes being higher), to follow is knowing potential fertile plots in for a fair consideration of the agricultural tax, consider it an opportunity for the most urgent at the moment;
5. Change categories of use and removal from circulation of the upper class areas of evaluation, is an opportunity of considering the changes occurred in the land of the last 20 years;
6. Expropriation of the land with "national interest" to be made in agreement with the pedological and compensation specialists depending soil evaluation class. The most recent conflict in such situations, is the overpass section Pipera Vacarescu Barbu, the capital, where m^2 was quoted at 41euro (soil: red preluvo-soil - ELrs), compared with the adjacent area, in town, Floreasca is rated at 600 EURO/m^2 (same soil - ELrs). Similar situations in the case of the A_4 motorway, Timisoara - Deva sector, where price m^2 of land out of agricultural production is 41 euro (Eutricambosoil), recitals in both cases took no account of soil evaluation.

For information about national (1/500,000), those approx. 1200 units, defined by 34 ecometric parameters, production capacity assessment was done for a total of five crops (wheat, maize, sugar beet, potato) and five uses (arable, pasturage, hay/field, vineyard, orchard).

The score ranges between 10 points per class, and the material code, the mapping are illustrated in table (suitability maps).

Table 1

Model field units grouped on climatic and ameliorative - the scale of information, at the national level 1/500,000

Unity number	County code	Natural province	Climate characterizations				Rock	Groundwater depth	Drainage	Landslides	The vegetation	Dominant soil	Traits of soil				Note of soil evaluation									
																	uses					crops				
			T^0	P mm	Σ temp	Other elements							Texture	Humus %	CAU %	Other traits	Arable	Pasture	Meadow	Vineyards	Orchards	Wheat	Maiye	Sunflower	Sugar beet	Potato

Suitability of land comprised in an agro-system, is a prime opportunity here because the information we find fertility potential of the area, also the amount and duration of investment.

Map location agro-ecosystems and their relationships positions us we find the place (soil properly, after assessing the production of evaluation score, works 1.F. etc). Noteworthy are two of the crops (wheat and maize) and that uses, arable land and pastures. Favorable classes cover 1, 4 and 5 units for wheat, respectively 4, 5 and 12 in maize. Geographically it is the Romanian Plain, Dobrogea and the Western part of the country.

Table 2

Global characterization of Romania agrosystem

No. crt. agro-ecosystem	Geographical area	Geomorphologic formula and the specific process	Climate (T^0 and P mm)	Dominant soil	Main attributes of soil fertility			Production capacity after the note of soil evaluation on uses and the estimated production				Surface	
								Soil evaluation note		Estimated production for pastures			
					Texture Ap	Humus reserves t/ha	pH	Arable land	Pastures	SU/ha	Thousands UN/ha	Thousands/ ha	%

Cartographic scale on which 23 is 1/1,000,000 agrosystem, considered optimal for information and decisions at national and regional. Parameter "process specific" group refers to land as required by the prevention and control of processes such as excess moisture, salinity, erosion, secondary acidification and so on.

Table 3

Risk to the phenomenon of excess moisture and ameliorative measures in agroecosystems

Specific measure	Land use and area in hectares			Total farming
	Arable	Pasture+Meadow	Vineyards + Orchardas	
Absence	5510	2119	416	8375
Refining soil	2183	785	132	3100
Superficial drainage	929	673	111	1743
Depth drainage	974	351	15	1340

Table 4

Risk of soil salinization in Romania agroecosystem

Degree of damage and intensity	Land use and area in hectares			Total farming
	Arable	Pasture+Meadow	Vineyards+Orchardas	
Unaffected	7361	3969	696	12026
Secondary salinization	2284	374	60	2718
Strong salinity	8	21	0	29

The opportunity of knowledge about the production potential of a territory remains the detail 1/10,000 and in particular the statements of investments 1:2000 (maps-growing design, greenhouses and so on).

Romania has coverage area of one third of the agricultural area, with studies mapping and soil evaluation marks. Soils are detailed to the variant level, conditional soil evaluation includes a total of 14 crops, 6 species of fruit and unknown uses. Cadastral plot sheet that accompanies a studio also includes legal references such as the land acquisition acts, the situation heirs, and so on form of exploitation.

In our country, with the opening of land market liberalization after 1997 and land traffic was up and evaluation, with pricing per hectare. Basically, now, any study or assessment on soil evaluation involves the land marks. The methods used are the agro-economical, such as agricultural production, capitalized land rent, to parametric methods.

Evaluation by soil evaluation of land resource marks, aims to return or income per hectare. Expression values, the price it gets ground, fixed assets are included in the balance of agriculture. The indicator of "stability" of agricultural land and not only is the natural potential fertility of the soil in question. Coefficients are added to this indirect indicator of evaluation, under or super-unitary. Their product with natural grade ups or downs the classification into classes (five in number, legislation after 1991). We also conducted a research on a farm in the Danube mead (Prundu-Greaca) which is the educational background protisoils and hydrosoils. Soil evaluation was done in two crops: wheat and barley.

Fig. 1. Natural soil evaluation for wheat and barley at Prundu-Greaca

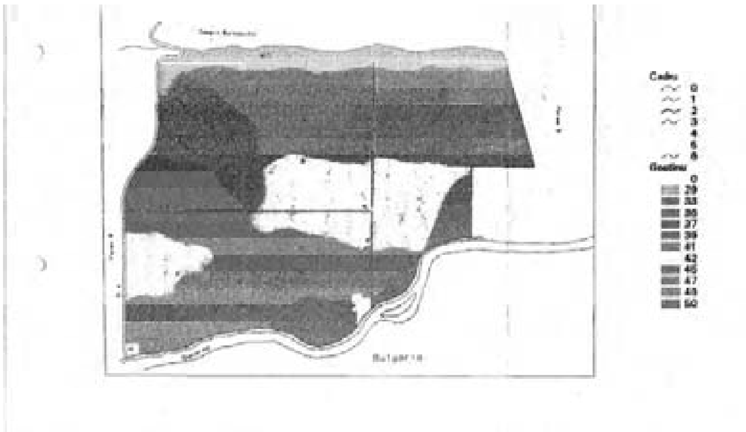


Fig. 2. The point - represent Kg per point of soil evaluation
The color - the amount of soil evaluation point

CONCLUSIONS

1. The paper represents our own point of view on some current opportunities regarding the resources of the Romanian land resources. Details of the

investigations take place at various scales, hence the territorial spread of land suitability, agro-default value.

2. Although there is valuable information on the agricultural potential of the entire national space, these are too little access and consultation of the almost neglected cartographic materials.
3. Opportunities on the land quality, its preservation and conservation will have to follow one direction ground and soil evaluation.

REFERENCES

1. Andreiasi N., 2005. *Foundations in Soil Science*. University Book Publishing House, Bucharest.
2. Andreiasi N., D. Teaci, M. Mihalache, 2001. *Suitability, agro-economic assessment and soil evaluation*. Ed Corwin, Deva.
3. Petcu Gretiana, 2003. *Agricultural land evaluation methods*. PhD Thesis, University of Agronomic Sciences and Veterinary Medicine of Bucharest.
4. Teaci D., 1999. *Romanian Forestry and Agriculture*. Ed. Omniapres, Bucharest.
5. xxx, 2003. *Romanian System of Soil Taxonomy*. Ed. Estfalia, Bucharest.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

BIOPOLYMERS SYSTEMS FROM LEATHER WASTES FOR DEGRADED SOILS REMEDIATION

G.A. ZĂINESCU*, M. MIHALACHE, P. VOICU***, RODICA CONSTANTINESCU*, L. ILIE**, MIHAELA OBRIŞCĂ****

*National Research and Development Institute for Textile and Leather - Division: Leather and Footwear Research Institute of Bucharest
**University of Agronomic Sciences and Veterinary Medicine of Bucharest
***National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection of Bucharest

Keywords: *biopolymer, protean wastes, tannery, soil, structural analysis*

Abstract

Most tanneries and leather product manufacturers have serious problems regarding waste discharge, as their disposal in dump wastes leads to chromium accumulation in soil with possible harmful effects on the ecosystem.

The use of untanned wastes presents a special interest, because it provides almost total fleshing waste discharge while obtaining qualitatively and economically valuable products.

The main target of this scientific paper is investigating the development possibilities for various multicompound systems of biodegradable polymers and studying the effects of these complex products on the structure and chemical and physical characteristics of degraded or contaminated soils (having a poor level of organic matter or submitted to a strong erosion process).

The paper presents a new pilot technology for biochemical decay of the tannery protein wastes and use of the resulted products as fertilizers. In the present paper, the agrochemical base of biofertiliser use is investigated, analyzing the principle and dynamics of nutrient elements penetrating soil and plants, their influence on weathered soil rehabilitation/conditioning and on plant growth and development, as well as in agrochemistry of nutritive elements.

INTRODUCTION

The exploitation of protein wastes from tanneries is a necessity of ecologic technologies, as the largest waste amount resulting from leather processing is that of untanned wastes. It is known from technological practice that, as a result of processing a ton of raw hide, wastes are 75% of which 50% are protein wastes which can be used in agriculture, as biofertilizer [1].

Soil conditioning consists in improving physical characteristics by using substances of various origins, known in the literature as soil conditioners.

Biodegradable polymers - organic polymers - are among soil conditioners with multiple advantages.

Soil contamination means a moderate increase of elements/substances which are not harmful for plant growth and development, but which can represent the initial phase of the pollution process. Reducing the effects of degradation/contamination/ pollution consists in applying remediation methods, of improving the characteristics of soil affected by degradation processes or by limitative factors, for the purpose of recovering to the original state of fertility and productivity, to a higher or at least similar state to the initial one.

Remediation refers to methods to be applied on terrains that are not suitable for agricultural or forest use, such as some dumps from mining or various residues, in order to recycle them into the environmental circuit.

In general, polyelectrolytes (such as polyelectrolytes based on polyacrylamide), as well as other categories of synthetic polymers, contribute to the improvement of soil characteristics through one or more of the following effects:

- increasing the degree of aggregation of structural elements of soils with degraded structure
- preventing crust formation in the period between plant seeding and emergence, particularly in those with small seeds, which are very vulnerable;
- increasing resistance to water and air erosion of soils situated on slopes and those with coarse structure (clay under 12%);
- preventing or reducing the intensity of water or air erosion and of negative phenomena that these entail;
- encouraging the formation of hydrostable structural aggregates to improve soil permeability, aero-hydric system, water infiltration, with beneficial effects on water retainment in soil and mitigation of negative effects of prolonged drought in vegetation season;
- modifying mobility and accesibility of heavy metals in polutted / contamined soils to plants. This effect could be used in the case of soils polluted with heavy metals or polluted areas near metallurgical plants.

The main methods recommended in polluted soil remediation are: stabilization, setting up protection barriers, thermal and microbiological depollution techniques [2].

The main purpose of research consists in improving soil structure on the surface of the germinative bed with multicomponent biopolymer systems and thus ensuring better conditions for plant emergence, growth and development, particularly in species where the seed is introduced in the soil at shallow depth (up to 4 cm) and the use of structurally stabilized soil. The efficiency of using fertilizers depends not only on soil composition, but also on nutrition particularities of agricultural plants [3].

Regarding plant crops in the experimental field, it is considered that soil structure improvement positively influences the following indicators: emergence rate; final number of emerged plants; root production; increasing the plant production per hectare.

It is noted that, in order to objectively characterize soil in terms of structure conditions, a quantitative research of its stable structural composition is necessary. This is done by means of the so-called soil structural analysis, which consists in establishing stable aggregate percentages, resistant to the dispersive action of water and by means of certain qualitative characterizations based on indexes and diagrams.

The most significant issue in the study of structure is aggregate formation. The process was initially considered a simple flocculation of colloids in the soil under the influence of certain electrolytes, of calcium first of all. However, it was immediately found that the process is a lot more complex and that a simple flocculation does not provide a satisfying explanation on aggregation. Then other phenomena were introduced, proving their importance in structure formation, such as: pressure exerted on aggregates and the cementing effect of irreversible colloids, such as humus saturated with calcium.

Many researchers consider that aggregate cement is found in the organic part of colloids in the soil and prove that in intensive, strongly chemicalized agriculture, the worm population in the soil decreases, sometimes totally disappears, which has negative effects on structure formation. Restoration of worm population in the soil by human intervention is quite difficult to accomplish, since the simple introduction of such organisms in the soil is not enough, fresh organic matter, which is basic food, must be provided [4].

In this sense, it can be claimed that these multicomponent systems of protein biopolymers are favorable to the improvement of degraded soils.

MATERIAL AND METHODS

Green house (Soil Module Hall) with controlled climate conditions within National Research and Development Institute for Pedology, Agrochemistry and Environmental Protection - ICPA Bucharest.

Pots with constant volume, filled with typical cambic chernozem soil from Fundulea. Equipment used: penetrograph; penetrometer; reflectometric probe; analytical pH-meter. Protein biopolymers: BAZ - with synthetic polymer in various percentages.

Methods used for analytical characterization and research of soils - according to ICPA instructions of pedologic mapping 1982 [5].

RESULTS AND DISCUSSION

Organic biopolymers are a source of raw material for agriculture, as the composition of protein wastes provides enough nutritive elements to improve soil composition and remediate degraded soils, facilitating greenhouse and field plant growth [6].

Biopolymers have been obtained by means of an innovative enzymatic procedure of processing protein wastes resulting from leather processing, which, in combination with other polymers (polyacrylamide, acrylic polymer, maleic polymer, cellulose, starch etc.) can be used to remediate degraded/eroded soils and for greenhouse and field plant growth. Pelt wastes have been taken from the SC Pielorex tannery in Jilava - Ilfov County.

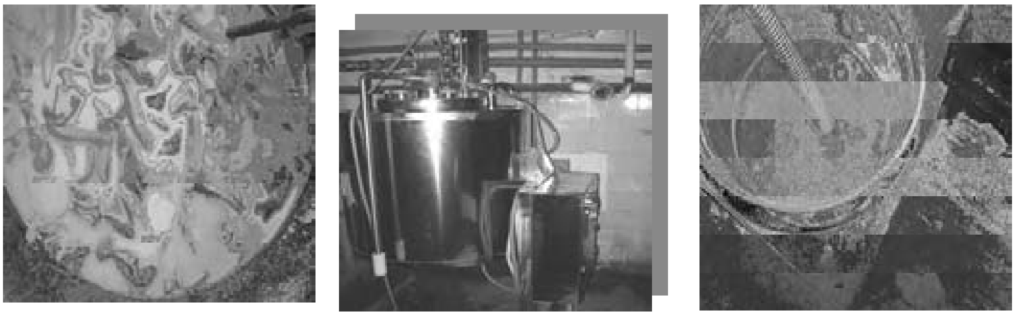


Fig. 1. Leather wastes; enzymatic hydrolysis

Fig. 2. Pots in the Soil Module Hall (ICPA green house)

In INCDTP Division: ICPI Bucharest, the BAZ (multicomponent biopolymeric systems) biofertilizers have been obtained which have been subsequently tested and experimented by ICPA - Bucharest in terms of their effect on soil structure [7].

The scientific paper presents the action of BAZ 50 biofertilizer in order to improve the structure of typical cambic soil Fundulea (with low organic substance content) under "greenhouse" conditions [8].
The morphological and chemical characteristics of typical cambic chernozem soil from Fundulea are presented below:

Name: Cambic chernozem - Fundulea
Location: The Romanian Plain, ICCPT Fundulea.
Pedogenetic conditions
Relief: plain, flat, relatively horizontal surface.
Absolute altitude: 65.3 m.
Parental material: loess deposits.
Groundwater depth: >8 m.
Natural global drainage: excessive.
Bioclimatic subarea: steppe.

Morphological Characterization of Soil Profile

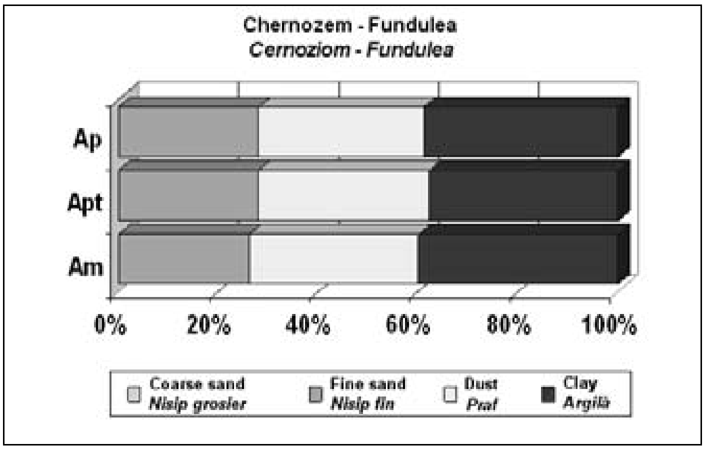


Fig. 3. Granulometry of cambic chernozem from Fundulea

Analytical data (Figure 3) regarding granulometric composition highlights the following contents of granulometric fractions: clay (<0.002 mm) values range between 37.8-40.0%. Dust content has a relatively uniform distribution, its values oscillate from 33.1 to 33.8%. Fine sand content has lower values (26.1-28.1%) than dust and has the same profile distribution. In terms of texture, this soil falls within the category of clayish-dusty clay soils.
In a soil with relatively low clay content and weak acid reaction (pH has values of 6.3-6.8), the humus quantity is low (2.4-3%) - Figure 4.

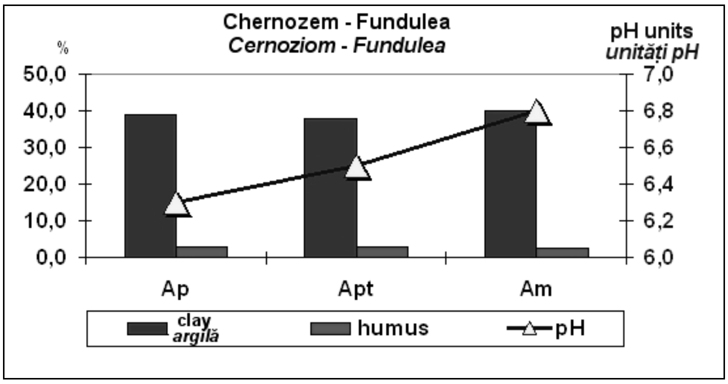


Fig. 4. Physical-chemical characteristics of cambic chernozem from Fundulea

In the development area of agricultural plant roots, the supply of total nitrogen is medium (Figure 5). The supply of mobile phosphorus is very low on the surface and low-medium everywhere else, and that of mobile potassium is low.

Table 1

Chemical properties of typical cambic chernozem - Fundulea

Horizon	UM	Ap	Aph
Horizon depth	cm	0-18	18-30
Humus (C x 1.72)	%	3.0	3.0
Total N	%	0.179	0.169
C : N	-	11.4	11.8
$CaCO_3$	%	0.0	0.0
pH (in H_2O)	pH unit	6.3	6.5
T	me/100g	21.1	21.3
$V_{8.3}$	%(T=100)	89.1	88.7
Total phosphorus (AL)	ppm	28	14
Mobile potassium	ppm	98	87

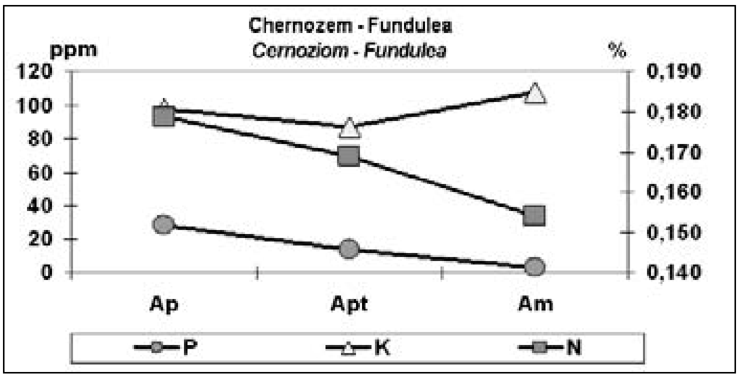


Fig. 5. The N, P supply of cambic chernozem from Fundulea

Results Obtained in the Greenhouse

Hydrostability

Regarding hydrostable macroaggregate content in the soil, laboratory analyses and determinations have highlighted the positive effect of the treatment applied with BAZ 50 biopolymer. Thus in the 0-10 cm layer, soil hydrostability of the control variant was 2-4% throughout the experimental cycle, and of the variant treated with BAZ 50 biopolymer ranged between 58 and 76% (at a concentration of 0.1% and 0.2% respectively).

In conclusion, treating typical cambic chernozem soil from Fundulea in pots with BAZ 50 biopolymer suspensions has contributed to the increase of hydrostable magroaggregate content and as far as the residual effect of treatment on hydrostability is concerned, results obtained emphasize a high content of hydrostable macroaggregates throughout experiments.

Dispersion

Regarding the effect of BAZ 50 biopolymer on the dispersion (percentage content of hydrostable microstructural elements with the diameter smaller than 0.01 mm) data obtained through laboratory analyses highlight the fact that the treated soil has lower dispersion values than the untreated soil.

Analyzing the results obtained on the soil from the 0-10 cm layer, the following are found: in the variants of treating soil on the 0-10 cm layer, the dispersion was 11.1% in the control variant, 4.2-5.3% in the treatment with BAZ 50 biopolymer in concentration of 0.1 and 0.2%. These values have clearly highlighted that application of treatment with biopolymers has led to the reduction of fine particles in the soil, namely microstructural elements with the diameter smaller than 0.01 mm. The statistic calculation emphasizes a significative difference between the variants with treated soil and the control variant with untreated soil.

Structural Instability

Structural instability expressed by a synthetic index comprising both macrostructural and microstructural data highlights the positive influence of the treatment with protein biopolymers on the structure of typical cambic chernozem from Fundulea. Analyzing data on the soil in the 0-10 cm layer, it is found that the structural instability index was 5.55 in the control variant and 0.05-0.06 in the variants treated with BAZ 50 biopolymer.

Bulk Density

Regarding soil settlement in the 0-10 cm layer, analytical data characterize bulk density as being low (1.20-1.23 g/cmc) in the control variant and extremely low (0.96-1.05 g/cm³) in variants of treating soil with suspensions of BAZ 50 biopolymer. The statistic calculation highlights a significant difference.

In conclusion, applying BAZ 50 biopolymer to improve the structure of cambic chernozem in pots has led to the improvement of settlement. Most often, the values of bulk density of the treated soil were significantly lower than the ones recorded for the untreated soil (control).

Resistance to Penetration

The analysis of laboratory determination results pn the influence of improving the structure of cambic chernozem in pots on the resistance to penetration highlights the positive effect of the treatment with BAZ 50 biopolymer. In the case of 0-10 cm layer soil, resistance to penetration was estimated as medium (approx. 32 kgf/cm²) in control and very low (7-10 kgf/cm²) in the treated variants. Statistically, the difference is significant.

Saturated Hydraulic Conductivity

Regarding soil permeability in pots, in the 0-10 cm layer, the analysis of results obtained in the laboratory highlights the positive effect of structure improvement on saturated hydraulic conductivity.

Thus permeability was moderate (0.01-0.05 log.mm-h) in the control and very high (2.27-2.66 log.mm-h) in the variants of soil treated with suspensions (0.1-0.2%) of BAZ 50 biopolymer, the difference being significant both between treated variants and particularly compared to the control.

Total Porosity

The results of laboratory analyses and determinations regarding total porosity in the 0-10 cm layer prove that total porosity was very high (58-59%) in the untreated soil from the control variant and extremely high (65-69%) in the soil treated with BAZ 50 biopolymer suspension.

CONCLUSIONS

1. Biopolymers have been obtained by means of an innovative enzymatic procedure of protein waste processing resulting from leather processing, in combination with other synthetic polymers (polyacrylamide, acrylic polymer, maleic polymer, celulose, starch, etc.).
2. The analysis of results from the determinations carried out in the Soil Module Hall (green house) regarding the effect of BAZ 50 biofertilizer (concentration 0.1-0.2%) on the improvement of cambic chernozem structure in pots.
3. Thus, the positive effect of the biopolymer was highlighted on hydrostability, dispersion, structural instability, saturated hydraulic conductivity, resistance to penetration and total porosity of cambic chernozem soil from Fundulea.

4. In conclusion, multicomponent biopolymer systems can be successfully used to remediate degraded/eroded soils and to enhance greenhouse and field plant growth.

ACKNOWLEDGEMENTS

This article was elaborated within the Project PNCDI II-IDEAS entitled "Research regarding the remediation and/or conditioning of degraded, eroded or contaminated soils with multi-component systems of biodegradable polymers", financed by UEFISCU, Romania, financing contract no. 1123/2009.

REFERENCES

1. Bailey A.J., 1992. J. Soc. Leath, Tech. Ch., 76, 111.
2. Canarache A., 1990. *Physics of Agricultural Soils (in Romanian)*. Ceres Publishing House, Bucharest.
3. Chițanu G.C., D.M. Creanga, T. Hirano, N. Badea, 2002. *Supramolecular Structures in Complex Systems from Natural and Synthetic Polymers*. I. Interaction between Collagen, Maleic Polyelectrolytes and Chromium Ions, Rev. Roum. Chim., 47 (3-4), 343.
4. Voicu P., S. Chivulete, M. Mihalache, V. Morărescu, G.C. Chițanu, A. Carpov, 1997. *Experimental Results Regarding the Possibility of Reducing the Intensity of Erosion Processes on Slopes with Agricultural Application Using Structural Stabilizers.* Soil Physics and Technology, SNRSS Publications, 29A (pp. 69-80).
5. Lăcătușu R. (coord.), 2004. *The Impact of Pollution Sources from Peri-urban and Urban Horticultural Sites on the Environment and Vegetable Products.* Estfalia Publishing House.
6. Zăinescu G., P. Voicu, A. Gherghina, L. Sandru, 2009. *Exploratory Research Regarding the Use of Organic Biopolymers from Tanneries in Agriculture*. (Part I and Part II), Leather and Footwear Journal, 9(4).
7. Zainescu G., P. Voicu, E. Albu, L. Sandru, 2008. Romania, Patent request no. A 00655: Innovative Process of Obtaining Biocompost Based on Hide Wastes.
8. Voicu P., 2008. *Research on the Use of Polymers in Agriculture*. Bren Publishing House, Bucharest.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

RAPID AND LOW-COST DETERMINATION OF HEAVY METALS IN SOIL USING AN X-RAY PORTABLE INSTRUMENT

MIHAELA ULMANU*, ILDIKO ANGER*, EUGENIA GAMENȚ, M. MIHALACHE***, ELEONORA NEAGU*, L. ILIE*****

*National Research and Development Institute for Nonferrous and Rare Metals of Pantelimon
**National Research and Development Institute for Soil Science, Agrochemistry and Environment Protection of Bucharest
***University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *heavy metals, polluted soil, portable X-ray fluorescence instrument*

Abstract

Contaminated soils present a major global health problem especially in urban areas with dense population. The common contaminants of soil are heavy metals. For risk – assessment studies and follow-up remediation projects is necessary to perform numerous analyses to determine the concentration of metal contaminants.

To minimize the need for laboratory analysis of soil samples, the XRF – technology can be used for screening the metal contamination in soil, with significant advantages. This method provided significant accuracy and well documented to support field decision making with reduced overall costs. The new generation of portable XRF instruments is equipped with miniatures X-ray tubes in order to reduce the regulatory demands encountered with radioactive isotopes.

The goal of this experiment was to complete the data obtained in the preliminary tests, by observing the influence of soil particle size and the metal concentration in soil upon the XRF results.

The XRF results are presented comparatively with laboratory analysis data. From these results is evident that the soil particle size have no important influence upon the XRF data, an important factor appears to be the metal concentration in soil.

INTRODUCTION

The soil forms the outer skin of the land masses of Planet Earth; it is our life - support system. Soil is a vulnerable resource, the largest disruption and destruction being caused by humans.

Contaminated soils present a major global health problem especially in urban areas with dense population. The common contaminants of soil are heavy metals. For risk - assessment studies and follow-up remediation projects is necessary to perform numerous analyses to determine the concentration of metal contaminants. The remediation projects could include the removal of metal contaminants from soil or the removal of surface - contaminated soils. The way selected for environmental remediation is dependent on the results of laboratory analysis of samples collected from the contaminated field. The prescribed reference methods for heavy metals determination in soil are: inductively coupled plasma - atomic emission spectrometry (ICP-AES) or atomic absorption spectrometry (AAS), characterized by time - consuming acid digestions, the high analysis costs and they may take a week to complete [1-3].

To minimize the need for laboratory analysis of soil samples, the XRF - technology can be used for screening the metal contamination in soil, with significant advantages. This method provided significant accuracy and well documented to support field decision making with reduced overall costs.

The principle of X-ray fluorescence is simple: when an X-ray emission from a radioactive source strikes a sample, the X-ray can either be absorbed by atoms or scattered through the material. After absorption the atoms becomes "excited" and give off a characteristic X-ray whose energy level is unique to the element impacted by the incident X-ray. The emission of these characteristic X-ray is called X-ray fluorescence, or XRF. Measurement of the discrete energy of the X-rays emitted is used to identify the metals species present; measurement of the number of emitted X-ray provides a quantitative indication of the concentration of the metal present in sample.

We have to emphasize that each of the atomic elements present in a sample produces a unique set of characteristic X-rays that is a fingerprint for that specific element. Different metals in soil can be measured quickly and non - destructively using an XRF instrument. Since XRF is completely non destructive, any sample collected and measured in field can be retained for verification by a laboratory [4].

The new generation of portable XRF instruments is equipped with miniatures X-ay tubes in order to reduce the regulatory demands encountered with radioactive isotopes.

Field portable XRF instruments have real potential for [5]:

- quickly and effectively determination of metals and metalloids concentration in soil, in laboratory or in field;
- producing a contaminant profile for a site;
- delineating contaminant "hot spot";
- evaluating the effect of remediation.

The goal of this experiment was to complete the data obtained in the preliminary tests [6], by observing the influence of soil particle size upon the XRF results.

MATERIAL AND METHODS

Soil Samples

Soil samples were collected from an old metallurgical industrial area, situated in South East of Bucharest, Romania.

XRF instrumentation

The X - MET 3000 TX XRF analyzer is manufactured by the Portable Division of Oxford Instruments Analytical Lmtd., Finland. The main characteristics of X-MET instrument are presented in table 1.

Table 1

Some characteristics of portable X-MET instrument

Characteristic	
Power supply	Two lithium ion - batteries of 220 AC power
Weight	1.8 kg
Data storage capacity	Up to 10 000 tests (64 MB memory)
Sample chamber	1 sample
X – ray source	Mini X-ray tube: 40kV, 40 microA
Detector	Diode Si – PiN, to convert X-ray emitted from the sample into measurable electronic signals
Data processing unit	Records the emission (fluorescence energy signals) and calculate the elemental concentrations in the sample
Measurement time	15…360 seconds
Elements domain	From titan to uranium
Memory	64 MB
Operation media	Temperature range : - 10 to +50^{o}C
Security element	IR sensor
Used software	Windows CE
Transfer data	USB or Bluetooth without fill

The X-ray tube based sources offer a faster analytical time because the X-ray flux can be higher than most isotope based sources. They can also be used over a wider range of excitation energies, eliminating the need for multiple isotope sources to produce X-ray over the entire excitation spectrum [7].

The main variables affecting the precision and accuracy of XRF analysis are [8]:

- physical properties of soil matrix, more exactly the variation of sample physical properties;
- chemical properties of the soil matrix - the absorption and spectral interferences;
- soil humidity higher than 10% influence the X rays transmission.

Laboratory analysis

For laboratory analysis was used as method Atomic Absorption Spectrometry, using an instrument ANALYTIC JENA AG - AAS - ZEEnit 700 in the determination of lead, copper and zinc concentrations, in agreement with national standards prescriptions.

For samples disintegration, was used an acid mixture: HNO_3- $HClO_4$ – H_2SO_4, in the ratio: 2:1:0,2. The resulting data were considered to be the total forms content of heavy metals.

RESULTS AND DISCUSSION

Soil sample collection and preparation

10 soil samples were collected from an old metallurgical industrial area in Romania, using a GPS instrument to establish the exact coordination points.

The soil samples were collected and prepared in agreement with actual Romanian standards.

The collected samples were XRF measured, then dried in air, XRF measured, sieved through the 2 mm sieve to remove non – soil particles and XRF measured again. The samples were homogenized and passed through the 200 microns sieve and XRF measured. After XRF determination, these fine samples were laboratory analized (XRF analysis being nondestructive).

The samples humidity ranged between 4.3 and 9.2%.

Laboratory analysis

Table 2 presents the metal concentrations in soil samples (10), minim and maxim values, determined by atomic absorption spectroscopy, in comparison with the limit values predicted by Romanian Environment Protection Law.

Table 2

Concentration range for lead, copper and zinc in contaminated soil samples determined by AAS method and the limit values predicted by Romanian Environment Protection Law, Order nr.756/ 03.11.1997 (mg metal/kg soil)

Element	**Metal concentration (AAS analyses), mg/kg soil**		**Limit of alert (Romanian legislation), mg/kg soil**		
	Min.	Max	Normal	Sensible areas	Less sensible areas
Copper	62	259	20	100	250
Lead	216	895	20	50	250
Zinc	189	599	100	300	700

From table 2 is evident that the concentration of heavy metals (Cu, Pb and Zn) in contaminated soil samples is higher than the limit predicted in Romanian legislation, even for less sensible areas (meaning non agricultural areas).

XRF results

To find the influence of soil particle size, the soil samples have been XRF measured as follows: the initial collected (humid) soil samples, the dried soil samples, the soil samples after passing through 2 mm sieve and samples having the particle size less than 200 microns. The analysis time was constant and equal to 120 seconds. The data presented in this paper represents the mean of five measurements with XRF instrument.

The results are presented in figures 1, 2 and 3, comparatively with the laboratory analysis data.

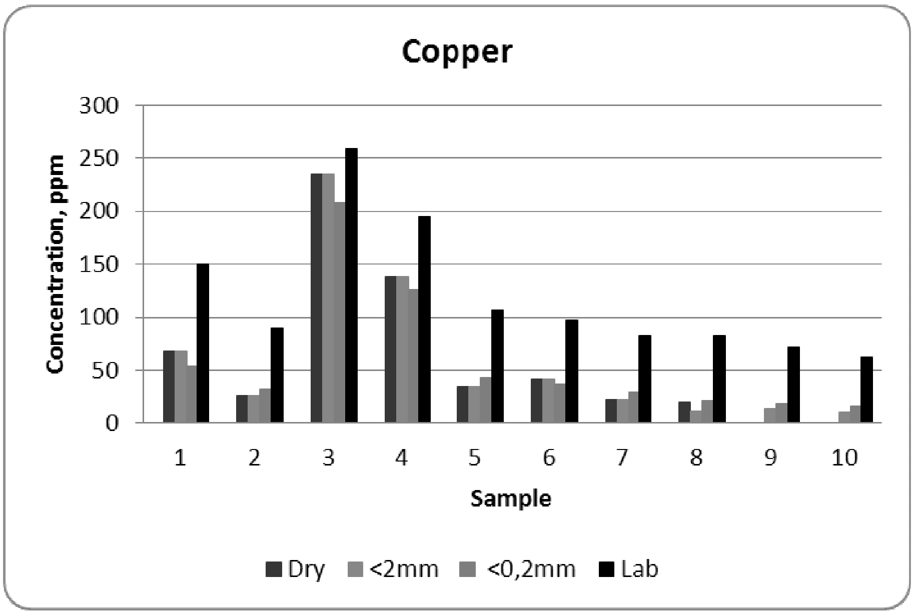


Fig. 1. Copper concentration in soil samples, XRF data versus laboratory analysis data

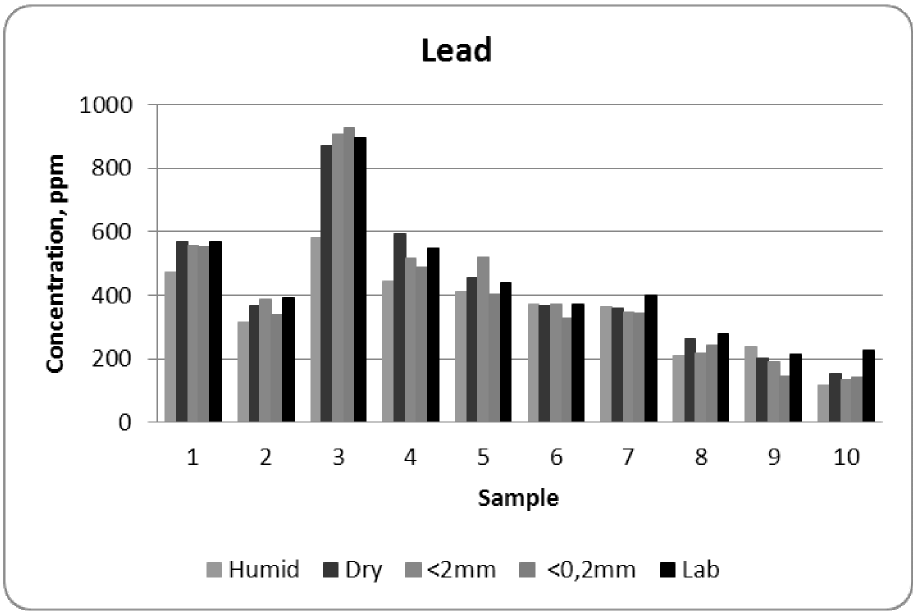


Fig. 2. Lead concentration in soil samples, XRF data versus laboratory analysis data

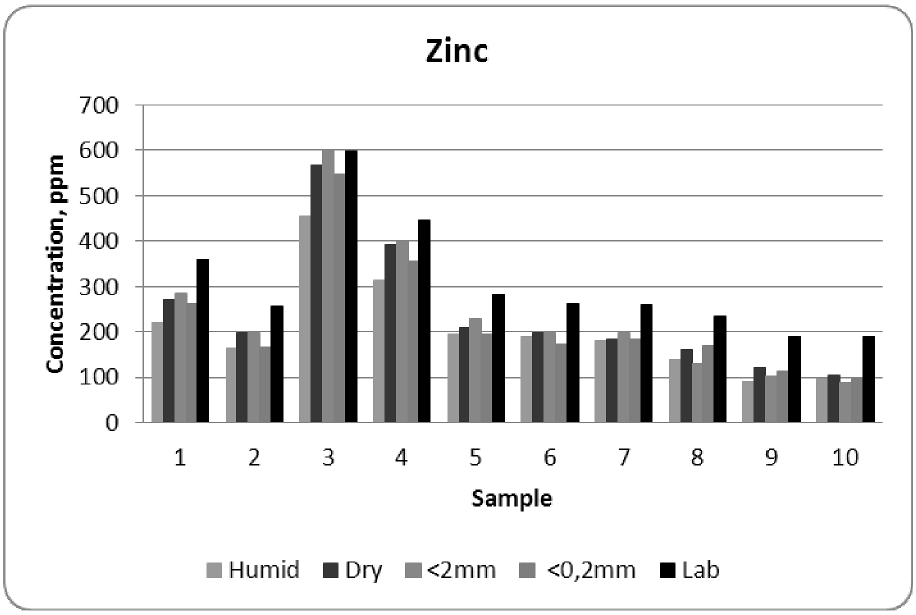


Fig. 3. Zinc concentration in soil samples, XRF data versus laboratory analysis data

In figures 1, 2 and 3: *Humid* refers to the soil samples fresh collected; *Dry* refers to the soil samples dried at room temperature; less than *2 mm* and less to *0.2 mm* are the sieved dried soil samples and *Lab*. are the results of laboratory analysis.

From the figure 1 results that in humid samples there are no XRF indication about the copper content, even in sample 3 in which the laboratory analysis give the highest concentration (about 250 ppm).

In the samples 9 and 10, in which the copper concentration determined in laboratory is less than 80 ppm, we have no XRF data in dry samples.

In all 10 samples laboratory results are higher than XRF data. Smaller is copper concentration in soil sample, higher are the difference between XRF and laboratory analysis results.

Referring to the influence of soil dimension particle upon the XRF data in copper concentration determination is evident that this characteristic have no an important influence, the copper concentration in soil sample being the determinant factor.

In figure 2 is illustrated the data for lead concentration determinate using XRF instrument comparatively with the laboratory data. The lead concentration in all soil samples is higher than copper concentration and the presence of lead is detected in all humid samples. The XRF data are very closed to laboratory analysis, with one exception, the sample 10 in which the lead concentration is only about 200 ppm, the maximum concentration of lead being higher than 800 ppm (sample 3).

The soil particle size did not affect the XRF measurements in the case of lead concentration determination.

In the case of zinc determination, figure 3, the same observation is valid. The soil dimension particle size is not an important influence factor in XRF results, the decisive factor being the metal concentration in soil. Good agreement exists in the case of sample 3, in which zinc concentration is the highest (600 ppm).

CONCLUSION

1. The goal of this experiment was to complete the data obtained in the preliminary tests, by observing the influence of soil particle size upon the XRF results in copper, lead and zinc concentration determination.
2. Ten soil samples were collected from an old metallurgical industrial area, situated in southeastern Bucharest, using a GPS instrument to have the exact coordination points, and were prepared in agreement with the actual Romanian standards.
3. To verify the influence of particle size of soil upon the XRF data were measured: the collected samples (humid), the dried samples, the samples sieved with the particle dimension less than 2 mm and finally the fine samples with de particle dimension less than 0.2 mm. These finest samples

were analyzed in laboratory, by Atomic Absorption Spectroscopy, in agreement with Romanian Standards.

4. The results XRF are presented comparatively with laboratory analysis data.
5. From these results is evident that the soil particle size have no important influence upon the XRF data, an important factor appears to be the metal concentration in soil.
6. The results confirm the influence of metal concentration in soil upon the XRF data, smaller is metal concentration in soil sample, higher are the difference between XRF and laboratory analysis results.

REFERENCES

1. Sterkeman T., A. Gomez and A. Cziesielski. Sci. Total Environ. 1996; 178 (pp. 63-69).
2. Mc.Grath D. Talanta, 1998. 46; 99 (pp. 439-448).
3. Florian D., R.M. Barnes, and G. Knapp, 1998. Fresenius J.Anal. Chem; 362 (pp. 558- 565).
4. Shefsky S., 1997. *Comparing field portable X-ray fluorescence to laboratory analysis of heavy metals*. Intern. Symposium of field screening methods for hazardous wastes and toxic chemicals. Las Vegas USA (pp. 29-31).
5. Ulmanu M., I. Anger, E. Gament and C. Lupu, 2010. *Rapid and low-cost determination of heavy metals in soil using an x-ray portable instrument. I. Preliminary tests*. Buletinul Universitatii Petrol-Gaze din Ploiesti, Seria Tehnica, Vol. LXII, no. 3A (pp. 155-162).
6. Pionek S., 2004. *Feasibility of analysis and screening of plastics for heavy metals with portable XRF analyzer with miniature X-ray tube*. Global Plastics Environmental Conference, GPEC-200; Feb., Detroit, Michigan USA.
7. ***CL:AIRE Research Bulletin, 2008. *Field portable XRF: a rapid and low cost alternative for measuring metal and metalloids in soil*. May, RB7 (pp. 1-4).
8. ***USEPA Method 6200 and Field Portable X - Ray Fluorescence.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

VULNERABILITY OF SOIL COVER IN RELATION TO CLIMATE TREND ARIDIZATION IN THE CENTRAL PLATEAU OF DOBROGEA

A. VRÎNCEANU*, P. IGNAT*, ALINA NIȚU, ANCA LĂCĂTUȘU*, M. MUȘAT**, I. JINGA****

*National Research and Development Institute for Soil Science, Agrochemistry and Enviromental Protection of Bucharest
**University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *vulnerability, aridization, soil formation deposits, soil cover*

Abstract

Increasingly obvious trend of climate change data through a gradual warming of the atmosphere, making the south-eastern Romania one of the most vulnerable regions in terms of the desertification phenomena that occur at the soil level.

The geographical position of Dobrogea is routed along the isotherm of 11ºC, which makes the plateau to register the lowest values of the index of dryness (Iar) from the whole Romanian territory, between 0.25 - 0.65 so it is that this aridization tendency to induce the climate soil cover a different graduations of various genetic types of soil vulnerability, which is due to both variability of soil formation deposits, the characteristics of topography, groundwater and salinization processes (salinization / sodization) etc.

Pedological mosaic of the plateau requires the recruitment of vulnerable groups of soils as a coherent management through sustainable management in an area where biodiversity is a tendency to decrease markedly.

INTRODUCTION

In Romania, the territory with high risk of drought, accompanied in some cases aridization and desertification includes large areas of the Romanian Plain, Dobrogea and partly in the Western Plain. These territories may be classified as fragile areas, facing with economic, social and environmental problems, induced by the excessive and prolonged drought. In extremely dry years, it covers every region in our country, as happened in previous years.

Drought, aridization and desertification are determined by natural causes, such as small quantities of precipitation or lack on the long period of time, as well as a number of factors such as anthropogenic ones. It is envisaged that some practices are most harmful, such as irrational deforestation, agro-technical works carried out improperly, leading to an inability to absorb water by soil, slope erosion and clogging of river beds, shares with unexpected consequences, which nobody has been able to manage them properly. These cases are supplemented by the faulty construction of land reclamation works, the failure to realize protection works and soil improvement, and destruction of irrigation systems in areas with high risk of drought. Drought in our country, without having a very strong cyclic character, returns in generally in intervals of 12-15 years, among them there are extremely dry years, but some disruption (1-3 years) with sufficient rainfall.

MATERIAL AND METHODS

This material was prepared having as basis the Soil Map of Romania, scale 1:200,000, processed using Geographic Information System (GIS). Soil types have been renamed in line with those of the Romanian System of Soil Taxonomy (SRTS 2003). It also covered a number of specialty papers (Methodology to Elaborating of the Pedological Studies, Part III, Ecopedological Indicators, MEPS, 1987) and the expert type analysis of existing information from the research area which is studied.

RESULTS AND DISCUSSION

In conjunction to the information available, it can be said that a large part of the Dobrogea, as is the Central Plateau of Dobrogea is subject to gradual degradation processes due climate aridization and the lands from this area shows soils with high vulnerability (Figure 1).

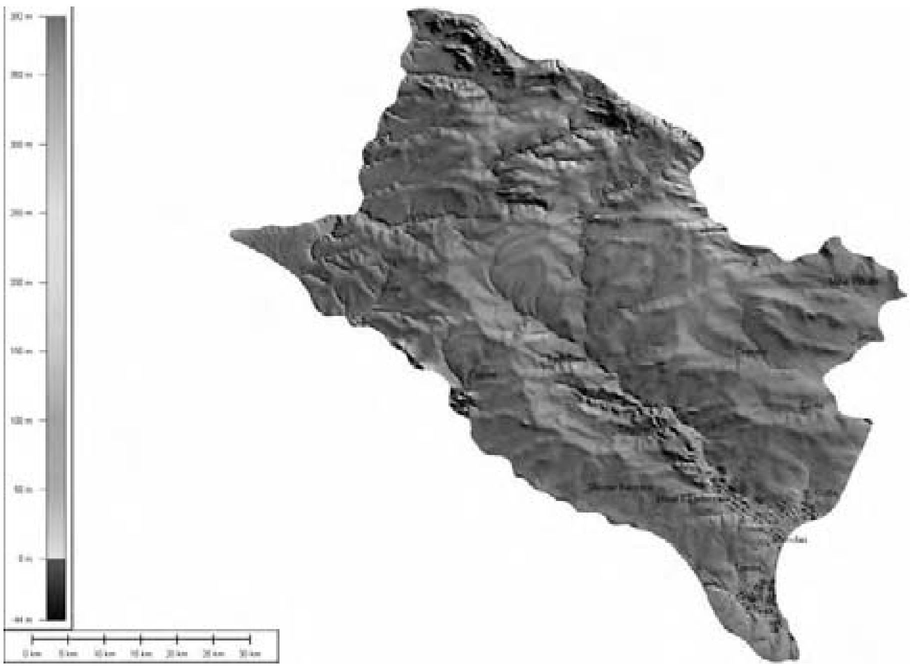


Fig. 1. General overview of the Central Plateau of Dobrogea

The most vulnerable lands are mostly formed from the sandy soils and open sands (such as arenosols) located in the coastal areas from the North of Constanta (near Năvodari), where the relief is hummocky by the eolian influences. These lands are not influenced from groundwater, because of their texture have an very good overall drainage, showing a great capacity for water infiltration, but instead the ability to easily accessible water for plants is very low, which makes the presence of vegetation cover very discreet, and facilitates their dissipation by the wind (wind erosion), not allowing the installation of soil formation processes (Figure 2).

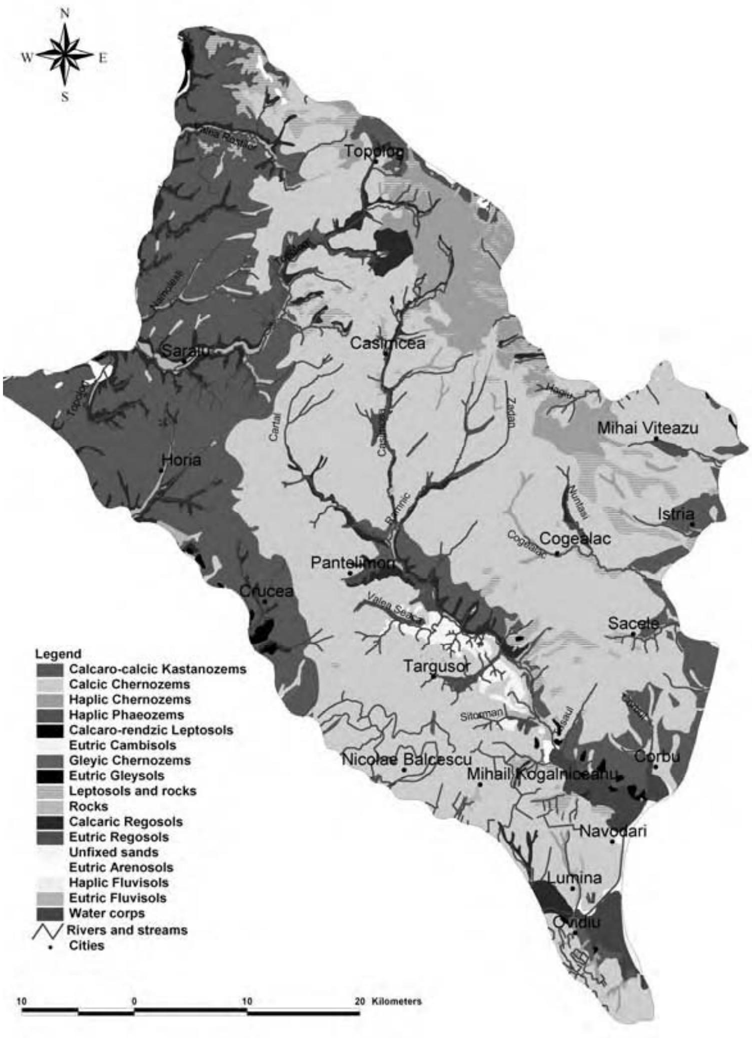


Fig. 2. Soil map of the Central Plateau of Dobrogea

A special group is the lands with salty soils (Solonetzs and Solonchaks) which are present especially around the Razelm-Sinoe lagoon complex, as a consequence of the ecopedological conditions in which they were formed and evolved increased exposure to solar radiation, the presence of groundwater at shallow depths but also because of its high mineralization degree.

Soils located on the lands comprising a fragmented landscape and an important role it is surface erosion (Figure 3) presence and depth that can sometimes be accompanied by landslides (slumps) are the typical and calcic kastanozems formed on loess and eolian deposits with medium texture (particularly in the western Central Plateau of Dobrogea), calcaro-rendzic leptosols and rendzic leptosols, and in some areas (along the valleys) meet regosols, eutri-lithic leptosols or haplic regosols (in the plateau areas).

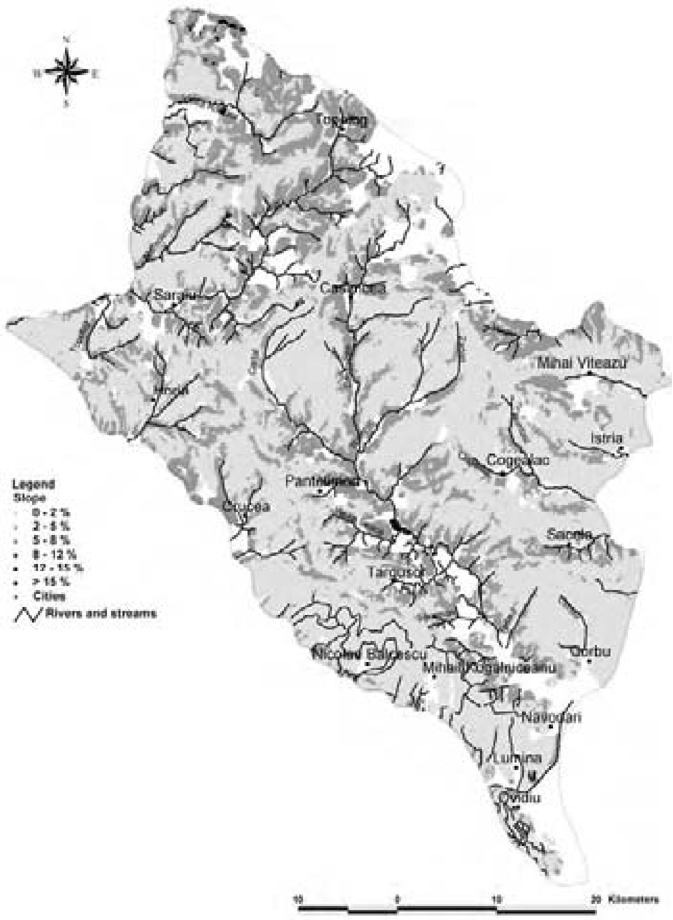


Fig. 3. Slope map of the Central Plateau of Dobrogea

There are also lands that have formed and evolved on loess and eolian deposits, but the relief is unfragmented or very slightly fragmented. Usually, they are represented mostly in Central Plateau of Dobrogea and west of the Razelm-Sinoe lagoon complex. The dominant soil types are represented by calcic and calcaro-calcic chernozem.

The soils located in a fragmented landscape, and those which were formed under conditions of unfragmented relief, are soils with a very large spatial distribution in the landshaft of Dobrogea, and their development on loess and eolian deposits give them favorable physical and chemical properties, which creates a high potential agro-productive (Figure 4).

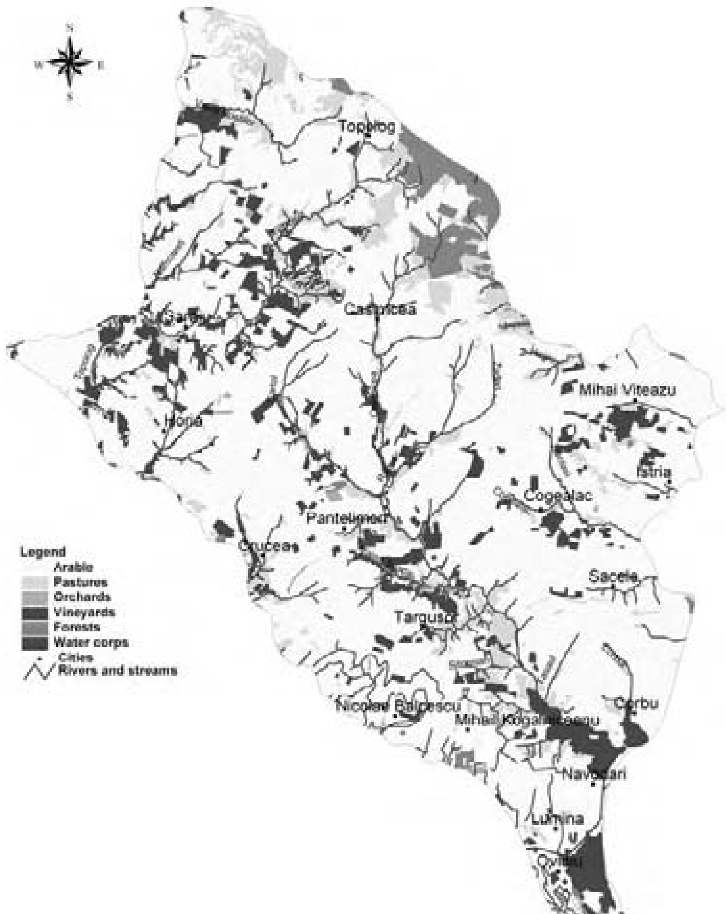


Fig. 4. The land use map of the Central Plateau of Dobrogea

CONCLUSIONS

The water and temperature regime (ustic-xeric) precisely due to its geographic location along the isotherm of 11^{0}C makes the summer temperatures and low rainfall level in conjunction with an unequal distribution of them; highlight the soil risks due to degradation on associated phenomena of the aridization and desertification. In addition, the study area has a very low coverage of forest vegetation (Constanta county has only about 5%) and with the most described above, makes it possible to install drought on the long and frequent periods (12-15 years).

All these problems caused by the aridization/desertification processes may improve by introducing some basic steps:

1. Administration regularly of organic fertilizers correlated with the chemical fertilizers.
2. Compensation of water shortfall from the soil in most of the year using irrigation systems and by an appropriate structure/rotation of crops.
3. Development of curtains protective forest system and culture that improves the thermo-fluid balance.

In conclusion, we can say that vulnerability of the soil cover to the complex phenomenon caused by drought, aridization, desertification is expressed with equal intensity in both areas with low hummocky or plan relief, in which soils are subjected to degradation both by processes of salinization/sodization but and the presence of wind erosion of soils, especially in the eastern Central Plateau of Dobrogea. Also the risk of degradation is on increasing and sloping surfaces, they present a major moisture deficit due to leakage of the slope, the water depth of the ground layer and caused by evapotranspiration losses.

REFERENCES

1. Canarache A., 1995. *Soils from the arid zones of Romania (a special view concerning of hydrophysic attributes*. Conference of the National Water Institute, Chisinau, Rep. Moldova (pp. 35).
2. Canarache A., 2002. *Possible methodology for estimation of soil limiting factors and degradation processes in Romania*. Proceedings of the International Conference "Soil under Global Change", Constanta, Romania (pp. 79-85).
3. Florea N., I. Munteanu, 2003. *The Romanian System of Soil Taxonomy*. Ed. Estfalia.
4. ****Methodology to Elaboration of the Pedologically Studies*, 1987. Vol. III, ICPA, Editors coord: Florea N., Balaceanu V., Rauță C., Canarache A., Ed. Centre of propaganda and agricultural equipment, Bucharest.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

PHYTOTOXIC EFFECTS OF CADMIUM ON MAIZE PLANTS GROWN UNDER GREENHOUSE CONDITIONS

NICOLETA VRÎNCEANU, D.M. MOTELICĂ, M. DUMITRU, EUGENIA GAMENȚ, ALEXANDRINA MANEA, VERONICA TĂNASE, MIHAELA PREDA

National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection of Bucharest

Keywords: *cadmium, maize, phytotoxicity*

Abstract

This paper is focused on the cadmium accumulation by maize (Zea mays) plants grown on Eutric Fluvisols material with different Cd contamination. The cadmium contents in soil material were increased by 3, 5, 10, 15, 20 and 30 mg/kg Cd using cadmium acetate. Results of tests carried out to determine the content of cadmium in soil and maize plants (roots and aboveground parts) showed that the cadmium uptake in maize plants increased with increasing total cadmium content in soil. An increases more than 14 times of total cadmium content in the soil increased the cadmium content in different parts of maize plants (185 times in roots and 54 times in aboveground parts). The high cadmium content in soil does not induce highly significant reductions of above-ground biomass of maize plants.

INTRODUCTION

Heavy metals such as cadmium enter the ecosystem chiefly as the result of human activities. The accumulation of heavy metals in the soil is dangerous for most living organisms. High concentrations of cadmium have been demonstrated to have carcinogenic and mutagenic effects in numerous animal species [1].

Exposure to high levels of these metals has been linked to adverse effects on human health and wildlife. In plant, cadmium is one of the most readily adsorbed and most rapidly transferred heavy metal, which explains why it exerts strong toxicity even at relatively low concentrations [4].

Plant uptake of cadmium is depended on the soil cadmium concentration and its availability. Cadmium metal itself does not break down in the soil but it can change into different forms. This transformation and therefore the availability of cadmium in soil, is influenced by factors such as pH, soil temperature, soil organic matter, calcium concentration and chlorine salinity, oxidation-reduction reactions and the formation of complexes [2, 3].

Crops like maize (*Zea mays*) show high tolerance to cadmium pollution. These plants are able to grow and develop on high polluted soils. There are some maize cultivar which might be considered as “Cd - shoot excluders” with cadmium accumulated at higher concentrations in roots than in shoots. This behavior is considered one of several strategies of tolerance to cadmium [4].

This paper is focused on the cadmium accumulation in the maize (*Zea mays*) 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 was used soil material collected from the upper horizon of Eutric Fluvisol from bottomland of 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 flame atomic absorption spectrometer in hydrochloric solution resulted by digestion of soil samples in acid mixture. Concentrations of mobile Cd in soil were determined following Na_2EDTA extraction method.

Plants material divided in roots and above-ground parts (stalks and leaves) 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 absorption 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 maize plants.

It is noted that in 4 of the 9 studied characteristics changes were statistically assured. Highly statistically significant changes were established for four 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 maize plants (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 89.7% of the total cadmium content. The values of mobile cadmium content in soil ranged between 0.4 mg/kg (control) and 28 mg/kg (highly polluted soil).

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 maize plant

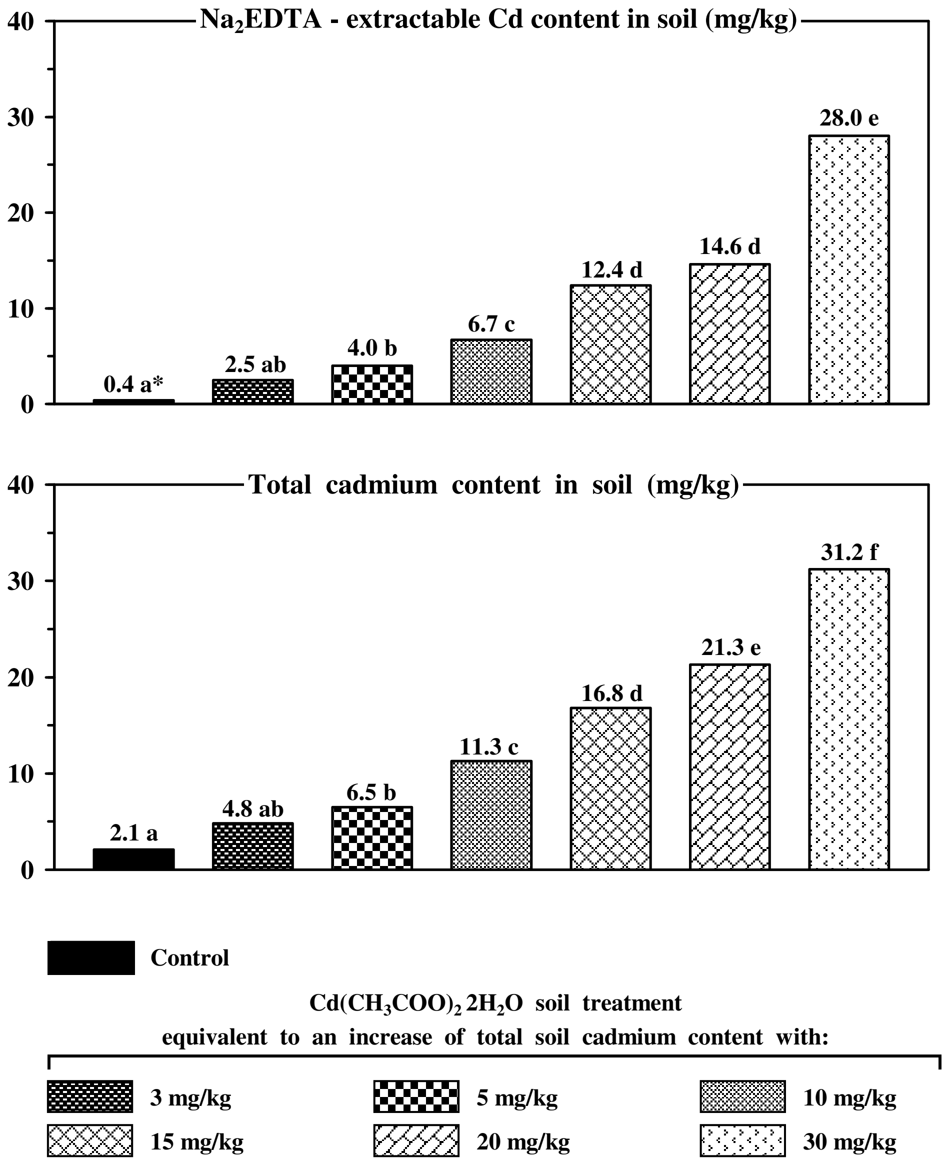
Maize plant characteristics / Soil material characteristics	Fisher Test significances
Total biomass of above-ground part of maize plant (stalks and leaves)	NS
Maize roots weight	NS
pH of soil material	NS
Organic carbon content in soil material	NS
Total nitrogen content in soil material	NS
Total cadmium content in soil material	***
Na_2EDTA-extractable cadmium content in soil material	***
Cadmium content in maize roots	***
Cadmium content in maize stalks and leaves	***

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) favored maintaining of significant metal amounts in soil solution, with direct effects on the cadmium content of plants.

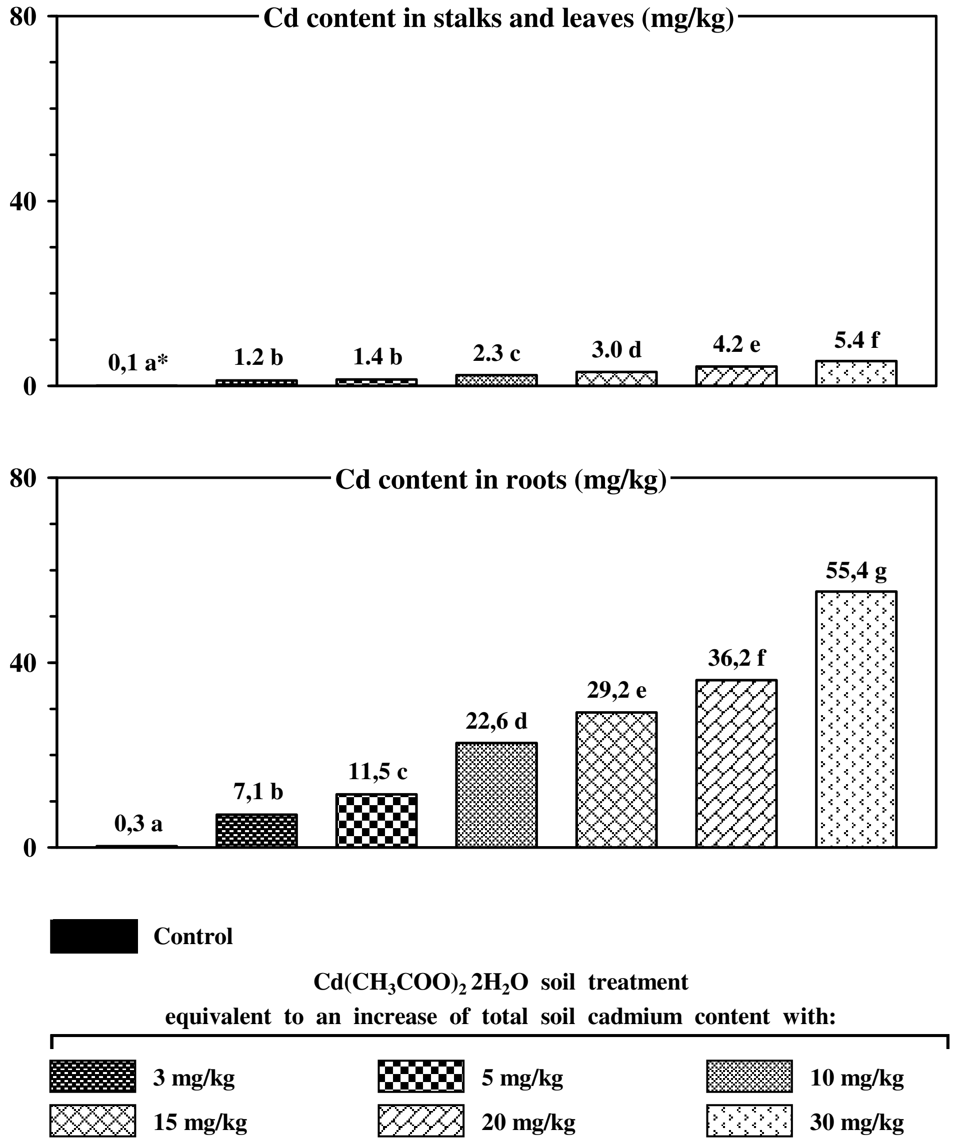
The level of cadmium uptake in higher plants is determined by the cadmium concentration of the soil and by its biological availability. The higher bioavailability of cadmium in soil enables the maize plants to uptake and to accumulate higher metal concentration in their tissues.

For the plants grown on cadmium polluted Eutric Fluvisols, the cadmium content determined in roots ranged from 0.3 mg/kg (control) to 55.4 mg/kg (maximum polluted soil). The values of cadmium content in roots were statistically significant as compared to control starting with the treatment appropriate to an increase with 3 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 maize plants grown on soil materials from upper horizon of an Eutric Fluvisols

The values of cadmium content in stalks and leaves of maize plants grown on polluted soil material ranged between 0.1 mg/kg in control and 5.4 mg/kg for plant grown on soil treated with the maximum amount of cadmium acetate (Figure 2).

The critical concentration for the phytotoxicity of cadmium was reported in the range 5-20 mg/kg fresh weight in plant tissues depending on plant species [5].

The results showed if average content of cadmium in soil was 31.2 mg/kg, cadmium content of maize roots was about 185 times higher than that determined in the roots of control plants. Also the cadmium content of maize above-ground parts was about 54 times higher than that determined in the stalks and leaves of control plants. These results support the hypothesis that the maize is a "Cd – shoot excluder" that develops a defense mechanism at root level.

CONCLUSIONS

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

REFERENCES

1. Das P., S. Samantaray, G.R. Rout, 1997. *Studies on cadmium toxicity in plants: a review*. Environmental Pollution, vol. 98 (pp. 29-36).
2. Dorris J., H. Bassam, 2002. *Cadmium uptake by radishes from soil contaminated with nickel-cadmium batteries: toxicity and safety considerations*. Toxicology Mechanisms and Methods, vol. 12 (pp. 265-276).
3. Moustakas N.K., K.A. Akoumianakis, H.C. Passam, 2001. *Cadmium accumulation and its effect on yield of lettuce, radish and cucumber*. Communications in Soil Science and Plant Analysis, vol. 32 (pp.1793-1802).
4. Pal M., E. Horvath, T. Janda, E. Paldi, G. Szalai, 2006. *Physiological changes and defense mechanisms induced by cadmium stress in maize*. J. Plant Nutr. Soil Sci. vol. 169 (pp. 239-246).
5. ***Environmental Agency, 2009. *Supplementary information for the derivation of SGV for cadmium*. Science report: C0500021/Technical review cadmium, ISBN: 78-1-84911-072-3.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

SOIL POLLUTION IN THE ROVINARI AREA UNDER THE INFLUENCE OF THE COAL-FIRED POWER STATION

CLAUDIA-ELENA BĂLĂCEANU, M. DUMITRU, ANCA-ROVENA LĂCĂTUŞU, N. FLOREA

National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection of Bucharest

Keywords: *pollution, soil, coal-fired power station*

Abstract

The coal-fired power stations are particularly complex, important polluting agents. The chimneys for evacuation of burning gases represent the high polluting sources on the environment, while the ash dumps - low sources. The Rovinari coal-fired power stations has an installed power of 1720 MW, including several energetic groups built in 1972-1979 period and it use as a fuel the lignite extracted by surface mining in the respective area.

From the geomorphological viewpoint, this area belongs to the Câlnic-Câmpul Mare inter-hilly depression whose altitude, at the Rovinari, is 150 m. The soil forming factors causing the soil evolution have been the rock, parental material and relief, all of them determining the evolution of lithomorphic zonal soils. The soils in the analyzed area represented by the classes: luvisols, hydrisols, cambisols and protisols. The subject of this paper is dealing with the loading degree of soils in the territory affected by the emissions from the Rovinari coal-fired power station. In this, soil samples have been collected from 40 main soil profiles oriented to all the cardinal directions. These soil samples have been analyzed in order to know: pH, base saturation degree, humus, total nitrogen, mobile phosphorus and potassium, heavy metals and sulfur. Within the zone influenced by the Rovinari coal-fired power station, the main pollutants are sulfur dioxide, coal dust and the ash which contains carbon as well as silicon dioxide, aluminium oxides, and alkaline and alkaline earth metals (Ca, Mg, K). Secondary pollutants are heavy metals (Cu, Pb, Zn and Cd), pollution which affects the normal contents of soil, on the one hand, and the concentrations in plants and the human health, on the other hand.

INTRODUCTION

In the case of the Rovinari coal-fired power station, 189 ha have been lost from the economic land use until 2004 and other 110 ha land after 2004 being occupied by the ash Cicani and Beterega dumps.

In order to analyze the effects of the emissions from the Rovinari coal-fired power station, as well as of the blowing of the ash dumps, soil samples have been collected from sites located on eight radial directions starting from the power station to the exterior.

Along each direction, the sampling sites are located at every 1.5 km distance in between, the last sites being at 7.5 km far from the power station. This spatial distribution of sites permitted to analyze the dispersion of pollutants coming both from the emission of chimneys and the ash dumps, as well as their contents in the sterile dumps.

The dusts and sulfur oxides are emitted by chimney at variable quantities depending on number of groups in operation. In the last time, the maximum effective concentration of settling dusts varied between 16.35 and 190.64 g/m^2, annual mean being 12.29-106.32 g/m^2, and the frequency of exceeding the maximum allowable concentration was of 67.82%

Generally, the contents of heavy metals in the Rovinari zone are at a normal-low loading, excepting some sites where the determined maximum values are ranked at the higher classes. The higher values are generally due to some particularly characterized soils met along the eight directions of site locations; but, also, in some site close to power station or located on Spolic Entianthrosols formed as a result of surface mining.

Finally, the burning gases fall on the soil and vegetation, as aerosols or acid rains. Until now, the field research carried out within the area of the main power stations did not find important modifications of soil reaction caused by the emissions from the coal-fired power stations. This fact is due to the high height of the chimneys for evacuation of burned gases that permits the dispersion of gas pollutants on large land surface areas. Secondary, many soils developed in the zone influenced by emissions are buffered, the calcium carbonates buffering the leaching and debasification processes.

MATERIAL AND METHODS

The carrying out of this work needed field studies to do soil sampling and observations on materials representing slopelands and terraces around the Rovinari fired-coal power station. Soil samples have been collected for 0-20 cm and 20-40 cm depths. The places of soil samples have been located on the map. The 40 collected soil samples have been collected along the cardinal directions, and the soil samples were analyzed for: pH, base saturation degree, humus, total nitrogen, mobile phosphorus and potassium, heavy metals and sulfur (as SO_4^{2-}).

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

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

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

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

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

RESULTS AND DISCUSSION

The study of pollution of soils in zone of the Rovinari coal-fired power station necessitated an ample analysis of soil properties because these form a complex mantle determined by the diversity of relief, groundwater, rock and parent material conditions.

Soils in the analyzed area represent the classes: Luvisols (Typic and Stagnic Preluvosols, Typic and Stagnic Luvosols), Hydric Sols (Typic Stagnolosols) and Protisols (Typic Regosols, Eutric and Entic Alluviosols, Spolic Entianthrosols).

The analyzed data emphasize that, generally, the heavy metals in the Rovinari zone present normal or slight loading, excepting some site where the determined values show high contaminations. The higher values are, generally, due to some particular characteristics of soils met along the eight directions for location of sites, but also due to the reducing of the distance to the power station or due to the location on the Spolic Entianthrosols resulted by the surface mining.

Each pollutant will be individually analyzed further on.

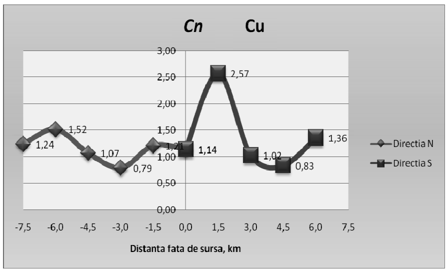


Fig. 1. Variation of coefficients exceeding the maximum normal values of copper on the N-S directions

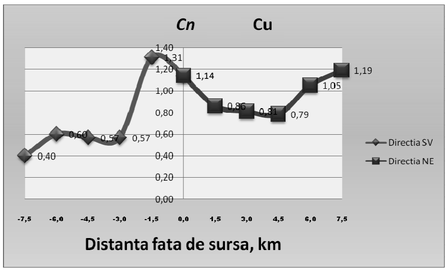


Fig. 2. Variation of coefficients exceeding the maximum normal values of copper on the W-E directions

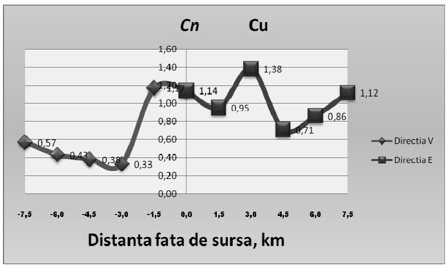


Fig. 3. Variation of coefficients exceeding the maximum normal values of copper on the NE-SW directions

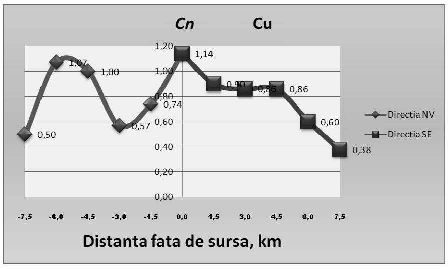


Fig. 4. Variation of coefficients exceeding the maximum normal values of copper on the NW-SE directions

The N-S direction is very expressive where the two maximum values (1.5 and 6 km) are evident on the both directions. As concerns W-E direction, the variation of values to W is less evident than to E.

Variations along the other directions are less prominent but evident, getting lower to the S-E direction. No value exceeds the alert coefficient, the power station influence being reduced.

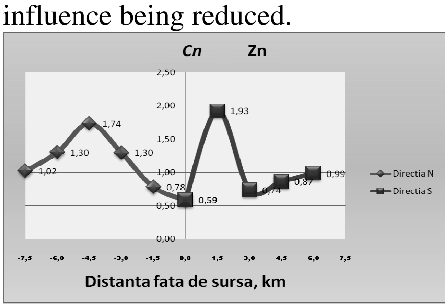


Fig. 5. Variation of coefficients exceeding the maximum normal va lues of zinc on the N-S directions

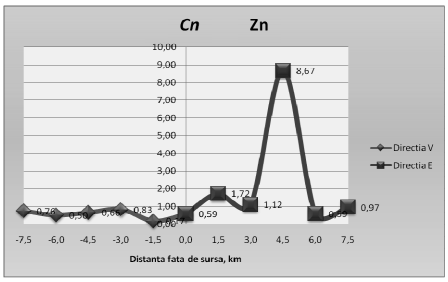


Fig. 6. Variation of coefficients exceeding the maximum normal values of zinc on the W-E directions

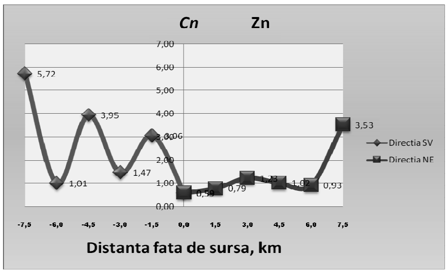


Fig. 7. Variation of coefficients exceeding the maximum normal values of zinc on the NE–SW directions

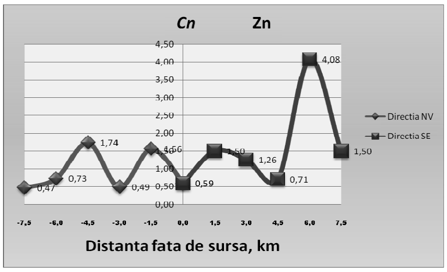


Fig. 8. Variation of coefficients exceeding the maximum normal values of zinc on the NW-SE directions

Along the W, N, S-W, N-W and S-E directions, the values of coefficient exceeding maximum normal content remain reduced near the power station. Along the other directions; along the other directions the increases occur even from a distance of 1.5 km. High increases beyond the alert coefficient (2.97) occur on the S-E, E, N-E, S-W directions. The value corresponding to the trigger coefficient is reached only on the E direction at a distance of 4.5 km.

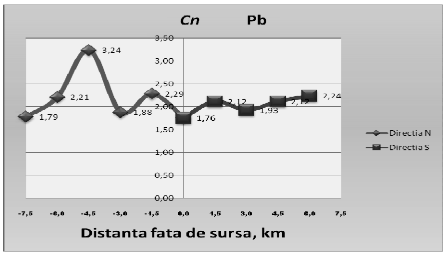


Fig. 9. Variation of coefficients exceeding the maximum normal values of lead on the N-S directions

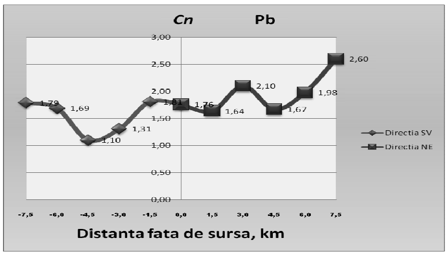


Fig. 11. Variation of coefficients exceeding the maximum normal values of lead on the NE–SW directions

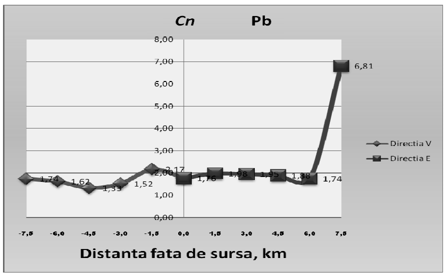


Fig. 10. Variation of coefficients exceeding the maximum normal values of lead on the W-E directions

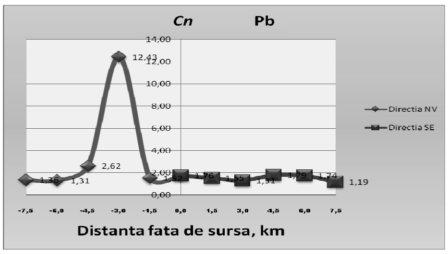


Fig. 12. Variation of coefficients exceeding the maximum normal values of lead on the NW-SE directions

Mean values determined at different distances present levels that reveal a certain loading with lead as compared to the coefficient exceeding the normal content; mean values determined at the distance of 3 km exceed the alert coefficient (2.97).

Along the different directions, increases over the coefficient exceeding the normal content are observed, such as: on the N direction at 4.5 km, on the E direction at 7.5 km, on the N/E direction at 7.5 km, and on the N/W direction at 3 km, where the highest value within the studied territory was more than two time higher than the triggering coefficient (12.43), this increase being due to other causes.

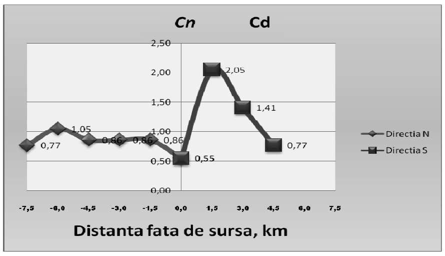


Fig. 13. Variation of coefficients exceeding the maximum normal values of cadmium on the N-S directions

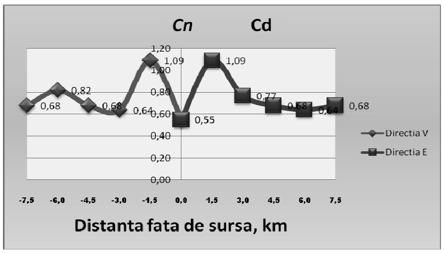


Fig. 14. Variation of coefficients exceeding the maximum normal values of cadmium on the W-E directions

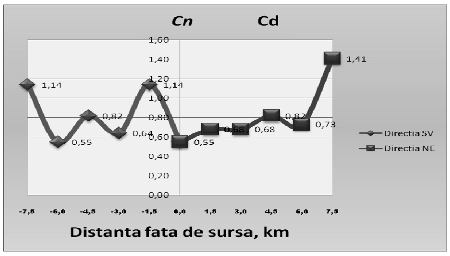


Fig. 15. Variation of coefficients exceeding the maximum normal values of cadmium on the NE–SW directions

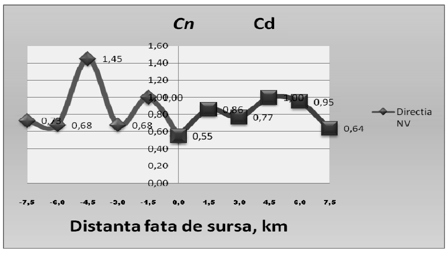


Fig. 16. Variation of coefficients exceeding the maximum normal values of cadmium on the NW-SE directions

The highest loading is on the S direction. Along the other directions, particular loadings do not occur, except site 38, where measured value (1.45) is higher than the coefficient exceeding the normal content. The alert coefficient is not exceeded.

CONCLUSIONS

1. In the area influenced by the Rovinari coal-fired power station, some more important aspects have been emphasized.
2. The Rovinari coal-fired power station, characterized by installed capacity of 1720 MW, represents a major source of soil pollution, by its sterile dumps provided by surface mining and ash dumps, as well as the gas emissions from the Rovinari coal-fired power station chimneys, especially, heavy metals (Cu, Zn, Pb, Cd).
3. The analyzes show that, according to the coefficients exceeding the normal maximum content, only the zinc, lead and nickel are the metals which

exceed the alert coefficient. With the lead, along the north-western direction, at 3 km far, there is the highest value in the whole the analyzed territory (12.43), values which exceeds two times the triggering coefficient, an increase due, probably, to other causes.

4. As regarding the most intensively loaded direction, this is the southern direction, the values due to the wind coming from the northern part, which has a frequency two times higher as compared to the other directions.
5. As concerns the pollution of soils caused by the Rovinari coal-fired power station, the following affirmations can be stated:

- the impact on the soil properties is usually produced in immediate neighborhood of the Rovinari coal-fired power stations;
- the level of heavy metal accumulation and the area of pollution phenomenon extending depend on the age of the coal-fired power stations, installed capacity, technical performances of installation for scrubbing the burning gases, and, finally, the managerial influence;
- the high capacity coal-fired power stations, like Rovinari, have a great impact on quality of soils, distribution zone of heavy metals exceeding 10 km far from the source.

6. From the viewpoint of the impact of the coal-fired power stations on soils, the following statements should be pointed out:

- The energetic sector in Romania is preponderantly ensured by the coal-fired power stations (85%) and less by the primary energy such as hydraulic and nuclear energy. The fuels used indigene coals that have a high content of sulfur, plus some liquid fuels, and gas. Relatively low performance of the energetic sector is caused by the inadequate repairs and maintenances as a result of financing shortage. This sector is one of the branches of the industrial activity potentially generating pollutants.
- While the pollution decreases in the last time, especially as a result of the generally decrease of economic activity, the energetic sector, still, remains one of the main source of environmental pollution (and implicitly of soil) with SO_2, NO_x, dust and CO_2.
- Besides the economic activity level, the proportion of pollution depends on both the fuel used for producing the electrical and thermic energy and the burning process technology. From this view point, the highly efficient eco-technological systems for burning have a particular importance and can lead to decreasing of the environmental pollution by reducing with about 30% the emissions gases (CO; CO_2; NO_x; SO_X).
- The best measure is to prevent the pollution or its decrease. Therefore, it is further necessary to improve, as much as possible, the fuel quality,

combustion procedures, sulfur removal technologies, the systems of retaining the dust and noxious substances, to improve the ash transport and deposition. Periodically, an analysis on the coal introduced in the technological process should be made to know the composition and to avoid the maximum potential risk and the element nature.

7. Also, in this context, the following recommendation could be made:

- Further monitoring within the area under the influence of coal-fire power station and establishing some sensitive site "sensor sites" to depict in real time the eventual negative evolutions;
- Further execution of works and studies for development of finished dumps, especially, by their use for forestry or edilitary purposes (recreational parks, lots for parking vehicles, etc.), but also for reclaiming the affected lands and increasing the soil fertility aiming at their as high efficient valuation as possible.
- In the case of using the dumps for agricultural production, it should be avoided their use for orchards, vegetables and forage plants; under such uses, the soil reaction should be maintained by liming to reduce the solubility of heavy metals, and if the irrigation is applied, the sprinkler irrigation is recommended (to wash the leaves).

REFERENCES

1. Căpitanu V., M. Dumitru, M. Toti, Daniela Răducu, Daniela Popa, M. Motelică, 1999. *Impactul emisiilor termocentralelor asupra mediului ambiant*. Institutul de Cercetări pentru Pedologie şi Agrochimie, Bucureşti.
2. Lăcătuşu R., 1995. *Metoda pentru evaluarea nivelului de încărcare şi de poluare a solurilor cu metale grele*. Soil Science, Journal of the Romanian National Society of Soil Science, vol. XXIX.
3. Mitchell M.J., S.E. Lindberg, 1992. *Sulphur chemistry, deposition and cycling in forests.* In: Johnson, D.W., Lindberg, S.E. (Eds.), Atmospheric Deposition and Forest Nutrient Cycling. A Synthesis of the Integrated Forest Study (Ecological Studies S.), vol. 91. Springer-Verlag Inc., New York (pp. 2-149).
4. Florea N., I. Munteanu, 2003. *Sistemul roman de taxonomie al solurilor-SRTS*. Ed. Estfalia, Bucuresti.
5. Tatomir Cristina, 2009. *Impactul exploatării si utilizării lignitului asupra mediului. Măsuri de remediere a solurilor degradate*. Teză de Doctorat, USAMV Bucuresti.
6. Reiss Aurora, 2003. *Poluarea şi protecţia mediului*. Ed. Sitech.
7. Räisänen M.L., G. Kashulina, I. Bogatyrev, 1997. *Mobility and retention of heavy metals, arsenic and sulphur in podzols at eight locations in northern Finland and Norway and the western half of the Russian Kola Peninsula*. J. Geochem. Explor. 59 (pp. 175-195).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

PERSISTENT ORGANIC POLLUTANTS IN URBAN AND PERIURBAN AREAS

MIHAELA PREDA, ALEXANDRINA MANEA, NICOLETA VRÎNCEANU, VERONICA TĂNASE

*National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection of Bucharest

Keywords: *soil, persistent organic pollutants, chromatography*

Abstract

Persistent organic pollutants are organic compounds that are resistant to environmental degradation through chemical, biological and photolytic processes. Because of this, they have been observed to persist in the environment, to be capable of long-range transport, bioaccumulate in human and animal tissues, biomagnify in food chains, and to have significant impact on human health and the environment. In this study the soil samples are collected from Bucharest and Ilfov county, from representative areas like gardens, parks, industrial zones. The compouds of interes are extracted with solvents and analysed by gas chromatography. The results indicate that organochlorine insecticides still contaminate the samples collected from periurban areas, while PCBs contaminate the soil samples from the center of Bucharest. The concentrations exceed normal values, but are smaller than the alert threshold.

INTRODUCTION

Persistent Organic Pollutants (POPs) are toxic chemicals that adversely affect human health and the environment around the world. Because they can be transported by wind and water, most POPs generated in one country can and do affect people and wildlife far from where they are used and released. They persist for long periods of time in the environment, and can accumulate and pass from one species to another through the food chain. To address this global concern, the United States joined forces with 90 other countries and the European Community to sign a groundbreaking United Nations treaty in Stockholm, Sweden, in May 2001. Under the treaty, known as the Stockholm Convention, countries agreed to reduce or eliminate the production, use, and/or release of 12 key POPs and specified under the Convention a scientific review process that led to the addition of other POPs chemicals of global concern. The 12 key POPs are:

- **8 pesticides**: aldrin, endrin, chlordan, dichlordiphenyl trichlorethane (DDT), dieldrin, heptachlor, mirex, toxafen;
- **2 industrial products**: hexachlorbenzen (HCB), polychlorinated biphenyls (PCBs);

- **2 unintentionally produced substances**: polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs).

Since 2006 hexachlorcyclohexane (HCH) was introduced in the POPs list.

The present study aimed to evaluate the POPs (HCH, DDT and PCBs) load level of some soils collected from representative areas (private gardens, urban zones).

Organochlorine insecticides, namely those based on DDT (pp'-dichlordifenyl-trichlorethane) and HCH (hexachlorcyclohexane) were placed in use in the 40s. They have long been used in crop protection and insect vectors of disease control, about 80% of the amount produced being applied in agriculture.

Technical hexachlorcyclohexane is a combination of isomers containing mainly five isomers in the following proportions: α-HCH (53%–70%), β-HCH (3%–14%), γ-HCH (11%–18%), δ-HCH (6%–10%) and ε-HCH (3%–5%) [3]. γ isomer is the only isomer with strong insecticidal properties and is known as lindane. After nearly forty years of widespread use throughout the world, technical HCH was gradual replaced with lindane. The world has not reported any use of technical HCH since 2000. For lindane, the Regulation on Persistent Organic Pollutants allowed member states to provide exemptions. Thus, until 1 september 2006, lindane could be used in industrial woodworking, construction and industrial applications. Now, both lindane and technical HCH are totally banned in the EU.

DDT was synthesized in 1874 and its pesticide activity was found in 1939 when it was used by the U.S. Army in the Second World War to control typhus, malaria and lice [2]. After the war, DDT was used in agriculture to control insect vectors of disease. For example, in the United States has been much used in cotton crops. So, the main source of DDT pollution is agriculture. In Romania, DDT was produced in one place, namely Borzeşti. Between 1975-1985, DDT was used as an insecticide. Since 1988, DDT-based products were banned in Romania. The DDT metabolites, namely DDD and DDE can be found as a result of metabolic processes that may occur in soil [1]. Monitoring these metabolites in soil is absolutely necessary because they are as toxic as DDT and their persistence may be much higher in soil, as in case of DDE [2].

PCBs have very high chemical stability, high electrical resistance, low volatility and resistance to degradation in the presence of high temperatures. This is the reasons of their many industrial applications. Thus, PCBs were used as dielectric fluids in capacitors and transformers, as plasticizers and additives for cement, as lubricating and cutting oils [4].

MATERIAL AND METHODS

The soil samples were collected from Bucharest (parks, gardens, industrial area) and from the private gardens of Ilfov County. The compounds followed in this study are:

- α, γ, β, δ hexaclorciclohexan;
- pp'-dichlordiphenyl trichlorethan (pp'-DDT) and its isomer op'-dichlordiphenyl trichlorethanul (op'-DDT);
- dichlordiphenyl diclorethan, with two isomers (op'-DDD and pp'-DDD);
- dichlordiphenyl dichlorethene (DDE);
- PCB 28 – 2,4,4' - trichlorobifenyl;
- PCB 52 – 2,2',5,5' - tetrachlorobifenyl;
- PCB 101 – 2,2',4,5,5' - pentachlorobifenyl;
- PCB 138 – 2,2',3,4,4',5 - hexachlorobifenyl;
- PCB 153 – 2,2',4,4',5,5' - hexachlorobifenyl;
- PCB 180 – 2,2',3,4,4',5,5' - heptachlorobifenyl.

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 POP 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 analytical results regarding the content of organochlorine insecticides are presented in Table 1. The total HCH content ranged between 0.002 mg/kg and 0.014 mg/kg, so concentrations slightly exceed normal values (<0.005 mg / kg). As the proportion of isomers, it is noted that in all analyzed samples the isomers β and δ are undetectable, while isomers α and γ contaminate all the samples. Thus, the concentrations of α HCH ranged between 0.0014 mg/kg and 0.0052 mg/kg. These values exceed the upper threshold of normal values (<0.002 mg/kg), but there are about 100 times smaller than the alert threshold (0,1mg/kg). γ isomer have concentrations in the range 0.0003 to 0.0064 mg/kg. In this case the concentrations exceed the upper threshold of normal values (<0.001 mg/kg), but there are about 10 times lower than the alert threshold (0.02 mg/kg).

DDT and its isomers contaminate all the samples. The highest concentrations are observed for isomers pp'DDT and pp'DDE. Thus, for pp'DDE the concentration range between 0.0112 mg/kg in sample collected from Pantelimon and 0.0962 mg/kg in samples taken from Jilava. Practically 50% of the samples have normal content of DDE and 50% exceed normal values(<0.05 mg/kg), but do not reach the alert threshold (0.25 mg/kg). The total content of DDT is normal in 58% of the analyzed samples, while 42% from samples have concentrations higher than the normal values (<0.15 mg/kg) but lower than the alert threshold (0.5 mg/kg). The highest values of concentration were observed in samples collected from Voluntari.

Table 1

Organochlorine insecticides content in periurban soil

Nr.crt.	*Identification*	*Depth (cm)*	**α-HCH**	**γ-HCH**	**HCH_{total}**	**pp'DDE**	**op'DDD**	**op'DDD**	**op'DDT**	**pp'DDT**	**DDT_{total}**
			mg/kg								
1	Popeşti Leordeni	0-10	0,0014	0,0003	**0,002**	0,0654	0,0016	0,0022	0,0039	0,0033	**0,076**
2		10 - 20	0,0025	0,0049	**0,007**	0,0248	0,0027	0,006	0,006	0,0204	**0,059**
3	Pantelimon	0-10	0,0026	0,0054	**0,008**	0,0273	0,0039	0,0161	0,0201	0,0930	**0,160**
4		10 - 20	0,0026	0,0049	**0,008**	0,0112	0,0028	0,0064	0,0058	0,0241	**0,050**
5	Fundeni	0-10	0,0021	0,0037	**0,006**	0,0380	0,0130	0,0065	0,0078	0,0308	**0,096**
6		10 - 20	0,0027	0,0046	**0,007**	0,0374	0,0187	0,0083	0,0093	0,0381	**0,112**
7	Roşu	0-10	0,0015	0,0032	**0,005**	0,0740	0,0011	0,0028	0,0044	0,0131	**0,095**
8		10 - 20	0,0023	0,0038	**0,006**	0,0256	0,0019	0,0037	0,0055	0,0128	**0,050**
9	Jilava	0-10	0,0031	0,0039	**0,007**	0,0962	0,0031	0,0066	0,0172	0,0481	**0,171**
10		10 - 20	0,0052	0,0092	**0,014**	0,0804	0,0033	0,0125	0,0180	0,0786	**0,193**
11	Voluntari	0-10	0,0043	0,0047	**0,009**	0,0843	0,0101	0,0300	0,0248	0,0929	**0,242**
12		10 - 20	0,0047	0,0064	**0,011**	0,0604	0,0142	0,0401	0,0305	0,1150	**0,260**
normal values			***<0,002***	***<0,001***	***<0,005***	***<0,05***	***<0,05***		***<0,05***		***<0,15***
alert threshold			***0,1***	***0,02***	***0,25***	***0,25***	***0,25***		***0,25***		***0,5***
intervention threshold			***0,2***	***0,05***	***0,5***	***0,5***	***0,5***		***0,5***		***1***

The analytical results regarding the PCBs contents are presented in Table 2. A brief examination of the data leads to the conclusion that PCB 28, the compound with three chlorine atoms in the molecule, is undetectable in all samples, while higher chlorinated compounds are present in all samples. PCB 52 and PCB 101 isomers appear in only one sample with concentrations which exceed normal value (0.0001 mg/kg and 0.0004 mg/kg) but are lower than the alert threshold for the sensitive use (0.002 mg/kg). PCB 138, the compound with six chlorine atoms in the molecule, contaminate all the analyzed soil samples, its concentration ranging between 0.0005 mg/kg in the soil sample collected from a garden located in Voluntari and 0.0095 mg/kg in Piața Universității.

Table 2

PCBs content in urban soil

Nr.crt.	*Location*	*Identification*	PCB 28	PCB 52	PCB 101	PCB 153	PCB 138	PCB 180	PCB total
			mg/kg						
1	PARKS	Herăstrău	nd	nd	nd.	0,0021	0,0026	0,0025	**0,0072**
2		Bucureştii Noi	nd	nd	nd.	0,0022	0,0024	0,0012	**0,0058**
3		Crângaşi	nd	nd	nd.	0,0036	0,0026	0,0018	**0,0080**
4		Drumul Taberei	nd	nd	nd.	0,0025	0,0033	0,0027	**0,0085**
5		Cişmigiu	nd	nd	nd.	0,0037	0,0028	0,0026	**0,0091**
6		Carol	nd	nd	nd.	0,0023	0,0030	0,0025	**0,0078**
7		Titan	nd	nd	nd.	0,0033	0,0024	0,0024	**0,0081**
8	INTERSECTION	Charles de Gaulle	nd	nd	nd.	0,0023	0,003	0,0025	**0,0078**
9		Victoriei	nd	nd	nd.	0,0070	0,0076	0,0067	**0,0213**
10		Crângaşi	nd	nd	nd.	0,0034	0,0036	0,0039	**0,0109**
11		Lujerului	nd	nd	nd.	0,0028	0,0026	0,0045	**0,0099**
12		Şos. Alexandriei	nd	nd	nd.	0,0044	0,0051	0,0066	**0,0161**
13		Piaţa Sudului	nd	nd	nd.	0,0026	0,0027	0,0032	**0,0085**
14		Grigorescu	nd	nd	nd	0,0027	0,0031	0,0031	**0,0089**
15		Universităţii	nd	0,0010	0,0012	0,0121	0,0095	0,0193	**0,0431**
16		Colentina	nd	nd	nd	0,0033	0,0038	0,0057	**0,0128**
17	GARDENS	Popeşti Leordeni	nd	nd	nd	0,0008	0,0010	0,0013	**0,0031**
18		Pantelimon	nd	nd	nd	0,0019	0,0030	0,0022	**0,0071**
19		Fundeni	nd	nd	nd	0,0063	0,0085	0,0120	**0,0268**
20		Roşu	nd	nd	nd	0,0007	0,0008	nd	**0,0015**
21		Jilava	nd	nd	nd	0,0006	0,0008	0,0012	**0,0026**
22		Voluntari	nd	nd	nd	nd	0,0005	nd	**0,0005**
23	INDUSTRIA LAREAS	IMGB	nd	nd	nd	0,0022	0,0045	0,0014	**0,0081**
24		Măgurele	nd	nd	nd	0,0024	0,0032	0,0008	**0,0064**
25		Neferal	nd	nd	nd	0,0029	0,0032	0,0022	**0,0083**
26		Faur	nd	nd	nd	0,0025	0,0034	0,0020	**0,0079**
27		Jilava	nd	nd	nd	0,0021	0,0023	0,0018	**0,0062**
normal value			***< 0,0001***	***< 0,0001***	***< 0,0004***	***< 0,0004***	***< 0,0004***	***< 0,0004***	***< 0,0100***
alert threshold			***0,002***	***0,002***	***0,0100***	***0,01***	***0,01***	***0,01***	***0,25***
intervention threshold			***0,01***	***0,01***	***0,04***	***0,04***	***0,04***	***0,04***	***1***

PCB 180, the high chlorinated isomer have concentrations ranged between undetectable and 0.0193 mg/kg. These concentrations exceed the upper threshold of normal (<0.0004 mg/kg), but do not reach the alert threshold (0.01 mg/kg).

The second isomer with six chlorine atoms in the molecule, PCB 153, contaminate all the soil samples studied, except the sample collected from Voluntari. The concentration of this isomer in the soil range from 0.0006 mg/kg and 0.0121 mg/kg. The highest concentration of PCB 153 is observed, again, in the sample collected from Piața Universității, where the content exceeds even the alert threshold. Regarding the highest chlorinated compound content, PCB 180, its concentration range between undetectable and 0.0193 mg/kg. The highest value is observed in the same location, Piața Universității.

CONCLUSIONS

1. Soil samples collected from periurban areas are contaminated with α and γ HCH and DDT (isomers and metabolites).
2. Total concentration of HCH is about 100 times smaller than the alert threshold (0.1 mg/kg).
3. 58% from the analyzed samples have normal content of DDT, while 42% of the analysed soil samples have concentration which exceed the normal values (<0.15 mg/kg) but are smaller than the alert threshold (0.5 mg/kg).
4. The highest value of total PCBs concentration, 0.0431 mg/kg, is observed in the sample collected from Piața Universității. This value exceeds the normal value, but is about ten times lower than the alert threshold.

ACKNOWLEDGEMENTS

Research was supported by Contract C3 bis/2010.

REFERENCES

1. Alexander M., 1994. *Biodegradation and bioremediation*. Ed. Academic Press.
2. Crinnion W.J., 2000. *Environmental Medicine, Part*: "*Pesticides-Biologically Persistent and Ubiquitous Toxins*". Altren Med. Rev. 5 (5) (pp. 432-447).
3. Maria Henriquez, J. Becerra, R. Barra, J. Rojas, 2006. *Hydrocarbons and Organochlorine Pesticides in Soils of the Urban Ecosystem of Chillan and Chillan Viejo*. J. Kilogram. Chem. Soc. Vol. 51, no. 3 (pp. 938-944).
4. Jones K.C., V. Burnett, R. Duarte-Davidson and K.S. Waterhouse, May 1991. *PCB's în the Environment*. Chemistry în Britain.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

PROPERTIES OF SEWAGE SLUDGE RESULTED FROM URBAN WASTEWATER TREATMENT IN THE REPUBLIC OF MOLDOVA

A. SIURIS

"Nicolae Dimo" Institute of Soil Science, Agrochemistry and Soil Protection of Chisinau

Keywords: *sewage sludge, chemical composition, physical properties, heavy metals, admissible limit*

Abstract

Sewage sludge represents the solid sediments accumulated at the urban wastewater sewage treatment plants through the sewage system. It consists of clay particles, organic substances contained in sewage water, human dejections, mineral salts with macro and microelements, heavy metals, pathogenic agents. The quantity of sewage sludge annually produced in the Republic of Moldova is of about 36,000 tons dry mass and of about 2,000 tons with the humidity of 50%. The organic waste materials which originate from urban activity are more known as a source of environment pollution and less as a source of nutritive elements having benefic effects on soil and vegetation. They are varied and have a very complex composition depending on the sector and the activities they originate from. Among the most difficult issues related to the waste materials are their storage, recycling, and usage. A possible solution in order to eliminate them from the given zones and use them purposefully is to introduce them as a component part in the technological systems of soil cultivation in various aspects of agriculture in the conditions of environment protection and maintaining some reasonable prices. The application of sewage sludge on agricultural lands for their reintegration in the matter circuit is a very feasible one [1-3].

INTRODUCTION

Sewage sludge is formed at the wastewater sewage treatment plants by being evacuated through the sewage system. It contains mineral, organic, and biological impurities in soluble, insoluble and colloidal forms. This residue is usually little used out of psychological, economic, juridical and technological reasons. Being accumulated year after year, it occupies extensive surfaces and harms the environment. On the other hand, sewage sludge has a fertilizing value rich in nitrogen and phosphorus similar to the manure. The nutritive elements it contains should be included in the general policy of fertilizers for agricultural lands. More profound knowledge of the properties of this residue and the elaboration of some efficient procedures of its use might contribute to the simultaneous solution of two issues: soil fertility increase and environment protection.

MATERIAL AND METHODS

In order to carry out this research, the data on the chemical and physical composition of sewage sludge originated from the wastewater sewage treatment plants in the cities Chisinau, Balti and Tighina of the Republic of Moldova in the period 1980 - 2005 have been generalized in Organic Fertilizers and Soil Fertility Laboratory of the Institute. The statistical processing of the obtained experimental data was performed according to Dospehov's method.

RESULTS AND DISCUSSION

The properties of sludge resulting from urban sewage wastewater treatment differ from place to place and depend on the structure of the population and its eating habits, season, diversity of industrial and agricultural units which overflow the wastewater into the urban sewage, on the way of its treatment in the purification plant, etc. The chemical composition demonstrates that sewage sludge is an important source of organic matter for the soil and of nutritive elements for the crops. Calculated in the dry mass, the contents of organic matter is in an average of 43.3% with a possible scattering of values ranging from 41.8% to 51.6% (Table 1). The variation coefficient is of 18%.

Sewage sludge is very rich in total nitrogen and phosphorus. The average of these values is higher than 2% in the dry mass. The dispersion of values is higher in phosphorus and more reduced in nitrogen. The variation coefficient is equal to 42% and 24% correspondingly. In some sludge samples the phosphorus contents may be higher than that of nitrogen. An average of 24% of the total nitrogen is in ammonium form. It exceeds 700 mg/100 g in the dry sludge. This fact confirms that the sewage sludge possesses a high capacity of absorption. It is characterized by an insignificant quantity of nitrates. The nitric nitrogen does not exceed 1% of the total nitrogen contents. The contents of phosphorus and accessible potassium (30 - 34%) are rather high in the total quantity. The high values of nitrogen and phosphorus (total contents and mobile form) is considered as very advantageous. Because of this the application of sewage sludge manifests a rapid and efficient fertilizing effect.

Out of the mineral macro elements, which constitute more than 50% of the dry mass of sewage sludge, silicon comes first (33.22%), followed by calcium (7.06%). The increased contents of calcium, as well as that of aluminum (1.98%) and sulfur (1.83%) renders to the sewage sludge an ameliorative function, thus justifying its application in soils affected by salinization. The average values of magnesium and sulfur contents are equal to 1.72% and 1.83% correspondingly. The quantity of sodium is small; it does not exceed 0.11% of the dry mass.

Table 1

Chemical composition of sewage sludge in different urban sewage treatment plants from the Republic of Moldova (Chisina, Balti, Tighina)

Analyzed element	X	min	max	V
pH aqueous extract	7.9	7.7	8.2	2
Humidity, %	59.3	48.1	65.7	9
Organic matter, %	45.3	41.8	51.6	18
total C, %	22.1	20.0	25.3	10
huminic acid C, %	4.5	2.6	6.0	35
fulvic acid C, %	3.8	2.0	4.8	20
total N, %	2.1	1.5	2.7	24
total C : total N	10.5	9.4	13.3	15
$N\text{-}NO_3$, mg/100g	13.5	8.3	17.4	29
$N\text{-}NH_4$, mg/100g	547.8	213.5	703.4	32
total P_2O_5, %	2.2	0.9	3.4	42
accessible P_2O_5, mg/100 g	754.6	215.4	954.6	35
total K_2O, %	0.97	0.35	1.36	46
accessible K_2O, mg/100 g	287.6	123.5	395.0	27
total SiO_2, %	33.22	20.89	46.41	32
total Al_2O_3, %	1.98	1.30	2.37	19
total Fe_2O_3, %	2.53	1.73	3.14	20
total CaO, %	7.06	6.30	7.81	9
total MgO, %	1.72	0.58	3.47	73
total SO_3, %	1.83	0.90	3.22	45
total Na_2O, %	0.07	0.04	0.11	39
total Mn, mg/kg	300	187	558	38
total Cu, mg/kg	486	136	1347	94
total Zn, mg/kg	795	135	1354	53
total B, mg/kg	53	24	71	30
total Mo, mg/kg	3	1	6	57
total Cd, mg/kg	14	1	39	86
total Pb, mg/kg	107	41	280	73
total Ni, mg/kg	57	15	91	51
total Co, mg/kg	9	4	16	49
total Cr, mg/kg	151	73	187	54

In comparison with other organic wastes, sewage sludge contains various heavy metals. Many of them (Mn, Zn, Cu, Co, Ni, B, Mo) are necessary as nutritive microelements for the pants. The insufficiency of these elements leads to the quantitative and qualitative decrease of the harvests. In this sense, the sewage sludge can be characterized as a mixed fertilizer that contains all the biophile elements. Yet, many of them are contained in insufficient quantities for the biological necessity of the crop plants. On the other hand, others, such as As, Cd, Hg, Pb are obviously toxic for the plants. It should be mentioned though, that in the sewage sludge produced at sewage treatment plants none of the chemical element exceeds the established maximum admissible concentration [4]. Thus, it can be permanently used carrying out preliminary sewage sludge tests and the analysis of treated soils to find out the modification of biophile elements contents, as well as of those with a pollutant potential.

The analysis of the aqueous extract demonstrates that 1.74-3.42% of the substances contained in sewage sludge are soluble in water (Table 2).

The organic substances constitute over 55%. Among the mineral components, anion HCO_3 (9.2-16.5 ml/100 g) predominates, followed by cation NH4 (6.0 - 12.5 ml/100 g). The liquid phase of the sludge is composed of two groups of bicarbonate salts (24.4 ml/100 g) and ammonium salts (14.8 ml/100 g). We consider that bicarbonate - ion is of biochemical origin; it is the final residue of organic substance mineralization in the sludge. The fact that it predominates in the liquid phase imposes the necessity of conducting a dynamic control of reaction and the salinity of soils where the sludge will be applied repeatedly.

Table 2

Composition of aqueous extract of sewage sludge, me/100 g dry matter

Analyzed element	X	min	max	S	V
Dry residue , %	2.61	1.74	3.42	0.69	27
Mineral residue, %	1.04	0.69	1.51	0.30	29
Ca^{2+}	3.3	2.4	3.9	0.61	18
Mg^{2+}	2.3	1.2	3.3	0.84	36
Na^+	2.7	0.8	4.1	1.30	49
K^+	2.6	1.3	3.9	1.19	46
NH_4^+	8.7	6.0	12.5	2.24	26
HCO_3^-	12.2	9.2	16.5	2.88	24
SO_4^{2-}	4.8	3.3	8.2	1.70	35
Cl^-	0.5	0.1	1.2	0.42	80
$H_2PO_4^-$	0.9	0.4	1.3	0.36	40
NO_3^-	1.2	0.6	1.9	0.56	47

The size structure of the sludge is formed of corpuscles of linear size between 0.01-0.25 mm in a proportion of 62-73% (Table 3).

Table 3

Physical properties of sewage sludge (dry matter)

Analyzed element	X	min	max	S	V
Granulometric fractions, %					
1.0 – 0.25 mm	2.7	1.8	4.2	0.85	30
0.25 – 0.05 mm	32.1	29.2	35.1	2.84	7
0.05 – 0.01 mm	35.7	33.2	38.2	1.90	5
0.01 – 0.005 mm	10.5	7.1	12.8	2.05	19
0.005 – 0.001 mm	11.7	8.4	14.4	1.96	16
< 0.001 mm	7.3	5.5	10.3	1.56	31
< 0.01 mm	29.5	21.0	37.5	4.68	17
Microstructural fractions, %					
1.0 – 0.25 mm	4.8	3.2	6.1	1.09	23
0.25 – 0.05 mm	58.1	55.3	60.4	1.63	3
0.05 – 0.01 mm	23.8	22.3	26.1	1.16	5
0.01 – 0.005 mm	5.0	3.1	6.8	1.28	26
0.005 – 0.001 mm	2.5	1.7	3.2	0.56	22
< 0.001 mm	5.8	3.3	9.5	2.19	38
< 0.01 mm	13.3	10.3	17.7	2.53	19
Hygroscopic coefficient, %	5.54	5.37	5.74	0.15	3
Density, g/cm³	2.25	2.17	2.35	0.06	3
Apparent density, g/cm³	0.81	0.74	0.88	0.06	7
Total porosity, %	64	62	66	1.62	2

Fine sand fractions constitute an average of 32.1% and coarse powder 35.7% of the dry mass of the sewage sludge. Medium and fine size powders constitute 10.5% and 11.7% correspondingly. The clay fractions (<0.001 mm) constitutes about 7.3% of the sludge dry mass. Physical sand contents (the total of particles larger than 0.01 mm) constitutes an average of 70.5%. If we evaluate the obtained results depending on the textural classification established for the soil, we may conclude that sewage sludge is characterized as sand, more exactly it fits into the fine clay sand subclass.

The micro structural composition compared to the granule metric one contains about five times less fine powder (0.005 - 0.001 mm) and two times less medium size powder (0.01 - 0.005 mm). The share of coarse powder is reduced in average to 11.9% from 35.7% for the granulometric analysis and up to 23.8% for the micro structural one. In total, these reductions of the enumerated fractions constitute 24.8%. The fine sand fraction (0.25 - 0.05) increased from 32.1% for the granule metric analysis to 58.1% for the microstructural analysis. The microstructural texture is coarser than the granule metric one and is characterized as medium clay sand.

Due to the large quantity of organic substances, the sewage sludge possesses a high hygroscopicity of 5.37-5.74%. Because of the same reason the apparent density is low 0.74-0.88 g/cm^3, which is an advantage for the loading, transportation and application works.

CONCLUSIONS

1. Sewage sludge preserved for more than five years had the humidity of up to 66%, which makes possible its usage as fertilizer from the sanitary and technological points of view.
2. The organic substances constituted an average of 45% of the dry mass, whose composition is formed of over 30% of humic substances.
3. Sewage sludge is characterized by high contents of total nitrogen and phosphorus. The average values exceed 2%. About 26% of the total nitrogen is found in ammonium form. The shares of phosphorus and accessible potassium are high and constitute 30-34% of the total values.
4. Silicon comes first among the mineral elements and constitutes 33.24%. It is followed by calcium (7.06%), iron (2.53%) and sulfur (1.83%).
5. Basically, all microelements necessary to plants can be found in sewage sludge. Yet, many of them (Cd, Co, Cu, Cr, Ni, Pb) are found in large quantities.
6. The microelements variation in the sludge is also high and constitutes 30-94%.
7. Bicarbonate–ion predominates in the aqueous extract of the sewage sludge. The texture is composed of small particles with a linear size between 0.01-0.25 in a proportion of 64-75%. The sewage sludge has a small apparent density of 0.74-0.88 g/cm^3.

REFERENCES

1. Dumitru M., C. Rauta, M. Vajiala, Eugenia Gamet, Maria Damian, Elizabeta Dumitru, 1993. *Influenta namolului orasenesc asupra solului si productiei agricole.* Analele ICPA, Vol. LII, Bucuresti (pp. 285-293).
2. Mihalache M., Dumitru M., Daniela Raducu, Eugenia Gamet, 2006. *Valorificarea in agricultura a namolurilor orasenesti*. Ed. Solness, Timisoara (pp. 25-36).
3. Ilie L., M. Dumitru, Nicoleta Vranceanu, Veronica Tanase, 2007. *Metodologie de utilizare a namolului orasenesc in agricultura*. Ed. Solness, Timisoara (pp. 126-148).
4. xxx, 2008. Hotărârea Guvernului Republicii Moldova nr. 1195 cu privire la aprobarea Reglementării tehnice *Măsurile de protecție a solului în cadrul practicilor agricole*. Secția 11. În: Monitorul oficial al Republicii Moldova nr. 193-194 din 28.10.2008 (pp. 16-17).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

EVALUATION OF EFFECTS OF COMPOSTED SEWAGE SLUDGE ON SOIL CHEMICAL PROPERTIES

VERONICA TĂNASE, M. DUMITRU, NICOLETA VRÎNCEANU, D.M. MOTELICĂ, MIHELA PREDA, ALEXANDRINA MANEA

National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection of Bucharest

Keywords: *soil, sewage sludge, fertilization, nutrients*

Abstract

Organic wastes can be applied to cropland to supply nutrients. Sewage sludge associated or not with mineral fertilization can be applied to improve soil chemical properties. A field study was carried out to investigate the effects of sewage sludge compost application on some chemical soil characteristics and yields of maize and oat. Experimental results showed that similar to literature data, sewage sludge compost application led to increases of mobile phosphorus contents in soil. Addition of mineral N-P fertilizers into composted sewage sludge increased the crop yield. Considering the accumulation of nutriens from organic wastes in cropland soil and their availabilty for crops, sewage sludge compost should be applied to croplandat high rates.

INTRODUCTION

It was observed that the massive use of mineral fertilizers led in time to lower content of organic matter in soils directly influencing the physical, chemical and biological properties and the risk of degradation of these soils [1]. Sewage sludge is an inevitable by-product of waste-water treatment processes [2]. Sewage sludge composting and its application on agricultural soils have many advantages, which include a whole array of nutrients to the soil. Agricultural use of sewage sludge can be considered both a way to eliminate organic wastes and in the same time, a posibility to use their content of organic matter and nutrients. Soil became the final step in this kind of treatment, capable to recycle nutrients for agricultural production. Composting sewage sludge with wheat straw transforms organic matter into a drier, more uniform and bilogically stable product that could act as a good source of nutrients [3]. The organic fertilization is not used instead of mineral fertilization but it is applied together, in order to meet the nutrient requirements of plants. The evaluation of compost qualities can be made by laboratory analyses and by field experiments. It is necessary to monitor the risk of potentially polluting substances accumulation in soil. It can be establish the evolution of soil chemical characteristics.

The objectves of this study was to measure the effects of different rates of sewage sludge compost associated or not with mineral fertilizer on crop yields and on pH value, nitrogen, organic carbon, phosphorus, potassium contents in soil.

MATERIAL AND METHODS

The experiments were organized on an experimental field at Albota, on a Haplic Luvisols, using subdivided parcels method, studying the two gradients: A factor - organic fertilization in 5 doses and B Factor - mineral fertilization, in 3 doses. There were determined pH values of soil and contents of organic carbon, phosphorus (by colorimetrically method), nitrogen (by Kjledahl method), potassium (by atomic emission spectrophotometry).

RESULTS AND DISCUSSION

The chemical and physical characteristics of soil samples from experimental field showed a low degree of fertility considering plant nutrition. It was a soil with poor aeration, with a high content of clay, with strong possibility of compactness, acidity pronounced and a high content of aluminum. The experiments were organized without irrigation. The chemical characteristics of compost showed that there were not restrictions regarding using it on cropland, this compost being an excelent fertilizer with high contents in nitrogen and phosphorus.

In Table 1 are presented, the effects of organic and mineral fertilization on soil reaction, after the first year of experimentation.

Table 1

Effects of organic and mineral fertilization on pH values of an Haplic Luvisols

Mineral fertilization	Compost fertilization					Mean value mineral fertilization
	Unfertilized with compost	Compost fertilization equivalent to a N rate of:				
		100 kg / ha	200 kg / ha	300 kg / ha	400 kg / ha	
Unfertilized	*5.07*	5.20 a	5.20 a	5.57 a	6.15 a	**5.44 A**[(1)]
N_{50} P_{50}	4.80	5.13 a	5.13 a	6.13 a	6.12 a	**5.46 A**
N_{100} P_{100}	4.75	4.97 a	4.98 a	6.38 a	**6.57** a	**5.53 A**
Mean value compost fertilization	**4.87 W**[(2)]	**5.10 W**	**5.10 W**	**6.03 X**	**6.28 X**	

[(1)] or [(2)] - Values followed by the same letter (A,B,C or W,X,Y) are not significantly different at the p=0.05 level (Tukey's honestly significant procedure)

Organic fertilization with high doses of ompost equivalent to a nitrogen rate of 300 and 400 kg/ha, resulted in statistically significant increases of soil reaction, compared with yhe control.

The content of soil in organic carbon under organic and mineral fertilization had a relatively high variability (Table 2).

Table 2

Effects of organic and mineral fertilization on organic carbon content in soil

Mineral fertilization	Compost fertilization					Mean value mineral fertilization
	Unfertilized with compost	Compost fertilization equivalent to a N rate of:				
		100 kg / ha	200 kg / ha	300 kg / ha	400 kg / ha	
	%					
Unfertilized	*1.41*	1.48	1.56	1.53	1.56	**1.51 A**[(1)]
N_{50} P_{50}	1.59	1.46	1.53	1.53	1.52	**1.53 A**
N_{100} P_{100}	1.44	1.45	1.56	1.47	*1.49*	**1.48 A**
Mean value compost fertilization	**1.48 W**[(2)]	**1.46 W**	**1.55 W**	**1.51 W**	**1.52 W**	

[(1)] or [(2)] - Values followed by the same letter (A,B,C or W,X,Y) are not significantly different at the p=0.05 level (Tukey's honestly significant procedure)

The highest value of total nitrogen content in soil was observed in variant fertilized with at a dose of compost equivalent to 200 kg N/ha (Table 3) plus mineral fertilization ($N_{100}P_{100}$). It was noticed a slight upward trend in mean values of nitrogen content with increasing dose of compost applied, but increases are not statistically significant.

Table 3

Effects of organic and mineral fertilization on total nitrogen content in soil

Mineral fertilization	Compost fertilization					Mean value mineral fertilization
	Unfertilized with compost	Compost fertilization equivalent to a N rate of:				
		100 kg / ha	200 kg / ha	300 kg / ha	400 kg / ha	
	%					
Unfertilized	*0.179*	0.181	0.187	0.177	0.178	**0.180 A**[(1)]
N_{50} P_{50}	0.179	0.183	0.184	0.183	0.160	**0.178 A**
N_{100} P_{100}	0.182	0.180	0.188	0.168	*0.186*	**0.181 A**
Mean value compost fertilization	**0.180 W**[(2)]	**0.181 W**	**0.186 W**	**0.176 W**	**0.175 W**	

[(1)] or [(2)] - Values followed by the same letter (A,B,C or W,X,Y) are not significantly different at the p=0.05 level (Tukey's honestly significant procedure)

The compost is considered mainly an important source of phosphorus so that, organic fertilization led to statistically significant increases compared to the unfertilized variant, at doses of compost application of 200 kg N/ha, 300 kg N/ha and 400 kg N/ha (Table 4). The highest values of mobile phosphorus in the soil were recorded in variants fertilized with high doses of compost plus mineral fertilizer.

Table 4

Effects of organic and mineral fertilization on mobile phosphorus content

Mineral fertilization	Compost fertilization					Mean value mineral fertilization
	Unfertilized with compost	Compost fertilization equivalent to a N rate of:				
		100 kg / ha	200 kg / ha	300 kg / ha	400 kg / ha	
	mg / kg					
Unfertilized	*38*	42	46	47	53	**45 A**(1)
N_{50} P_{50}	48	47	48	50	55	**50 A**
N_{100} P_{100}	40	43	44	55	**54**	**47 A**
Mean value compost fertilization	**42 W**(2)	**44 WX**	**46 WX**	**51 WX**	**54 X**	

(1) or (2) - Values followed by the same letter (A,B,C or W,X,Y) are not significantly different at the p=0.05 level (Tukey's honestly significant procedure)

The content of mobile potassium did not change statistically significant (Table 5) as a result of fertilization with composted sewage sludge and mineral N-P fertilizers. The average values of potassium content in soil ranged between 73 mg/kg - 81 mg/kg. The combination of organic (400 kg N/ha) and mineral fertilization ($N_{100}P_{100}$) led to the highest content of mobile potassium in the soil.

Table 5

Effects of organic and mineral fertilization on mobile potassium content

Mineral fertilization	Compost fertilization					Mean value mineral fertilization
	Unfertilized with compost	Compost fertilization equivalent to a N rate of:				
		100 kg / ha	200 kg / ha	300 kg / ha	400 kg / ha	
	mg / kg					
Unfertilized	*78*	79	78 a	67 a	*79* a	**76 A**(1)
N_{50} P_{50}	73	73	78 a	73 a	79 a	**75 A**
N_{100} P_{100}	79	78	73 a	73 a	81 a	**77 A**
Mean value compost fertilization	**77 W**(2)	**77 W**	**76 W**	**71 W**	**80 W**	

(1) or (2) - Values followed by the same letter (A,B,C or W,X,Y) are not significantly different at the p=0.05 level (Tukey's honestly significant procedure)

As expected, under the mineral and organic fertilization the yield oat increased statistically significant compared to control (Table 6). The highest oat yield (3710 kg/ha) was obtained in variant fertilized with highest doses of fertilizers.

Table 6

Effects of organic and mineral fertilization on oat yield

Mineral fertilization	Compost fertilization					Mean value mineral fertilization
	Unfertilized with compost	Compost fertilization equivalent to a N rate of:				
		100 kg / ha	200 kg / ha	300 kg / ha	400 kg / ha	
	kg / ha					
Unfertilized	*1659*	2121	2260	2410	2516	**2193 A**(1)
N_{50} P_{50}	1960	2338	2480	2795	3038	**2522 B**
N_{100} P_{100}	2059	2540	2856	3322	**3710** e	**2897 C**
Mean value compost fertilization	**1893 W**(2)	**2333 X**	**2532 Y**	**2842 Z**	**3088 U**	

(1) or (2) - Values followed by the same letter (A,B,C or W,X,Y) are not significantly different at the p=0.05 level (Tukey's honestly significant procedure)

A similar situation was obtained at maize yield, statistically significant increases of maize yield, compared with unfertilized variant, being recorded after both, mineral and organic fertilization (Table 7).

Table 7

Effects of organic and mineral fertilization on maize yield

Mineral fertilization	Compost fertilization					Mean value mineral fertilization
	Unfertilized with compost	Compost fertilization equivalent to a N rate of:				
		100 kg / ha	200 kg / ha	300 kg / ha	400 kg / ha	
	kg / ha					
Unfertilized	*5867*	6014	6119	6234	6393	**6125 A**(1)
N_{50} P_{50}	5890	6077	6275	6431	6679	**6270 B**
N_{100} P_{100}	6124	6381	6569	6858	**7277**	**6642 C**
Mean value compost fertilization	**5960 W**(2)	**6157 X**	**6321 XY**	**6508 Y**	**6783 Z**	

(1) or (2) - Values followed by the same letter (A,B,C or W,X,Y) are not significantly different at the p=0.05 level (Tukey's honestly significant procedure)

The highest yield maize (7277 kg/ha) was obtained in variant fertilized with highest doses of fertilizers.

CONCLUSIONS

1. In order to maximize the benefits of nutrients from sewage sludge compost, it should be applied as close as possible to the period of time in which the crop use these nutrients and in doses that take into account crop nutrient needs.
2. It can be said that sewage sludge compost fertilization had positive effects on yields and soil quality and by composting organic waste, it is assured a high recovery of municipal wastewater treatment plants.

ACKNOWLEDGEMENTS

The research was supported by the Research Program Agral, Contract 82.

REFERENCES

1. Tejada M., M.M. Dobao, C. Benitez, J.L. Gonzales, 2001. *Study of composting of cotton residues*. Biores. Technol. 79 (pp. 199-202).
2. Wei J., Y. Liu, 2004. *Effects of sewage sludge compost application on crops and cropland in a 3-year field study*. Elseviere, Chemosphere, 59 (2005) (pp. 1257-1265).
3. Sullivan D.M., A.I. Bary, D.R. Thomas, S.C. Fransen, C.G. Cogger, 2002. *Food waste effects on fertilizer nitrogen efficiency, availabile nitrogen, and tall fescue yield*. Soil Science Society of America Journal 66 (pp. 154-161).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222 – 5339

RESEARCH ON THE ZINC REGIME FROM AGRICULTURAL ECO-MEDIUM IMPROVED BY SEWAGE SLUDGE

G. MUJEA*, MARILENA DIACONU*, N. IONESCU, ANA IORDANESCU*, KATALIN IONESCU***

*Wastewater Treatment Plant Pitesti Company
**Agricultural Research and Development Station of Pitesti

Keywords: *processed sludge, Zn, luvisoil, maize, wheat, soybeans*

Abstract

*Together with other chemical elements (macronutrients- $MACRO_n$ and micronutrients- $MICRO_n$), zinc (Zn) takes active part in plant nutrition. The application of waste sludge increases Zn contents in both soil and plants. The study of heavy metal was done in terms of sludge rates increased from 0-50 t.ha^{-1}, with and without chemical fertilizers. For luvisoil sensitive growth were observed with near-normal oscillations of the average concentrations of total Zn. Mobile forms of zinc have seen significant growth, with indices of correlation between 0.977 for maize, the wheat (2) 0.834, 0.933 for soybean and 0.889 for wheat (4). However, zinc ions (Zn^{2+}) were specifically absorbed by the crop: maize, winter wheat and soybeans. The correlations obtained between Zn concentrations in plants with sludge rates, showed increases in all cases: statistically ensured in flowering period (in leaves) and insignificant in maturity period (in grains), except wheat (2) with r=0,674**. Zinc-rich waste sludge enhanced the favorable and non-dangerous ecosystems studied. Case is a complex character, even total bio-fertilizer of such sludge (processed: anaerobic digestion, treated, dried).*

INTRODUCTION

The sources of zinc (Zn) in agricultural eco-environment are represented both by the primary forms and secondary forms. Soils in their state of both forms of zinc include: initial reserve and the degree of literacy practiced in agricultural areas. Recent studies have shown that Zn in soils generally has a mean concentration of 80 mg.kg^{-1} d.w. (dry weight), with oscillation between 10 and 300 mg.kg^{-1} d.w. Zn in soil under different forms, distinguished by two features: the energy of retaining and availability to plants [12]. Solubility and availability varies from soluble forms to the highly restrained. Retained strong forms are unavailable to plants, and mechanisms that power them are still little known [1]. The application of waste sludge rich in Zn and its accumulation occurs in the soil, thus contributing to a possible change of the circuit in nature of this valuable chemical element. In soil, zinc is absorbed as Zn^{2+} ions and a reduced manner under other forms. As in the case of other heavy metals, Zn occupies octaedric position through partial replacement of aluminium (Al), iron (Fe) and manganese (Mn) in the structure of clayey minerals. Zn can also be incorporated in the hydrated oxides of Fe and Mn existing in specific concretions, bobovines (small balls), or as thin layers on clayey mineral surface. The zinc regime in soil has a strong complex character, due to several factors according to which the cultivation plant can absorb or not. The most important factors would be: soil's reaction, redox potential, rains, temperatures, minerals composition, phosphates level in soil, crop rotation [3]. In soils with pH between 5.1 and 6.5 Zn becomes accessible to plants [13]. From this point of view, luvicsoil has good accessibility conditions of Zn for plants. Between the Zn ions and phosphorus (Zn-P relation) there is a clear antagonism when the zinc phosphate precipitate forming takes place - $Zn(OH)_2$, little accessible to plants. In carbonated soils, in those with plenty of organic matter, as well as in those for which amendments were used, Zn is also accessible in a reduced manner. New researches demonstrate that there is a tendency for Zn to form little soluble compounds in soil by precipitation under the form of: carbonates, hydro-oxides and phosphates [12]. However, the eco-environment luvisoil on which sludge spreading was used demonstrate both the existence of Zn total and Zn mobile, as well as large options of being adsorbed and used in that multitude of biological processes in which it is involved [3, 4, 6, 8]. However, using different rates of sewage sludge it is possible that in this favorable environment for Zn to have some excesses which could lead to toxic effects upon field plants. In the present paper there are presented some results of the way cultivation plants - maize, winter wheat and soybeans - grew and developed under progressive rates of processed sludge, rich in zinc.

MATERIAL AND METHODS

In the period of four years (2004-2007) a complex experiment was initiated. During this experiment plants were cultivated by the crop rotation: 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 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 rates 1/2 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 rates. 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 rates and the B factor - chemical fertilizers rates. Each variant had a surface of 100 m^2 each and was replicated for three times. Leaves samples were taken during flowering period: at maize the leaves located at cob level, at winter wheat the last 3 leaves including the standard leaf and the soybeans the leaves in the central part of the plant but also with bean- pods in formation. 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: Zn total forms from soil (Zn_{TF}), leaves (Zn_{LV}) and grains (Zn_{GR}) - SR ISO 11047-99, Zn- mobile forms (Zn_{MF}) 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

The zinc contents from crop eco-medium. After the determinations made, soil Zn content show the existence of heavy metal forms both of total and by mobile forms. Total soil zinc values ranged from average to be considered good (Table 1).

Table 1

Zinc contents from soil (mg.kg^{-1} d.w.), total forms

Heavy metal	Maize	Wheat	Soybeans	Wheat	Toxic limit
Zn, limits	50 - 206	52 - 120	50 - 123	40 - 98	
media	111	79	78	63	250

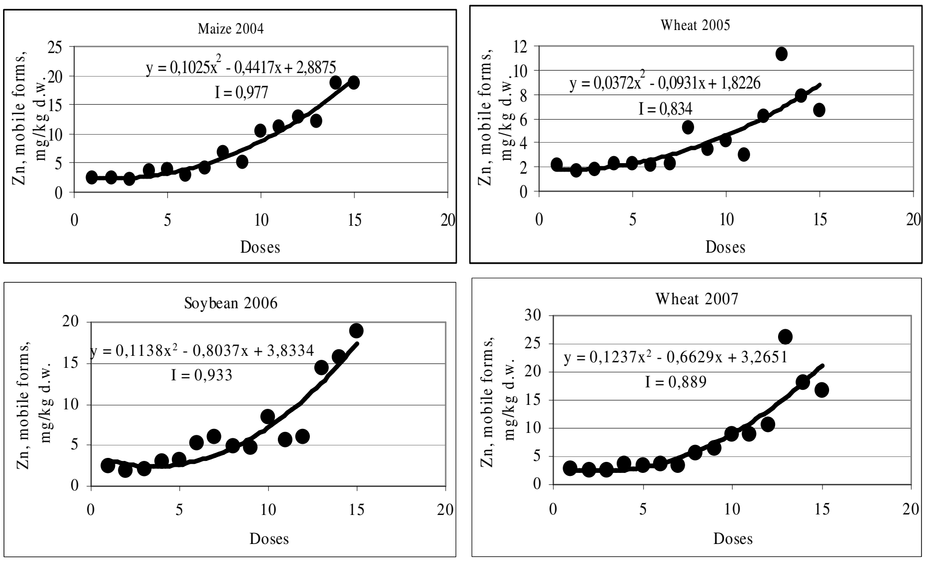


Fig. 1. Correlations between Zn concentrations, mobile forms (Zn_{MF}), and sludge & chemical rates used

Thus, in the four years this ranged between 40-52 mg.kg^{-1} d.w. Zn_{TF} as minimum and 98-206 mg.kg^{-1} d.w. the maximum value. Due to the positive effect of waste sludge introduced into the soil, zinc Zn_{MF} has evolved highly significant positive (figure 1). Depending on the dosage used Zn_{MF} evolved from 2.5 mg.kg^{-1} d.w. of control at 20 mg.kg^{-1} d.w. in large rates for maize, between 2 to 8.6 mg.kg^{-1} d.w. for wheat from second year, between 3 to 17 mg.kg^{-1} d.w. for soybeans, and between 2.5 and 20 mg.kg^{-1} d.w. the wheat from last year. Considering the critical limits of Zn it is considered that the data values obtained show favorable conditions to ensuring absorbing this chemical element by plants studied [5, 7, 11].

<u>Influence of experimental factors on the contents of Zn from leaves and grains.</u> In new terms of food, plants absorbed [14] and trans-located Zn into plants organs [17]. Recent research has shown that the normal average of Zn in plants is 20 mg.kg^{-1} d.w. [2, 8, 9], range between 20 and 100 mg.kg^{-1} d.w. [1]. Under 15 (20) mg.kg^{-1} d.w. Zn deficiency can occur in [16]. The correlations obtained between the rates used and concentrations of Zn in the three plants show very significant increases in insurance and statistically significant (Figure 2).

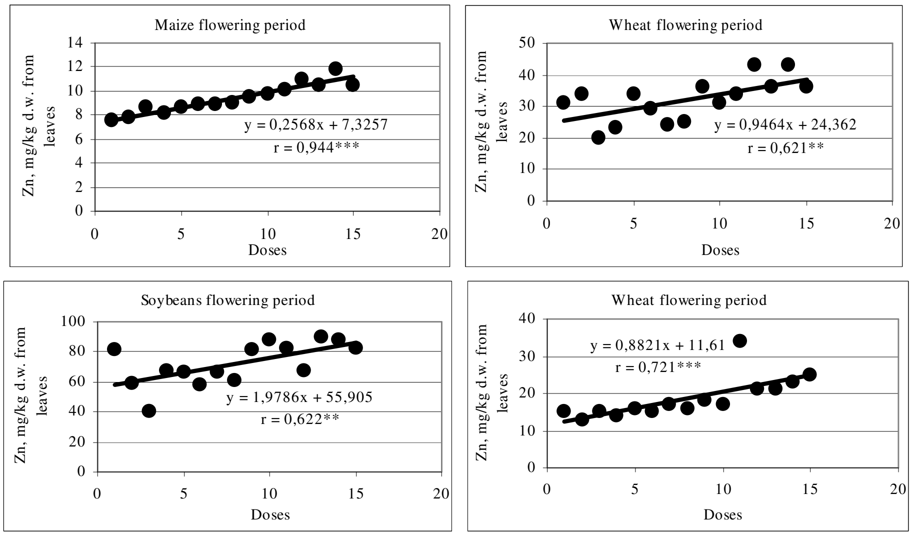


Fig. 2. Correlations between Zn concentrations from plant leaves (Zn_{LV}) and sludge & chemical rates used

In the flowering stage of crop plants, the content of Zn was in various concentrations. Zn in maize leaves was between 8 (check plot) to 11 mg.kg^{-1} d.w. The increase is highly significant (r=0.944***). In the second year of wheat leaves Zn varied between 25 to 39 mg.kg^{-1} d.w. and r=0.621***. Zn content in soybean leaves was between 60 to 84 mg.kg^{-1} d.w. (r=0.622**). Last year, wheat leaves had 13 to 25 mg.kg^{-1} d.w. Zn (r=0.721***). All these concentrations demonstrates that plants have absorbed different quantities of Zn (as species). Chemical analysis showed that theree plants were used Zn at all stages of the vegetation period, after which they were stored in the grains, as a final product (Figure 3).

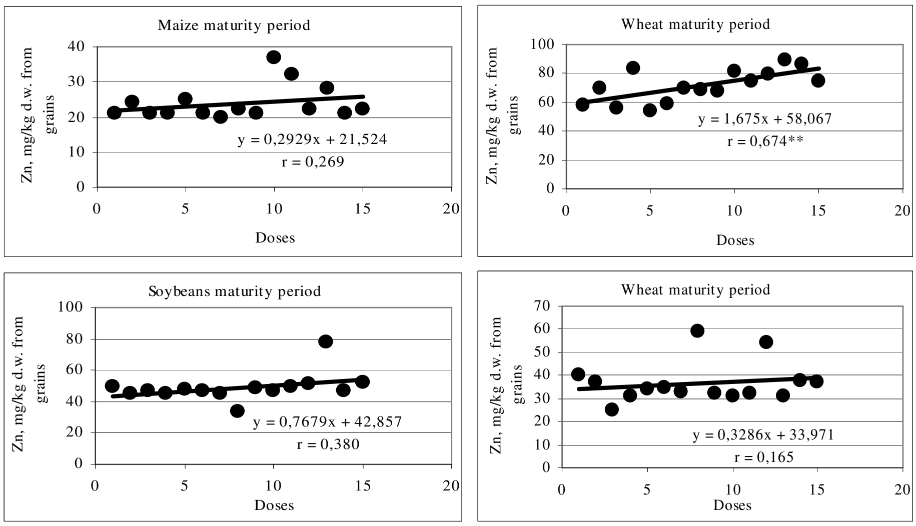


Fig. 3. Correlations between Zn concentrations from plant grains (Zn_{GR}) and sludge & chemical rates used

Zn concentrations of grains were specifically framed between: 22 to 26 mg.kg^{-1} d.w. for maize, 60-81 mg.kg^{-1} d.w. for wheat (year 2), 42-53 mg.kg^{-1} d.w. for soybean and 34-39 mg.kg^{-1} d.w. for wheat (last year). These figures show the amounts of Zn that were exported with the harvest grains.

CONCLUSIONS

1. Waste sludge occured in the regime of zinc (Zn) in agricultural eco-environment. Depending on the dose applied, with and without chemical fertilizers, Zn contents increase moderate total forms (Zn_{TF}) and significant mobile forms (Zn_{MF}).
2. Armed with good concentration Zn_{MF}, plants absorbed Zn^{2+} in specific amounts. Rates of sewage sludge favored absorbtion and increasing direct relationship with them.
3. Zinc has proven to be a micronutrient necessary for plant life. It is relatively easily absorbed in the rich soil in Zn_{MF}, it is trans-located throught the plant and used in many biochemical processes. When it meets the specific physilogical functions of Zn in grains was stored, as a final product of plant growth and development. The grains contents represent the export of zinc from soil fertilized with sludge waste.

4. The data obtained with the use of waste sludge in agricultural eco-environment boundaries were scored between both non-hazardous soil and plants. For these reasons this valuable product to be used in field crop production as bio-fertilizer.

REFERENCES

1. Bajescu Irina, Aurelia Chiriac, 1984. *Distributia microelementelor in solurile din Romania. Implicatii in agricultura.* Ed. Ceres Bucuresti (pp. 157-198).
2. Bergman W., P. Neubert, 1976. *Pflanzendiagnose und Pflanzenanalyse*. VEB Gustav Fischer Verlag, Jena.
3. Bilteanu Gh., 1988. *Mica enciclopedie agricola.* Ed. Stiintifica si Enciclopedica Bucuresti (pp. 363-364).
4. Boawn L.C., Jr. F.G. Viets, C.L. Crawford, 1960. *Effects of nitrogen carrier, nitrogen rate, zinc rate, and soil pH on zinc uptake by sorghum, potatoes, and sugar beets.* Soil Science, vol. 90 (pp. 329-332).
5. Borlan Z., C. Hera, 1982. *Tabele si nomograme agrochimice.* Ed. Ceres, Bucuresti (pp. 27).
6. Brown A.L., B.A. Kranz & P.E. Martin, 1963. *Plant uptake and fate of soil-applied zinc.* Proceedings SSSA, vol. 26 (pp. 167-171).
7. Davidescu D., V. Davidescu, 1972. *Chimizarea agriculturii. Testarea starii de fertilitate prin planta si sol.* Ed. Academiei Romane, Bucuresti (pp. 264-253).
8. Davidescu D., V. Davidescu, 1981. *Agrochimia moderna.* Ed. Academiei Romane, Bucuresti (pp. 34-205).
9. Edwards J.H., E.J. Kamprath, 1974. *Zinc accumulation by corn seedlings as influenced by phosphorus, temperature and light intensity.* Agronomy Journal, vol. 66 (pp. 208-214).
10. Juste C., 1970. *Action toxiques des oligo-elements.* Annales Agronomiques, vol. 21(5) (pp. 549-553).
11. Thorne W., 1949. *Zinc deficiency and its control.* Advanced Agronomy, vol. 9 (pp. 31-36).
12. Tisdale S.L. & W.L. Nelson, 1966. *Soil fertility and fertilizers.* Ed. Mc Millan Publishing Co.Inc. New York (pp. 325-330).
13. Wear J.I., 1956. *The effect of soil pH and calcium on uptake of zinc by plants.* Soil Science, vol. 81 (pp. 311-315).
14. Wilkinson H.F., J.F. Loneragan & J.P. Quirk, 1968. *The movement of zinc to plant roots.* Proceedings SSSA, vol. 32 (pp. 831-837).
15. ***Ordinul nr. 344/708/2004. *Normele tehnice privind protectia mediului, in special a solurilor cand se utilizeaza namoluri de epurare in agricultura.* Monitorul Oficial 959/10 oct.
16. ***Yara International ASA, 2007. *Technical elements.* Oslo, Norge (pp.1-32).
17. ***www.fao.org.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

DYNAMICS OF PHYSICAL QUALITY INDICES OF THE TYPICAL LOW HUMIFIED CHERNOZEMS IN VARIOUS CONDITIONS OF FERTILIZATION AND SOIL PROCESSING

INA CHIRCU, MARIA MOTELICA, ECATERINA CHISLARI

State University of Moldova

Keywords: *chernozem, agrophysical indices, structural aggregative indices*

Abstract

In the studied land, a few crop variants of soybean and alfalfa were examined: in both cases there is the control variant, mineral fertilization variant ($N_{60}P_{38}K_{175}$) and organic fertilization variant with 70 t/ha farmyard manure (two times in seven years for alfalfa, and one time in seven years for soybean). Due to the fact that humidity is below the critical values for the both variants, the report between apparent density and total one presints values between 0.9-1.0 g/cm^3. The COLE values in the plowing variant (for soybean) comprise up till 16%, which implies the idea that with the plowind occurs the desagregation and soil mass dispersion processes. The higher values of Ka on the organic fertilisation variant (3.03 for soybean and 2.77 for alfalfa) says that organic fertilizers contribute to the biological processes intensification and structuring capacity conservation of the soil. Mineral fertilization is an factor of structure degradation.

INTRODUCTION

Evaluation of the physical quality of the soil involve the measurement of some soil proprieties and traits that serve as sensitive indicators to the modification of the soil functions resulted from using and managing of the soil resources. The determinations of these indicators should underpin the evaluation regarding degradation and soil pollution.

The soil physical properties have a major influence on the way of soil functioning within the ecosystem. Using various technical methods, this traits can be ameliorated so this leads to development of the soil capacity to ensure optimal conditions for plant vegetation.

The soil physical characteristics like structure, porosity, apparent density, hydrological regime, air regim and heat regime, changes depending by soil processing. The purpose of this study implies the evaluation of the dynamics of physical quality indices of the typical low humified chernnozems in various conditions of fertilization and soil processing.

MATERIAL AND METHODS

The researche included field activities and laboratory analysis.

The land research took place in the experimental field of the Microbiology and Biotechnology Institute under Academy of Science of Moldova, located in the ecological micro-district Băcioi. In the studied land, were examinated a few crop variants of soy and alfalfa: in the both cases there is the control variant, mineral fertilization variant ($N_{60}P_{38}K_{175}$) and organic fertilization variant with 70 t/ha farmyard manure (two times in seven years for alfalfa, and one time in seven years for the soybean).

For alfalfa was applied the rotation system in such way: soil plowing on 25-27 cm depth for during three years, in the fourth year the arable surface were treated with the disk about 8 -10 cm depth after what on the land were sown wheat.

The laratory analysis was performed in the laboratory LCŞ „Pedogenetic Processes" from the State University of Moldova using the classical method of examination.

RESULTS AND DISCUSSION

Within the studied object, the apparent density of the both variants (control and organic fertilization) in the arable layer, presents values from the optimal interval (1.1-1.3 g/cm^3) (Table 1). Moreover, the density values are identical for the both alfalfa and soy cultures. To note that, the total density is practicaly identical for all the variants, but presents almost equal values with the apparent density, result caused by the low humidity values (W,%) for the both variants. Therefore, the main factor which determine the values of apparent density and its dynamic in dry period and dry years is humidity. With reference to the humidity, in the variant of annual plowing, for the soybean crop, the value of humidity is bigger than in the case of rotation system on alfalfa crops. So, this justifies the affirmation from speciality literature that alfalfa crop, in virtute of a higher water utilization coeficient, leads to a higher consumption of water from the pedosphere.

The ratio between apparent density and total one presents values between 0.9-1.0 g/cm^3, this is caused by the humidity which is below the critical values in the both cases.

The extension linear coefficient (COLE) is a soil humidity function. This coefficient within the rotational system of soil processing (alfalfa) presents values under 10%. In the case of plowing variant (soybean) - COLE presents value untill 16%, and this implies the ideea that the plowing work determine the soil matter disintegration and dispersion.

As is shown in the table 1, in all the cases the total porosity presents excelente values. Almost 50% from total porosity space is occupied by aggregate porosity and characterizes an excellent pore space condition (refering to the capilar porosity). But in the same time, the experimental data shows that interaggregate porosity is about 75% from total porosity. This could be explained by the hard soil fissures caused by the pronounced water deficit. As a consequence of these fissuring processes is the intensive physical evaporation and water depletion.

The structuring process, and respectively structural - aggregative conditon, are integral indices for the dynamic of all pedogenetic elementary processes, characteristic of one or another pedogenesis type. The fertilization is one of the factors with impact on the structuring process.

Structural/aggregative component of the studied soil is included in the optimal model of the structural/aggregative condition of the chernozems, with the major part of agronomic valuable aggregates (10-0.25 mm) more that 70% for all the variants (Table 2). The boulder aggregate content (>10 mm) presents values under 30%, thing that indicate the achieving of the structural processes in autonomous regime. Techno\anthropogenetic interventions have no role in the structure modification. Also for all the variants, to note, the boulder degree is greater in the 20-40 cm layer, fact caused by the classical soil processing system that result with slightly compaction processes in the arable layer.

From table 2 we can see that the content of aggregate >10 mm is lower on the organic fertilization variant than for witness variant, regularity characteristic for the both crops. Moreover, the content of aggregate <0.25 mm is lower on the organic fertilization variant than mineral fertilization. These data implies the idea that the organic fertilizers are an stabilizing factor of the structure. More Intensive spraying of the structural-aggregative compound (with the highest content of aggregate <0.25 mm) is observed on the mineral fertilization variant ($N_{60}P_{38}K_{175}$). Therefore, we can conclude that the systematic application of the mineral fertilizers leads to the structure dispersion either under K cation influence or indirectly as a result of partial decalcification of the adsorbtiv complex. In the favor of this conclusion comes also the agronomically valuable aggregates (10-0.25mm), with a lower content on the mineral fertilisation variant than on the witness variant. Analyzed in terms of hydrostability, the aggregative - structural component shows the clear growth trend of aggregation and hydro stability. The content of hydrostable macroaggregates varies between %-75% (for soybean) and 65%-78% (for alfalfa). Values higher than 80% is noticed in the 0-10 cm layer.

One integrator parameter of the soil structuring is the structuring coefficient (Ka).

In the study experience the structuring capacity remains on a higher level, fact resulted from the structuring coefficient between the values 2-4. From the same table, is proved that the structuring potential occurs in equal proportions in the witness and mineral fertilisation variant. Therefore, the higher values of Ka on the organic fertilisation variant (3.03 for soybean and 2.77 for alfalfa) says that organic fertilizers contribute to the biological processes intensification and structuring capacity conservation of the soil.

To assess all the processes what influence the structural aggregate size, were used the degree of structure crushing (GMS). A more intense structure crushing is found on the mineral fertilization variant, compared with the witness variant. Here the GMS values are over 60%. And again is confirming the above statement that the mineral fertilization is an factor of structure degradation. The most pronounced process of structure crushing is in the variant of clasical system of soil processing (soybean), when the GMS values is even 67%.

In favor of this conclusion are also the lower values of the medium weighted diameter (DMP) on the mineral fertilization variant, comparing with the witness variant. Higher values of DMP we notice in the 20-40 cm layer for all the variants, because of the higher boulder degree in this layer, as a result of clasical system of soil processing.

CONCLUSIONS

1. Agricultural use and fertilization implies characteristics and particular dynamic of the physical quality indices, which, assigna specific agricultural trait to the typical low humified chernozems.

REFERENCES

1. Canarache A.,1990. *Fizica solurilor agricole*.
2. Jigău Gh., 2009. *Geneza şi fizica solurilor*.
3. Jigău Gh., T. Nagacevschi, 2006. *Ghid al disciplinei Fizica Solului.*

Table 1

Agrophysical indices

		Soybean									Alfalfa								
Variant	***Depth, cm***	***W, %***	***ρ_b, g/cm³***	***ρ_t, g/cm³***	***ρ_b/ρ_t, g/cm³***	***COLE %***	E_t	E_a	$E_{\sum agr}$	E_{ia}	***W, %***	***ρ_b, g/cm³***	***ρ_t, g/cm³***	***ρ_b/ρ_t, g/cm³***	***COLE, %***	E_t	E_a	$E_{\sum agr}$	E_{ia}
Control	0-10	3.94	1.07	1.12	0.95	4.32	59	24.5	13.8	44.7	5.38	1.03	1.09	0.94	5.49	63	25.0	12.5	51.2
	10-20	10.74	1.06	1.17	0.90	10.64	60	26.0	14.2	45.8	7.41	1.14	1.22	0.92	7.26	56	26.5	16.6	39.5
	20-30	13.41	1.12	1.27	0.87	13.71	57	28.1	16.8	40.0	8.38	1.17	1.26	0.92	7.94	56	24.1	14.3	41.6
	30-40	14.37	1.21	1.38	0.87	14.00	53	22.5	14.1	39.1	8.82	1.18	1.28	0.91	9.02	53	25.1	15.7	37.9
	Average	***10.61***	***1.11***	***1.23***	***0.89***	***10.66***	***57***	***25.3***	***14.7***	***42.4***	***7.49***	***1.13***	***1.21***	***0.92***	***7.42***	***57***	***25.2***	***14.8***	***42.6***
$N_{60}P_{38}K_{175}$	0-10	3.57	1.17	1.21	0.96	3.11	55	25.9	15.9	39.0	4.17	1.04	1.08	0.96	4.69	61	25.1	13.2	48.1
	10-20	10.68	1.12	1.23	0.90	10.41	57	25.5	14.9	42.0	7.71	1.12	1.21	0.92	8.04	56	29.3	14.5	42.2
	20-30	12.20	1.09	1.21	0.90	12.63	59	27.1	15.4	43.1	8.76	1.15	1.24	0.93	8.10	55	27.7	17.4	38.4
	30-40	13.03	1.17	1.32	0.88	12.16	56	24.3	14.1	41.9	9.85	1.11	1.25	0.88	10.02	57	25.7	15.0	42.2
	Average	***9.87***	***1.13***	***1.24***	***0.91***	***9.57***	***57***	***25.7***	***15.1***	***41.5***	***7.62***	***1.10***	***1.19***	***0.92***	***7.71***	***57***	***27.0***	***15.0***	***42.7***
Organic 1 / 7 years 70 t/ha	0-10	7.61	1.05	1.14	0.91	8.85	60	27.1	15.4	44.3	5.00	1.11	1.17	0.94	5.09	57	25.1	14.6	42.8
	10-20	14.55	1.01	1.15	0.87	14.14	60	26.8	14.6	45.7	8.55	1.11	1.21	0.91	8.40	58	25.6	15.2	42.9
	20-30	16.06	1.08	1.25	0.85	15.79	58	27.6	16.0	42.3	8.70	1.10	1.19	0.92	8.08	57	27.9	17.2	41.0
	30-40	15.49	1.14	1.34	0.86	14.97	55	24.2	14.4	40.8	8.84	1.11	1.24	0.89	8.42	56	23.0	12.9	44.2
	Average	***13.42***	***1.07***	***1.22***	***0.87***	***13.43***	***58***	***26.4***	***15.1***	***43.3***	***7.77***	***1.11***	***1.20***	***0.91***	***7.49***	***57***	***26.4***	***14.9***	***42.7***

Table 2

		Soybean								Alfalfa							
Variant	***Depth, cm***	***structural aggregative indices***			***structure hydrostability indices***		***medium weighted diameter DMP***	***degree of structure crushing GMS***	***structuring coefficient Ka***	***structural aggregative indices***			***structure hydrostability indices***		***medium weighted diameter DMP***	***degree of structure crushing GMS***	***structuring coefficient Ka***
		>10 mm	***10-0.25 mm***	***<0.25 mm***	***10-0.25 mm***	***<0.25 mm***				***>10 mm***	***10-0.25 mm***	***<0.25 mm***	***10-0.25 mm***	***<0.25 mm***			
Witness	0-10	15.2	70.4	14.4	91.3	8.7	3.74	72.4	2.37	9.2	68.4	22.4	3.0	7.0	3.10	78.2	2.16
	10-20	19.8	71.8	8.4	67.8	32.2	4.66	62.2	2.54	20.2	67.8	12.0	66.0	34.0	4.70	61.8	2.10
	20-30	25.2	70.4	4.4	67.4	32.6	5.48	51.8	2.37	21.8	69.8	8.4	68.0	32.0	5.24	54.2	2.31
	30-40	17.0	82.8	0.2	71.8	28.2	5.04	52.8	4.81	14.8	74.8	10.4	78.2	21.8	4.62	60.8	.96
	Average	***19.3***	***73.8***	***6.9***	***74.6***	***25.4***	***4.74***	***59.8***	***2.81***	***16.5***	***70.2***	***13.3***	***76.3***	***23.7***	***4.42***	***63.8***	***2.35***
$N_{60}P_{38}K_{175}$	0-10	6.8	68.6	24.6	83.4	16.6	2.76	83.6	2.18	4.8	73.4	21.8	89.2	10.8	2.42	84.0	2.75
	10-20	16.8	74.0	9.2	77.6	22.4	4.60	65.0	2.84	24.4	62.6	13.0	75.4	24.6	5.06	57.0	1.67
	20-30	17.6	77.0	5.4	53.8	46.2	4.84	60.0	3.34	18.0	69.2	12.8	64.2	35.8	4.72	60.8	2.24
	30-40	19.8	71.6	8.6	79.2	20.8	4.88	59.6	2.52	19.6	71.8	8.6	84.6	15.4	4.98	57.8	2.54
	Average	***15.2***	***72.8***	***12.0***	***73.5***	***26.5***	***4.28***	***67.1***	***2.67***	***16.7***	***69.3***	***14.0***	***78.4***	***21.6***	***4.30***	***64.9***	***2.25***
Organic 1 / 7 years 70 t/ha	0-10	10.8	75.0	14.2	89.8	10.2	3.58	74.0	3.00	8.4	75.0	16.6	93.6	6.4	3.32	76.8	3.00
	10-20	13.8	78.0	8.2	67.4	32.6	4.56	63.4	3.54	18.2	69.6	12.2	56.4	43.6	4.38	64.8	2.28
	20-30	21.2	74.2	4.6	62.0	38.0	5.34	55.2	2.87	22.4	69.0	8.6	52.0	8.0	5.28	53.8	2.22
	30-40	20.2	73.8	6.0	81.6	18.4	5.16	56.0	2.81	13.0	80.4	6.6	61.6	38.6	4.90	58.6	4.10
	Average	***16.5***	***75.2***	***8.3***	***75.2***	***24.8***	***4.66***	***62.2***	***3.03***	***15.5***	***73.5***	***11.0***	***65.9***	***34.1***	***4.48***	***63.5***	***2.77***

Soil Structural - aggregative component

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

INTERPRETATIONS OF SOIL PROPERTIES AND SOIL CLIMATE IN THE TRANSYLVANIAN PLAIN, ROMANIA

D.C. WEINDORF*, B. HAGGARD*, T. RUSU, M. SOPTEREAN**, H. CACOVEAN*****

*Louisiana State University AgCenter, Baton Rouge, LA, USA
**University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca
***Soil and Agrochemical Studies Office of Cluj-Napoca

Keywords: *soil temperature, soil classification, Transylvanian Plain*

Abstract

The Transylvanian Plain is an important region for agronomic productivity. However, limited soils data and adoption of best management practices hinder land productivity. Soil temperatures of the Transylvanian Plain (TP) were evaluated using a set of 20 datalogging stations positioned throughout the plain. Soil temperatures were monitored at the surface and at depths of 10, 30, and 50 cm. Soil moisture was monitored at 10 cm. During soil pedogenesis, soil properties and features developed in response to differential lithology and macro/microrelief. Evaluated soils were found to largely be a complex mix of Cernisols, Luvisols, and Antrisols. Soil temperatures of the TP are mesic, with small differences between the northern and southern extents. Differences in seasonal warming and cooling trends across the plain were noted. Influences of slope aspect and inclination are suspected as a cause for local temperature variation on TP soils. Temperature variation has important implications for planting recommendations (i.e. germination temperature, maximum growing season, etc.).

INTRODUCTION

The Transylvanian Plain (TP), with an area of approximately 395,000 ha, is an important agricultural production area of Romania. Once forested, the area was cleared hundreds of years ago and is now used largely for agricultural production. Today, steppe vegetation is found in non-agricultural areas of the TP and few areas of virgin forest remain. The TP has generally fertile soils and is capable of large agronomic production (corn, sunflower, wheat, soybeans, potatoes) (Badea, 2009; Haggard et al., 2010). Contrary to its name, the TP is characterized by extensive rolling hills and is bounded by two main rivers, the Someş to the North and West, and the Mureş to the South and East. Elevation of the TP ranges from 231 to 662 m. Original geologic deposits in the area are Miocene, with contemporary hills largely derived from Pliocene and Quaternary materials [2].

Over time, the rugged terrain, deforestation, erosive slopes, and irrational agrotechnical practices for crop production have combined to degrade large areas of agricultural land, reducing its productivity. Within the TP, tens of thousands of hectares of land show signs of denudation or reduced productivity [9]. Furthermore, most of the land is non-irrigated, owing to a lack of available groundwater and limited access to surface waters in the central TP [8].

Climate of the TP is highly dynamic, with hot summers (high temperatures >25°C) and cold winters (lows ~-5°C) [3]. Moisture regimes of the TP are generally udic to ustic with moisture increasing slightly to the north [5]. Climatic research inside the Carpathian basin has identified an increase in mean air temperatures over the last 100 years of ~0.7°C [8]. Evidence of warming is further supported by the fact that six of the warmest years of the 20th century were registered in the 1990's. However, long-term documentation of temperature and moisture data in soils of the Transylvanian Plain has never been established. Regimes currently set forth for the region are based on estimation or limited short-term observations of soil moisture and temperature. As such, this research on temperature, moisture, and precipitation of the Transylvanian Plain is a first for Romanian soil science.

The methods and analyses established by this study are instrumental in defining a rubric for future soil climatic studies throughout Romania. As such, the objectives of this study were to: 1) establish 20 datalogging stations for long term documentation of soil temperature and moisture on soils of the TP, 2) characterize the physicochemical soil properties and establish the taxonomic classification, moisture and temperature regimes of the studied soils, 3) determine the significant relationships between soil temperature/moisture and soil physicochemical properties, and 4) evaluate the influence of ancillary factors such as slope inclination and aspect on soil temperature/moisture.

MATERIAL AND METHODS

Twenty datalogging stations were deployed across the TP on divergent soil types, slopes, and aspects. The location of each site was recorded using a Garmin eTrex Vista (Olathe, KS, USA) handheld global positioning system unit. Ten datalogging stations were installed in March of 2008, with an additional ten stations installed in March of 2009. HOBO Smart Temp (S-TMB-M002) temperature sensors and Decagon EC-5 (S-SMC-M005) moisture sensors were connected to HOBO Micro Stations (H21-002) at each site (On-set Computer Corp., Bourne, MA, USA). Additionally, at 10 of the 20 sites, tipping bucket rain gauges (RG3-M) were deployed to measure precipitation (On-set Computer Corp., Bourne, MA, USA) (Figure 1).

At sites with a tipping bucket rain gauge, the following data was recorded: soil temperature at depths of 10, 30, and 50 cm; soil moisture at 10 cm; surface air temperature; and precipitation. At sites without a tipping bucket rain gauge, the following data was recorded: soil temperature at 10 and 50 cm; soil moisture at 10 cm; and surface air temperature. Data was downloaded from the Micro Stations every two months via laptop computer using HOBOware Pro Software Version 2.3.0 (On-set Computer Corp., Bourne, MA, USA).

Soils at each site were initially sampled and described to a depth of 50 cm. Field descriptions were made per the Soil Survey Staff (2002) as a collaborative effort between soil scientists from the University of Agricultural Sciences and Veterinary Medicine Cluj Napoca (USAMV Cluj Napoca), Soil and Agrochemical Studies Office Cluj Napoca (OSPA Cluj Napoca), and the Louisiana State University (LSU) AgCenter (Baton Rouge, LA, USA). Soils samples were processed at LSU AgCenter in Baton Rouge, LA. Prior to lab analysis, soils were oven dried at 40°C and ground to pass a 2 mm sieve. Particle size analysis was conducted via the pipette method (Gee and Bauder, 1986) with 24 h clay determinations. Sands were sieved with a 53 µm sieve. Soil pH and electrical conductivity were accomplished via saturated paste and read on an Orion 2-Star pH meter (Thermo Scientific, Waltham, MA, USA) and model 4063CC digital salinity bridge (Traceable Calibration Control Company, Friendswood, TX, USA) (Salinity Laboratory Staff, 1954; Soil Survey Staff, 2004). Organic matter was determined via loss on ignition testing at 400°C and converted to organic carbon following [10]. Elemental analysis was accomplished via Mehlich III digestion with quantification via a CIROS model inductively coupled plasma atomic emission spectrometer (Spectro Analytical Instruments, Marlboro, MA, USA).

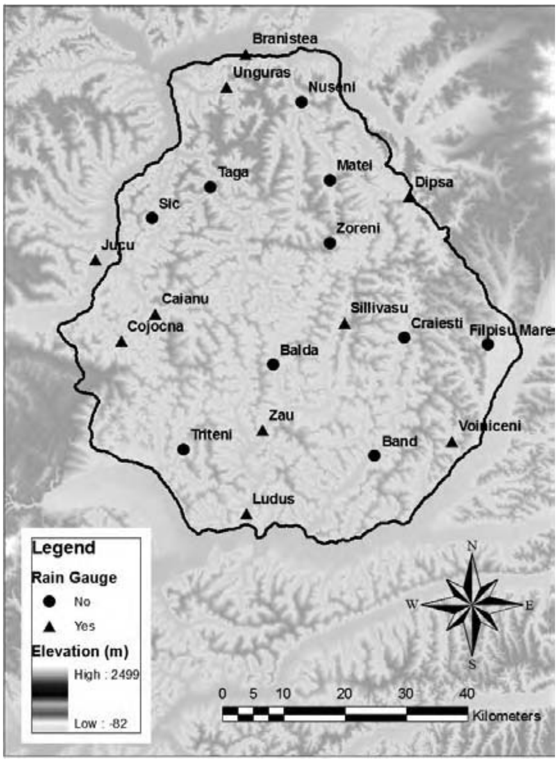


Fig. 1. Location, elevation, and configuration of soil temperature and moisture monitoring stations within the Transylvanian Plain, Romania

Data processing was accomplished with several software packages. Digitization of existing 1:200,000 scale soil maps of the TP was accomplished via ArcGIS 9.3 [4]. Inverse distance weighting and spline interpolations of soil temperature data were made with ArcGIS 9.3. Multiple regression analysis was accomplished using SAS 9.2 (SAS Institute, Cary, NC, USA).

RESULTS AND DISCUSSION

Soils of the TP were digitized and converted into the contemporary taxonomic system used in Romania [5]. A total of 1,472 polygons were digitized and classified by soil class, type, and subtype (Figure 2, Table 1).

Table 1

Total area and extent of soil classes for soils of the Transylvanian Plain, Romania derived from digitization of 1:200,000 scale soil maps

Class	Area (ha)	% of TP
Antrisoluri	58921	14.9%
Cambisoluri	35679	9.0%
Cernisoluri	200543	50.7%
Hidrisoluri	6816	1.7%
Luvisoluri	86410	21.8%
Pelisoluri	6737	1.7%
Protisoluri	154	0.0%
Salsodisoluri	356	0.1%
Total:	395616	100.0%

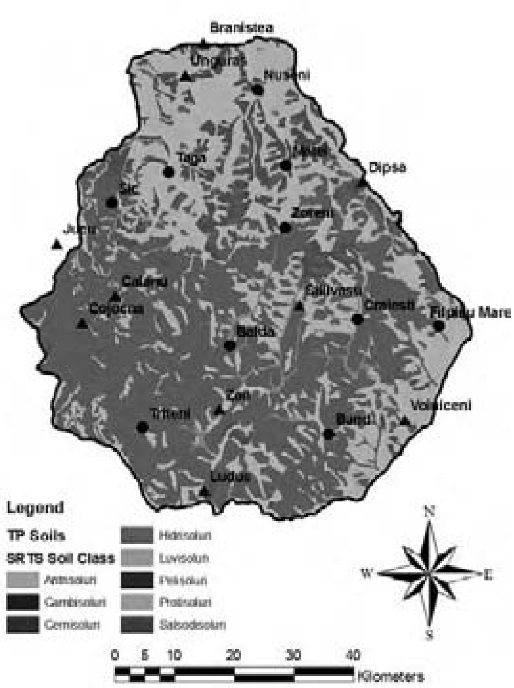


Fig. 2. Soil classes of the Transylvanian Plain, Romania derived from digititation of 1:200,000 scale soil maps

Calculation of soil temperature regime according to the Soil Survey Staff (2010) consists of averaging soil temperatures at 50 cm between summer (June, July, and August) and winter (December, January, and February). The Soil Survey Staff (2010) defines mesic soil temperature as a “mean annual soil temperature that is >8°C, but <15°C where the difference between mean summer and mean winter soil temperatures is more than 6°C at 50 cm or at a densic, lithic, or paralithic contact, whichever is shallower.” Data from the monitoring sites clearly indicated that all sites have a mean annual soil temperature of ~10°C at 50 cm with more than 6°C variation between summer and winter. Thus, the soil temperature regime of the TP was determined to be mesic.

Although soil temperatures were mesic across the TP, differences were noted between the northern and southern extents. Taken as an annual average, temperatures at Cojocna, Caianu, Sic, Taga, Zoreni, Sillivaşu, and Nuşeni were noted to be 1-2°C cooler than temperatures at Filipişu Mare, Zau, Luduş, Voiniceni, and Dipşa (Figure 3). Possible reasons for the observed differences in temperature spatial variability include: distance to the Someş and Mureş Rivers, albedo effects imposed by humic substances common to Cernisoluri, slope inclination, and slope aspect. To evaluate these possibilities, a multiple regression model was created such that euclidean distance to the Mureş River and elevation (derived from a digital elevation model) were used as regressors to explain observed temperature. Soil temperature estimation at 10 cm was constructed using June, 2009 data. Temperature predictions align with drainage basins of the Someş and Mureş with surprising accuracy ($r^2 = 0.5073$). However, other months showed less robust prediction accuracy. To address these shortcomings, an exploratory factor analysis was established across 15 months and 20 sites. The months analyzed were: March 2009 - May 2010. Results of factor analysis showed that two factors substantially impact soil climate on the TP. Specifically, the factor analysis differentiated April-October (Factor 1) as being influenced dominantly by a separate factor from November-March (Factor 2). Factor 1 is associated with higher amounts of evapotranspiration, while factor 2 reflects moisture recharge, where evapotranspiration is less than the rainfall input [13].

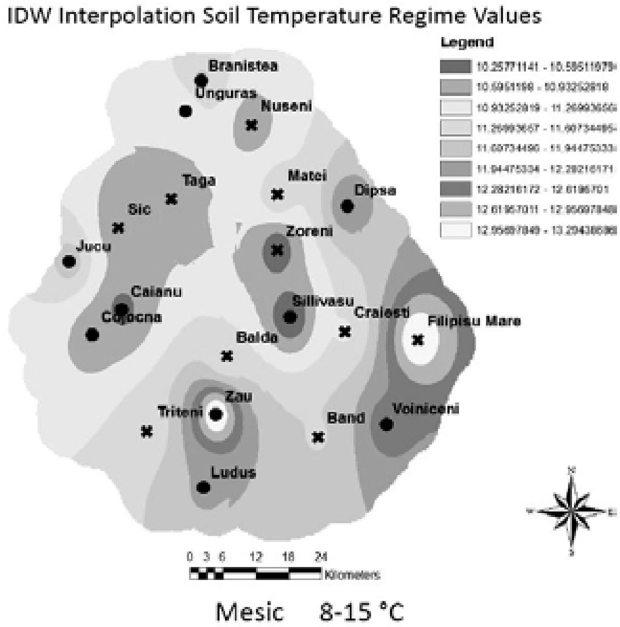


Fig. 3. Average annual soil temperatures (°C) at 50 cm across the Transylvanian Plain, Romania in 2009

Using data generated from this study, a land classification map was initially created with soil type and slope. The US equivalent of Mollisols were classed as 3, Alfisols, Alluvium, and Inceptisols were classed as 2, Spodosols, Histosols, and Entisols were classed as 1, and highly eroded soils, salt affected soils, and lithic soils were classed as 0. Slopes classes were established as follows: 0-0.5% slope (class 4), 0.5-5% (class 3), 5-15% slope (class 2), 15-25% slope (class 1), and >25% slope (class 0). Once complete, these two rankings were reclassified together, to produce a land classification map ranking the suitability of soils for production agriculture across the TP (Figure 4). Results indicate that superior agronomic soils are generally located in the southern TP, with less desirable soils located in the northern TP.

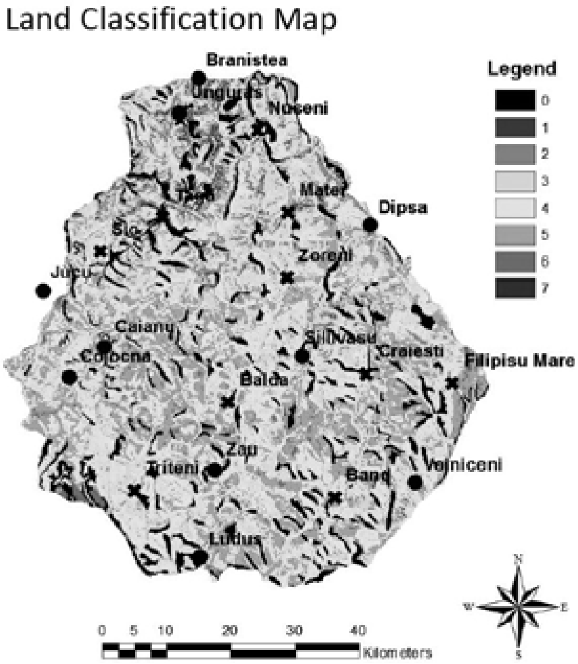


Fig. 4. Land classification map of soils of the Transylvanian Plain, Romania using soil type and slope inclination as inputs. Scale of 0 to 7 is a synthesis of land type and slope such that 7=best and 0=worst land for agronomic production

Results of soil physicochemical data across the plain were dynamic, though generally within the boundaries established by previous studies. Soil pH was generally moderately alkaline, with many soils exhibiting pH from 7.2 – 7.7. Isolated soils had pH values as high as 8.0. Soil textures were largely silty clay, clay, and clay loam. These textures have significance in the context of organic matter preservation across the TP. Soil organic matter is well protected by clays, where its macromolecular complexes become bound to the surfaces of electrostatically charged clays. Soil organic matter levels commonly ranged from 3-6%, though values as high as 8.6% were observed. Soil organic matter levels generally showed a decrease with depth, commonly observed in upland soils. The elemental range and mean of common exchange complex elements in the soils is given in Table 2. As expected, soil organic carbon levels aligned rather well with the spatial distribution of Cernisoluri (Figure 5).

Table 2

Mehlich III elemental concentrations in soils (0-50 cm depth) of the Transylvanian Plain, Romania

	P	K	Ca	Mg	Zn	Cu	Na	S	Fe	Al	Mn
	--mg kg^{-1}---										
Mean	224	780	5878	413	13	6	43	78	307	481	220
Minimum	5	106	1700	147	1	1	6	10	99	0	106
Maximum	1608	3492	11528	1090	143	12	194	223	476	1485	359

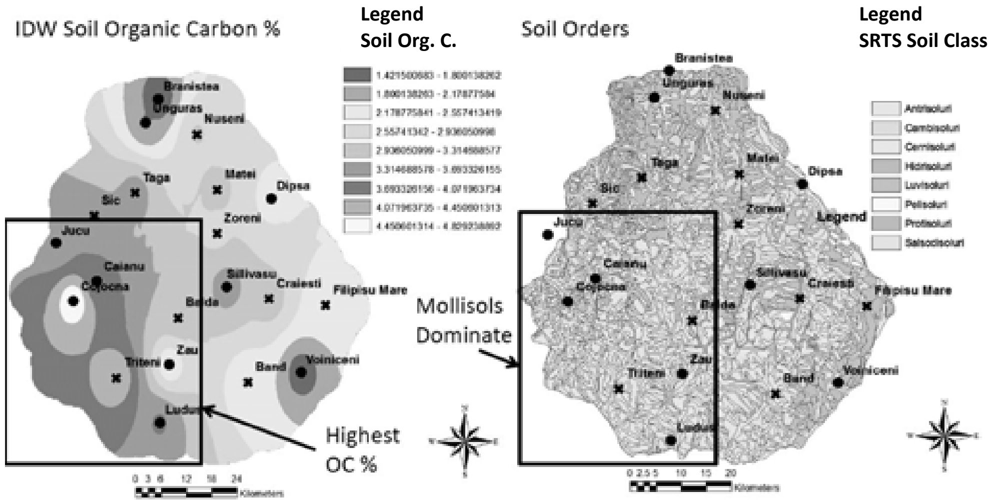


Fig. 5. Inverse distance weighted interpolation of soil organic carbon on the Transylvanian Plain, Romania and associated soil classes

The data collected to date notwithstanding, further study on the influence of soil slope and aspect are required for a better model of soil temperatures across the TP. As such, an array of 11 soil temperature/moisture monitoring stations was deployed in March, 2011 at Caianu, Romania to study aspect differences in temperature around a single hill as well as catena effects imposed by slope and elevation across a valley. Data will be collected from March through October, 2011 then analyzed for differences in soil temperature and moisture effects. Aspect and slope inclination effects will be incorporated into the data model for the entire TP to more accurately describe soil temperature and moisture dynamics.

CONCLUSIONS

1. Soil temperatures of the Transylvanian Plain, Romania were evaluated via 20 datalogging stations in 2009 and 2010.

2. Data from the loggers indicated that the soil temperature regime of the TP is mesic. More than 50% of the soils on the TP were Cernisoluri, followed by Luvisoluri (21.8%) and Antrisoluri (14.9%). Interpolations of soil organic carbon based upon levels documented at the research sites generally show association with Cernisoluri.
3. Soils across the TP were classified according to agronomic use with slope and soil type as input factors. Output from this map shows that superior agronomic lands are located in the southern portion of the TP. Distance to the Mureş River was shown to be a significant variable in explaining spatial temperature variation across the TP.
4. Two factors were differentiated within the data, indicating that the temperatures of winter months are related to a different factor than the remaining months.
5. Ongoing studies of the impact of slope aspect and inclination will allow for further refinement of the soil climate model for the entire TP.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the contributions of Laura Paulette in preparing this work.

REFERENCES

1. Badea D. (ed.), 2009. *Anuarul Statistic al Romaniei*. National Institute of Statistics, Bucharest.
2. Balteanu D., 1997. *Romania.* In Embleton, C. (ed.) Geomorphological hazards of Europe. Elsevier, Amsterdam (pp. 409-427).
3. Climate Charts, 2007. *Climate, global warming, and daylight charts and data for Cluj-Napoca, Romania.* [online]. Available at http://www.climate-charts.com/Locations/r/RO15120.php. Verified 26 May 2009.
4. ESRI, 2011. *ArcGIS Desktop*. Release 9.3. ESRI, The Redlands, CA.
5. Florea N., I. Munteanu, 2003. *Sistemul Roman de Taxonomie A Solurilor*. Institutul de Cercetari Pentru Pedologie şi Agrochimie, Bucureşti.
6. Gee G.W. and J.W. Bauder, 1986. *Particle size analysis*. In Bigham, J.M. (ed.) Methods of soil analysis: Part 1- physical and mineralogical methods. SSSA-ASA, Madison, WI.
7. Haggard B.J., D. Weindorf, H. Cacovean, T. Rusu, J. Lofton, 2010. *Analysis of Growing Degree Days in the Transylvanian Plain, Romania*. Studia Universitatis Babeş-Bolyai, Geographia, Anul LV, nr. 2/2010 (pp. 13-20).
8. Man T., R. Pop, 2000. *Considerations on the treatment of deficient rainfall in Transylvania Plain*. Studia Universitatis Babes-Bolyai, Geographia, XLV, No. 2.

9. Ministry of Agriculture and Rural Development, 2011. [online]. Available at http://www.madr.ro/. Verified 28 March 2011.
10. Nelson D.W., L.E. Sommers, 1996. *Total Carbon, Organic Carbon, and Organic Matter.* In Sparks, D.L. (ed.) Methods of Soil Analysis - Part 3 - Chemical Methods. SSSA, Madison, WI (pp. 961-1010).
11. SAS Institute, 2008. *The SAS system for Windows*. Release 9.2. SAS Inst. Inc., Cary, NC.
12. Salinity Laboratory Staff, 1954. *Diagnosis and Improvement of Saline and Alkali Soils - Agriculture Handbook No 60.* USDA. US Gov. Print. Off., Washington, DC.
13. Serban E., 2008. *Climate phenomena of the risk of rainfall in West Plains located north of the Mures.* PhD thesis, University of Oradea.
14. Soil Survey Staff, 2002. *Field Book for Describing and Sampling Soils, Version 2.0*. NRCS-NSSC, Lincoln, NE.
15. Soil Survey Staff, 2004. *Soil Survey Laboratory Methods Manual, Version 4.0.* USDA-NRCS. US Gov. Print. Off., Washington, DC.
16. Soil Survey Staff, 2010. *Keys to Soil Taxonomy - 11th Ed.* USDA-NRCS. US Gov. Print. Off., Washington, DC.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

LEAD PHYTOEXTRACTION FROM SOILS BY MAIZE PLANTS USING EDTA TREATMENT

GEORGIANA PLOPEANU*, EUGENIA GAMENȚ*, M. DUMITRU*, MIHAELA ULMANU**

*National Research Development Institute for Soil Science, Agrochemistry and Environmental Protection of Bucharest
**National Research and Development Institute for Nonferrous and Rare Metals of Pantelimon

Keywords: *polluted soils, lead, maize, EDTA*

Abstract

The experimental research in greenhouse aims at the reproducibility checking of determined parameters on selected plant (maize) and from conclusions of the preliminary experimental test. Verification consisted in achievement of 2 experiments with 2 graduations of artificial loading of soil with Pb: 1000 mg Pb/kg soil and the concentration of EDTA in a ratio Ligand/Lead between 0 and 0.5 and 2000 mg Pb/kg soil and a ratio Ligand/Lead between 0 and 0.4 and 2 vegetation cycles (Cycle 1, Cycle 2 - remanent effect). This paper presents experiments from greenhouse to determine the remanent effect of treatment with lead and EDTA on the capacity of lead translocation in maize. Just as in the first cycle, following the evolution of leaf weight, plant height of maize and lead concentration in leaves was found that there are significant differences depending on treatment.

INTRODUCTION

Phytoextraction could be considered as a new alternative technology to remediate the heavy metals polluted soils by direct translocation to aboveground harvestable plant parts.

The implementation of the phytoextraction program is based on cultivation of contaminants hyperaccumulators crop species.

Related to the application the phytoextraction program for different polluted sites, one has to take into account some conditions such as: amendments, pollution degree, hyperaccumulators crop species, crop vegetation period etc. [1].

Phytoextraction involves cultivation one or more species of hiperaccumulators plants, that create the best conditions for growth to ensure a higher vegetal mass as possible in order to extract, accumulate and remove a higher metal quantity. The mass of harvested crop will be subject to other treatments of metals extraction will be dried and incinerated and the ashes placed in a controlled garbage dump [2].

The name "hiperaccumulator" was used for plants species that show the capacity to accumulate and tolerate metals concentrations 10-100 times higher than normal crops [3].

Adequate plants for phytoremediation must accumulate the metal in the surface horizon and tolerate accumulated metal concentration [5].

MATERIAL AND METHODS

Experiments achieved in the second cycle of vegetation are carried out to study the remanent effect of treatment with Pb and EDTA. The conditions were the same as in Cycle 1 [4]. It was used maize as test plant, the vegetation period was by 8 weeks, as in Cycle 1. Experimental variants were set according to the conclusions and in the end of Cycle 1 (V1, V2 - V12). Experiments were achieved in the same treated pots from Cycle 1, Sowing was effectuated immediately after harvesting of the first serie and was followed by remanent effect of treatment with Pb and EDTA. No phytosanitary treatments and no mineral or organic fertilizers were applied.

RESULTS AND DISCUSSION

Experiment 1 – soil with initial lead content by 1000 mg Pb·kg^{-1}and different EDTA contents (molar ratio 0; 0.1; 0.2; 0.3; 0.4; 0.5) – Cycle 2 (Remanent effect)

Table 1 shows the evolution of leaf weight, plant height of maize and the lead content of leaves in a soil initially polluted with 1000 mg Pb·kg^{-1} and with increasing ligand concentrations (EDTA) in the 2nd vegetation Cycle on a remanent background with Pb and EDTA.

The lower value of leaves weight registered at the control variant (without Pb and EDTA) in comparison with any of the variants has several explanations:

- Either in series I or II, the maize plants did not receive organic manure or mineral fetilizers; nutrient requirements consisted in the reserves remaining in the soil of series I;
- The rest of variants (V1 - V7) received additional nitrogen due to treatment with $Pb(NO_3)_2$.

Compared with the experimental variant V2 $\left[\text{Soil}\left(+1000\text{ mg Pb/kg}\right)* +\text{EDTA}\left(\frac{\text{Ligand}}{\text{Lead}}=0\right)\right]$, the leaves weight do not decrease significantly.

The same behavior was registered at the plant height: The plants height did not decrease significantly to any variant compared with V2 experimental variant that did not received a ligand (chelating agent).

Regarding lead accumulation in leaves, significant increase starts at variant V4 $\left[\text{Soil}\,(+1000\ \text{mg Pb/kg})^{*}+\text{EDTA}\left(\frac{\text{Ligand}}{\text{Lead}}=0.2\right)\right]$ and continues in all variants (V5, V6, V7). This means that Pb concentration by 1000 mg Pb·kg^{-1} soil in the 2nd vegetation cycle, plant height and weight are not affected by ligand concentrations (EDTA) which initially formed a ratio with lead between 0.2 -0.5, the effect of the pollutant phytoextraction being significantly to this treatment.

Table 1

Biomass, height and Pb content of maize on a polluted soil with 1000 mg Pb·kg^{-1} and some EDTA contents - Cycle 2

Treatment	**Biomass (g)**	**Height (cm)**	**Pb (mg Pb·kg^{-1} d.w.)**
V1 **Control** Chernozem Fundulea	86.7	50.0	1.63
V2 : Soil (+ **1000** mg Pb·kg^{-1})* + EDTA (EDTA:Pb)=0	146.7	55.0	27.23
V3 : Soil (+ **1000** mg Pb·kg^{-1})* + EDTA (EDTA:Pb)=0.1	134.0	59.0	40.73
V4 : Soil (+ **1000** mg Pb·kg^{-1})* + EDTA (EDTA:Pb)=0.2	122.7	53.7	60.17
V5 : Soil (+ **1000** mg Pb·kg^{-1})* + EDTA (EDTA:Pb)=0.3	125.3	52.0	61.60
V6 : Soil (+ **1000** mg Pb·kg^{-1})* + EDTA (EDTA:Pb)=0.4	137.0	56.0	69.23
V7 : Soil (+ **1000** mg Pb·kg^{-1})* + EDTA (EDTA:Pb)=0.5	130.3	53.0	188.73
DL 5% (Tukey Test)	27.2	7.8	22.16
Fisher Test	**	*	**

*1000 mg Pb/kg soil – lead quantity absorbed by maize in Serie I (Cycle 1) – remanent background

Experiment 2 – soil with initial lead content by 2000 mg Pb·kg^{-1}and different EDTA contents (molar ratio 0; 0.1; 0.2; 0.3; 0.4; 0.5) – Cycle 2 (Remanent effect)

Table 2 shows the evolution of leaf weight, plant height of maize and the lead content of leaves in a soil initially polluted with 2000 mg Pb·kg^{-1} and with increasing ligand concentrations (EDTA) in the 2nd vegetation Cycle on a remanent background with Pb and EDTA.

The lower value of leaves weight registered at the control variant (without Pb and EDTA) in comparison with any of the variants (except V12 experimental variant) has the same explanation as the experiment 1 – lack of fertilizers.

A significant decrease of leaves weight of maize occurs in experimental variants V11 $\left[\text{Soil}\left(+2000\,\text{mg Pb/kg}\right)*+\text{EDTA}\left(\frac{\text{Ligand}}{\text{Lead}}=0.3\right)\right]$ and V12 $\left[\text{Soil}\left(+2000\text{ mg Pb/kg}\right)*+\text{EDTA}\left(\frac{\text{Ligand}}{\text{Lead}}=0.4\right)\right]$.

This means that the remanent effect of ligand (EDTA) from plant weight point of view is considered in the experimental variant V10 $\left[\text{Soil}\left(+2000\text{ mg Pb/kg}\right)*+\text{EDTA}\left(\frac{\text{Ligand}}{\text{Lead}}=0.2\right)\right]$.

Compared with the control (without Pb and EDTA), in all variants can be observed a distinctly significant increase of lead concentration in plants. Values higher than 80,66 mg/kg (DL 5%, Tukey Test) compared with experimental variant V8 $\left[\text{Soil}\left(+2000\,\text{mg Pb/kg}\right)*+\text{EDTA}\left(\frac{\text{Ligand}}{\text{Lead}}=0\right)\right]$ appears starting with experimental variant V11 $\left[\text{Soil}\left(+2000\,\text{mg Pb/kg}\right)*+\text{EDTA}\left(\frac{\text{Ligand}}{\text{Lead}}=0.3\right)\right]$.

Correlating statistical interpretations of the plant weight evolution with lead accumulation in vegetative part can be said that the remanent effect of ligand (EDTA) on a soil initially loaded with 2000 mg Pb / kg from phytoextraction point of view, it appears to variants V10 $\left[\text{Soil}\left(+2000\,\text{mg Pb/kg}\right)*+\text{EDTA}\left(\frac{\text{Ligand}}{\text{Lead}}=0.2\right)\right]$ and V11 $\left[\text{Soil}\left(+2000\,\text{mg Pb/kg}\right)*+\text{EDTA}\left(\frac{\text{Ligand}}{\text{Lead}}=0.3\right)\right]$.

CONCLUSIONS

1. Lead concentration in the aerial part of plant increased with increasing EDTA concentration to the same degree of lead pollution (1000 mg Pb/kg soil and 2000 mg Pb/kg soil) in all two cycles of vegetation. It explained chelating agent's capacity to increase the solubility of lead in soil and facilitate phytoextraction.
2. Treatment with EDTA on a chernozem loaded with 1000 mg $Pb \cdot kg^{-1}$soil (experiment 1) DID NOT AFFECT plant growth and soil reaction at a ratio EDTA/Pb between 0.2 and 0.3. Lower concentrations of EDTA are not typical for phytoextraction and higher concentrations have negative effects on plants.
3. Treatment with EDTA on a chernozem loaded with 2000 mg $Pb \cdot kg^{-1}$soil (experiment 1) DID NOT AFFECT plant growth and soil reaction at a ratio EDTA/Pb=0.1. Lower concentrations of EDTA are not typical for phytoextraction and higher concentrations have negative effects on plants and soil acidification high after cycle 2.

4. EDTA capacity to increase the lead solubility in soil (chernozem) by phytoextraction method without negative effects on maize, can be implemented as a practical solution only on low and moderate polluted soils with lead (total lead concentration <1000 mg $Pb \cdot kg^{-1}$soil). EDTA can be applied every two years in a concentration expressed in molar ratio EDTA/Lead between 0.2 and 0.3.

Table 2

Biomass, height and Pb content of maize on a polluted soil with 2000 mg $Pb \cdot kg^{-1}$ and some EDTA contents -Cycle 2

Treatment	**Biomass (g)**	**Height (cm)**	**Pb (mg $Pb \cdot kg^{-1}$ d.w.)**
V1 **Control** Chernozem Fundulea	86.7	50.0	1.63
V8: Soil (+ **2000** mg $Pb \cdot kg^{-1}$)* + EDTA (EDTA:Pb)=0	146.0	55.0	61.93
V9: Soil (+ **2000** mg $Pb \cdot kg^{-1}$)* + EDTA (EDTA:Pb)=0.1	145.0	58.0	86.10
V10: Soil (+ **2000** mg $Pb \cdot kg^{-1}$)* + EDTA (EDTA:Pb)=0.2	132.0	50.7	108.40
V11: Soil (+ **2000** mg $Pb \cdot kg^{-1}$)* + EDTA (EDTA:Pb)=0.3	89.7	46.7	164.50
V12: Soil (+ **2000** mg $Pb \cdot kg^{-1}$)* + EDTA (EDTA:Pb)=0.4	43.7	40.0	306.40
DL 5% (Tukey Test)	33.3	4.7	80.66
Fisher Test	**	**	**

* 2000 mg Pb/kg soil – lead quantity absorbed by maize in Serie I (Cycle 1) – remanent background

REFERENCES

1. Chaney R., S. Brown, Y.M. Li, J.S. Angle, F. Homer, C. Geen, 1995. *Potential use of metal hyperaccumulators. Mining Environmental Management*. September.
2. Fuentes Alicia, C. Buitrago, Andrea Lodolo, S. Miertus, 2002. *Survey of Soil Remediation.* Technology. UNIDO, Trieste.
3. Hinchman R.R. et al., 1996. *Phytoremediation using green plants to clean – up contaminated soil, ground water and wastewater*. In Proc. Int. Topical meeting on Nuclear and Hazardous Waste Management, spectrum, 96, Seattle, WA.
4. Plopeanu Georgiana, Eugenia Gamenț, M. Dumitru, Vera Carabulea, 2010. *Experimental verification of results reproductibility and residual effect in Greenhouse on artificialy polluted soil with lead (I)*. Lucrările Ştiințifice ale U.Ş.A.M.V. Bucureşti, Seria Agronomie, Vol. LIII (pp. 128-134).
5. Vassil A.D., Y. Kapulnik, I. Raskin, D.E. Salt, 1998. *The role of EDTA in lead transport and accumulation by Indian mustard*. In Plant Physiol., 117 (pp. 447-453).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

ASPECTS OF THE EVOLUTION OF A GREENED TAILING DUMP

MIRELA COMAN*, G. TARO*, ADRIANA MUNTEAN**

*North University of Baia Mare
**Water Management System Maramureş

Keywords: *ecological stockpile, ecological succession*

Abstract

It has been proven that the tailing dumps and tailing dams affect the environment both through agro-forestry sealing of significant areas of land and, especially, through the negative effects they produce on ecosystems and human health in the surrounding areas. In the Baia Mare Depression there have been identified dozens of such inactive "artificial anthills", but which store millions of tonnes of tailings material removed from the channels of natural biogeochemical mater.

This paper presents issues relating to the greening area of the former dump "Meda", an area located in the west of Baia Mare, on the Săsar River bank. This plateau with a stretch of 21.4 hectares is, in fact, a warehouse area that was isolated by sterile seal, the work being completed in 2004. Freeze-thaw phenomena that have taken place on a little congealed substrate and high rainfall throughout the year have led to degradation of surface layers, respectively transforming it into a swampy area and, also, they have led to the emergence of micro-basins, which have, at times, depths of up to 10 cm. On the surface these micro-depressions occupy about 15-20% of the total rehabilitated area, being positioned especially in the centre of the plateau.

Greening the mining perimeters closed lines is necessary and it also is a priority on the agenda of EU Member States, but field data show that these activities should take into account the particularities of the natural environment and the specific of the polluting substances.

INTRODUCTION

Waste dumps and tailing dams affect the environment both through agro-forestry sealing of significant areas of land and especially through the negative effects that they produce in ecosystems and human health in surrounding areas [2, 3].

In the Baia Mare Depression there have been identified dozens of waste dumps, some that have impressive dimensions. Most of these "artificial anthills'' are inactive, but they store millions of tons of material and have more or less content of known heavy metals. In contact with atmospheric precipitation the metals in the dump form toxic compounds that flow into the nearby lands, affecting groundwater

and/or nearby water courses [1]. These facts fully justify the environmental and ecological monitoring activities of the mining perimeters close.
The place of research is the area of the former dumps "Meda", located on the West of Baia Mare, on the left bank of the Săsar river. This site was originally known as the “Săsar Preparation Pond”, the first deposit of waste from the UP Săsar (1962). This store has occupied an area of approx. 21.4 ha [5] and functioned until 1971, then went into storage. The city expanded and developed closer to the dump site since 1975-1980. The dust particles carried by air currents represent a risk factor for the health of the inhabitants in the neighbouring district.
In 1992 technical documentation was prepared for the reprocessing of tailings dumps, the operating mode being the excavation of the material. It was seen as an opportunity to reprocess the precious metals that remained in the tailings and the resolution of environmental problems, the priority for a city in full expansion (Figure 1).

Fig. 1. Site of “Green Dump Meda"(source: Google Earth)

Tailings operation were completed in 2002, the site being ecologically restored. The technology used for the rehabilitation of soil and groundwater was that of isolation by sealing. This technology had the purpose of creating a vertical barrier sealing perimeter and side the area on its lowest topographic level, a "funnel gate" system, a permeable reactive barrier, allowing the discharge of groundwater remediation and also inside them.

The rehabilitation works were completed in 2004, monitoring post-rehabilitation being done until the end of 2005.

After a lot of local controversy on the use of the land, the owner supported the idea of making a residential area. An urban plan was developed, considering how the commercial networks hould cross the veil of sealing without affecting its functionality, but the project was never realized. Although it was perceived as an area with great economic and social potential, now presents itself as an open space on which many question marks hover.

MATERIAL AND METHODS

Quantification the transformations that took place in the coating of the rehabilitated site has been made on the following program:

- documentation that preceded the study of greening works and some works of literature on the specifics of the area [2, 5];
- consulting the technical execution of the works projects and final acceptance;
- measurements and geomorphologic observations, periodic flora and fauna monitoring;
- systematization and analysis of data collected.

RESULTS AND DISCUSSION

From the geomorphologic point of view, the area looks like an open plateau, studded with positive and negative microforms relief. The humps of the plateau are of entropic nature. They are located mainly on the Eastern side of the plateau, near the residential area and are the result of storage of demolition waste. On the North side of the plateau various domestic waste is stored.

Micro-depressions shelves are the result of natural evolutionary processes and human impact. Natural processes lead to the degradation of the surface layers (creating swampy areas) and are predominantly influenced by the prolonged stagnation of rainwater and freeze-thaw phenomena of a little congealed substrate.

Field observations have shown that there have outlined micro-basins in which water stagnates and which communicate with each other through water channels that have irregular geometric shape. Their depth has not yet passed the first coating (15 cm of soil), but sometimes is up to 10 cm in depth. These micro-depressions cover about 15-20% of the total rehabilitated area, being positioned especially in the centre of the plateau. There has also been observed that the margins of the micro-basins tend to transform into swamps.

As an anthropogenic impact, is distinguished the kneading hooves created by the animals that grazed this area regularly. Here graze horses, cows and sheep, belonging to the community placed in the south-southwest of the plateau. Also, on East-West direction, in the centre of the area, there has been formed a path, linking outlying communities to the residential area.

In terms of vegetation cover, the surface is well covered. On the North side of the site, on the bank of the Săsar River, vegetal cover includes, besides local specify vegetation (willow, poplar, birch), oak and Austrian black pine (*Pinus nigra* *austriaca*), planted decades ago to protect the adjacent areas. Among herbaceous plants the dominant species on the North side is *Reinutria japonica*, invasive species that we find, moreover, throughout the middle of the Săsar river. The predominant species covering the lower places is *Juncus effusus*.

CONCLUSIONS

Greening the closed mining perimeters is a necessity and a priority on the agenda of EU Member States. Field data show that these activities should take into account the particularities of the natural environment (geological, chemical-toxicological and also the weather factors) [4]. For better following results we recommend special attention on the following factors:

1. Priority consideration of the tope-climatic factors in the area where the site is located.
2. Consideration in the design phase of the project of self-sustaining mechanisms for the newly formed ecosystem.
3. Additional measures and drainage works for large plates, like hundred of hectares.

REFERENCES

1. Coman Mirela, 2006. *Depresiunea Baia Mare. Protectia mediului din perspectiva dezvoltarii durabile*. Ed. Risoprint, Cluj-Napoca (pp. 98-102).
2. Coman Mirela, V. Oros, Bianca Fălăuş, R. Pop, 2010. *Soil Pollution with Heavy Metals - Specific Issues for Baia Mare Area.* ProEnvironment/ProMediu, Vol. 3, No. 5 (2010) (pp. 29-32).
3. Fodor D., G. Baican, 2001. *Impactul industriei miniere asupra mediului*. Ed. Infomin, Deva.
4. Marcu M., Mirela Coman, 2005. *Aspecte privind unele particularitati climatice ale Depresiunii Baia Mare si influenta lor in procesele poluante*. In: Buletin Stiintific al Universitatii de Nord Baia Mare, Seria D, Exploatari Miniere, Prepararea Substantelor Minerale Utile, Metalurgie Neferoasa, Geologie si Ingineria Mediului, Vol. XIX (pp. 479-483).
5. ***Bilanturi de mediu nivel I si II la Halda de steril Meda. Arhiva IPMMM.
6. ***Google Earth.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

ASPECTS REGARDING THE USE OF A FAR-INFRARED TECHNOLOGY OVER THE ENVIRONMENT

MIRELA COMAN

North University of Baia Mare

Keywords: *far-infrared lamps, growth of plants*

Abstract

In the last decades, there have been developed lamps with far-infrared radiations emission (about 10,000 nm). This paper presents the results obtained in the great frame of an applicative research contract upon the use of far-infrared technology, with the purpose of using it in Romania in different domains of activity.

Monitoring a greenhouse microclimate using far-infrared lamps has proved that the lamps create an optimum atmosphere for the air temperature, humidity and ventilation, for speed in seeds germination and plants growth. For cucumbers, as an example, there has been noticed a continuous benefic difference in growing when far-infrared radiations have been used. Plants have developed wonderfully in dimensions and color, strength, extend on the vertical wire. There has been registered a maximum of length of the plants and the crop. The obtained results show that by using far-infrared radiations it can be created a specific microclimate, different from the classic microclimate, which help plants growing up. Also, considering the European strategy in the energy and gas emissions domains, the research results show that far-infrared technology is an innovative one.

INTRODUCTION

We have learned from the sun and have created different artificial sources of radiation. Some of them, infrared, are called A, B or C. In all these cases, solid corps around get heated and pass on to the surroundings the heat absorbed from the source. Therefore, the whole environment can be warmed by the solid corps that it contains (Boltzmann, 1900, Ruiter, 1980, Bunget, 1988, etc.).

In the last decades, there have been developed systems with far-infrared radiation emission about 10,000 nm (type C) which respect European energetic laws and standards. So we can implement such lamps in glasshouses (in our experiment we have noticed that the glass materials are retaining ultraviolet and infrared radiations), the usual plastic materials are less transparent for infrared radiation and far red radiation.

The obtained results applied on practical conditions reveal that far-infrared technology can be applied in agriculture (greenhouses and animal husbandry farms) but can be also adopted for others domains [2].

MATERIAL AND METHODS

Vegetables were cultivated in pots, with the notification that the experimental plot was placed in classic „Prinz-Dokkum" glasshouses from Baia Mare city, Romania.

Monitoring the greenhouse microclimate proved that air temperature, within thew 18°C to 24°C interval, was optimum for seed germination and plant growth. There were simple fluctuations of temperature inside: early in the morning, before the sun rising, the recorded temperature was minimal. Usually, in the afternoon, the recorded temperature was maximal.

The following observations where made:

- general monitoring of the greenhouse regarded as an artificial ecosystem;
- seedling and monitoring of 7 vegetable species (tomatoes, sweet peppers, egg plants, cucumbers, cabbage, turnip cabbage and onion) and 4 flower species (sage, nemesia, primula, amaryllis);
- phonological and biometrical measurements have been taken regular;
- photographic recordings of growth and development stages;
- prevailing and editing a data base with different electronic devices.

RESULTS AND DISCUSSION

For cucumbers, as an example, there has been observed a continuous benefic difference in growth when far-infrared radiations have been used (Table 1).

The seeds of cucumbers have been planted on 12th of February and the first harvest has been recorded on the 22nd of April (69 days from seed to mature fruit) from the far-infrared area, while from the sample area the first harvest has been recorded on the 6th of May (83 days from seed to mature fruit). It has been noticed that the plants that have grown up in the far-infrared environment do not significantly suffer if they are moved in other environments and they also well fructify.

The plants were harmoniously developed in dimensions and colors, strength and have also extended on the vertical wires. There has been registered a maximum length of the plants of about 130 cm in far-infrared area, while, at the same time, in control area have been recorded only 50 cm length and after two weeks have been recorded a maximum length about 70 cm. The color of the flowers was a nice yellow, magnetized for bees and the others pollinate insects. The dimensions of the fruits of this kind of cucumber, Regal F1, recorded usually sizes for their kind.

As we can see (Table 1), we have noticed that far-infrared environment help cucumbers to generate earlier harvest and finish well their life-cycle.

Table 1

Cucumber crop (*Cucumis sativus,* L.)

Date	Far-infrared	Sample
12.02	planted seeds	planted seeds
18.02	came up; 2 leafs; H= 2.5 cm	no one came up
20.02	2 leafs + buds; H= 3.5- 4.5 cm	came up 80%
25.02	3 leafs (curly leaflet); H=5-6 cm	2 leaflets
04.03	put into own bag	3 leafs (curly leaflet); H=5-6 cm
11.03	4 well develop. leaves; first tendril; H=7-8 cm	3 leafs (curly leaflet); H=5-6 cm
18 .03	have tendril about 4-5 cm	2-3 leaves; appeared the pest; H=3 cm
25 .03	lies on the string; 5-6 leaves Hmax=23 cm; D=5-6 mm	not very well develop.; 4 leaves; H=4-6 cm; D=4-5 mm
01.04	*first flower bud* had appeared	4-5 leaves; Hmax=18 cm; Have=8 cm; D=5-6 mm
15.04	starting to produce fruits Lmax.= 8 cm; Gmax.=4 cm	*first flower bud* had appeared; Have=17 cm; D=6-7 mm
22.04	*first harvest*; Lmax=12 cm; Lave=10 cm; D=3-4 cm.	mass flowering; Have=30 cm; D=8 mm
29.04	second harvest; H max plant=120cm; Hmave=80 cm; for cucumbers: Lmax=12 cm; D=3-4 cm;	first little cucumber; Have plants=35 cm; Dcuc.=8 mm
06.05	third harvest; H max plant=120 cm; Have=90 cm; cucumbers: Lmax=13.5 cm; D=3-5 cm	*first harvest*; Have=45 cm;cucumber: Lmax=8.5 cm; Dmax=3 cm
13.05	fourth harvest; H max plant= 130cm; Have=9 0cm; cucumbers: Lmax=13 cm; D=3-5 cm; the plants are ill	second harvest; Have=50 cm;cucumber: Lmax=9 cm; Dmax=3 cm; 90-95% fruits
20.05	fifth harvest; H max plant=130 cm; Have=90 cm; cucumbers: Lmax=15 cm; D=3-5 cm;	third harvest; Have=50 cm;cucumber: Lmax=9.5 cm; Dmax=4 cm
26.05	sixth harvest; H max plant= 130cm; there are flowers; cucumbers: Lmax=13.7 cm; D=3-5 cm	fourth harvest; Hmax=70 cm; stagnation; cucumber: Lmax=13 cm; D=3-4 cm
02.06	seventh harvest; H max plant= 130cm; there are flowers; cucumbers: Lmax=10.5 cm; D=3-4 cm;	fifth harvest; Hmax=70 cm; stagnation; cucumbers are missing
10.06	eight harvest; there are flowers; started to yellow the leaves; cucumbers: Lmax=10 cm; D=3-4 cm;	sixth harvest; stagnation; cucumbers: Lmax=8 cm; d=3-4 cm; diminish the fruits
16.06	nienth harvest; flowers + yellow leaves;	seventh harvest; stagnation
24.06	no fruits; there are flowers at the top of the fruits	eight harvest=1 cucumber; stagnation

CONCLUSIONS

The results show that a selected type of far-infrared radiations can create a specific microclimate, different from the classic microclimate. This new environment helps plants growth. Also, considering the European strategy in the energy and gas emissions domains, the research results show that far-infrared technology produce the following:

1. The germination period is shorter for the species cultivated under the influence of far-infrared radiations compared with the classic cultivated species.
2. For cucumber were noticed important differences in growing up.
3. Can be used in the agro-industrial applications.
4. Can be successfully implemented in Romania agriculture domain.

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, especially for producing our daily food.

REFERENCES

1. Coman Mirela, V. Oros, G. Taro, R. Pop, T. Naforeanu, A. Radu, 2009. *Research Regarding the Use of a Far-Infrared Heating Technology Over the Environment*. In: Scientific Papers, UASVM, Bucharest, Series A, Agronomy, LII (pp. 164-170).
2. Coman Mirela, G. Taro, R. Pop, P. Pop, T. Naforeanu, A. Singeorzan, 2008. *On the Use of the Ecologic, Biogenetic Heating System of Lexin Type in Romania (I)*. In: Scientific Papers, UASVM, Bucharest, Series A, Agronomy, LI (pp. 1010-1015).
3. Coman Mirela, A. Dăscălescu, V. Oros, V. Tisan, 2009. *Regarding the usage of the infrared radiation technology in Romania*. International Scientific and Technical Conference Oil and Gas Power Engineering: Problems and Perspectives, Ivano Frankiwsk, October 20-23, 2009 (pp. 158).
4. Coman Mirela, 2010. *Greenhouse Project. Final Report*. North University of Baia Mare, Romania.
5. Indrea D. &, 2007. *The culture of vegetables*. Ed. Ceres, Bucharest (pp. 506-523).
6. http://*www.lexin.com/*gb/index.php?option=com_content&task=view&id=46&Itemid=3.
7. http://whois.domaintools.com/lexinglobal.com.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

CHANGES IN THE STRUCTURE OF *AESCULUS HIPPOCASTANUM* SPECIES INDUCED BY POLLUTION

EMILIA BRÎNDUŞA ŞCHIOPU (SĂNDULESCU), T. ŞCHIOPU, MALA-MARIA STAVRESCU-BEDIVAN

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *leaves, petioles, pollution*

Abstract

Although the organism's behaviour to pollution depends on many factors such as health, sex, etc. [2], we have proposed in this paper to highlight a small part of the structural transformation in Aesculus hippocastanum petioles and leaves induced by pollution caused by motor vehicles.

INTRODUCTION

Motor vehicles produce carbon dioxide (CO), hydrocarbons (unburned, partially burned, cracked), nitrogen oxides and sulfur compounds. The largest amount of CO is produced by motor vehicles. Due to the addition of tetraethyl lead in gasoline, the lead is eliminated with the exhaust gases, which are deposited on plants and soil (pollution).

Exhaust gases contain lead vapor which condensed, giving rise to the suspension. Plants and soil at a distance of 50-100 m from the road networks with heavy car traffic are most contaminated with lead. Our research aimed to reveal possible changes in the dimensions of leaves and petioles tissues belonging to *Aesculus hippocastanum* pollution exposed compared with those taken from less polluted areas.

MATERIAL AND METHODS

For the anatomical study, we used fresh material from *Aesculus hippocastanum* (leaf, petiole) harvested from two areas: a polluted (Crângaşi district) and other less polluted (Tineretului Park).

Numerous cross sections were made through leaves and petioles collected from both the less polluted and polluted area. Numerous micrometer measurements were made [1] to leaf and petiole tissues with a microscope ML-4M IOR found in the laboratory of Botany, UASVM Bucharest. The photos were taken with the digital camera Panasonic Lumix DMC-LS60 (6MPX, 3X optical zoom).

RESULTS AND DISCUSSION

The dimensions for the petiole tissues (Figure 1) harvested from less polluted area are shown in figure 2.

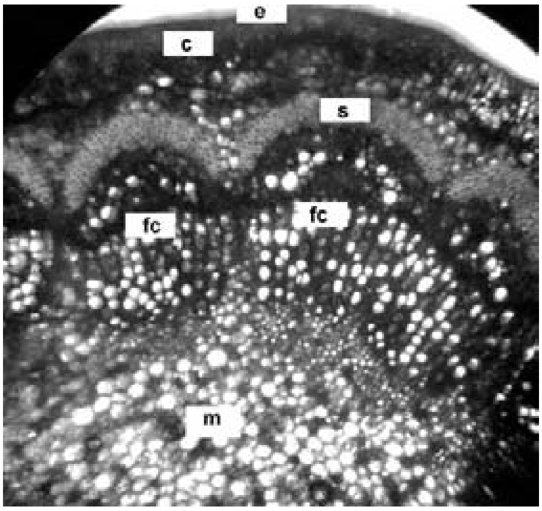


Fig. 1. Cross section through the petiole - less polluted area: e - epidermis; c - colenchyma; s - sclerenchyma; f.c. - vascular bundles; m - pith

The vascular bundles circularly arranged are well developed, showing values of 211.2 μ for phloem, the wood (xylem) being more developed (414 μ).

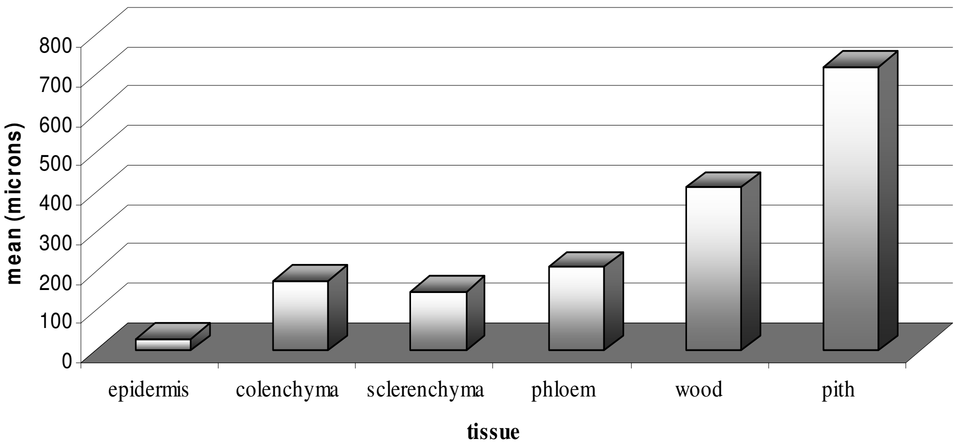


Fig. 2. Dimensions for various tissues of petiole structure - less polluted area (measurement: objective 10x)

The leaf has bifacial structure, dorsal-ventral, consists of upper epidermis, palisade tissue and lacunar tissue disposed under the lower epidermis.

Figure 3 presents different dimensions of the tissue from structure of leaf, harvested from the less polluted area.

Upper epidermis (28.8 μ) is more developed than the lower (16.2 μ) and the average size for the lacunar tissue composed of several layers, is about 102.6 μ.

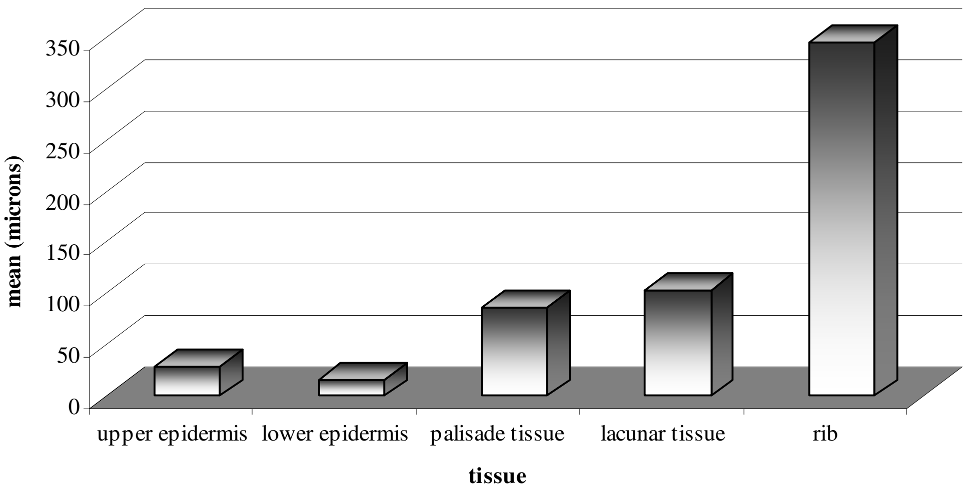


Fig. 3. Dimensions of the various tissues of the leaf structure - less polluted area (measurement: objective 10x)

The dimensions of the petiole vascular tissues harvested from the polluted area are shown in figure 4.

All the tissue measurements recorded weaker growth compared with tissues belonging to the petioles harvested from less polluted area, especially the epidermis (18 μ) and sclerenchyma (105.6 μ), followed by phloem (187.2 μ), xylem (wood) (384 μ) and pith (612 μ).

The lacunar tissue of the leaves taken from polluted area (Figure 5) has fewer cell layers compared with the same type of tissue examined in the leaves collected from less polluted area.

It was also noted a reduction in the size of the vascular bundles.

The measurements of tissues (Figure 6) belonging to the leaves sampled from the polluted area showed some reductions in their size.

Significant differences were recorded mainly in the palisade tissue (57.6 μ) and ribs (288 μ).

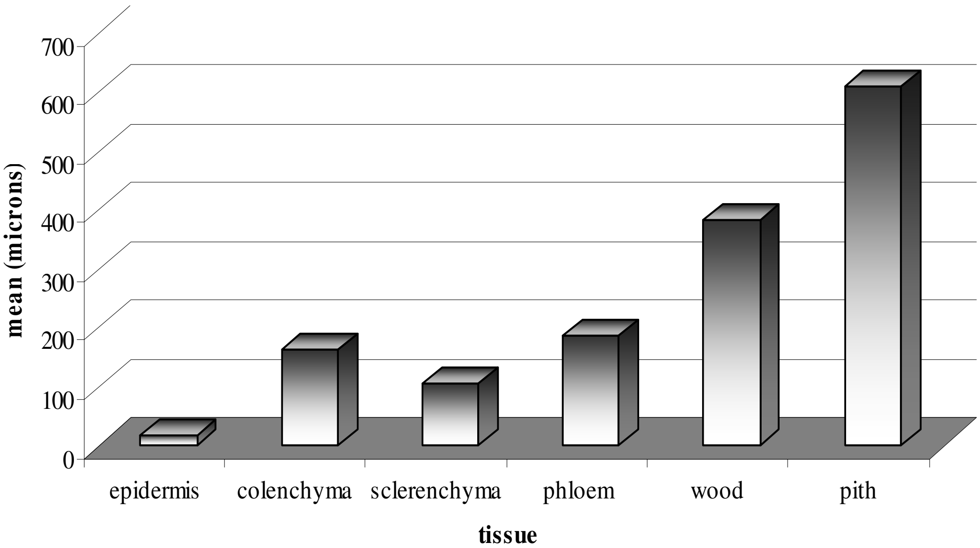


Fig. 4. Dimensions of various tissues from petiole structure - polluted area (measurement: objective 10x)

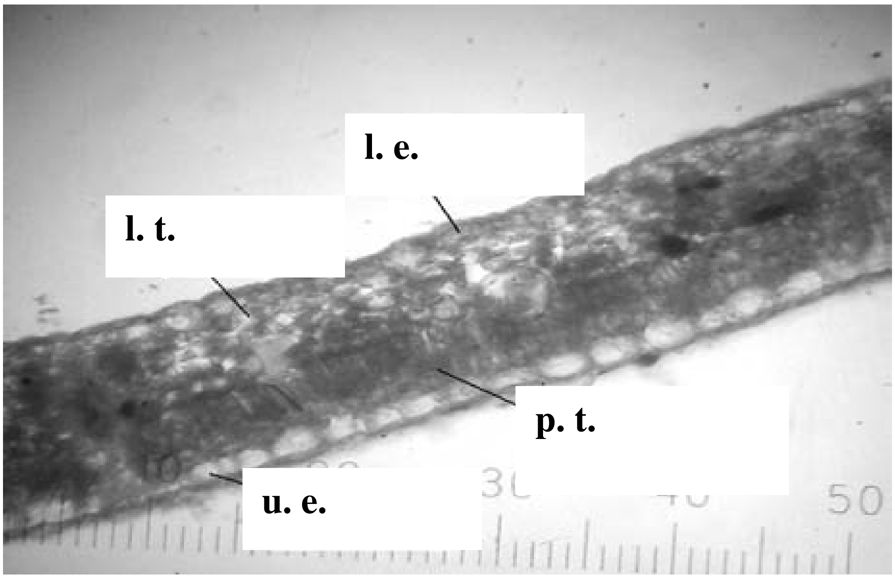


Fig. 5. Cross section through the leaf - polluted area: u.e.- upper epidermis, p.t. - palisade tissue; l.t. - lacunar tissue; l.e. - lower epidermis

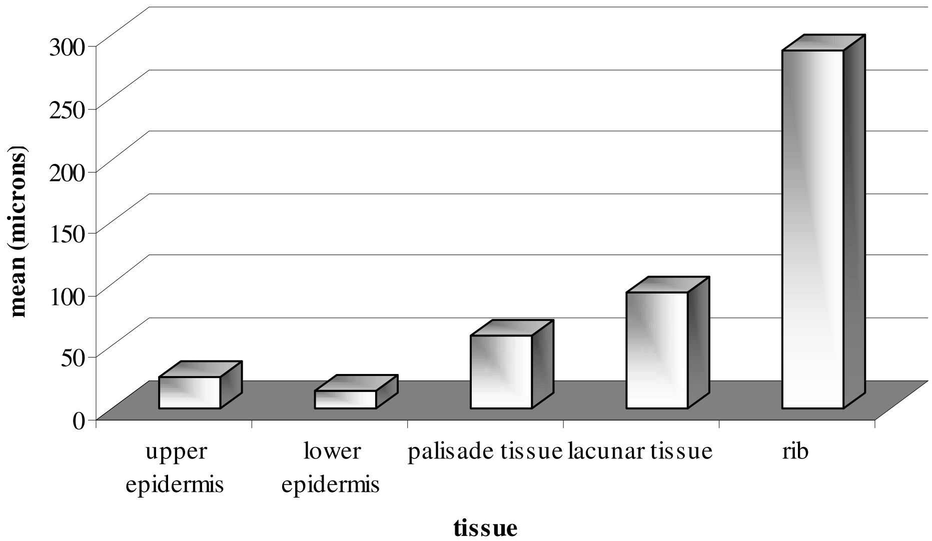


Fig. 6. Dimensions of various tissues from leaf structure - polluted area (measurement: objective 10x)

CONCLUSIONS

1. All measured tissues of the petioles structure belonging to the polluted area, showed a slower growth compared with tissues belonging to the petioles harvested from less polluted area, especially the epidermis and sclerenchyma, followed by vascular bundles and pith.
2. Leaves taken from the polluted area present less developed tissues; lacunar tissue is being formed from a smaller number of cell layers compared with the same type of tissue examined in the leaves collected from less polluted area.

REFERENCES

1. Andrei M., 2003. *Microtehnică botanică*. Ed. Niculescu, Bucureşti.
2. Şchiopu T., 2008. *Ecologie şi protecţia mediului*. Ed. Dominor, Bucureşti.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

STUDIES REGARDING CHEMICAL COMPOSITION OF SNOW IN BUCHAREST (WINTER 2011) CORRELATED WITH ENVIRONMENTAL POLLUTION

A. PENESCU, GINA VASILE, MARIA PELE

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *pollution, snowmelt water, nitrate, nitrite, lead, phosphate*

Abstract

Environmental pollution became a problem nowadays and snow covers reflect the level of pollution in a certain area. In was developed a research in order to evaluate the levels of some pollutants for snow collected from different sites in Bucharest. For all samples were determined pH values. The quantitative determinations of nitrate, nitrite, ammonium, phosphate were performed spectrophotometrically and lead was quantified using atomic absorption spectrometry. For all snow samples it was also evidenced the presence of chloride, sulphate, sodium, potassium and calcium. The results were compared with those obtained last year.

INTRODUCTION

During the last decades, the environment has been strongly exposed to the effect of different harmful pollutants, especially from the atmosphere. Snow is a well suited medium for fingerprinting environmental pollution sources.

Snow can function as a significant source of water pollution since it accumulates a variety of contaminants from the atmosphere and roadways and therefore snow melt water could represent a serious pollution threat to the environment. These contaminants could be nitrogen and sulphur species, phosphates, heavy metals, organic pollutants, pesticides and salts used as de-icing agents. A very broad range of air pollutants represented mainly of nitrogen and sulphur oxides present acidifying effect, are toxic and can damage living organisms.

Environmental pollution by heavy metals has become one of the world's most serious problems and strict periodic surveillance of these contaminants is therefore advisable. The major problem for urban areas with intense traffic is the presence of lead. Automobile emissions are still considered an important source of lead contamination in snow even though lead concentrations in gasoline have been recently banned.

Lead is a well-known toxic heavy metal and the effects of lead on human health have been the subject of many scientific studies over the last decade [1-4]. Lead poisoning has severe adverse health impacts, and it has been linked to neurological, neurobehavioral and developmental problems. Lead it has no essential function for plants, animals and microorganisms and affects some enzymatic systems, especially those that potentate haemoglobin synthesis [5].

Also, the presence of nitrate and nitrite in water and different food products has toxic effects, most common manifestation being methemoglobinemy, gastric cancer [6], different health disturbances (changes in vitamin level, thyroxin production and negative influence in reproduction) [7].

The purpose of the research that we carried out was to determine the concentrations of nitrogen species (nitrite, nitrate, ammonium), phosphate, lead in snowmelt waters collected from Bucharest and to compare the results with similar that was obtained last year [8].

The idea of this project appeared because Bucharest is one of the most polluted cities in Europe and environmental pollution is a significant matter that is important to be taken into consideration.

MATERIAL AND METHODS

Studied area

Snow samples were collected from four different points, as follows:

V1 - Botanic Garden, UASVM Bucharest

V2 - Unirii Square

V3 - Victoriei Square

V4 - Vatra Luminoasa Square

For comparison a water sample was analyzed: V5- drinking water from the UASVM network.

Samples

The samples were collected from $1m^2$ surface (depth and width) at two periods of time (31.01.2011-freshly fallen snow and 11.02.2011-snow in standing accumulation several days). 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. The determination of all species was performed in duplicates and the presented results are the average of the determinations.

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

- Nitrite was quantified by the Griess reaction, involving the formation of a pink-coloured azo derivative upon treatment of a NO_2^--containing sample with sulphanilic acid and naphthyl-1-amine in acidic medium.
- The phosphate concentrations were determined by the spectrophotometric method as molybdenum blue.
- Nitrate and ammonium concentrations were assessed spectrophotometrically. For nitrate was used phenoldisulphonic acid in alkaline medium to develop nitrate-characteristic yellow colour and ammonium ions were determined with the aid of Nessler reagent.
- 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 dilution, 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

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) [9] and also for surface waters (Table 3) [9]. The pH values for snow samples were generally between the ranges settled for drinking water. Nitrate concentrations are range between 1.60-6.43 mg/L, levels that are not dangerous taking into account that for drinking water the maximum admissible level is set at 45 mg/L. Nitrite concentrations for all samples are below 1 mg/L, value that was set for surface water (1st category). Ammonium levels are between 0.28-6.24 mg/L, values that are higher than those obtained last year (0.51-3.75 mg/L) [8] and also much higher than limits set for drinking water.

The presence of different quantities of nitrogen species in the samples could be a consequence of the existence of nitrogen compounds in the air because 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 [10]. Nitrites appear as intermediates in the nitrogen cycle. They are unstable and depending on the conditions, are transformed into nitrates or ammonia [11].

Table 1

Chemical parameters of snow (February 2011)

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	30.01.2011	5.74	1.76	0.15	0.28	<LD	18.45
	11.02.2011	6.81	2.03	0.21	0.42	<LD	20.32
V2	30.01.2011	7.07	2.78	0.73	5.43	<LD	106.82
	11.02.2011	7.02	2.35	0.50	4.66	<LD	153.34
V3	30.01.2011	6.73	6.43	0.30	0.32	<LD	147.84
	11.02.2011	7.02	3.75	0.67	2.03	<LD	189.53
V4	30.01.2011	6.95	3.21	0.48	5.95	<LD	63.26
	11.02.2011	7.25	1.60	0.25	6.24	<LD	88.63
V5	30.01.2011	6.83	<LD	<LD	<LD	<LD	<LD
	11.02.2011	6.76	<LD	<LD	<LD	<LD	<LD

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

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

Of particular concern is lead presence presumably originating in automobile exhaust. Lead levels ranges between 18.45-189.53 μg/L. For snow samples collected from botanical garden the values were below limits set for drinking water. The lead levels for samples collected from areas with intense road traffic are much higher and all of them exceed the value 50 μg/L. Anyway, samples collected this year accumulated less lead than those analyzed last year when for a snow sample it was recorded an astonishing and alarming value (1886 μg/L) [8].

Taking into account that in recent years large quantities of phosphate have been used in fertilizers, beverages, detergents [12, 13] we assumed that is possible to find this species into melt water. For all samples, the phosphate level was below the detection limit of the method, situation that was encountered last year with few insignificant exceptions.

Also, for all samples it was evidenced the presence of sulphate, chloride, sodium, potassium, calcium. The existence of these ions in snow melt waters could be a consequence of using different salts as de-icing agents but the results will be presented elsewhere.

CONCLUSIONS

Because the melt waters contain some or all of the major constituents usually found in surface water or groundwater and this reflect the level of environmental pollution, we developed a research during two years and we conclude:

1. Nitrogen species were evidenced in all snow samples and this is due the existence of nitrogen compounds in the air as a consequence of pollution.
2. Even if phosphate is a frequently encountered pollutant, in all samples it was below detection limit of the method.
3. The content of lead absorbed in the snow reached alarming levels but lower than those recorded last year.
4. The presence of different levels of sulphate, chloride, sodium, potassium, calcium was evidenced as a consequence of using de-icing agents.
5. In order to decrease environmental pollution in Bucharest it is recommended to reduce car traffic as much as possible.

REFERENCES

1. Jarup L., 2003. *Hazard of heavy metal contamination*. British Medical Bulletin, 68 (pp. 167-182).
2. Schell L.M., M. Denham, 2003. *Environmental Pollution in Urban Environments and Human Biology*. Annual Review of Anthropology, 32 (pp. 111-134).
3. Shparyk Y.S., V.I. Parpan, 2004. *Heavy metal pollution and forest health in the Ukrainian Carpathians*. Environ. Pollution, 130(1) (pp. 55-63).

4. Tong S., E. Yasmin von Schimding, T. Prapamontol, 2000. *Environmental Lead exposure: a public health problem of global dimensions*. Bulletin of the World Health Organisation, 78(9).
5. Grecu I., M. Neamtu, L. Enescu, 1982. *Implicatii biologice si medicale ale chimiei anorganice*. Ed. Junimea, Iasi.
6. Prakasa R., K. Puttanna, 2000. *Nitrates, agriculture and environment.* Curr. Sci., 79 (pp. 1163-1168).
7. Vermeer I.T.M., D.M.F.A. Pachen, J.W. Dallinga, J.C.S. Kleinjans, J.M.S. Van Maanen, 1998. *Volatile N-Nitrosamine formation after intake of nitrate at the ADI level in combination with an amine-rich diet*. Environ. Health Perspect., 106 (pp. 459-463).
8. Penescu A., G. Vasile, M. Artimon, M. Pele, C. Ciontu, D.I. Marin, 2010. *Quantification of environmental pollution in Bucharest by assessment of chemical quality parameters of snow*. Scientific Papers UASVM Bucharest, Series A, Vol. LIII (pp. 152-160).
9. Mănescu S., M. Cucu, M.L. Diaconescu, 1994. *Chimia sanitară a mediului*. Ed. Medicală, Bucureşti.
10. Walna B., I. Kurzyca, J. Siepak, 2004. *Local Effects of Pollution on the Chemical Composition of Precipitation in Areas Differing in the Human Impact.* Pol. J. Environ. Stud., 13 (pp. 36-42).
11. Michalski R., I. Kurzyca, 2006. *Determination of Nitrogen Species (Nitrate. Nitrite and Ammonia Ions) in Environmental Samples by Ion Chromatography*. Polish Journal of Environmental Studies, 15(1) (pp. 5-18).
12. Kamath D.K., V.C. Savanth, D.N. Suryanarayana, 1995. *A rapid and highly selective method for the estimation of pyro-, tri- and orthophosphates.* Talanta, 42(3) (pp. 365-373).
13. Torres F.M., J.M. Estela, M. Miro, A. Cladera, V. Cerda, 2004. *Sequential injection spectrophotometric determination of orthophosphate in beverages. Waste waters and urine samples by electrogeneration of molybdenum blue using tubular flow-through electrodes.* Anal. Chim. Act., 510 (1) (pp. 61-68).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

INFLUENCE OF SOIL ACIDIFICATION ON SOME SOIL CHEMICAL PROPERTIES (EXCHANGEABLE ALUMINIUM AND MOBILE PHOSPHORUS)

ALEXANDRINA MANEA, M. DUMITRU, NINETA RIZEA, VERONICA TANASE, MIHAELA PREDA

National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection of Bucharest

Keywords: *exchangeable aluminium, acidification, mobile phosphorus, Zlatna*

Abstract

Emissions of dioxide and trioxide sulfur from Ampellum S.A caused acid precipitation in Zlatna area, wich affected the soil physical, chemical and biologic properties. In studies area dominated are Cambisol sand acid rain lead to increased total soil acidity, mobilization of aluminium ions, immobilization of soil phosphorus. The objectives of this study were therefore to investigate the influence of acidification on exchangeable aluminum and mobile phosphorus of soils from Zlatna area. Content in aluminum exchangeable was determined in soil sample with reaction below 5.8 and ranged from very low to high according to soil type. Exchangeable aluminum correlates significantly with soil reaction, degree of base saturation, hydrolytic acidity. Content in mobile phosphorus correlates significant with soil reaction and was lower compared with specific values of monitoring sites from the Alba County.

INTRODUCTION

In Zlatna area, because of Ampellum S.A activity was issued large quantities of SO_2, SO_3, heavy metal oxides and sulfates [12, 13]. Dioxide and trioxide sulfur in contact with rain water converts to sulfuric acid that leading to the formation of acid precipitation. Gaseous emissions (SO_2, NO_X) and fall-out of particles enriched in Pb, Zn, Cu and Cd cause acid precipitation and heavy metal contamination (Bartok, 1982, quoted by Williamson et al.).

Acid rain leads to increased total soil acidity. The main effects of increased acidity are: decreasing the cationic exchange capacity, mobilization of aluminum ions, degradation of primary minerals, reduced biological activity, changes in surface properties of minerals and soil solution, loss of alkaline cations: Ca^{2+}, Mg^{2+}, K^+, Na^+ [4]. As soil pH declines, the supply of most plant nutrients decreases while aluminum and a few micronutrients become more soluble and toxic to plants [7].

The pH of aqueous suspension below 5.8 shows that soil containing aluminum ion adsorbed, whose participation in soil adsorption complex grows with soil acidification [1].

In general, the toxic effect does not occur when the pH (H20) is greater than 5.5 (Mc. Cart and Kamprath, 1965, quoted by Davidescu & Davidescu), but increases strongly when it is less than 5.

MATERIAL AND METHODS

The content of the exchangeable aluminum of soil samples collected from the Zlatna area, which had a pH <5.8, was determined.

Soil reaction (pH) was determined by the potentiometric method, in water suspension (1:2.5). The values of the percentage base saturation ($V_{8.3}$, %) were determined through calculation, sum of exchangeable bases (SB, me/100 g soil) and hydrolytic acidity (HA) by Kappen procedure, and the total cationic exchange capacity through calculation.

Exchangeable aluminum by Sokolov method and the Ca by Schollenberger, Dreibelbis, Cernescu method. The available phosphorus contents were determined by Egner-Riehm-Domingo procedure, by extraction the ammonium lactate acetate.

RESULTS AND DISCUSSION

Most of soil samples with pH<5.8 belong to Dystric Cambisols, Regosols, Luvisols, Podzols, Erodisols.

Exchangeable aluminum was in the range of extremely low-high, mean (2.1 me/100 g soil) belongs to the moderate class. In the medium-high classes are found 50% of the values of the exchangeable aluminum (Table 1).

The highest values were recorded in the sites belonging to a Leptic-dystric Regosols and Umbric-entic Podzols on the whole soil profile. In the case of Dystric Cambisols, values of exchangeable aluminum range in the low-moderate classes, generally, on the whole profile. In the case of Luvisols, exchangeable aluminum varies from low to high classes and in some soils high values took place only in the upper horizons. In the most soil profiles, exchangeable Al content is moderate either on the soil surface or on the whole soil profile. Correlations of exchangeable aluminum content and chemical properties (soil reaction, hydrolytic acidity, sum of exchangeable bases, degree of base saturation) of studied soils are shown in Figures 1 and 2. The correlations were negative, highly significant with sum of exchangeable bases (r=-0.5440), degree of bus saturation (r=-0.683) and significant with soil reaction (r=-0.33). Between content of mobile Al^{3+} and degree of soil base saturation of soils there is a strong correlation in both A and B horizon. Also, they showed that the highest values of mobile Aluminum (4-7 me/100 g soil) were found at the degree of saturation below 10-15% and lowest values (0.1-0.2 me/100 g soil) at the degree of saturation of 75-80% [6]. Very significantly positive correlation was established with hydrolytic acidity (r=0.793).

Table 1

Statistical parameters of soil exchangeable Al and Pm from Zlatna area

Statistical parameter	**Al $^{3+}$, me/100 g soil**	**Pm, mg/kg (0-50 cm)**
Number of samples	74	30
Minimum	0,04	1,2
25th percentile	0,89	4,8
Median	1,98	5,0
Mean	2,09	8,1
75th percentile	2,88	7,4
90th percentile	4,04	11,8
Maximum	5,87	56,7
Coefficient of variation	66	120

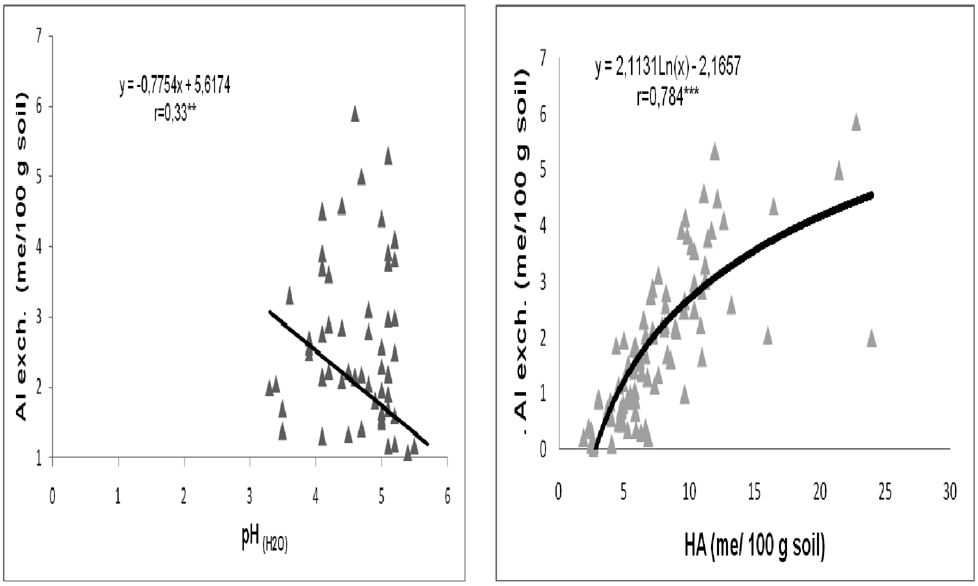


Fig. 1. Relationships of exchangeable Aluminium with soil reaction (pH $_{H2O}$) and hydrolitic acidity (HA)

The incoming strong acids mobilize aluminum in the soil minerals and aluminum displaces Ca and other cations from the exchange complex [2]. In the soils studied, between aluminum and Ca content of the adsorption complex has established a very significant negative exponential relationship (r =- 0.625) (Figure 3).

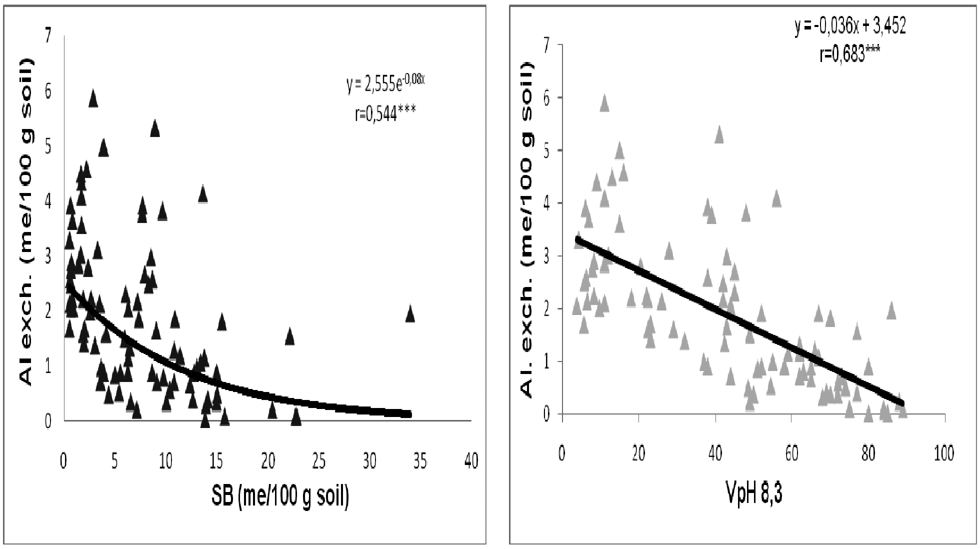


Fig. 2. Relationships of exchangeable Aluminium with sum of exchangeable bases (SB) and degree of base saturation (V, %)

Indirect action of aluminum is shown by immobilization of soil phosphorus and by inhibiting the negative influence of microbiological activity and increase soil acidity [10].

Solubility and accessibility of inorganic phosphorus compounds depend on many factors, including soil reaction that has an important role [11].

In the moderate and strong acid, as in the neutral and alkaline concentration the content of phosphorus in the soil solution is reduced, due to fixation in inaccessible forms. In acid soils, phosphorus is retained as iron and aluminum phosphate [7, 8].

Phosphorus content of soil range in the studied area, at the depth of 0-50 cm, from extremely low (1.2 mg/kg) to high (56.7 mg/kg), and the average is 8.1 mg/kg. Over 75% of the class values are very low and only 10% of values exceed the value of 12 mg/kg Pm (Table 1).

Determined values are much lower than the values Pm of agricultural monitoring sites from Alba County, which range from 3.6 mg/kg to 99 mg/kg, and the average of Pm, at the depth of 0-50 cm, was 14 mg/kg [9].

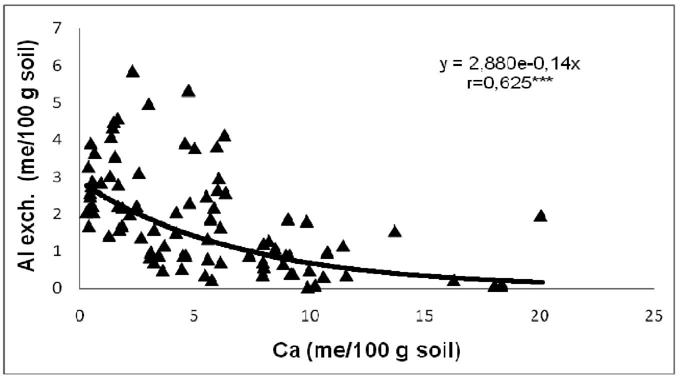


Fig. 3. Relationships of exchangeable Aluminium with Ca

Values of pH below 4 the contents of mobile phosphorus decreased dramatically (1-17 mg/kg P) [5].

Very significant exponential relationship was established between mobile phosphorus and values of soil reaction, in the studied area (Figure 4).

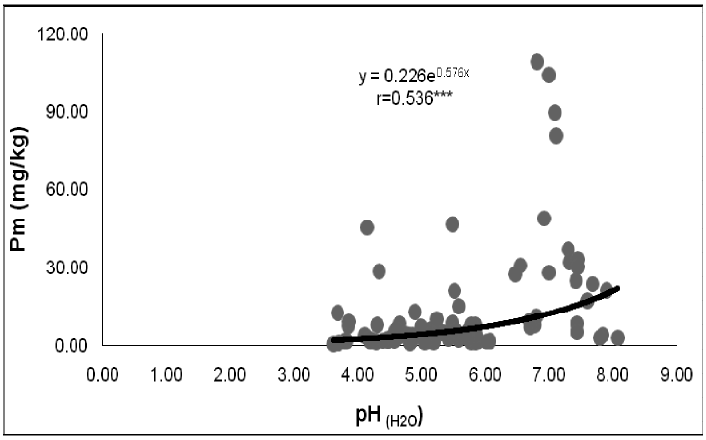


Fig. 4. Relationships of Pm with soil reaction (pH_{H2O})

CONCLUSIONS

1. Exchangeable aluminium was in the range of extremely low-high, mean belongs to the moderate class.
2. In most soil profiles, exchangeable Al content is moderate either in the upper horizons or on the whole soil profile.

3. The coefficient of correlation of exchangeable aluminium with some soil chemical properties decreased in the order: HA>V>Ca>SB>pH.
4. Phosphorus content of soils range in the studied area, at the depth of 0-50 cm, from extremely low to high and is much lower than the Pm values of agricultural monitoring sites.

REFERENCES

1. Borlan Z., I. Boeriu, C. Nicolae, 1969. *Amendarea solurilor acide*. Ed. Agrosilvică. Bucureşti (pp. 156).
2. Brad N.C & R.R. Weil, 2008. *The nature and properties of soils*. Fourteenth Edition, Pearson Education, Inc., Upper Saddle River, New Jersey (pp. 965).
3. Davidescu D., V. Davidescu, 1992. *Agrochimie Horticola*. Ed. Academiei Romane (pp. 546).
4. Dumitru M., 1992. *Impactul ploilor acide asupra mediului ambient*. in Ecologie şi protecţai mediului, Călimanesti (pp. 50-55).
5. Dumitru M., C. Răuţă, D.M. Motelică, Elisabeta Dumitru, Eugenia Gamenţ, M. Rusu, P. Guş, 1997. *Research for establishing measures to ecologically restore soils polluted with heavy metals in Zlatna area*. Lucrările celei de-a XV-a Conf. Naţ. pentru Ştiinţa Solului, Publicaţiile SNRSS, Nr. 29B, Bucureşti (pp. 155-161).
6. Florea N., Elena Stoica, Dorothea Manes, 1964. *Corelatia dintre pH si gradul de saturatie in baze la solurile zonale din R.P. Romania*. Studii tehnice si Economice, Seria C. Pedologie, Nr. 12.
7. Harter R.D., 2007. *Acid soils of the tropics*. http://people.umass.edu/psoil370/Syllabus-files/Acid_Soils_of_the_Tropics.pdf.
8. Lăcătuşu R., 2006. *Agrochimie*. Ed. Terra Nostra, Iasi (pp. 384).
9. Alexandrina Manea, M. Dumitru, Nicoleta Vrînceanu, Irina Calciu, Mihaela Preda, Veronica Tanase, 2010. *Soil quality monitoring in Alba county*. Scientific Papers UASVM Bucharest, Series A, Agronomy, Vol. LIII (pp. 29-34).
10. Oanea N., Gh. Rogobete, 1977. *Pedologie generală şi ameliorativă*. Ed. Didactică şi Pedagocică. Bucuresti (pp. 346).
11. Obrejanu Gr., Al. Măianu, 1965. *Pedologie ameliorativă*. Ed. Agro-silvică, Bucureşti (pp. 277).
12. Răuţă C., C. Ciobanu, M. Dumitru, Eufrosina Dulvara, Beatrice Kovacsovics, L. Latis, 1998. *Studiu caz priind poluarea solurilor cu metale grele şi compuşi ai sulfului in zona Zlatna*. În Monitoringul stării de calitate a solurilor din Romînia, vol. I, Publistar. Bucuresti (pp. 143-154).
13. Smejkal Gh.,1982. *Pădurea şi poluarea industrial*. Ed. Ceres, Bucureşti (pp. 194).
14. Williamson B.J., N. Har, W.O. Purvis, Ana Maria Rusu, 2003. *Preliminary studies of airborne particulate emissios from the Ampellum S.A. copper smelter, Zlatna, Romania*. Studia Universitas Babeş-Bolyai, Geologia, XLVIII, 1 (pp. 67-76).

Scientific papers, UASVM Bucharest, Series S, Vol. LIV, 2011, ISSN 1222-5339

DYNAMICS OF PROTECTION AND USE OF MANURE IN THE REPUBLIC OF MOLDOVA AGRICULTURE

A. RUSU, V. PLĂMĂDEALĂ

"Nicolae Dimo" Institute of Soil Science, Agrochemistry and Soil Protection of Chisinau

Keywords: *manure, livestock, livestock units, statistics, waste recovery*

Abstract

Based on the information provided by the Moldovan statistics yearbooks, a justifiable analysis of the dynamics of manure production and usage is presented for the period 1950-2010. The largest amount of manure amounting to 15.6-16.6 million tons per year, was produced within 1981-1990. The highest level of usage totalling to 58-82 percent of the total quantity produced was registered during the same period. During those years about 4.4-6.0 tons of garbage was distributed per arable hectare annually. In 2006-2010, the smallest amount of manure was produced, about 3.4-4.5 million tons per year, and even less was used, about 0.1-0.2 percent of the amount produced. Even if for 1 invested dollar 1.6-3.6 lei are recovered by the production increase over the following four years, the main reason of the allegedly ignored attitude towards the usage of manure lies in the lack of financial and technical resources necessary to prepare and apply manure. These costs can vary between 160 and 360 lei per ton (10 to 23 euros/t).

INTRODUCTION

Since ancient times, manure is known as a fertilizer having multilateral fertilizing action on soil and plants. It enriches the soil with organic matter, restores its structure, thus the soil becoming mellower and less resistant at plowing, increasing soil permeability and capacity for water and air. During the process of manure decomposition in the soil, that lasts several years, soil is significantly enriched with all nutrients almost in the necessary proportions for plants. Simultaneously, manure indirectly increases the content of soluble minerals in soil reserves, by the dissolving action of acids formed in the process of organic matter decomposition.

Manure use is sustained and argued not only from an agronomic, ameliorative and ecological point of view but also from an economic one. A comprehensive recent study accomplished in the "N. Dimo" Institute demonstrates that the use of different types of manure, prepared according to different technologies and applied to various crops, provides a specific income between 90 and 930 lei/tone. One leu invested in the use of manure is recovered by 1.55 to 3.64 lei. The expenses for manure preparation, transportation (3 km), distribution and incorporation into the soil is fully recovered with production gains in a year for vegetable and horticultural crops and for field crops in three years maximum. Despite all listed benefits and increasingly stringent need for vegetal production, nowadays, manure is practically not used, left to chance, causing mess, dirt and danger to health.

The purpose of this paper is to present a sound analysis of manure production dynamics from the main species of domestic animals exiting in the Republic of Moldova, as well as the degree of its use as fertilizer during the period 1950-2010.

MATERIAL AND METHODS

As materials, we used statistical data for the given period recording the use of natural organic fertilizers, the absolute majority of which was manure and also the information about livestock per years. The latter was converted using the factors presented in table 1 and offered the opportunity of assessing the amount of produced manure depending on animal breed and breeding regime, as well as the methods of manure cleaning in stables.

Table 1

Calculation factors of manure quantity from an animal depending on the breed and breeding regime, tones/year

Animal breed	Population farms	Livestock and poultry farms with mechanical cleaning	Livestock and poultry complexes with water cleaning
Cattle	8.1	11.0	9.8
Pigs	1.4	1.2	1.1
Poultry	0.0023	0.0046	0.0021
Sheep	0.5	0.5	-
Horses	5.1	-	-

In the case of large livestock and poultry farms the notion of manure was given to the mud with the humidity below 84%. On the basis of all mentioned and obtained statistical data we analyzed and generalized the information according to the methods and rules of logics in order to achieve the established purpose.

RESULTS AND DISCUSSION

During the investigated period, 1950-2010, the mass of manure produced in the Republic of Moldova consisted mainly of cattle manure, which made up 68% of the arithmetic average of that period (Table 2). Pigs manure had an average rate of 14%. Sheep, horses and poultry manure was produced in roughly equal quantities, each about 5-7% of the total. Both the types of manure and total quantity presented rather large quantitative oscillations.

During the investigated period, when we recorded the maximum amount of manure accumulated in the period 1981-1990 - years recording an extreme intensification of agriculture, including animal husbandry, our country registered an increase of livestock units up to 2.475 thout heads. The smallest manure quantity, 3.4 million tones, was produced in 2010. The livestock in that year was only 822 thout livestock units. Mathematical analysis of the accumulated manure mass per years showed that the arithmetic average in the mentioned period was of 9.585 thout tones/year and had a very great deviation from the standard - 4.88 thout tones - and an impressive variation coefficient of 51%. In such a sample of numbers, for approximately 95% of cases the arithmetic average of annual manure mass could amount from 5499 to 13.671 thout tones/year.

Table 2

Annual dynamics of manure production depending on animal breed in the Republic of Moldova

Annually	Cattle		Pigs		Sheep		Horses		Poultry		Total, thout t
	thout t	%	thout t	%	thout t	%	thout t	%	thout t	%	
1941	4259	59	468	6	732	10	1709	24	102	1	7270
1950	5174	74	441	6	511	7	734	11	129	2	6989
1961	6926	68	1462	14	869	9	704	7	239	2	10200
1971	9406	73	1910	15	710	6	444	3	356	3	12826
1981	11971	76	2324	15	590	4	260	1	585	4	15730
1986	12746	77	2280	14	627	4	250	1	715	4	16618
1990	11451	74	2403	15	669	4	235	2	800	5	15558
1996	6034	71	1172	14	697	8	291	3	296	4	8490
2000	3586	63	929	17	515	9	342	6	293	5	5665
2003	3414	64	697	13	478	9	398	7	381	7	5368
2007	2477	54	731	16	474	10	342	7	577	13	4601
2010	1792	53	629	19	211	6	289	8	468	14	3389
Arithmetic average of the period 1950-2010											
-	6816	68	1362	14	577	7	390	5	440	6	9585

We can suppose that such quantitative fluctuations in the livestock and, respectively manure, were caused primarily by radical changes in the socioeconomic sector of our country in the early 90's of the last century. Until then, especially during the period of intensification, the state invested much in agriculture, which had the effect of increasing the number of animals. In the period after the land reform, the investment in animal husbandry became insignificant and since 1992 the livestock reduced sharply and continued to decrease uninterruptedly until today. Manure quantity reduces concomitantly with the livestock, similar to an arithmetic progression, having the mathematical ratio of manure mass reduction of about 640,000 tones/year.

The second factor causing quite large variations in the number of animals and manure mass is due to oscillations in forage crops productivity, which directly determines the size of livestock, reducing it when the year is dry and the harvest is poor or redressing it during a year rich in rainfall. In this regard, it should be mentioned that the unexpected reduction of livestock in the early 90's is not only the result of land reform but also of a very dry period in the Republic of Moldova during 1989-1994 [1]. It’s obvious that during such a period and in the following years the livestock reduces sharply.

In this period, both quantitative and qualitative radical changes have occurred in the number of livestock and, respectively, in manure quantity. At the peak of animal husbandry development, in 1986, there was a total of 16.618 thout tones of manure, where cattle manure, being of low technological quality and poor in nutrients, had a dominant share of 77% (Table 3). The share of poultry manure, which recorded the highest fertilizing effect, made up only 4%. By 2009, the share of cattle manure was reduced to 53%, while that of poultry has increased, making up 14% of the total manure mass. It has been registered an increase in the share of pigs, sheep and horses manure up to 2-7% which contains more nutrients and better technological features than that of cattle. Therefore, nowadays the produced manure mass is less than in the intensification of animal husbandry development, but it is of a higher agronomic quality.

The investigations concerning manure use showed that since 1970 the usage rate has exceeded 2 million tones/year, increasing till 1998 with an annual derivative of 200-775 thout tones. The largest amount of manure, 10.8 million tones, was incorporated in 1988, and constituted 82% of the produced quantity. In that year, on the average, 6 tones of manure were incorporated in each hectare of crops. But since 1991, the amount of used manure continuously decreases and in 2000 it reaches the level of 22,000 tones/year making up only 0.4% of the produced manure mass. And in the period 2006-2010, there have been incorporated only 6-8 thout tones/year or 0.1-0.2% of the produced manure quantity. At present, an annual average of a ridiculous manure amount – 10 kg – is incorporated per one hectare of crops.

The causes of such outdated and vicious situations of non-use of manure, mostly manifested in recent times, may be different. But, in fact, they are based on two reasons: farmers lack the necessary money resources and secondly, they lack the knowledge about the necessity and advantages of using manure. Insufficiency of funds makes it impossible to rent the service of manure preparation and application. According to the price level of 2010, this work is estimated at 160-360 lei per tone or 3000-9000 lei to fertilize one hectare. Closely related to the deficiency of money resources, the non-use of manure can often be caused by the lack of necessary equipment for its reshuffling, loading, transportation and distribution, operations that will imply incomparably heavy expenditures.

Table 3

Composition of livestock in the Republic of Moldova and of produced manure in 1986 and 2010

Animal breed	Calculation factor, in livestock units (lu)	1986					2010				
		Living eads, thousand	Conventional heads (lu)		Manure		Living eads, thousand	Conventional heads (lu)		Manure	
			thout	%	thout	%		thout	%	thout	%
Cattle	1,0	1259	1259	68	12746	77	218	218	50	1792	53
Pigs	0,2	1962	392	21	2280	14	459	92	21	629	19
Sheep	0,1	1253	125	7	627	4	421	42	10	211	6
Horses	0,9	49	44	2	250	2	56	50	11	289	9
Poultry	0,002	22631	45	2	715	4	18328	37	8	468	14
TOTAL	-	-	1865	100	16618	100	-	439	100	3389	100

We are tempted to believe that one of the reasons that influence the formation of an indifferent attitude towards this resource may be the lack of knowledge. Manure is practically not used more than 20 years - a period when a new generation of farmers emerged, who may be unaware about the methods of manure use, don't have the skills to manage this material, are not documented about the benefits of its use and damage caused by its continuous accumulation.

CONCLUSIONS

1. Manure produced in the Republic of Moldova during the period 1950-2010 consisted on average 68% of cattle manure, 14% of swine manure and horses, sheep and poultry manure have almost equal shares between 5 and 7% of the total mass. Both within each type of manure and the total mass, there were found rather large quantitative and qualitative oscillations.

2. In the Republic of Moldova, the largest amount of manure - 15.6-16.6 million tones per year - was recorded in 1981-1990, period characterized by maximal intensification of agriculture, when there have been recorded 2.475 thout heads of livestock units and 103 livestock units corresponded to 100 hectares of agricultural land. That period was highlighted by the highest degree of manure use, when about 7.9-10.8 million tones/year or 58-82% of the total manure mass were incorporated into the soil, thus about 4.4-6.0 tones of manure were incorporated per one plowed hectare.
3. The period 2006-2010 recorded the smallest amount of manure produced in the last 50 years - 3.4-4.5 million tones/year. In 2010, our country registered 822,000 livestock units. 37 livestock units corresponded to 100 hectares of agricultural land. The mentioned period was highlighted by the lowest mass of manure use, about 6-8 thousand tones/year or 0.1-0.2% of the produced quantity.
4. We suppose that the main reasons of not using manure are the lack of necessary money resources and lack of knowledge about the necessity and advantages of using manure. According to the price level of 2010, the expenses for manure preparation and application can vary between 160 and 360 lei per tone (10-23 euros/t). One lei invested in the use of manure is recovered by production increases in about 4-6 years, with about 1.60-3.60 lei.
5. Currently produced manure is distinguished by a more superior fertilizing and technological quality than the one produced in the period before the land reform, by reducing in the annual mass the share of cattle manure from 77 to 53% and increasing poultry manure from 4 to 14%, by increasing the share of manuare with litter mass from 20% annually in 1986 to 91% in 2010.

REFERENCES

1. Constantinov Tatiana, V. Sofroni, I. Mangul, 2000. *Particularităţile climei în Republica Moldova*. În: Degradarea solurilor şi deşertificarea, SNMSS, Chişinău (pp. 28-35).
2. ****Anuarele statistice ale Republicii Moldova din anii 1950…2010*. Departamentul de Statistică, Chişinău.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

EFFECT OF AMELIORATIVE WORKS ON YIELDS IN EXPERIMENTAL FIELD LACU SARAT, BRAILA COUNTY

VALENTINA COTEȚ

National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection of Bucharest

Keywords: *salinization, yield, Braila Plain*

Abstract

The management of saline soils requires a combination of agricultural practices depending on the careful investigations of soil characteristics, water quality and local conditions including climate, crops, economical, social, political, and cultural conditions of the environment, as well as the existent farm systems.

The research was carried out in the eastern part of the Romanian Plain (Braila Plain), in a depressionary area, on a slightly-moderately salinized chernozem. Taking into account the natural conditions of the experimental field, an improvement scheme on an eight hectares area was established, with multiple variants of ameliorative treatment.

The results presented in this paper were obtained within 1998-2004 period at the Lacu Sarat trial plot in natural conditions in the frame of the ameliorative field scheme and also the crops structure. The results presented here are faced with the benchmark variant = 100, identified as the variant with the minimum ameliorative practices, due to the lack of a real benchmark variant.

INTRODUCTION

In all countries, there are concerns for improving saline soils and those with risk of salinization, to increase agricultural production, to reduce content of soil soluble salts, therefore to increase the range of crops suitable for these lands, to obtain technical elements to improve breeding technologies, environmental protection and economic efficiency of improvement technologies, and to increase standards of living in areas with saline and alkaline soils.

In Romania, saline soils have been identified in 29 of the 41 counties. Total area of these soils is about 614,000 ha. Generally, saline soils are located on low lands, in depressionary areas, with low natural drainage, and, sometimes, on hilly regions (saline soils on slope). On irrigated soils, as a result of increased groundwater level, the risk of salinization occurs mainly in soils with shallow groundwater and in drought conditions.

MATERIAL AND METHODS

The Lacu Sărat micro-depressionary area is located in the eastern part of Romanian Plain (Braila Plain or Northern Baragan), (Posea, 1989) in a micro depressionary area („crov"), on a total area of about 300 ha which accumulates groundwaters from neighbouring higher areas, this phenomenon also being the cause of soil degradation processes by salinization and recurrent waterlogging. This micro-depressionary area is a representative area for micro-depressionary areas from Northern Baragan affected by salinization. Surface deposits are made of loess and the texture varies from loamy-sandy to loamy-clayey. On the bottom of the valley, where the trial plot is located, groundwater table reaches levels of less than 2 m and, in some parts, less than 1 m depth. Groundwaters are moderat and strong mineralized (mineral residue of 1 – 4.5 g/l) in peripheric areas and low–moderat mineralized (4.5 – 11 g/l) in central areas of micro-depressionary area. Trial plot was located on slightly-moderately salinized chernozem (SRTS, 2003). The trial plot is sited in the dry steppe (Bogdan, 1999), characterized by hot and dry summers, with an average multiannual temperature of 10.9^0C, precipitations of 452 mm annually, potential evapotranspiration of 705 mm and a climatic water deficit of 345 mm (Braila Weather Station).

The natural conditions of the trial plot (with an area of 8 ha) were the basis to design the layout for several treatments, each of them composed from several ameliorative works, as follows: horizontal drainage, deep loosening, ameliorative irrigation, organic fertilization, chemical fertilization, soil tillage with soil material inverting, soil tillage without soil material inverting, mulching and amendment.

RESULTS AND DISCUSSION

The yield for the studied crops in the trial plot for the agricultural years 1998 – 1999, 1999 – 2000, 2002 – 2003, 2003 – 2004 are presented both as absolute and relative values compared to the benchmark treatment = 100, which in the trial context can be considered the V_{8a} variant (***No drainage*** + *chemical fertilization* + *soil tillage with soil material inverting* + *amendment*) which undergone the least improvements, an actual benchmark (with no improvement) treatment missing (Table 1).

The interpretation of yield data was performed to highlight the influence of a single improvement, by comparison the pairs of variants related in terms of works, but differing by a specific improvement work (the first of them being considered the comparison variant), (Figure 1) as follows:

- For the **influence of organic fertilizers V_1** variant were compared with **V_2** variant - Under ***organic fertilization*****,** yield increases could be noticed for all crops and for all years as follows: 18 - 50% for maize, 2 - 5% for sunflower, 7 - 35% for

Table 1

Improvements applied to Lacu Sarat trial plot, Braila

Treatment variants	Treatments										
	Drainage			Deep loosening	Ameliorative irrigation	Fertilization		Soil tillage		Mulching	Amendment
	high intense (20 m)	moderately intense (40 m)	no drainage			organic	chemical	with soil material inverting	without soil material inverting (paraplaw)		
V_1	✓			✓	✓	✓	✓		✓		✓
V_2	✓			✓	✓		✓		✓		✓
V_3	✓			✓	✓		✓	✓			✓
V_4	✓				✓		✓		✓		✓
V_5	✓			✓			✓		✓		✓
V_6	✓			✓			✓		✓	✓	✓
V_7		✓		✓	✓		✓		✓		✓
V_8			✓	✓	✓		✓		✓		✓
V_{8a} (B)			✓				✓	✓			

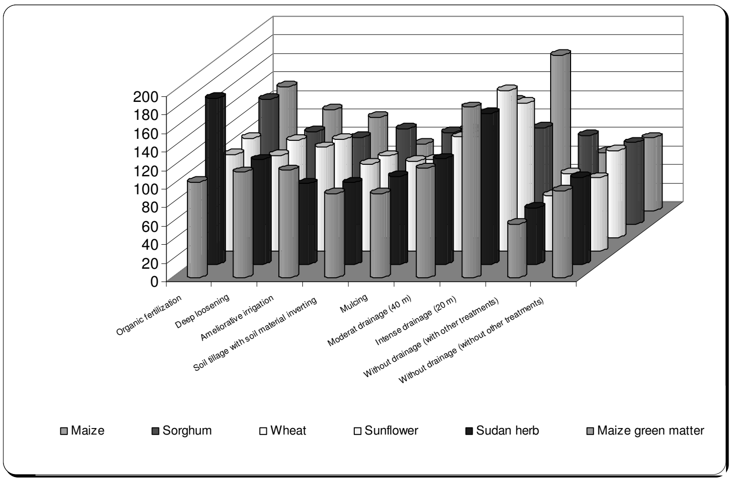


Fig. 1. Variation of mean relative yield (%) for different crops, due to ameliorative works

sorghum and 2 - 79% for Sudan grass. It could be noticed that the highest yields were obtained in the agricultural year 1998 - 1999, an agriculturally favourable year, with precipitations of 563 mm, compared to the multiannual average of 452 mm and an annual mean temperature of 11.1^{0}C compared to the multiannual average of 10.9^{0}C, another explanation being the fallowing of the meadow before setting up the trial plot (Coteț, 2009a).

- For **deep loosening V$_2$** variant were compared with **V$_4$** variant - The use of ***deep loosening*** tillage as ameliorative treatment leaded to small improved increases for maize, sorghum, and sunflower, between 0 to 11%, with the exception of Sudan grass and maize green matter, which obtained increases of 11 to 18% (Coteț, 2009b).

- For **ameliorative irrigation V$_2$** variant were compared with **V$_5$** variant - ***Ameliorative irrigation*** resulted, in agricultural year 1998 – 1999, to lower yields for all crops, namely between 4 and 6% for maize, sorghum, and 13% for Sudan grass, unlike the next years, when an yield increase for all cultures have been obtained, between 3 – 26%. This is explained by the fact that the first year was a wet year, leading to a less favorable aerohydric regime (Coteț, 2008).

- For **soil tillage with soil material inverting V$_3$** variant were compared with **V$_2$** variant - The application of ***tillage with soil material inverting***, as an improvement methods, in the first two years leaded to yield decreases quite large, between 10 and 30%, excepting sorghum and sunflower, where yields are similar to the compared variant. In the further years, the decrease of yields is still present, but at lower values of 3 to 5% (Coteț, 2009c).

- For **mulching V$_6$** variant were compared with **V$_5$** variant - ***Mulching*** with straw gave no production increases, instead they were lower by 1-5%, except agricultural year 1999 - 2000 when the yield decline was 2-28%. The smallest decrease recorded sunflower yield between 2 and 5% (Coteț, 2008).

- For **moderate drainage V$_7$** variant were compared with **V$_8$** variant - ***Moderate drainage*** (D = 40 m) lead to important yield enhancements, between 6 and 36% in all crops, the highest being recorded for sunflower, 15 - 36%.

- For **intense drainage V$_2$** variant were compared with **V$_8$** variant - ***Intense drainage*** (D = 20 m) determined significant yield enhancements, reaching 25 - 114%, the highest being for maize green matter and sunflower.

- For **without drainage V$_8$** variant were compared with **V$_2$** variant - ***Without drainage*** (D = 0 m), but with the application of different ameliorative measures, low yields were obtained, even 50% lower than the reference treatment, with decreases of 20 - 53% for all crops.

- **When no ameliorative measures are applied V$_{8a}$** variant were compared with **V$_8$** variant - The yield decrease is obvious, but 4 - 24% lower than the previous case (Coteț et al., 2009).

CONCLUSIONS

1. The application of manure together with the other improvements had favourable effects, especially in maize, sorghum, and Sudan grass. The application of manure in doses of 60 t/ha leads to the improvement of permeability and structuring degree, the reactivation of microbiological activity etc., with positive effects together with other agropedoameliorative measures.
2. The use of deep loosening tillage in the complex of measures leaded to low increases of crop yields, excepting the Sudan grass, with yield increases between 11 and 18%.
3. Application of ameliorative irrigation has led to slight ameliorative production increases between 3 - 26%.
4. The tillage with soil material inverting has low or nonconclusive effects due to medium texture and relatively good soil characteristics. Favourable effect, although relatively moderate, had also the tillage without soil material inverting (paraplaw). Soil tillage at shallow depth and without soil material inverting is recommended, and in order to reduce subplough layer compaction, annually changes of ploughing depth are recommended.
5. Soil mulching has inconclusive effects in experimental conditions, causing slight decreases of yields.
6. Drainage triggered significant yield increases, the value being double in the case of intense drainage (D = 20 m).
7. The lack of drainage strongly affects the development of crop plants, due to the unfavourable air-water regime related to the presence of groundwater close to the surface.
8. The most important conclusion is that even soils like slightly-moderately salinized chernozem could have yields closed to the ones obtained on unsalinized soils.

ACKNOWLEDGEMENTS

The research was supported by the Research Program PN II RU-PD, Contract 192/10.08.2010

REFERENCES

1. Bogdan Octavia, 1999. *Principalele caracteristici climatice ale Câmpiei Române*. Com. Geogr., III.
2. Coteț Valentina, 2008. *Cercetări privind influența unor măsuri agrofitotehnice asupra solului și producției la principalele culturi de câmp în condițiile cernoziomului freatic umed slab salinizat și slab alcalizat din zona Brăila*. Teză de doctorat.

3. Coteț Valentina, 2009a. *The effect of organic fertilisation on yields at main field crops from the Lacu Sărat trial plot, Brăila*. Scientific papers, Year LII – Vol. 52, Horticulture Series, Ed. „Ion Ionescu de la Brad", Faculty of Horticulture, U.S.A.M.V. „Ion Ionescu de la Brad" Iaşi (pp. 963-968).
4. Coteț Valentina, 2009b. *The effect of deep loosening on crop production in the trial plot Lacu Sărat, Brăila*. Proceedings of the 52nd International Scientific Conference „Ecological agriculture - priorities and perspectives", Faculty of Agriculture, U.A.S.V.M. „Ion Ionescu de la Brad" Iaşi, p. CD.
5. Coteț Valentina, 2009c. *The influence of tillage with soil material inverting on crop production in the trial plot Lacu Sărat, Brăila*. The Scientific Conference with International Participation „Durable Agriculture - Agriculture of the Future", the fifth edition, Faculty of Agriculture, University of Craiova, p. CD.
6. Coteț Valentina, M.L. Eftene, Victoria Mocanu, 2009. *The influence of horizontal drainage on crops production in the trial plot Lacu Sărat, Brăila*. Research Journal of Agricultural Science, vol. 41 (1), Agroprint Editorial, Timişoara, U.A.S.V.M.B. Timişoara (pp. 409-414).
7. Posea Gr., 1989. *Câmpia Bărăganului*. Terra, XXI (XLI), 1.
8. xxx, 2003. *Sistemul Român de Taxonomie a Solurilor*. Autori: N. Florea, I. Munteanu, Ed. Estfalia, Bucureşti.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

PHOSPHORUS SPRING FERTILIZATION IN THE OIL SEED RAPE

H.V. HĂLMĂJAN, F. RENCIU, GINA VASILE, P. DOBRE

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *oil seed rape, phosphorus, pod number*

Abstract

The purpose of this experimentation is to find a solution to the situations in which, for various reasons, there was no phosphorus fertilisation before sowing. The experiment was conducted in Murgeanca village, Ialomita district, in the S.C Farmnet S.R.L. exploitation. The methodology used was the one described in the CETIOM brochure, "Guide de l'expérimentateur colza". By applying 250 kg/ha of complex fertilisers containing 10% N, 20% P_2O_5 and 30% SO_3, the number of pods has increased significantly with 45%, reaching up to 5000 pods/m^2. In the literature, this is considered the threshold from which satisfactory productions can be obtained. Also, the sole application of nitrogen determined the non significant growth in the number of pods, but in this case, the number of pods slightly exceeded 4000 pods/m^2.

INTRODUCTION

The purpose of this experimentation is to find a solution to the situations in which, for various reasons, there was no phosphorus fertilisation before sowing. We verified the following hypothesis: in the case of oilseed rape, the application of phosphorus in spring as a complex fertiliser can determine significant production increase.

Economic Framework**.** High prices of oilseed rape yield, the rise of chemical fertilisers' price and the care for pollution avoidance, have determined many specialists to lay a greater emphasis on the fertilisation optimisation for this crop. For this reason, there have been many fertilisation plans that take into account the soil analyses or the images taken by satellites.

In the last few years, the oilseed rape has been very profitable for many farmers [1 ,2]. There have also been happy exceptions when, in the first years of cultivation in an exploitation/parcel, large yields have been obtained, using low inputs technologies (small amount of fertilisers and few crop protection treatments). Jean Nicolas Simon, a French expert, an employee of Roullier Group (fertilisers producer), says that this phenomenon has been noticed in many places: after the first oilseed rape reseeding on the same parcel, the yields tends to decrease slightly, if the same level/quality of inputs is maintained. In order to obtain yields larger than 3 t/ha, the oilseed rape plants must absorb over 200 kg N/ha. On the other hand, from the remarks we have made until now, the doses exceeding 150 kg N/ha have not determined the production growth because of climatic limitations (lack of humidity and high temperatures in the flowering/grains development period) [3, 4]

Fertilisation is one of the key elements of technical ways, being able to determine growths up to 40-50% [5].

Phosphorus Fertilisation Optimization. The oilseed rape is a crop that has high demands for phosphorus supply. For this reason, plants react to phosphorus application even when the soil is well supplied with mobile phosphorus. This is one of the explanations for which, on soils rich in phosphorus, French experts recommend the application of superphosphate in spring, when the fertilisation could not be done in autumn, as oilseed rape plants require phosphorus (particularly) in April and May [6].

British specialists also consider that phosphorus fertilisers can be applied anytime, in order to maintain a high level of mobile phosphorus in the soil [1].

In most cases, it is recommended that phosphorus fertilisation to be done before sowing. For soils with a low content of phosphorus, French specialists even recommend the application of fertilisers on the tillage for the oilseed rape seedlings to find very quickly the phosphorus in the superficial layers, following the preparation of the seedbed. If they would have been applied before ploughing, fertilisers would have been placed too deep for the young plants, therefore being inaccessible in the first stages of vegetation. The lack of fertilisation with phosphorus (particularly on the low supplied soils), affects the production [3, 4].

In the case of oilseed rape phosphorus deficiency is often easily noticed. In the last years the symptoms of phosphorus deficiency on large surfaces have been observed. They can appear in the first stages of vegetation even from the second week following the emergence as the phosphorus from the grain reserve is used in the first 7 days. The insufficient absorption_of phosphorus is often manifested in young plants, after prolonged periods of cold weather [1, 3, 4].

MATERIAL AND METHODS

The experiment was conducted in Murgeanca village, Ialomita district, in the S.C Farmnet S.R.L. exploitation.

The methodology used was the one described in the CETIOM brochure, “Guide de l'expérimentateur colza” [7].

During winter, fertilisation was done using 200 kg/ha complex fertilisers 28:28:0 and 200 kg/ha ammonium nitrate. Plants’ density after winter was of 45 plants/m². We used 4 replications which were set up in blocks. The harvested surface was of 30 m² (1.5 m x 20 m). During vegetation period, samples were taken from the surface of 4 m² (1 m²/replication).

We used the following treatments:

T1 - Control – fertilisation in February with 80 kg N/ha.

T2 - Supplementary fertilisation on 10^{th} of March, using 25 kg N/ha as ammonium nitrate.

T3 - Supplementary fertilisation on 10^{th} of March, using 250 kg of Euro Cereal, complex fertilisers, produced by Timac Agro Romania. The composition was the following: 10% N, 20% P_2O_5 and 30% SO_3.

Comparisons were made using the Duncan test.

RESULTS AND DISCUSSION

Oilseed rape plants have accumulated dry matter differently, according to the treatment applied (Table 1).

On 29^{th} of April, the plants were weighing 1706 g/m². Until 10^{th} of June, the plants biomass increased with 668 g/m² at the Control (139%), with 856 g/m² at the supplementary fertilisation with ammonium nitrate (150%) and with 1138 g/m² at the application of complex fertilisers (167%).

Table 1

Fertilisers influence on plant dry weight and pod number per m^2

Treatment	Control	N	N +P +S
Plant dry weight on 10.03.2009 (g)	885	910	860
Plant dry weight on 10.03.2009 (g)	2374 (c)	2562 (b)	2844 (a)
Differences in plant dry weight (g)	1489	1652	1984
Differences in plant dry weight %	100	108	120
Pod number/m^2	340 (c)	4011 (b)	5004 (a)
Pod number/m^2 (%)	100	117	145

Means in the same line followed by the same letter do not differ significantly P (>0.05).

The number of pods/m² varied from 3440 (Control), to 4011 for supplementary fertilisation with ammonium nitrate and to 5004 at complex fertilisers application, the increase being of 17% for nitrogen and of 45% for complex fertilisers.

CONCLUSIONS

1. In this work, we have studied the effect of fertilisers applied in spring to the oilseed rape plants, which have not been fertilised before sowing. Oilseed rape reacts favourable to the late application of phosphorus through the increase of plant's biomass and the number of pods, regardless the mobile phosphorus content in the soil.
2. By applying 250 kg/ha of complex fertilisers containing 10% N, 20% P_2O_5 and 30% SO_3, the number of pods has increased significantly with 45%, reaching up to 5000 pods/m^2. In the literature, this is considered to be the threshold from which satisfactory productions can be obtained.

3. Also, the sole application of nitrogen has determined the non significant growth in the number of pods, but in this case, the number of pods slightly exceeded 4000 pods/m^2.

ACKNOWLEDGEMENTS

Partnerships in priority areas Grant no. 22138/2008 TINOCIP financially supported this study.

REFERENCES

1. Hălmăjan H.V. (Coordonator), 2006. *Ghidul cultivatorului de rapiță*. Ed. Agris.
2. Halmajan H.V., 2007(a). *Din experiența cultivatorilor de rapiță*. Ed. Agris.
3. Hălmăjan H.V., G. Vasile, A. Ionescu, 2007(b). *Fertilizarea plantelor de rapiță afectate de înghețurile târzii.* USAMV Iaşi, Lucrări Științifice, Vol. 50, Seria Agronomie, Nr. 2: 317-320, Ed. Ion Ionescu de la Brad Iaşi.
4. Hălmăjan H.V., G. Vasile, G. Ciuboată, 2007(c). *Fertilizarea suplimentară cu azot şi sulf a plantelor de rapiță*. Universitatea de Ştiinţe Agricole şi Medicină Veterinară Iaşi, Lucrări Științifice, Vol. 50, Seria Agronomie, Nr. 2: 321-324, Ed. Ion Ionescu de la Brad Iaşi.
5. Berca M., 1999. *Optimizarea tehnologiilor la culturile agricole*. Ed. Ceres.
6. ***www.Cetiom.fr.
7. ***Guide de l'expérimentateur colza. Ed. CETIOM.

Scientific Papers, UASMV Bucharest, Series A, vol. LIV, 2011, ISSN 1222-5339

INFLUENCE OF FERTILIZATION WITH POTASSIC FERTILIZERS ON CARROT CROP

C. URZICĂ*, M. DUMITRU**, M. MUŞAT*, LAVINIA PARVAN**, ALEXANDRA RADU*

*University of Agronomic Science and Veterinary Medicine of Bucharest
**National Institute of Research and Development of Soil Science, Agrochemistry and Environmental Protection of Bucharest

Keywords: *fertilization, chernozem, alluvial soil*

Abstract

This research deads with the behavior of various root chemical fertiliser types, especially potassic ones, applied to carrot grown on two types of soils, taking into account the yield quality and quantity, fertiliser residues in soil, nitrate pollution risk, as well as the impact on environment.

INTRODUCTION

Research was carried out in glasshouse. The two soils fertilized with several simple or combined fertiliser types (superphosphate, urea, potash salt, potassium sulfate) were quantitatively and qualitatively analyzed both before crop planting and after crop harvesting. The two soil types used for the experiment were: Alluvial soil (Ciorogârla) and Cambic chernozem (Ştefăneşti).

MATERIAL AND METHODS

The experiment was made by applying the pot-culture method with pots of 30 l capacity and 17 treatments x 4 replicates for each soil type. In this view a bifactorial experiment was organized such as:
A factor: soil type with two graduations: a_1 - Chernozem and a_2 - Alluvial soil.
B factor: fertilization system with 17 graduations.

No. of treatments	Treatments
b1	*Control*
b2	$N_{100}+KCl_{100}$
b3	$N_{100}+K_2SO_{4100}$
b4	$N_{100}+KCl_{150}$
b5	$N_{100}+K_2SO_{4150}$
b6	$P_{100}+KCl_{100}$
b7	$P_{100}+K_2SO_{4100}$
b8	$P_{100}+KCl_{150}$

b9	$P_{100}+K_2SO_{4150}$
b10	$N_{100}+P_{100}+KCl_{100}$
b11	$N_{100}+P_{100}+K_2SO_{4100}$
b12	$N_{100}+P_{100}+KCl_{150}$
b13	$N_{100}+P_{100}+K_2SO_{4150}$
b14	KCl_{100}
b15	K_2SO_{4100}
b16	KCl_{150}
b17	K_2SO_{4150}

RESULTS AND DISCUSSION

The analysis of production results led to the conclusion that the highest yields have been obtained in the case of Cambic chernozem, in contrast to the Alluvial soil where the yields were clearly lower, even if the applied technology was the same (Figure 1).

Fig. 1. CZ - chernozem and AS - aluviosoil

In both cases, the nitrogen V2; V3; V4 and V5 treatments, as well as, V10; V11; V12 and V13, i.e., where the highest rates were applied, the yields were the highest (Tables 1 and 2).

The analysis of data in table 1 regarding the yields with the carrot crop grown on **Chernozem** shows that the yields varied between 101 g/pot in the case of the control and 237 g/pot in the case of the $N_{100}+P_{100}+K_2SO_{4100}$ treatment, and, from the statistical viewpoint, as compared to the control:

- V2, V10 and V11 treatments obtained very significant yield increases;
- V3, V4, V5, V12 and V13 treatments obtained distinctly significant yield increases;
- V9 and V14 treatments obtained significant yield increases; and
- V6, V7, V8, V15, V16 and V17 treatments recorded no yield modifications.

Table 1

Interpretation - Chernozem

Treatments	Treatments	Mean, (g/pot)	Dif., (g/pot)	Significance
V1	Control	101	mt	-
V2	N_{100}+KCl_{100}	208	107	***
V3	N_{100}+KSO_{4100}	201	100	**
V4	N_{100}+KCl_{150}	192	91	**
V5	N_{100}+KSO_{4150}	194	93	**
V6	P_{100}+KCl_{100}	161	60	-
V7	P_{100}+KSO_{4100}	147	46	-
V8	P_{100}+KCl_{150}	139	38	-
V9	P_{100}+KSO_{4150}	176	75	*
V10	N_{100}+ P_{100}+KCl_{100}	218	117	***
V11	N_{100}+ P_{100}+KSO_{4100}	237	136	***
V12	N_{100}+ P_{100}+KCl_{150}	194	93	**
V13	N_{100}+ P_{100}+KSO_{4150}	198	97	**
V14	KCl_{100}	174	73	*
V15	KSO_{4100}	153	52	-
V16	KCl_{150}	142	41	-
V17	KSO_{4150}	152	51	-

LSD 5% - 60.5 *LSD1% - 81.1* *LSD0.1% - 105.7*

Table 2

Interpretation - Alluvial soil

Treatments	Treatments	Mean, (g/pot)	Dif., (g/pot)	Significance
V1	Control	73	Mt	-
V2	N_{100}+KCl_{100}	102	29	***
V3	N_{100}+KSO_{4100}	106	33	***
V4	N_{100}+KCl_{150}	99	26	***
V5	N_{100}+KSO_{4150}	100	27	***
V6	P_{100}+KCl_{100}	88	15	**
V7	P_{100}+KSO_{4100}	85	12	*
V8	P_{100}+KCl_{150}	91	18	***
V9	P_{100}+KSO_{4150}	88	15	**
V10	N_{100}+ P_{100}+KCl_{100}	120	47	***
V11	N_{100}+ P_{100}+KSO_{4100}	115	42	***
V12	N_{100}+ P_{100}+KCl_{150}	105	32	***
V13	N_{100}+ P_{100}+KSO_{4150}	119	46	***
V14	KCl_{100}	88	15	**
V15	KSO_{4100}	89	16	**
V16	KCl_{150}	78	5	-
V17	KSO_{4150}	87	14	*

LSD5% - 10.1 *LSD1% - 13.4* *LSD0.1% - 17.5*

The analysis of data in table 2 regarding the obtained yields with the carrot crop grown on **Alluvial soil** shows that the yields varied between 73 g/pot in the case of the control and 120 g/pot in the case of the *N_{100}+P_{100}+KSO_{4100},* treatment, and, from the statistical viewpoint, as compared to the control:

- V2, V3, V4, V5, V8, V10, V11, V12 and V13 treatments obtained very significant yield increases;
- V6, V9, V14 and V15 treatments obtained distinctly significant yield increases; and
- V7 and V17 treatments obtained significant yield increases.

Measurements regarding the diameter and length of roots have been carried out, performing a cubage of roots, where the highest yields are confirmed for the same treatments above mentioned (Tables 3 and 4).

Table 3

Biometrical data of carrot on Alluvial soil

No.	**Treatments**	**r1**			**r2**	
		Φ (mm)	*L (mm)*	*V (cm^3)*	*Dif. (cm^3)*	*Signif.*
V1	Control	9.75	102.75	996.5	*Mt*	
V2	N_{100}+KCl_{100}	10.05	120.25	1201.5	*205.00*	-
V3	N_{100}+KSO_{4100}	10.55	137.5	1458	*461.50*	***
V4	N_{100}+KCl_{150}	11.75	117.25	1372	*375.50*	**
V5	N_{100}+KSO_{4150}	10.88	108.75	1183.3	*186.75*	-
V6	P_{100}+KCl_{100}	10.93	97	1058	*61.50*	-
V7	P_{100}+KSO_{4100}	10.18	83.25	853	*-143.50*	-
V8	P_{100}+KCl_{150}	8.78	103.25	900	*-96.50*	-
V9	P_{100}+KSO_{4150}	10.5	91.75	953.75	*-42.75*	-
V10	N_{100}+ P_{100}+KCl_{100}	12.38	132	1611.5	*615.00*	***
V11	N_{100}+ P_{100}+KSO_{4100}	11.63	105.5	1230.3	*233.75*	-
V12	N_{100}+ P_{100}+KCl_{150}	11.65	117	1350.8	*354.25*	**
V13	N_{100}+ P_{100}+KSO_{4150}	11.5	115.25	1327.5	*331.00*	*
V14	KCl_{100}	9.98	101.5	1015	*18.50*	-
V15	KSO_{4100}	9.48	101	952.25	*-44.25*	-
V16	KCl_{150}	9.38	91.5	848	*-148.50*	-
V17	KSO_{4150}	8.78	95.5	840.75	*-155.75*	-

LSD5% - 249.400 LSD1% - 334.027 LSD0.1% - 435.829

The analysis of data in table 3, under the ***Alluvial soil*** conditions, shows that:

- the diameter of carrot roots varies between 8.78 mm in the case of V8 treatment and 12.38 mm in the case of V10 treatment;
- the length of carrot roots varies from 91.5 mm in the case of V16 şi 137.5 mm in the case of V3;

- volume of roots varies from 840.7 cm^3 in the case of V17 treatment to 1611.5 cm^3 in the case of V10 treatment.

From the statistical viewpoint, the fertilization with N_{100}+K_2SO_{4100} and N_{100}+ P_{100}+KCl_{100} determined very significant changes of these biometrical parameters, that is, 1458 cm^3, and 1611.5 cm^3, respectively.

Table 4

Biometrical data of carrot on Cambic chernozem

No.	Treatments	r1			r2	
		Φ (mm)	*L (mm)*	*V (cm^3)*	*Dif. (cm^3)*	*Signif.*
V1	Control	16.88	178.50	3029.50	0.00	-
V2	N_{100}+KCl_{100}	19.35	213.00	4123.00	1093.50	**
V3	N_{100}+KSO_{4100}	21.03	215.00	4527.50	1498.00	***
V4	N_{100}+KCl_{150}	19.55	205.75	4031.75	1002.25	*
V5	N_{100}+KSO_{4150}	20.38	209.25	4268.00	1238.50	**
V6	P_{100}+KCl_{100}	16.43	182.50	3034.50	5.00	-
V7	P_{100}+KSO_{4100}	15.35	168.50	2670.25	-359.25	-
V8	P_{100}+KCl_{150}	16.25	172.50	2821.50	-208.00	-
V9	P_{100}+KSO_{4150}	18.05	186.00	3357.75	328.25	-
V10	N_{100}+ P_{100}+KCl_{100}	20.45	214.00	4380.25	1350.75	**
V11	N_{100}+ P_{100}+KSO_{4100}	21.25	211.25	4489.50	1460.00	***
V12	N_{100}+ P_{100}+KCl_{150}	21.58	224.00	4847.25	1817.75	***
V13	N_{100}+ P_{100}+KSO_{4150}	19.78	224.00	4446.75	1417.25	***
V14	KCl_{100}	17.8	162.00	2899.50	-130.00	-
V15	KSO_{4100}	16.53	170.50	2809.50	-220.00	-
V16	KCl_{150}	16.5	168.00	2765.75	-263.75	-
V17	KSO_{4150}	15.93	154.75	2536.25	-493.25	-

LSD5% - 785.152 LSD1% - 1051.572 LSD0.1% - 13720.058

The analysis of data in table 4, under the ***Chernozem*** conditions, shows that:

- the diameter of carrot roots varies between 15.35 mm in the case of V7 treatment and 21.58 mm in the case of V12 treatment;
- the length of carrot roots varies from 154.75 mm in the case of V17 to 224 mm in the case of V3;
- volume of roots varies from 2536.25 cm^3 in the case of V17 treatment to 4847,25 cm^3 in the case of V12 treatment.

From the statistical viewpoint, fertilization with N_{100}+KSO_{4100} and N_{100}+ P_{100}+KCl_{100} determined very significant changes of these biometrical parameters, that is, 1817.75 cm^3, and 1498.0 cm^3, respectively.

Table 5

Qualitative results (carotene)
Determination of total carotene (mg/fresh product)

No. treatm.	**CZ**			**AS**		
		Dif.	Signif.		Dif.	Signif.
V1	12.86	CT		10.53	CT	
V2	14.75	1.19	*	9.60	-0.93	-
V3	14.55	1.69	*	11.46	0.93	-
V4	12.92	0.06	-	12.56	2.23	*
V5	14.48	1.62	*	11.58	1.05	-
V6	11.76	-1.10	-	11.34	0.81	-
V7	14.54	1.69	*	11.28	0.76	-
V8	15.30	2.45	*	10.70	0.17	-
V9	15.78	2.93	**	10.54	0.01	-
V10	14.67	1.81	*	10.31	-0.22	-
V11	14.96	2.11	*	10.53	0.00	-
V12	11.61	-1.25	-	10.03	-0.50	-
V13	12.24	-0.62	-	11.59	1.07	-
V14	12.93	0.07	-	11.85	1.33	*
V15	15.30	2.45	*	9.33	-1.20	-
V16	10.86	-2.00	-	12.08	1.55	-
V17	12.35	-0.50	-	10.35	-0.18	-
CZ				AS		
	LSD5%	*1.358*			*1.158*	
	LSD1%	*2.498*			*3.230*	
	LSD0.1%	*3.868*			*4.519*	

Under the **Alluvial soil** conditions, the total carotene content (fresh product) varied from 9.33 mg in the case of V15 treatment to 12.56 mg in the case of V4 treatment, while, under the **Chernozem** conditions, this varied from 10.86 mg in the case of V16 treatment to 15.3 mg in the case of V8 and V15 treatments.

Under the **Alluvial soil** conditions, the total carotene content (dry product) varied from 74.27 mg in the case of V12 treatment to 104.25 mg in the case of V4 treatment, while, under the **Chernozem** conditions, this varied from 82.72 mg in the case of V6 treatment to 119.65 mg in the case of V15 treatment.

The analysis of the results obtained with the both soil types shows clear differences as concerns the total carotene content firstly between the two soil types and then between the treatments.

Table 6

Qualitative results (carotene)
Determination of total carotene (mg/dry product)

No. treatm.	CZ			AS		
		Dif.	Signif.		Dif.	Signif.
V1	92.65			82.51		
V2	114.92	22.27	-	74.79	-7.72	-
V3	117.00	24.35	-	87.88	5.36	-
V4	104.39	11.74	-	104.25	21.74	**
V5	119.65	27.00	*	92.16	9.65	-
V6	82.72	-9.93	-	90.04	7.53	-
V7	103.76	11.11	-	81.17	-1.34	-
V8	118.30	25.65	*	92.04	9.53	-
V9	104.87	12.22	-	75.80	-6.71	-
V10	113.81	21.16		84.20	1.69	-
V11	112.95	20.30		81.88	-0.63	-
V12	88.46	-4.19		74.27	-8.24	-
V13	96.81	4.16		94.10	11.59	
V14	93.65	1.00		97.47	14.96	*
V15	112.84	20.19		74.69	-7.83	-
V16	88.63	-4.02		91.73	9.22	-
V17	88.77	-3.88		81.53	-0.98	-
CZ				AS		
	LSD5%	*25.367*			*12.115*	
	LSD1%	*33.975*			*19.959*	
	LSD0.1%	*44.330*			*26.395*	

CONCLUSIONS

1. The yields are clearly higher in the case of the Chernozem as compared with the Alluvial soil; the highest yields have been obtained with both soils at the V10, V11, V12 and V13 treatments followed by the V2, V3, V4 and V5, where nitrogen fertilizers were applied, biometrical measurements revealed the same results.
2. The quality of carrot roots is emphasized by the total carotene content, the differences being significant in the case of the Chernozem as compared to the Alluvial soil; and a clear differentiation is observed at the V11 and V13 treatments receiving N_{100}+P_{100}+KSO_{4100} *si* N_{100}+P_{100}+KSO_{4150} in the case of the both soil types.

REFERENCES

1. Borlan Z., Cr. Hera, 1984. *Optimizarea agrochimică a sistemului sol-plantă*. Ed. Academiei R.S.R.

2. Davidescu D., Velicica Davidescu, 1992. *Agrochimie horticolă*. Ed. Academiei Române.
3. Dorneanu A., 1976. *Dirijarea feritității solurilor*. Ed. Ceres.
4. Florea N., I. Munteanu, 2003. *Sistemul Român de Taxonomie a Solurilor*. Ed. Estfalia, 2003.
5. Filipov F., I. Rusu, S. Udrescu, D. Vasile, 2005. *Pedologie*. Ed. AcademicPres, Cluj-Napoca.

Scientific Papers, UASMV Bucharest, Series A, vol. LIV, 2011, ISSN 1222-5339

INFLUENCE OF FERTILIZATION WITH POTASSIC FERTILIZERS ON TOMATOES

C. URZICĂ*, M. DUMITRU, M. MUŞAT*, LAVINIA PARVAN**, ALEXANDRA RADU***

*University of Agronomic Science and Veterinary Medicine of Bucharest
**National Institute of Research and Development of Soil Science, Agrochemistry and Environmental Protection of Bucharest

Keywords: *fertilization, chernozem, alluvial soil*

Abstract

The theme is intended to know the behavior of different root chemical fertilizer types, especially potash, applied to tomatoes on two soil types, taking into consideration the quality and quantity of obtained production, their retention in the soil, the risk of nitrate pollution and the impact on the environment.

INTRODUCTION

Research was carried out in green house making the quantitative and qualitative analysis on the two soil types used in experiment, either single or combined application of several fertilizer types (superphosphate, urea, potash, potassium sulphate) and after the crop harvesting. The soil used for experiment was collected from two soil types: Eutric alluvial soil (Ciorogârla) and Cambic chernozem (Ştefăneşti).

MATERIAL AND METHODS

The experiment was made by applying the pot-culture method with pots of 30 l capacity and 17 treatments x 4 replicates for each soil type. In this view a bifactorial experiment was organized such as:

A factor: soil type with two graduations: a_1 - Chernozem and a_2 - Alluvial soil.

B factor: fertilization system with 17 graduations.

No. of treatments	Treatments
b1	Control
b2	N_{100}+KCl_{100}
b3	N_{100}+KSO_{4100}
b4	N_{100}+KCl_{150}
b5	N_{100}+KSO_{4150}
b6	P_{100}+KCl_{100}

b7	P_{100}+KSO_{4100}
b8	P_{100}+KCl_{150}
b9	P_{100}+KSO_{4150}
b10	N_{100}+P_{100}+KCl_{100}
b11	N_{100}+P_{100}+KSO_{4100}
b12	N_{100}+P_{100}+KCl_{150}
b13	N_{100}+P_{100}+KSO_{4150}
b14	KCl_{100}
b15	KSO_{4100}
b16	KCl_{150}
b17	KSO_{4150}

RESULTS AND DISCUSSION

The analysis of production results led to the conclusion that the highest yields have been obtained in the case of Cambic chernozem, in contrast to the Alluvial soil where the yields were clearly lower, even if the applied technology was the same (Figure 1).

Fig. 1. Chernozem - left and Alluvial soil - right

In the both cases, the nitrogen V2; V3; V4 and V5 treatments as well as V10; V11; V12 and V13 treatments, i.e., where the highest rates were applied, the yields were the highest. Figure 1 shows the obtained yields with the two soil types.

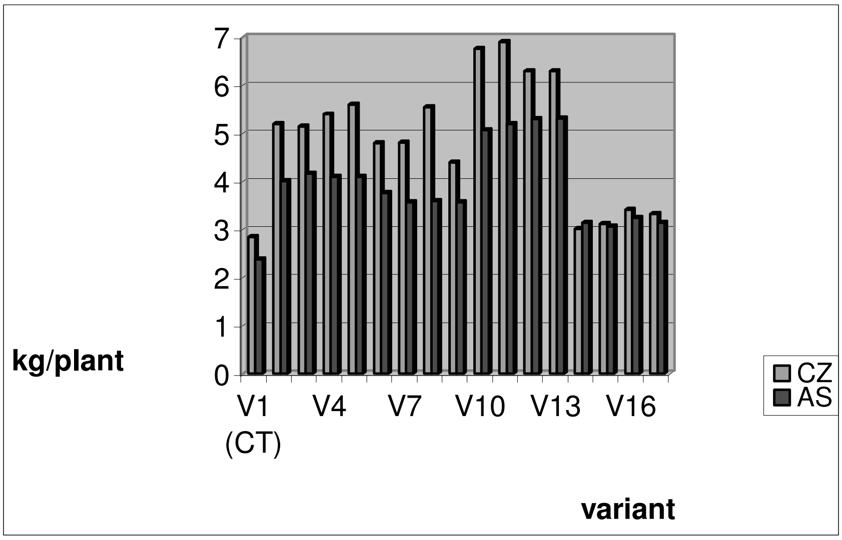


Fig. 1. Influence of fertilizers on tomato crop

The analytical data regarding total nitrogen content in tomatoes grown on the two soil types are showed in figure 2.

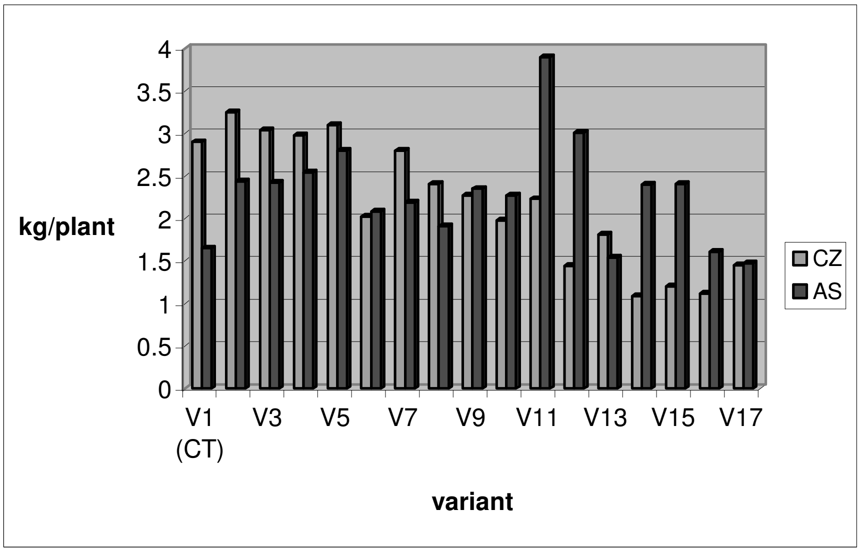


Fig. 2. Residual nitrogen in tomato fruits

The analytical data regarding total phosphorus content in tomatoes grown on the two soil types are showed in figure 3.

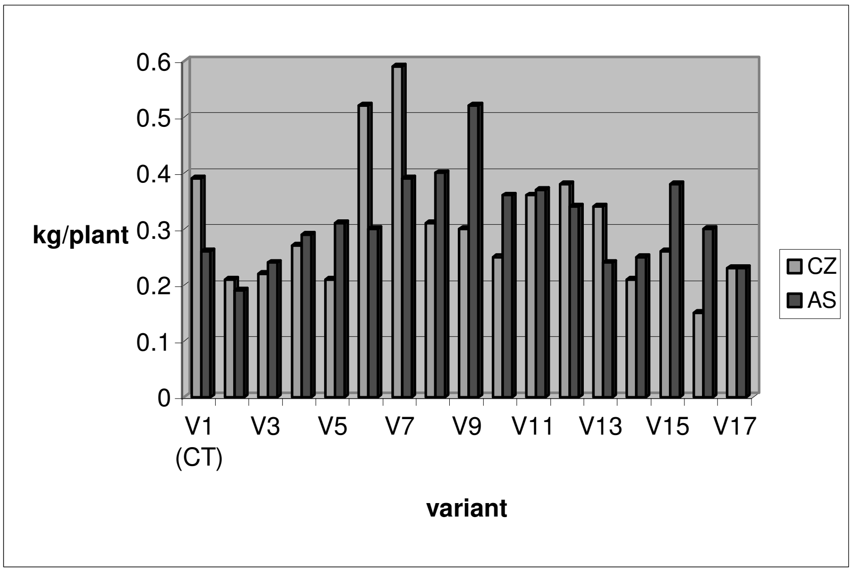


Fig. 3. Residual phosphorus in tomato fruits

The analytical data regarding total potassic content in tomatoes grown on the two soil types are showed in figure 4.

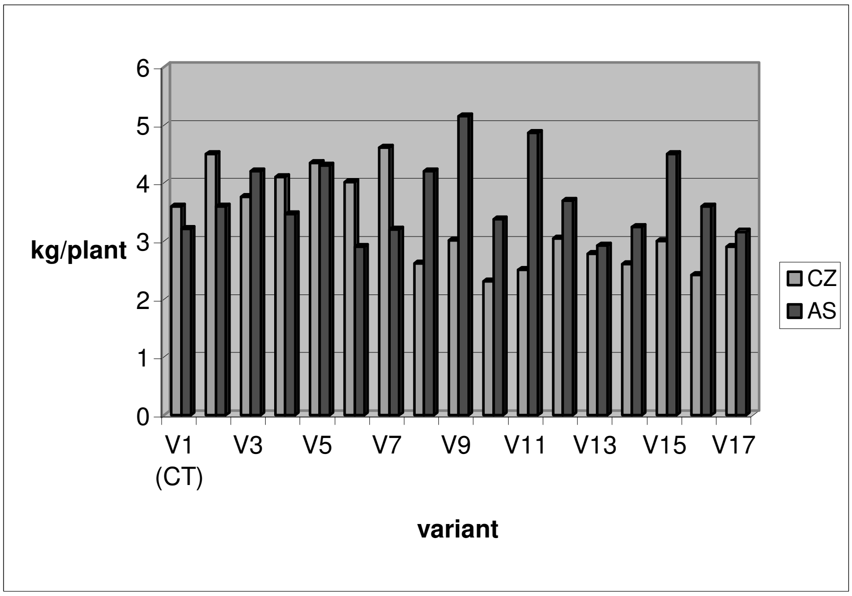


Fig. 4. Residual potassic in tomato fruits

CONCLUSIONS

1. The yields were higher in the case of Cambic chernozem as compared to the yields obtained in the case of Alluvial soil, especially with the treatments receiving nitrogen fertilizer.
2. Tomatoes quality was much higher in the case of treatments receiving phosphorus and potassium fertilizers as compared to the treatments receiving nitrogen fertilizer.
3. The nitrogen content values measured in soil after nitrogen fertilizer application were lower than the admissible limit for nitrogen soil pollution.
4. Content of nutritive elements (N, P and K) both in fruits and leaves does not show modifications as compared with the control.
5. The appearance of fruits (uniformity, color, etc.) obtained on Chernozem is much higher as compared to those obtained on Alluvial soil.

REFERENCES

1. Borlan Z., Cr. Hera, 1984. *Optimizarea agrochimică a sistemului sol-plantă*. Ed. Academiei R.S.R.
2. Davidescu D., Velicica Davidescu, 1992. *Agrochimie horticolă*. Ed. Academiei Române.
3. Dorneanu A., 1976. *Dirijarea feritității solurilor*. Ed. Ceres, Bucureşti.
4. Florea N., I. Munteanu, 2003. *Sistemul Român de Taxonomie a Solurilor*. Ed. Estfalia, Bucureşti.
5. Filipov F., I. Rusu, S. Udrescu, D. Vasile, 2005. *Pedologie*. Ed. AcademicPres, Cluj-Napoca.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

RESEARCH REGARDING THE INFLUENCE OF THE FERTILIZATION SYSTEM ON MAIZE PRODUCTION IN BRĂILA PLAIN

GABRIELA ALINA CIOROMELE

„Dunarea de Jos" University of Galati

Keywords: *maize, fertilization, yield, influence*

Abstract

Due to the fact that the fertilization system of the maize plant is directly involved in the growth and development processes, they influence both the fertility of the soil and the yields obtained.

The main objective for the research conducted in the crop year 2008-2009 was to determine what is the effect of chemical fertilization in the climatic conditions of this specific year, particular to the Râmnicelu area from Brăila Plain, on PR36R10 and Florencia maize hybrids.

The polyfactorial experiment was made here in order to investigate and estimate the influence of the fertilization factor on the crops that were obtained, analyzing the differences between the productions obtained in the crop year 2009 and 2010.

The average yield obtained was directly influenced by climatic conditions, rain and by the amount of fertilizer used.

In 2009, the average yield produced for the Florencia hybrid varied from 5800 kg/ha for the unfertilized version, to 9280 kg/ha for the fertilized ones while the production for the PR36R10 hybrid registered a growth of 2130 kg/ha for the version placed on an agrofond of $N_{100}P_{50}$.

INTRODUCTION

In the agricultural production, natural and anthropogenic factors act simultaneously, not separately (Dimancea St., 1966).

In agriculture, chemical fertilizers can be used to supply plants with nutritive elements but only as a complement to other agrophytotechnical measures like biological nitrogen fixation and crop rotation.

Maize is one of the most important plants for a country's economy due to the fact that it can be used as food for both humans and animals. That is why, in 1994, at a National Maize Growers Association Conference they said: "Life without maize would be a lot tougher".

The yield of maize however, varies from variety to variety, location to location and also depends on the availability of essential factors such as soil nutrient status and application of fertilizers. Nitrogen is a vital plant nutrient and a major yield-determining factor required for maize production (Adediran and Banjoko, 1995; Shanti et al., 1997).

Making this experiment in field conditions was the primary mean of establishing the optimal dose of fertilizer to be used in the specific soil conditions of Râmnicelu area.

MATERIAL AND METHODS

All the weather data, regarding the temperature, air humidity and rain was provided by SCDA Brăila.

The research on the influence of the dose of fertilizer was made on a soil that is specific to this area: aluviosol.

The experiment has been materialized on field following the method of parcels subdivided in 3 repetitions with two factors.

The first factor was represented by the hybrid with two graduations:

Factor A - the hybrid: a_1 - Florencia; a_2 - PR36R10. The second factor was represented by the agrofond with 2 graduations: b_1 - unfertilized and b_2 - fertilized with $N_{100}P_{50}$.

The cultivation technology was the same for both hybrids, placed in an unirrigated regime, and being fertilized with NPK complex fertilizer.

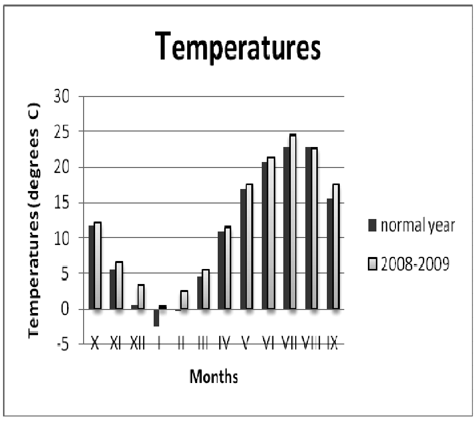
RESULTS AND DISCUSSION

The hydro-climatic characterization of the crop year 2009 highlighted a year with high temperatures that exceeded the normal limit with 1.2^0C (Figure 1).

From all the recorded temperatures it has been found that there were no negative monthly average temperatures in the cold period. The minimum was 0.3^0C in January.

Across the whole agricultural year the total rainfall was 363 mm, below the normal limit (447 mm) with 84 mm, attesting a year below average but highly contrasting. In April, May and June, the rainfall values registered, situated between 25 and 38 mm, were the lowest compared to the normal limit. This is why this crop year was described as poor when it comes to precipitations, and because of the low pluviometric input in the phenophase, the grain production was affected.

The soil on which the experiment was located was gley typically immersed. On the ploughed stratum, the soil was alkaline, eith 8.02 pH value, the humus content was good (4.12%), very well supplied with nitrogen (0.29%), phosphorus (42 ppm) and potassium (190 ppm).



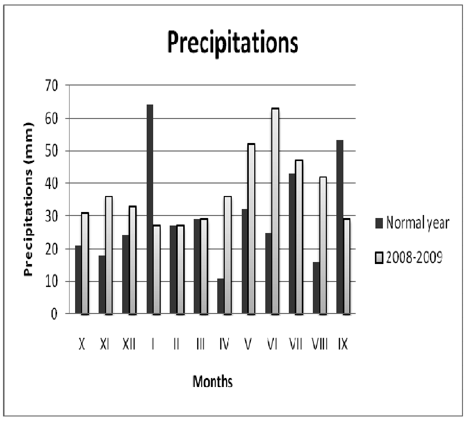


Fig. 1. Climate elements - temperatures and precipitations

Following the results obtained and materialized in the Table 1 it has been found that both PR36R10 and Florencia hybrids have registered significant production increases up to 3.5 t/ha. Thus, the Florencia hybrid has registered a production increase of maximum 3.4 t/ha in the first repetition compared with the unfertilized version while the PR36R10 hybrid has registered an increase of 2.13 t/ha.

Table 1

Influence of fertilizer rate on the maize crop yield

Hybrid / Rate	Florencia (kg/ha)	Dif. (kg/ha)	Signif.	PR36R10 (kg/ha)	Dif. (kg/ha)	Signif.
N_0P_0	5810	Control	-	6123	Control	-
$N_{100}P_{50}$	9279	3469	***	8253	2130	***

DL5% = 258 kg/ha; DL1% = 599 kg/ha; DL0.1% = 1881 kg/ha

Fertilization has positively influenced the productions obtained, observing a significant relationship between the level of production and the specific climatic conditions registered in the vegetation period of both hybrids. The correlation ratio between the 2 analyzed factors (the hybrid and the fertilization system) was 0.64, the yields obtained in all repetitions following the regression curve, which conducted to the conclusion that the "a" factor is dependent on the "b" factor.

CONCLUSIONS

1. The research conducted certifies that the production gain increases in the case of chemical fertilization, ranging between 1.4 and 1.6 t/ha.
2. A good result on grain production was recorded in hybrid PR36R10, this one satisfying better adaptability conditions than the Florencia hybrid.

3. The agricultural year of 2009 was characterized, in the vegetation period, as being extremely dry. This characteristic has negatively influenced the grain production obtained. In comparison with the agricultural year of 2010, when both hybrids have been observed in the same technological conditions, the yields obtained registered significantly higher values of approximately 12 t/ha for PR36R10 and 11.8 t/ha for the Florencia hybrid.
4. The results obtained from these studies showed more emphasis on the importance of N and P for maize, high fertilizer input is one of the conditions required to obtain maximum yield of Florencia and PR36R10 hybrid maize.
5. Production variations were influenced by both climate and the application of chemical fertilization, apply fertilizer based on nitrogen and phosphorus led to significant increases in production.

REFERENCES

1. Adediran J.A., V.A. Banjoko, 1995. *Response of maize to N, P, and K fertilizers in the savanna zone of Nigeria.* Commun. Soil Sci. Plant Anal. 26 (pp. 593-606).
2. Dimancea St., 1966. *Agrotehnica cu elemente de tehnica experimentala agricola*. Ed. Didactica şi Pedagogică, Bucureşti.
3. Kaulen B.T., 2005. *Effects of tillage, NPK Fertilization and time of sowing on the yield of Maize*. J. Appl. Sci. 3(2) (pp. 222-227).
4. Shanti K.V.P., M.R. Rao, M.S. Reddy, R.S. Sarma, 1997. *Response of maize (Zea mays) hybrid and composite to different levels of nitrogen*. Indian J. Agric. Sci. 67 (pp. 424-425).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

EXPERIMENTAL RESEARCH ON THE APPLICATION OF NEW FOLIAR FERTILIZERS ON LETTUCE CROP IN SOLAR

IULIA ANTON*, A. DORNEANU*, GEANINA BIREESCU, L. ILIE***, CARMEN SÎRBU*, ADRIANA GRIGORE***

*National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection of Bucharest
**Biological Research Institute of Iaşi
***University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *nutrients, foliar fertilization, environmental protection*

Abstract

Among the unconventional means of action on the internal environment of plants, to reduce the entropy dissipation of nutrients on the soil profile and to increase the degrees of productive use of nutrients in harvest, the newly created foliar products are part of research topics for their introduction in the Romanian agriculture [1, 6, 9, 10, 11].

Research was conducted in 2010, in the University of Agronomic Science and Veterinary and Medicine of Iasi, experimental field of the SDE V. Adamachi (horticultural farm Adamachi and Ezăreni ranch) and was aimed at:

- *increasing the productive potential of soil under conditions of environmental protection;*
- *establishing of unpolluting fertilization technologies;*
- *testing new Romanian and foreign fertilizers.*

For this purpose, experiments were tested on lettuce, Silvia cultivar, in the solarium, and seven liquid products of foliar application were tested.

INTRODUCTION

The results of the research in field, solarium and greenhouses with foliar fertilizers determined their recommendation and implementation in the agricultural and horticultural practice, globally. This encouraged progressive production of foliar fertilizers in many countries, both for their local use and export [12, 11, 5, 13, 9, 6, 1, 3, 4].

Newly created foliar products, tested for their introduction in Romanian agriculture are unconventional and non-polluting means of action on the internal environment of plants, to reduce the entropy dissipation of nutrients on the soil profile and to increase the degrees of productive use of nutrients in harvest [3, 4, 5, 11].

Foliar fertilizers are preferred by many countries [12, 13] as it was found that they had special advantages such as:

- provide enrichment plants with nutrients, micronutrients, minerals and vitamins that improve plant health, helping to increase production;
- are 100% water soluble and easy to apply;
- stimulate the production of microbial biomass, by increasing the fertility of the soil;
- prevent the development of pathogens in plants;
- stimulate plant health;
- determine the production of compounds that stimulate the natural defense mechanisms of plants.

MATERIAL AND METHODS

Research was conducted in 2010, in the University of Agronomic Science and Veterinary Medicine of Iasi, experimental field of the SDE V. Adamachi (horticultural farm Adamachi and Ezăreni ranch) and was aimed at:

- increasing the productive potential of soil under conditions of environmental protection;
- establishing of unpolluting fertilization technologies;
- testing new Romanian and foreign fertilizers.

For this purpose, experiments were tested on lettuce, Silvia cultivar, in the solarium, and seven liquid products of foliar application were tested.

V.1	Control, sprinkled with water
V.2	F111 Hum - 1%
V.3	F111 Hum - 3%
V.4	F311 Hum - 1%
V.5	F311 Hum - 3%
V.6	Humat de potasiu - 1%
V.7	Accele-GRO-M - 0.1%
V.8	Accele-GRO-M - 0.3%

RESULTS AND DISCUSSION

The soil on which the experiments were located was a hortic antrosol from the SDE UASVM Iasi, with a potential for high fertility. The main physical and chemical qualities of soil are presented in table 1, both in unfertilized control variant, but sprinkled with water, and also for highly productive variants, foliar fertilized.

Figure 1 shows the influence of fertilization with fertilizers tested.

Foliar fertilization increased the total assimilatory pigments (39.34%-Accel-GRO-M-0.1% and 43.30% - F 311-1%) and the content of each pigment (Table 2).

It appears that by foliar fertilization are obtained significant increases (36.23% - potassium humate-1% and 40.77% - F311 Hum -1%) (Figure 1, Table 3).

Fig. 1. Influence of fertilization on lettuce, in solar (Silvia cultivar)

CONCLUSIONS

1. Foliar fertilization is a complementary measure, unconventional and ecological fertilization can improve the mineral nutrition and plant tissues which can created, of course, a nutritional balance that makes the plants to withstand stress conditions and also to ensure satisfactory yields.
2. It appears that the foliar fertilizers applied have stimulated plants to additional consumption of mobilized nutrients from the reserve soil, increasing root absorption capacity.
3. The foliar fertilizers used to lettuce, Silvia cultivar, during vegetation plants, provide significant production increases statistically compared with control unfertilized. It appears that by foliar fertilization are obtained significant increases (36.23% - potassium humate-1% and 40.77% - F311 Hum-1%).
4. In particular the following products were highlighted, foliar applied, which realized the significant production increases and energy balance: F 311 Hum-3% (40.77%), (31.34%); and F111 Hum-3% (39.05%), (29.79%), respectively.
5. Fertilizers tested by foliar fertilization increased the total content in assimilatory pigments (39.34% - Accel-GRO-M - 0.1% and 43.50% - F 311 Hum-3%) and content of each pigment in part.

REFERENCES

1. Anton Iulia, A. Dorneanu, P. Niculiță, D. Dana, G. Bireescu, I. Oprică, 2008. *Results regarding the effects of Fertec fertilizers on tomatoes grown in glasshouse of S.C. SERE S.A., Codlea*. Lucr. Şt., seria Agronomie, vol. 51, Ed. Ion Ionescu de la Brad, Iaşi.

2. Anton Iulia, A. Dorneanu, D. Dana, G. Bireescu, L. Ilie, V. Coteț, I. Oprică, D. Mihalache, A. Grigore, 2009. *Research on ecological protection effect on the environment ensured by fertilization with new range of liquid fertilizers*. Scientific Papers, Series A, LII, Agronomy, Bucharest.
3. Anton Iulia, 2010. *Utilizarea îngrăşămintelor lichide în spații protejate în vederea optimizării regimului elementelor nutritive în sistemul sol-plantă la tomate şi ardei*. Ed. Sitech, Craiova.
4. Anton Iulia, 2010. *Optimizarea regimului elementelor nutritive la culturile din sere*. Ed. Sitech, Craiova.
5. Bireescu Geanina, L. Bireescu, Dorneanu Emilia, I. Gavriluta, 2006. *Cercetari privind efectul unor fertilizanti foliari noi asupra productivitatii si calitatii culturilot in conditiile conservarii mediului.* Lucrarile Simpozionului International: Managementul Nutrientilor pentru Imbunatatirea Calitatii Culturilor si Conservarea Mediului, Craiova (pp. 291-299).
6. Bireescu L., Geanina Bireescu, A. Dorneanu, Iulia Anton, 2007. *Studiul eficientei agronomice si energetice a fertilizarii foliare in vederea optimizarii sistemelor de fertilizare.* Lucrarile Simpozionului International: Restaurarea Fertilitatii Solurilor prin Diferite Sisteme de Fertilizare in Agricultura Durabila, Timisoara (pp. 375-383).
7. Burzo I., Elena Delian, Aurelia Dobrescu, Viorica Voican, Liliana Bădulescu, 2004. *Fiziologia plantelor de cultură. Vol. I, Procesele fiziologice din plantele de cultură*. Ed. Ceres, Bucureşti.
8. Cioroianu T., C. Sîrbu, M. Dumitru, A. Dorneanu, D. Ştefănescu, 2009. *Îngrăşăminte neconvenționale - Fertilizanți lichizi*. Ed. EstFalia.
9. Dana Daniela, Veronica Găină, 2006. *Fertilizarea foliară un mijloc eficient de prevenire şi combatere a dereglărilor de nutriție cu micronutrienți la cultura de porumb şi floarea soarelui*. Ed. Cartea Universitară.
10. Dana Daniela, Daniela Ştefanescu, Maria Soare, Iulia Anton, Ioana Oprica, Carmen Sarbu, 2007. *Cercetari preliminare privind efectul fertilizarii cu diferite doze de azot si ingrasaminte foliare asupra compozitiei chimice a plantelor de floarea soarelui.* Lucrarile Simpozionului International: Restaurarea Fertilitatii Solurilor prin Diferite Sisteme de Fertilizare in Agricultura Durabila, Timisoara (pp. 367-375).
11. Dorneanu A., M. Dumitru, Iulia Anton, 2009. *Foliar fertilization-a complementary tehnology of high efficiency for improving plant nutrition in the sustainable agriculture*. The IVth Congress of the Academy of Romanian Scientists "Quality of Life", Timişoara, Romania.
12. El Fouly M.M., 2002. *Quality of foliar fertilizers.* ISHS Acta Horticulturae 594: International Symposium on Foliar Nutrition of Perennial Fruit Plants.
13. Mengel K., 2002. *Alternative or complementary role of foliar supply in mineral nutrition.* ISHS Acta Horticulturae 594: International Symposium on Foliar Nutrition of Perennial Fruit Plants.

Table 1

Main physical and chemical characteristics of soil

Ecopedotop	Specification	Clay under 0.002 mm	Text. cls.	Porosity of aeration	EC, mS/cm	pH in H_2O	Humus, %	Nt, %	P_{AL}, ppm	K_{AL}, ppm	SB, me	T, me	V, %
SDE USAMV Iaşi 20.07.10 *Hortic Antrosol Solars (0-20 cm)*	Lettuce, row of plants	35.1	TT	25	0.386	6.73	3.754	0.256	88	254	27.7	30.4	93
	Lettuce, interspace of plants	35.8	TT	13	0.441	6.88	3.775	0.275	95	267	29.8	32.5	95

Table 2

Efficiency of foliar fertilization on lettuce photosynthesis in solar, non-irrigated (Silvia cultivar)

Variants	a Clorophyll				b Clorophyll				Carotene				Total pigments (mg/g s.pr)			
	mg/g	*dif*	*%*	*Sem*	*mg/g*	*Dif*	*%*	*Sm*	*mg/g*	*Dif*	*%*	*Sm*	*mg/g*	*Dif*	*%*	*Sm*
Control, sprinkled with water	0.2051	-	100	-	0.1743	-	100	-	0.1406	-	100	-	0.5200	-	100	-
F111 Hum -1%	0.2897	0.0846	141.26	xxx	0.2503	0.0760	143.66	xxx	0.2008	0.0602	142.83	xxx	0.7408	0.2208	142.46	xxx
F111 Hum - 3%	0.2943	0.0892	143.51	xxx	0.2541	0.0798	145.83	xxx	0.2033	0.0627	144.66	xxx	0.7517	0.2317	144.55	xxx
F311 Hum - 1%	0.2920	0.0869	142.38	xxx	0.2514	0.0771	144.25	xxx	0.2018	0.0612	143.59	xxx	0.7452	0.2252	143.30	xxx
F311 Hum - 3%	0.2957	0.0906	144.19	xxx	0.2560	0.0817	146.91	xxx	0.2049	0.0643	145.78	xxx	0.7566	0.2366	145.50	xxx
Humat de potasiu - 1%	0.2887	0.0836	140.78	xxx	0.2486	0.0743	142.67	xxx	0.1987	0.0581	141.35	xxx	0.7360	0.2160	141.53	xxx
Accele-GRO-M - 0.1%	0.2845	0.0794	138.73	xxx	0.2446	0.0703	140.35	xxx	0.1955	0.0549	139.07	xxx	0.7246	0.2046	139.34	xxx
Accele-GRO-M - 0.3%	0.2883	0.0832	140.57	xxx	0.2483	0.0740	142.48	xxx	0.1986	0.0580	141.28	xxx	0.7352	0.2152	141.38	xxx

DL5%-0.0217 mg/g s.pr *DL5%-0.0271 mg/g s.pr.* *DL5%-0.0214 mg/g s.pr* *DL5%-0.0861 mg/g s.pr.*
DL 1%-0.0386 mg/g s.pr *DL 1%-0.0315 mg/g s.pr* *DL 1%-0.0337 mg/g s.pr* *DL 1%-0.1358 mg/g s.pr*
DL 0.1%-0.0514 mg/g s.pr *DL 0.1%-0.0578 mg/g s.pr* *DL 0.1%-0.0426 mg/g s.pr* *DL 0.1%-0.1784 mg /g.s.pr*

Table 3

Energy and productive efficiency on lettuce fertilization in solar, non-irrigated (Silvia cultivar)

Variants	Average prod. (kg/ha)	Productiv efficiency (kg/ha)			Energy efficiency (Mcal/ha)					
		Dif.	*%*	*Smn.*	*Output*	*Input*	*Balance*	*Dif.*	*%*	*Smn.*
Control, sprinkled with water	8028	-	100	-	1204	301	903	-	100	-
F111 Hum – 1%	11016	2988	137.22	xxx	1652	496	1156	253	128.02	xxx
F111 Hum – 3%	11163	3135	139.05	xxx	1674	502	1172	269	129.79	xxx
F311 Hum – 1%	11120	3092	138.52	xxx	1668	500	1168	265	129.35	xxx
F311 Hum – 3%	11301	3273	140.77	xxx	1695	508	1186	283	131.34	xxx
Humat de potasiu – 1%	10936	2908	136.23	xxx	1640	492	1148	245	127.13	xxx
Accele-GRO-M – 0,1%	10939	2911	136.26	xxx	1641	492	1149	246	127.24	xxx
Accele-GRO-M – 0,3%	11083	3055	138.05	xxx	1662	499	1163	260	128.79	xxx

DL 5%-1372 kg/ha
DL 1%-1903 kg/ha
DL 0.1%-2516 kg/ha

DL 5%-105 Mcal/ha
DL 1%-156 Mcal/ha
DL 0.1%-214 Mcal/ha

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

EFFECTS OF IRRIGATION AND AMELIORATION TECHNOLOGY ON MICROBIOLOGICAL AND ENZYMATIC PROPERTIES OF SOIL

IRINA SENIKOVSKAYA, V. FILIPCHIUK

"Nicolae Dimo" Institute of Soil Science, Agrochemistry and Soil Protection of Chisinau

Keywords: *irrigation, microorganisms, enzymes, amelioration, wastes*

Abstract

The significant negative effects on the microbiological and enzymatic properties of typical chernozem located in the Northern zone of the Republic of Moldova were observed as a result of long-term irrigation with saline water. The stocks of microbial biomass in the 0 - 160 cm layer were of 8073,5; 5274,2 and 4486,9 kg ha^{-1} in the fallow chernozem (natural standard), arable un-irrigated and arable irrigated chernozems respectively. A similar trend has been noticed in the vertical distribution of enzymatic activities. There was a 3,6 - fold increase in the amount of humus - mineralizing microorganisms.

A soil management with the application of wastes (sugar industry sugar lime, manure) created conditions for the improvement of the microorganisms' vital activity in the degraded chernozem. Microbiological and enzymatic soil parameters depended on the doses of sugar lime material and the content of Na^+ in the absorbing complex. A scale for assessing the ameliorative status of irrigated soils and for developing national standards of soil quality was elaborated. The use of sugar industry waste (the reserve of five years) with manure 60 t ha^{-1} has been recommended for the regeneration of microbial communities, immobilization of enzymes and improvement of soil quality.

INTRODUCTION

The degradation of soils in the Republic of Moldova is the most critical, threatening problem for agriculture, for environment and people's habitat. Significant negative influence of the irrigation management using unsatisfactory water quality on soil's physical and chemical properties was observed. The mitigation of negative consequences caused by irrigation may be achieved by applying different wastes. Annually, about 250-300 thousand of sugar industry waste materials (sugar lime) accumulate in the country [1]. This waste is the liming material with an alkaline reaction (pH=7.75-8.05), it has a moderate organic matter content (3.8-4.2%). It has been determined that sugar lime is a biologically active material, in which bacteria are predominant among microbial population. Preliminary researches demonstrated that the biota's status of irrigated soils depends on the irrigation cycles, water quality, peculiarities of plants and other factors. On the other hand, microbiological processes are important for the transformation of wastes of different compositions in soils. That is why the problem of the evaluation of the new reclamation technology to reduce the degradation of irrigated chernozem is so up-to date. The purpose of the research was to determine the influence of the irrigation management and amelioration technology by applying wastes (sugar industry waste material, manure) on the change of the microbiological and enzymatic properties of soil and to develop scale parameters of the stability of the microbial community.

MATERIAL AND METHODS

Experimental site. The experimental site is located in the northern zone of the Republic of Moldova. For a period of 23-25 years, the irrigation was carried out using poor water quality from the Reut river. The mineralization of irrigation water fluctuated between 0.780 and 1.200 mg $dm^{(3)-1}$; pH=8.4-8.6; SAR=4-6. The experiment was replicated four times in a randomized split-plot design without using waste management treatments and by applying sugar lime material annually, by dose with a reserve for three years and dose with a reserve for five years (24.9; 26.8 and 28.8 t ha^{-1} accordingly). The dose of the ameliorant was calculated taking into account the full replacement of the exchangeable Na^+ and the content of this element in the irrigation water. Reclaimed plots received 60 t ha^{-1} of manure. The research was conducted in 2007-2009. Before the experiment, the soil indices in the 0-30 cm layer were as it follows: humus content - 4.21%; P_2O_5 - 5.30 mg 100 g^{-1}; K_2O - 30.4 mg $100g^{-1}$; water-soluble salts content - 0.064 %; exchangeable Na^+ was 4.73 me $100g^{-1}$ or 12% from the total exchangeable cations; pH=7.6.

Soils. The site's soil is a typical chernozem. The irrigation effect was studied by comparing irrigated chernozem with un-irrigated and fallow (natural standard) chernozems. Sampling was carried out in three soil profiles to a depth of 170 cm. Samples of the experimental plots were collected from 0-30 cm and 30-50 cm layers twice during the growing season.

Microbiological properties. Microbial biomass (MB) was measured by the rehydratation method based on the difference between C extracted with 0.5 M K_2SO_4 from dried soil at 65-70^{0}C for 24 h and fresh soil samples by K_c coefficient of 0.25. K_2SO_4 - extractable organic C concentrations in the dried and fresh soil samples were simultaneously measured by dichromate oxidation. The quantity of K_2SO_4 - extractable C was determined at 590 nm with "Specol-221" spectrophotometer (Germany). Stocks of the MB have been calculated taking into account the carbon content of the microbial cell and the bulk density of soils.

Counts of culturable microorganisms (heterotrophic bacteria, humus-mineralizing microorganisms, bacteria from *Azotobacter* genus and fungi) were obtained on agar plates.

Enzymatic activity. The dehydrogenase activity (potential) was determined by the colorimetric technique on the basis of occurring triphenylformazan (TPF) from

TTC (2,3,5-triphenyltetrazolium chloride) added to air-dry basis of soil. The polyphenoloxidase activity (potential) was determined by the colorimetric technique on the basis of the oxidation of phenolic compounds to quinones.

Soil chemical properties. Organic C was analyzed by the dichromate oxidation method. Available P and K was extracted with 1% $(NH_4)_2CO_3$ by the Olsen method. P_2O_5 was determined by colorimetric technique, K_2O - by flame photometric method. Exchangeable cations were extracted with 1M NH_4Cl in the 60% C_2H_5OH at pH=8.5; Ca and Mg in the extracts were analyzed by the complexometric method, Na - by the flame photometric technique. Soil pH was measured in a 1:2.5 soil : water slurry using a glass electrode. The microbiological and enzymatic indices were evaluated statistically by analysis of variance.

RESULTS AND DISCUSSION

The influence of irrigation. The long-term irrigated typical chernozem showed a significant decrease in the microbiological and enzymological indices as compared to un-irrigated and fallow soils (Table 1, Figure 1). The highest level of the microbial biomass and organic carbon content as well as enzymatic activities have been determined in the A_1 horizon of the fallow chernozem and whereas the lowest - in the BC and C horizons of all profiles. The stock of microbial biomass in the 0-160 cm layer of the arable irrigated chernozem decreased by 14.9% as compared with the un-irrigated chernozem and was 1.8 times lower than in the fallow soil.

Irrigation affected the structure of soil microbial communities. There was a 3.6 -fold increase in the number of humus-mineralizing microorganisms. Irrigation led to decreases in the number and diversity of soil fungi. Shannon index went down from 2.53 in the fallow chernozem to 2.28 in the irrigated chernozem. In the irrigated soil there were fungi of *Penicillium*, *Fusarium* families and *Alternaria alternata* species. A negative impact on soil's enzymatic properties was observed as a result of the irrigation with poor water quality (Figure 1). Dehydrogenase and polyphenoloxidase activities in the soil profiles increased with its depth. The dehydrogenase activity in the 0-50 cm of the irrigated chernozem was 1.2 - 5.2 times lower than in un-irrigated and fallow soils. The profile distribution of the polyphenoloxidase activity was more complex. However, the inhibitory effect of irrigation on the activity of this enzyme is obvious.

Modifications of the microbiological and enzymatic properties in the degraded chernozem are reported as by changes in the chemical and physical properties of the soil. Negative shifts in the state of microorganisms and enzymes occurred because of the soil alkalization, changes in the composition of the organic matter and the deterioration of the soil structure. The number of exchangeable Na^+ in the irrigated chernozem reached 12%, which corresponds to the moderate degree of alkalization.

Table 1

Profile distribution of the organic C and microorganisms in the irrigated typical chernozem in comparison with un-irrigated and fallow soils

Genetic horizon and depth, cm	Organic C, %	MB		Heterotrophic bacteria, CFU $g^{-1}soil*10^6$	Humus-mineralizing microorganisms, CFU $g^{-1}soil*10^6$	Stock of MB, kg ha^{-1} (0-160 cm)
		μ g C g^{-1} soil	kg ha^{-1}			
Typical chernozem (40-year-old fallow land)						
A_1 0-3	3.53	979.5	640.6	10.5±1.29	5.7±0.12	8073.5
A 3-38	2.64	519.2	4070.5	6.1±0.64	4.9±0.07	
B_1 38-79	2.16	298.3	2959.7	1.3±0.06	0.6±0.03	
B_2 79-101	0.71	66.8	402.7	0.6±0.03	0.2±0.01	
BC101-123	0.59	0	0	0.07	0.2±0.01	
C 123-170	0.62	0	0	0	0	
Un-irrigated arable typical chernozem						
Ap 0-25	2.45	237.5	1460.6	5.2±0.38	15.9±0.28	5274.2
A 25-41	2.14	206.9	1387.9	4.1±0.21	9.8±0.18	
B_1 41-64	1.47	176.6	1121.1	1.8±0.10	2.8±0.10	
B_2 64-89	0.85	107.5	763.3	0.3	0.6±0.03	
BC 89-114	0.51	22.4	160.2	0.1	0.2	
C 114-160	0.60	27.8	381.1	0	0.4	
Arable typical chernozem irrigated with water from the Reut river						
Ap_1 0-21	2.45	214.8	1127.7	5.4±0.36	19.5±0.25	4486.9
A_2 21-35	2.23	213.9	778.6	5.3±0.11	15.3±0.09	
A 35-49	2.02	193.3	774.0	4.5±0.05	12.8±0.02	
B_1 49-69	1.10	164.0	944.6	2.6±0.09	4.7±0.10	
B_2 69-91	0.87	92.9	605.0	1.3±0.09	2.3±0.04	
$BC_1$91-110	0.67	45.7	257.0	0.8±0.02	0.3±0.01	
C 110-150	0.56	0	0	0	0	

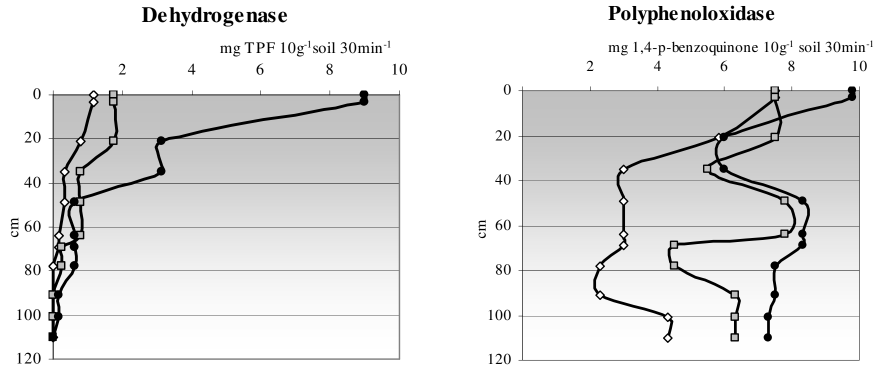


Fig. 1. Effects of long-term irrigation on the profile distribution of enzyme activity of typical chernozem (—fallow; —un-irrigated; —irrigated)

The soil became slightly alkaline, pH increased from 7.1 to 7.6. The data presented in these studies demonstrate that the long-term irrigation of typical chernozems with water from the Reut river has negatively affected the microbial communities and the soil in general. The values of microbiological and enzymatic indices were typical for degraded chernozems. These soils have a low ecological stability and need the amelioration of the soil's root layer.

Effects of amelioration technology. The application of wastes to improve the ameliorative status of irrigated soils changes the habitat of microorganisms. The ameliorants improve the microbiological and enzymatic properties of the irrigated chernozem. The modifications that occurred were higher in the 0-30 cm layer than in the 30-50 cm layer. However, there were significant differences in the enzymatic activities between the values of the control (un-irrigated) plot and the amended plots to a depth of 50 cm. Positive effects of wastes on soil chemical and physical properties and organic matter content promote microbial proliferation in the soil's root layer. The use of wastes (3 and 5 years reserve) together with 60 t ha^{-1} of manure led to an increase of the microbial biomass content from 170.3-217.7 µC g^{-1} soil to 245.0-302.3 µC g^{-1} soil in the 0-30 cm layer. This fact has been interpreted as the response of soil microbial communities to the favorable environmental conditions.

Table 2

Scale of microbiological and enzymatic parameters (confidence intervals) of the irrigated typical chernozem (0-30 cm)

Degree of stability	**MB, µ g C g^{-1} soil**	**Viable counts of microorganisms**		**Enzymatic activity**	
		Humus miner.micr., CFU g^{-1}soil*10^6	***Azotobacter*, CFU g^{-1}soil**	**Dehydrogenase, mg TPF 10g^{-1} soil 24h^{-1}**	**Polyphenoloxidase, mg 1,4-p-benzoquinone 10g^{-1} soil 30 min^{-1}**
Control (Na^+, 12 % from the total exchangeable cations)					
Low	170-218	18 – 19	111 – 115	1.2 – 1.9	5.3 – 6.9
Sugar lime applied annually (Na^+, 10 % from the total exchangeable cations)					
Low	219-313	16 – 17	151 – 185	1.7 – 3.2	8.1 – 13.7
Sugar lime, 3 years reserve (Na^+, 8 % from the total exchangeable cations)					
Moderate	249-302	13 – 16	195 – 231	1.9 – 4.0	9.8 – 14.0
Sugar lime, 5 years reserve (Na^+, 7 % from the total exchangeable cations)					
Moderate	245-291	11 – 14	232 – 254	2.5 – 4.7	11.3 – 16.5

Wastes amended soils showed a significant increase in the counts of culturable microorganisms. The number of heterotrophic bacteria increased on average by 18-37%. There was a 1.5-2.2-fold increase in the counts of bacteria from *Azotobacter* genus compared to the un-irrigated control plot. Counts and diversity of fungi were higher under application of wastes. Shannon index raised from 2.28 to 2.45. As a result of the application of waste with in reserve for 5 years the counts of humus - mineralizing microorganisms decreased by 30%.

The amelioration technology significantly improves the enzymatic status of irrigated chernozem. According to the statistical parameters, the dehydrogenase activity in the 0-30 cm layer increases by 1.6-2.3 times and the polyphenoloxidase activity - by 1.8-2.3 times depending on the ameliorants doses. A similar trend has been noticed in enzymatic activities in the 30-50 cm layer.

The microbiological and enzymatic parameters of soil depended on the doses of sugar lime material and the content of Na^+ in the absorbing complex. A scale to estimate the irrigated chernozem reclamation was elaborated (Table 2). The use of sugar industry waste (the reserve for five years) with manure 60 t ha^{-1} has been recommended for the regeneration of microbial communities, immobilization of enzymes and improvement of soil quality.

CONCLUSIONS

1. The long-term irrigation of the typical chernozem with saline water leads to its degradation. This is reflected in the deterioration of soil microbiological and enzymatic properties. The stocks of microbial biomass decreased by 1.8 times in comparison with the standard. The enzymatic activity went down 3.2 times. The structure of microbial community changes. In the irrigated soil humus destroying microorganisms dominate. The values of the microbiological and enzymatic indicators, the organic carbon content decrease in the following sequence: typical chernozem (40-year-old fallow land) → typical un-irrigated arable chernozem → typical irrigated arable chernozem. The soil's root layer is covered by degradation processes.
2. The soil management with the application of wastes (sugar industry sugar lime, manure) created conditions for the improvement of the microorganism's vital activity in the soil which degraded as a result of irrigation. The microbial system is stabilized, increasing the microbial biomass content in average by 1.4 times, improving biodiversity, reducing the content of humus-mineralizing microorganisms by 30% and activating enzymes. A microbiological method to estimate the ameliorative status of irrigated soils has been elaborated. A scale of microbiological and enzymatic parameters for the national soil quality standards has been proposed.

REFERENCES

1. xxx, 2004. *Programul complex de valorificare a terenurilor degradate şi sporirea fertilităţii solurilor*. Partea a II-a, Red. resp. S. Andrieş. Chişinău, Pontos (pp. 38).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

INFLUENCE OF ORGANIC AND MINERAL FERTILIZATION ON THE LEVEL OF SOIL FERTILITY IN A LONG DURATION EXPERIMENT IN MOARA DOMNEASCA - ILFOV

L. DINCĂ, D.I. SĂNDOIU, G. ŞTEFANIC

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *organic and mineral fertilization, biologic and enzymic indicators, soil fertility*

Abstract

In this paper the influence of different organic or mineral fertilizers on soil fertility level is studied in a long term experiment, in field, on reddish preluvosol. Soil vital activity (respiration and cellulozolitic one) and pedoenzymic activities (catalase, saccharase, phosphatase and amidase) were analyzed. For a good and easier interpretation of experimental data, the partial and synthetic indicators of soil fertility level are presented. The final conclusion, which can be presented, is that the fertilization with composted manure (30 t/ha/3 year), refuses of sugar-beet and a minimum dose of mineral fertilizers are the best for soil fertility.

INTRODUCTION

In the second part of the 20th century, and at present also, the applied agrotechnologies have determined parallelly with the high crops, the soil fertility degradation. However, all these observations were made by the means of the soil chemistry, phytopatology and entomology of plants as a consequence of chemical treatments used in agriculture. European Commission "EC agricultural policy for the 21-st century, Bruxelles, 1994" presented one's own proposals for a sustainable agriculture, but the determinant measures were of economic nature, not regarding to the soil fertility. Because we are interested to know the impacts of the chemical fertilizers and the organic fertilization on soil fertility, we analyzed the soil fertility evolution in a field experiment on reddish preluvosol, using biotical and pedoenzymic tests.

MATERIAL AND METHODS

1.1. In experimental field. Location: Experimenal and Training Station from Moara Domnească, Ilfov County on reddish preluvosol. The experiment has been carried out since 1992, with 3 plants in crop-rotation (sugar beet, winter wheat and winter barley), with **factor A (organic fertilization): $\mathbf{a_1}$**-Organically and mineral unfertilized; $\mathbf{a_2}$-Manure (natural composted, with cca. N_t 1%) in **the** second year from the application of 30 t/ha, at 3 years; **a$_3$**-Application of 40 t/ha (leaves and crowns of sugar-beet), and **factor B (annual mineral fertilization): b$_1$.** N_0;**b$_2$.** N_{50}; **b$_3$.** N_{100}; **b$_4$.** N_{150}; **b$_5$**. N_{200} kg/ha. The soil samples were sampled in autumn, after the fertilization with ammonium nitrate and with supperphosphate (a part of the total dose). This experiment was founded in collaboration with J.V. Liebig University from Giessen, Germany [4].

1.2. ***Pedobiological research.*** Sampling was made from each randomized repetition of the variants. Analitycal data express the soil biotical potentials of: respiration and cellulolyse and potentials of: catalase, saccharase, phosphatase and amidase. The work methods are described after [10, 11, 12] and Dincă and Ştefanic [in this papers].

Soil respiration was quantified in Ştefanic's respirometer. Soil cellulolyse was quantified by the method of [12], after 18 days of incubation, at 28^0C. Soil catalase activity was quantified by the automatic catalase apparatus [10]. Soil saccharase activity was quantified by Hofmann and Seegerer's method, improved by us [4]. Soil total phosphatase activity was quantified by an original method of us [6, 1]. Soil total amidase activity was quantified by the original method of us [11], in the same conception as for phosphatases.

Dincă and Ştefanic have achieved an improved of the laboratory technique by determining the total phosphatase and total amidase activities in the same enzymic mixture and filtrate.

1.3. Calculation of partial and synthetic indicators for estimating the soil ferility level. According with his definition of soil fertility [7], a maximal empirical value (MEV) have proposed and used the calculation of some indicators of soil fertility level. A maximal empirical value (MEV) for each analytical result was introduced as reference. For classifying the level of each result and for making it comparable with other results it uses this formula: X% = Xa*100 / MEV in which: X % = percentual value of each parameter; Xa = analytical result. MEV for respiration = 150; for cellulolyse this is even in %; for catalase is 2000, for sacharase is 3500; for total phosphatase = 25 and for total amidase = 1.

Formula for soil biotical indicator is: **IVAP%** = Respiration % + Cellulolyse % / 2.

Formula for soil enzymical indicator is: **IEAP%** = (Catalase % + Saccharase % + Total Phosphatases % + Total Amidases %) / 4.

Finally, **B**iological **S**ynthetic **I**ndicator is calculated**: BSI%=IVAP%+IEAP% / 2**

RESULTS AND DISCUSSION

Influence of agricultural measures applied, annually, on reddish – preluvosoil from Moara Domnească - Ilfov, has produced some modifications in the level of soil fertility, presented in the tables 1 and 2. The influence of fertilizers on soil vital activity can be generally appreciated by the Indicator of Vital Activity Potential

(IVAP %). The IVAP % registered better influences on soil vitality by mineral fertilization (table 1), especially in variants fertilized with plant remains or manure. A second group of laboratory tests for evaluating human influence on soil fertility is that of pedoenzymes. We introduced (after Ştefanic, 1994) the following tests: catalase, saccharase, total phosphatases and total amidases, all this enzymes exist free in soil, from micro- and macropopulation or from other terrestrial sources, being named *pedoenzymes.*

Table 1

Influence of organic and mineral fertilization of reddish preluvosol on respiration (CO_2 evolved – mg/100 g soil d.s.) and biodegradated cellulose (%), estimated by the Indicator of Vital Activity Potential (IVAP %)

Experimental variants		**Respiration**	**Biodegradated cellulose**	**IVAP %**
a_1 Unfertilized organically	b_1-N_0	**e** 40.15	**b** 13.38	**b** 20.08
	b_2-N_{50}	**e** 40.25	**b** 17.38	**b** 23.44
	b_3-N_{100}	**d** 52.26	**a** 25.20	**a** 30.02
	b_4-N_{150}	**c** 58.21	**a** 30.20	**a** 34.5
	b_5-N_{200}	**c** 63.72	**b** 8.690	**b** 25.58
a_2 Manure (natural composted) in the second year from the application of 30 t/ha	b_1-N_0	**e** 44.09	**b** 17.38	**b** 23.39
	b_2-N_{50}	**d** 57.71	**b** 20.69	**a** **29.58**
	b_3-N_{100}	**d** 56.57	**a** 26.80	**a** **32.25**
	b_4-N_{150}	**d** 51.02	**a** 35.11	**a** 29.94
	b_5-N_{200}	**c** 64.53	**b** 15.43	**a** 29.23
a_3 Application of 40 t/ha (leaves and crowns)	b_1-N_0	**e** 39.51	**b** 8.170	**c** 17.25
	b_2-N_{50}	**d** 57.47	**b** 17.81	a 28.06
	b_3-N_{100}	**a** 87.41	**b** 9.47	**a** **33.87**
	b_4-N_{150}	**a** 90.67	**c** 6.360	**a** **33.40**
	b_5-N_{200}	**b** 77.22	**b** 16.42	**a** 33.95
DLP 5%		6.75	13.95	7.67

Researches [2] put in evidence that the process of fermentative burning of energetic material from the colloidal particle surface of soil is controlled by catalase. According to one sees from table 2, mineral fertilizers, applied to soil since 1992, have had a negative influence on catalase activity in soil. The highest activity was found only in lack of mineral fertilization. The chemical reaction of soil, treated with ammonium nitrogen and superphosphate, diminished between pH 5.27 and 4.92, depending on the N dose. Catalase is destroyed at pH 3 [5]. Concerning the saccharase activity, the variations are't dependent of the treatments. The following two hydrolytic enzymes, phosphatase and amidase (in an original methodological conception [6, 1, 11] have given possibility to find oneself whether the organic and mineral manures have somebody influence in accumulation of enzymes and in the same time, in the concentration of specific substrates. The classical enzymic methods have given information only about the accumulation of phosphomonoesterase, diphosphomonoesterase, nuclease etc, or urease, asparaginase etc. introducing the specific enzymical substrate. In our case, one ascertains that, organic or mineral manures applied in soil, along of time, hadn't certain effect in the hydrolysis of phosphorics or amidics compounds. Indicator of Enzymic Activity Potential (IEAP %) shows that only in the case of application of vegetal refuses (**a$_3$**) and high doses of mineral N one manifests a dwpression of enzymic potential.

Table 2

Influence of organic and mineral fertilization of reddish preluvosol on pedoenzymic activity estimated by the Indicator of Enzymic Activity Potential (IEAP %)-Data are repported to 100 g soil d.s.

Experimental variants		Catalase (O_2 cm^3)	Saccharase (glucose mg)	Phosphatase (P mg)	Amidase (NH_4 mg)	IEAP %
a$_1$ Unfertilized organically	b_1-N_0	a 240.38	b 556.66	a 6.57	b 0.11	a 15.31
	b_2-N_{50}	a 306.40	b 609.79	b 4.99	a 0.14	a 16.57
	b_3-N_{100}	b 186.45	b 537.33	a 6.10	a 0.13	a 12.97
	b_4-N_{150}	b 187.16	a 690.70	b 4.50	0	a 11.78
	b_5-N_{200}	b 187.65	a 703.50	b 4.56	a 0.02	a 11.68
a$_2$ Manure (natural composted) in the second year from the application of 30 t/ha	b_1-N_0	a 240.18	a 657.87	b 4.82	a 0.09	a 14.85
	b_2-N_{50}	b 218.15	b 608.21	b 5.20	a 0.03	a 12.07
	b_3-N_{100}	b 210.72	b 612.60	a 7.58	a 0.17	a 14.12
	b_4-N_{150}	b 182.40	c 463.12	c 0.71	a 0.15	b 9.47
	b_5-N_{200}	b 166.74	c 500.16	0	b 0.05	b 6.98
a$_3$ Application of 40 t/ha (leaves and crowns)	b_1-N_0	a 277.71	a 739.62	c 1.64	a 0.03	b 11.25
	b_2-N_{50}	b 151.78	b 602.40	0	0	c 5.90
	b_3-N_{100}	b 166.53	c 462.67	b 4.23	b 0.04	b 10.10
	b_4-N_{150}	b 203.36	b 509.95	c 1.42	a 0.16	a 11.49
	b_5-N_{200}	b 225.20	b 568.10	0	a 0.15	b 10.60
LSD P = 5%		78.52	109	1.96	0.15	5.11

In tables 3 and 4 are presented the data concerning the organic and mineral manures which influenced the soil vital and biochemical processes, using Biological Synthetic Indicator (BSI%), as a unique criterion for knowing which agrotechnology can be recommended for maintaining a good soil fertility. The type of organic fertilization (Factor A) didn't influence, significantly, the evolution of soil fertility. But we must specify that theapplicated manure had only cca. Nt 1%. The influence of the factor B is significant even at N_{50} dose. With refference to the N doses, one observs that in the lack o organic manuring or after an year after the application of manure, the dose N_{200} had an negative influence on soil fertility. The same dose had a positive effect in the case of the incorporation of the sugar-beet refuses, as organic manure.

In the table 4, we are presenting a comparison between all experimental variants for having a complex information about the soil fertility level and a suitable technology for a sustainable agriculture with minimum expenses. In the preface of the admirable book [3] about the method for conserving or restablishing the soil fertility, Louis wrote: "What is biologic correct is economic advantageous". Examining the table 4, one observes that with the letter- **a** - many data characterize a favorable influence of the different agrotechnologies on the soil, but we must recommend only the variant $\mathbf{a_2b_2}$ for applying, because the best fertilization is that with composted manure (30 t/ha at 3 years).

Table 3

Influence of organic and mineral fertilization of reddish preluvosol from Moara Domnească, Ilfov County, Experimental Station, on soil fertility level, estimated by Biological Synthetic Indicator (BSI %). Factorial and interfactorial influences

F_A	F_B	b_1-N_0	b_2-N_{60}	b_3-N_{100}	b_4-N_{150}	b_5-N_{200}	F_A
a_1-Unfertilized organically		a 17.70 b	a 20.00 a	a 21.49 a	a 23.14 a	a 18.63 b	20.19
a_2-Manure (natural composted)		a 19.12 a	a 20.82 a	a 23.18 a	a 19.70 a	b 18.10b	20.18
a_3-Application of 40 t/ha (leaves and crowns)		b 14.25 b	b 15.07 b	a 21.98 a	a 22.44 a	a 22.27 a	19.20
Factor B		17.02 b	18.63 a	22.22 a	21.76 a	19.67 a	

Limite differences DL P $5F_A$% : F_A unsignificant; F_B 2.39; B x A 4.3; A x B 4.9

Tabel 4

Effect of fertilization mode on reddish preluvosol fertility in connection with the technological expenses

a_1 Unfertilized organically	b_1 – N_0	b 17.70
	b_2 – N_{50}	**a 20.00**
	b_3 – N_{100}	**a 21.49**
	b_4 –N_{150}	**a 23.14**
	b_5 – N_{200}	b 18.63
a_2 Manure (natural composted) in the second year from the application of 30 t/ha	b_1 – N_0	**a 19.12**
	b_2 – N_{50}	**a 20.82**
	b_3 – N_{100}	**a 23.18**
	b_4 –N_{150}	**a 19.70**
	b_5 – N_{200}	b 18.10
a_3 Application of 40 t/ha (leaves and crowns)	b_1 – N_0	b 14.25
	b_2 – N_{50}	b 15.07
	b_3 – N_{100}	**a 21.98**
	b_4 –N_{150}	**a 22.44**
	b_5 – N_{200}	**a 22.27**
LSD P = 5%		4.39

CONCLUSIONS

1. Soil organic fertilization, valuated by Biological Synthetic Indicator (BSI %), didn't significantly influenced the level of the fertility. But the manure had only cca. N_t 1%, that is 10 kg/ha/year.
2. Mineral fertilization, by a part of the total dose, has influenced favorably, significantly, the soil vitality. N_{200} kg/ha influenced negatively the soil fertility.
3. The favorable actions on soil fertility level were estimated by the Biological Synthetic Indicator (BSI %), in all factorial interactions, except with N_{200}.
4. Application of the mineral fertilizers has diminished the chemical reaction of the soil and by this, the soil biotical activity.

REFERENCES

1. Irimescu-Orzan M.E., Ştefanic G., 1998. *A new method for determining soil phosphatase capacity*. SSSC NewsLetter, 3-4 (pp. 3-8).
2. Pavlovschi G., M. Groza, 1947. *Studiul sistemelor fermentative din solul arabil.* Analele ICAR, XIX (pp. 3-17).
3. Pfeifer E., 1972. *La fértilité du sol - méthode pour conservé ou rétablir la fertilité du sol.* Le principe biodynamique dans la nature, Éd. Triades, Paris.
4. Săndoiu D.I.D., E. Boguslawski, V. Săndoiu, 1996. *Effect des engrais azotee et organiques sur le rendement du ble, dans des differentes conditions de milieu***.** În vol. Proceeding of the international Scientific Conference Bucharest, "The effect of Cropping systems on yield, farm, produce quality, profitability and environement protection in the main crop and pasture lands" (pp. 7-12).
5. Sumner J.B., G.F. Somers, 1953. *Chemistry and methods of enzymes*. Acad. Press inc., Publishers, N. York.
6. Ştefanic G., 1971. *Total soil phosphatasic capacity*. Biologie du sol, Paris, 10-11.
7. Ştefanic G., 1999. *Metode de analiză a solului (biologică, enzimatică şi chimică).* Probleme de Agrofitotehnie teoretică şi aplicată, XXI (supliment).
8. Ştefanic G., Th. Beck, J. Schwemmer, A. Vărbanciu, 1984. *Apparatus for measuring the soil catalase activity*. Fifth Symp. on Soil Biology, Iaşi, 1981 (pp. 47-50).
9. Ştefanic G., Niculina Gheorghiță, 2008. *A new approach for quantification of soil amidasic potential.* Romanian Agricultural Research, 25 (pp. 51-53).
10. Vostrov I.S., A.N. Petrova. *Opredelenie biologhiceskoi pocivî razlicinâmi metodami*. Mikrobiologhiia, XXX, 4 (pp. 665-672).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

RESEARCH CONCERNING THE INFLUENCE OF CROP ROTATION ON MAIZE GROWN ON THE REDDISH PRELUVOSOIL FROM MOARA DOAMNEASCA

C. CIONTU, D.I. SĂNDOIU, A. PENESCU, M. GÎDEA, MIHAELA OBRIŞCĂ

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *crop rotation, sustainable agriculture*

Abstract

This paper presents the average data for 2000-2010 in the crop rotation field of Moara Domnească-Ilfov. The bifactorial experiment began in 1981 and was conducted in 4 repetitions. The variants were based on crop rotation for A – Factor and nitrogen applications for B – factor. The A – factor consisted in: a_1 - maize monoculture, a_2 – rotation: wheat – maize, a_3 – rotation: soya – wheat – maize, a_4 – rotation: pea – wheat – sugar beet – maize, a_5 – rotation: sunflower – wheat – maize – maize / alfalfa . The B factor – nitrogen: b_1 – N_o, b_2 – $N_{50,}$ b_3 – N_{100} and b_4 – N_{150}. Determinations were performed on weeds and maize yields in every crop rotation of the experimental plot. Finally, we proved that crop rotations are the central point of the sustainable agriculture systems.

INTRODUCTION

Crop rotation with carefully studied crops are the basic links of the sustainable agricultural system. Moreover, in terms of ecological agriculture practice, their role has acquired a new role: to maintain balance in agricultural ecosystems, maintain and enhance soil fertility, reduce energy consumption, weed, pest and disease control, improve the efficiency of agro-phytotechnical measures in the culture technology, achieve high yields and stable and high quality, etc. All these favorable effects can be achieved without any additional investment but only through good organization and performance skills of those who lead the production process in agriculture. Through the research undertaken, this paper is aimed at strengthening the idea that crop rotation is the main element of the sustainable agriculture system [1, 2, 3, 4].

MATERIAL AND METHODS

This paper presents the average data collected during a long interval of time (between 2000 and 2010) in the crop rotation fields of the Moara Domnească Research Station belonging to the Faculty of Agriculture, UASMV Bucharest. It is important to mention that the crop rotation experiment began in 1981, i.e. it is 30 years old. This bifactorial experiment split the method into 4 repetitions. Variant A

- Factor crop rotation included: a_1 - maize 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; a_5 - 4 years rotation: 1. sunflower - 2. wheat - 3. maize - 4. maize / alfalfa. The B - Factor nitrogen: b_1 - N_o; b_1 - N_{50}; b_1 - N_{100} and b_2. - N_{150}. P_{70} was applied to all experimental plots.

The weeding status was determined by the square frame 2-3 weeks before harvesting wheat crop, the quantification of the crop yield on variants and repetitions and the production increase was calculated resulting from nitrogen application compared with the unfertilized variant, as well as the successive increase in the nitrogen rate.

RESULTS AND DISCUSSION

1. The influence of crop rotation and nitrogen to weed biomass (Table 1).

Determination of weed biomass has led to the following observations:

a) The highest values regarding weed biomass were recorded in maize monoculture on the agricultural resources, N_{150} of 221 g/m^2 and N_{100} of 200 g/m^2;

b) The use of rotation in the maize crop led to a significant decrease of the weeding status, as differences were by monoculture of 27.5 - 52.0%, according to rotation and agricultural resources.

c) In many cases, the application a nitrogen rate of 50, 100, and 100 kg/ha determined an increase in weeding up to 16.1%.

2. The influence of crop rotation and nitrogen on maize yield (Table 2).

Crop production increased significantly under the influence of nitrogen and crop rotation, as follows:

a) The highest production was recorded in the 3-year rotation (soya - wheat - maize) of 4,250 kg/ha on N_0, 5,020 kg/ha on N_{50}, 5,680 kg/ha on N_{100}, and 5,805 kg/ha on N_{150}.

b) 4-year rotations also increased production. The focus lies particularly on the residual effect of the alfalfa crop in the 4-year soil-ameliorative field.

c) Compared to the unfertilized variant, the application of nitrogen rates of 50, 100 to 150 kg/ha resulted in statistically assured production increases in all the variatnts, i.e. 890-1825 kg/ha in monoculture and 765-1715 kg/ha in different rotations.

d) Under non-irrigated conditions, the application of N_{150}, N_{100} rates recorded nosignificant increase in production.

Table 1

Influence of crop rotation and nitrogen on weed biomass

Crop rotation		N-dose	Weed biomass					
			g/m^2	%	difference %			
maize (monoculture)		N_0	196	100.0	100.0			
		N_{50}	190	96.9		100.0		
		N_{100}	200	102.0			100.0	
		N_{150}	221	112.8				100.0
2-year rotation (maize - wheat)		N_0	123	100.0	62.8			
		N_{50}	133	108.1		70.0		
		N_{100}	138	112.2			69.0	
		N_{150}	142	115.5				64.3
3-year rotation (soya - wheat - maize)		N_0	112	100.0	57.2			
		N_{50}	110	98.2		57.9		
		N_{100}	123	109.8			61.5	
		N_{150}	130	116.1				58.8
4-year rotation (pea - wheat - sugar beet - maize)		N_0	127	100.0	64.8			
		N_{50}	130	102.4		68.4		
		N_{100}	145	114.2			72.5	
		N_{150}	142	111.8				64.3
4-year rotation with ameliorative crops (sunflower - wheat - maize - maize/alfalfa)	maize after wheat and alfalfa	N_0	94	100.0	48.0			
		N_{50}	105	111.7		55.3		
		N_{100}	110	117.0			55.0	
		N_{150}	105	111.7				47.5
	maize after maize	N_0	113	100.0	57.7			
		N_{50}	103	91.2		54.2		
		N_{100}	123	108.9			61.5	
		N_{150}	121	107.1				54.8

Table 2

Maize yields in crop rotation at Moara Domnească (average 2000-2010)

Crop rotation		N dose	maize yields						
			kg/ha	%	difference kg/ha				
maize (monoculture)		N0	3150	100	Mt.	Mt.			
		N_{50}	4040	128	890^{**}		Mt.		
		N_{100}	4790	152	1640^{***}			Mt.	
		N_{150}	4975	158	1825^{***}				Mt.
2-year rotation (maize - wheat)		N_0	3870	100	Mt.	720^{*}			
		N_{50}	4705	122	835^{**}		665^{*}		
		N_{100}	5390	139	1520^{***}			600^{*}	
		N_{150}	5560	144	1690^{***}				585^{*}
3-year rotation (soya - wheat - maize)		N_0	4250	100	Mt.	1100^{***}			
		N_{50}	5020	118	770^{**}		980^{**}		
		N_{100}	5680	134	1430^{***}			890^{**}	
		N_{150}	5805	137	1555^{***}				830^{**}
4-year rotation (pea - wheat - sugar beet - maize)		N_0	3930	100	Mt.	780^{**}			
		N_{50}	4750	121	820^{**}		710^{*}		
		N_{100}	5530	141	1600^{***}			740^{**}	
		N_{150}	5645	144	1715^{***}				670^{*}
4-year rotation with ameliorative crops (sunflower - wheat - maize - maize/ alfalfa)	maize after wheat and to 3 years alfalfa	N_0	4110	100	Mt.	960^{**}			
		N_{50}	4875	119	765^{**}		835^{**}		
		N_{100}	5620	137	1510^{***}			830^{**}	
		N_{150}	5765	140	1655^{***}				790^{**}
	maize after maize	N_0	3880	100	Mt.	730^{*}			
		N_{50}	4720	122	840^{**}		680^{*}		
		N_{100}	5470	141	1590^{***}			680^{*}	
		N_{150}	5585	144	1705^{***}				610^{*}
Dl 5% (kg/ha)					482.3				
Dl 1% (kg/ha)					731.3				
Dl 0.1% (kg/ha)					993.2				

3. Production increase resulting from nitrogen application in different maize crop rotations (Table 3).

The calculations revealed that production increases varied widely depending on the combination of the two factors, i.e. the dose of nitrogen and crop rotation, as follows:

a) The production increases in kg grains per kg nitrogen varied from 17.8 to 15.3 on the agro N_{50}, 16.4 to 14.3 on the N_{100} and 12.2 to 10.4 on the N150.

b) The production increases for successive nitrogen rate increases showed that the rate of N_{150}, compared to N_{100}, resulted in low increase, i.e. 3.7 kg grain/kg N in monoculture and 3.4 - 2.3 kg grain/kg N in different rotations.

Table 3

Production increase determined by nitrogen application (kg grains/kg a.s.) in maize crop in different rotations

Crop rotation		**Compared to unfertilized variant**			**For successive increase in nitrogen rates**		
		N_{50}	N_{100}	N_{150}	N_{50} - N_0	N_{100} - N_{50}	N_{150} - N_{100}
maize (monoculture)		17.8	16.4	12.2	17.8	15.0	3.7
2-year rotation (maize - wheat)		16.7	15.2	11.3	16.7	13.7	3.4
3-year rotation (soya - wheat - maize)		15.4	14.3	10.4	15.4	13.2	2.5
4-year rotation (pea - wheat - sugar beet - maize)		16.4	16.0	11.4	16.4	15.6	2.3
4-year rotation with ameliorative crops (sunflower - wheat - maize maize/alfalfa)	maize after wheat and alfalfa	15.3	15.1	11.0	15.3	14.9	2.9
	maize after maize	16.8	15.9	11.4	16.8	15.0	2.3

CONCLUSIONS

1. Compared with the monoculture, crop rotation resulted in the decrease of the weeding level by 27.5 - 52.0%.
2. The application of the nitrogen rate led to increased weeding, up to 16.1%, especially on the agricultural resourcess of N_{100} şi N_{150}.

3. Crop rotation increased grain production in all variants and all agricultural resourcess, with differences ranging from 585 to 1100 kg/ha.
4. Compared with the unfertilized variant, the application of nitrogen rates of 50, 100 and 150 kg as/ha resulted in production increases in all the statistically assured variants, 890-1825 kg/ha in monoculture and 765-1715 kg/ha in different rotations.
5. The production increase in kg grains per kg nitrogen a.s. varied from 17.8 to 10.4, depending on the rotation and agricultural resources.
6. Compared to N_{100}, the N_{150} agricultural resources recorded very low production increase, i.e. only 3.7 to 2.3 kg grains per kg nitrogen a.s.
7. Under the climatic conditions of Moara Domnească, the rates of 150 kg nitrogen are not justified in the unirrigated variant.

REFERENCES

1. Ciontu C., D.I. Săndoiu, Ileana Fulvia Săndoiu, D.I. Marin, Narcisa Băbeanu, 1999. *Crop rotation influence-on the determinant basic elements of sustainable agriculture system.* Scientific papers, USAMV Bucureşti, Agronomy, Series A, XLII (pp.121-128).
2. Ciontu C., 1996. *Cercetări privind rolul asolamentelor pentru ameliorarea fertilităţii solului, reducerea consumului de energie şi sporirea producţiei plantelor cultivate pe solul brun-roşcat*. Teză de doctorat, USAMV Bucureşti.
3. Ciontu C., D.I. Săndoiu, A. Penescu, M. Gîdea, Mihaela Obrişcă, 2010. *Researches concerning the influence of crop rotation to the winter wheat on the reddish preluvosoil from Moara Domnească.* Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339 (pp. 240-245).
4. Penescu A., C. Ciontu, 2001. *Agrotehnica*. Ed. Ceres.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

INFLUENCE OF SOIL TILLAGE SYSTEM ON SAPLINGS QUALITY IN THE FORESTRY NURSERIES

N. BOJA, F. BOJA

"Vasile Goldiş" Western University of Arad

Keywords: *diameter of the collets, height of saplings, technical work, nursery*

Abstract

The present research has as a purpose the determination of the optimal tillage systems of the soil, used in the forestry nurseries, meant to facilitate the development of saplings of high quality. The research has been carried out in Iarac Forestry Nursery from O.S. Iuliu Moldovan during 2006-2009, on an alluvial soil, the vertical-gleizated subtype. In the present paper, we display the results obtained after the working of the soil in the classical tillage system and minimum tillage system on the dimensional elements of the forestry saplings of ash trees and oak trees (diameter of the collets and height), measured at the mid season of vegetation. The work systems applied have been: classical tillage system (plough + disc 2X) and minimum tillage system (paraplow+ harrow). The usefulness of this paper lays in the research data gathered, processed, analyzed and exploited in order to provide a pertinent study material, which could be effectively used by the specialists in the design of obtaining saplings in the forestry nurseries and the choice of the tillage system for the optimal soil.

INTRODUCTION

The tillage system for the soil has represented and still represents one of the main elements of technology through which one intervenes in order to raise the production of the cultivated plants (forestry saplings), and lately, at an even greater extent, for the optimization of the relation between production-profit- fertility and resources conservation [3].

Soil tillage applied irrationally and, in particular the classical tillage system determined in time a degradation of the soil characteristics, the strong reduction of the content of organic substance and, implicitly, of its productive potential [2].

The soil processing in the classical tillage system leads to an excessive break-up through repeated interventions, leaving it without vegetal remains through the reversal of the clods in the ploughing process, thus being strongly eroded under the action of the water and wind [1].

Worldwide, there is a tendency to replace the classical tillage system of the soil, through the extension of the minimum work system, method recommended both from the viewpoint of sol preservation and for the reduction of energy consumption [6].

In our country, the extension of these systems of soil processing in the forestry nurseries is slow because of the lack of unitary strategies to sustain the technology, the lack of unitary strategies to correspond to the biological requirements of each culture, the lack of specialized knowledge related to the new system [4].

It is important to remember that the unconventional system appeared as an alternative for the reduction of erosion, leaving behind the production level and neglecting at first the advantages related to the fuel consumption [5].

With this system, the objective was to reduce the number of soil tillage which determines the dusting, the subsidence and the lowering of soil fertility. It was proven that, as a result of the excessive exploitation of the prairie soil, the compaction increased with 20% and the porosity decreased with 10%. [8].

Retrospectively analyzing the development of the tillage systems of the soil in Romania, we realize that the research intended to put into practice the tillage systems adequate to the biological requirements of the plant, underlined the way in which the methods of soil exploitation influence its physical-chemical properties, its production and energetic efficiency [7].

MATERIAL AND METHODS

Research was carried in the Iarac Forestry Nursery from O.S. Iuliu Moldovan during 2006-2009, on an alluvial soil, the vertical-gleizated subtype. The experiment had poly-factors of **A** X **B** X **C** type. The placements of sample markets were done using the „method of divided parcels”, repeated twice, while the surface of a parcel was of 80 m^2.

The factors studied:

Factor A Soil tillage system:

a1 classical system (plough + disc 2X)

a2 minimum system (paraplow + rotative harrow)

Factor B Species:

b1 oak

b2 ash tree

Factor C Dimensions measured:

c1 diameter at collet

c2 height

The present paper shows the results obtained after soil exploitation by means of a classical and minimum tillage systems on the dimensional elements of the forestry saplings of oak and ash tree (diameter at the collets and height), measured in the mid-season of vegetation. The systems applied were: classical system (plough + disc 2X) and minimum system (paraplow + rotary harrow).

RESULTS AND DISCUSSION

In order to observe the variance of the dimensional elements of the oak and ash-tree saplings, after the soil preparation in classical and minimum tillage systems, the intensity of growth of saplings will be presented. In order to emphasize the growth vitality, it was taken into consideration the basic elements for this expression: diameter at collets and the height of the sapling. This is the truth criterion regarding the choice of soil tillage system. Each tillage system has an influence more or less significant for the growth of saplings.

The best system will be the one in which the number of works done is smaller, but at the same time, the saplings must have a very active growth. The concrete effects of the soil preparation system were researched by observing the dimensional parameters at the mid-season of vegetation.

In order to observe the influence of the soil preparation system on the quality of saplings, one passed on to the analysis of the growth in diameter at the collets and the height for the following species: oak and ash tree. In table 1 there are the indexes for dissemination which underlined the dispersion rate of the measured growth, while the Figures 1…4 appear in diagram box-plot their variance.

Table 1

Values determined for the indexes of dispersion

Nursery	Species	System	Elements measured	Indexes of dispersion				
				Q0 Min	Q1 25%	Mediana 50%	Q3 75%	Q4 Max
Iarac	Oak	Classical	Diameter at collet, mm	0.40	1.50	2.50	3.00	8.83
			Height, cm	4.80	8.53	10.50	12.00	18.00
		Minimum	Diameter at collet, mm	1.21	2.44	3.43	4.20	6.98
			Height, cm	8.00	18.00	22.00	27.00	39.00
	Ash tree	Classical	Diameter at collet, mm	2.20	5.00	6.00	6.60	9.60
			Height, cm	12.00	21.00	25.00	29.00	39.00
		Minimum	Diameter at collet, mm	2.00	6.20	7.30	8.60	18.00
			Height, cm	18.00	35.00	42.00	51	86.00

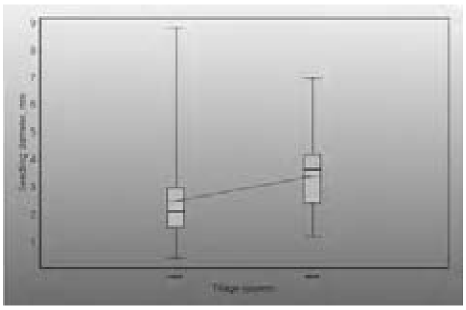


Fig. 1. Variation of the diameter at the ground tissue at oak in the classical and minimal tillage system

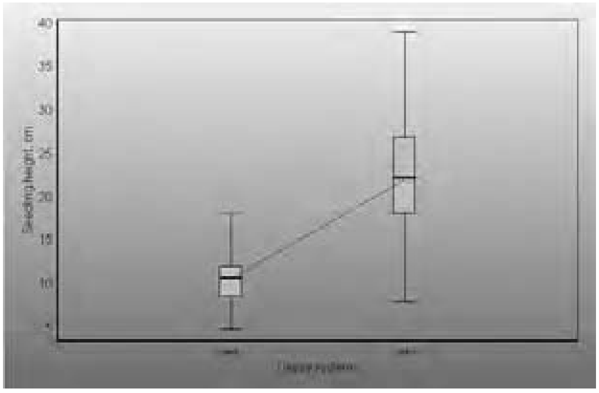


Fig. 2. Variation of the height at oak in the classical and minimal tillage system

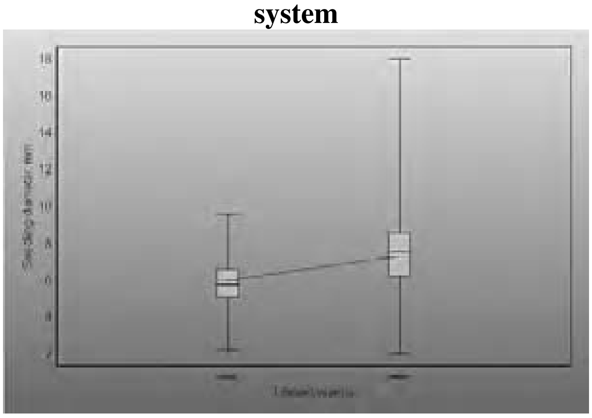


Fig. 3. Variation of the diameter at the ground tissue at ash tree in the classical and minimal tillage system

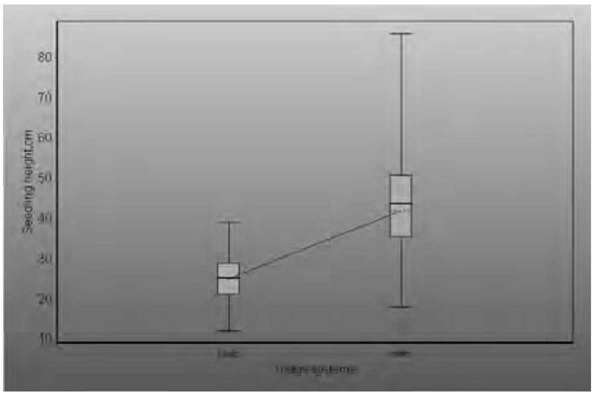


Fig. 4. Variation of the height at ash tree in the classical and minimal tillage system

To synthesize more efficiently the data taken and to be able to describe completely the intrinsic characteristics of the sample, it was chosen a statistic processing with the aid of the program KyPlot. The results obtained are given in table 2 for oak and in table 3 for the ash tree, having as a purpose to underline the variance of the dimensions of saplings (diameter at the collets and height), comparative with the tillage system (minimum/classical systems).

Without insisting too much on the interesting aspects contained as an informational message in the value of the statistical indexes, we noticed though that the height of the oak saplings, as a striking visual element, has an average of 22.25 cm and a maximum value of 39.00 cm, in the case of the tillage system of the soil, compared to the average of 10.64 cm and the maximum value of 18.00 cm in the case of the classical system. Within the same species, there is a significant difference at the level of the diameter at the collets in the following values: classical system 2.12 mm compared to the 3.63 mm at the minimum system.

There can also be noticed the value of the coefficients of variance of the geometric sizes, which range from 26-27% (height) and 42-49% (diameter at collects), which indicates a certain oscillation of groups of multitudes between homogenous and non-homogenous.

At the level of asymmetries, there is a very strict law governing in relation with the two dimensional elements, the experimental distributions are of the right, both for the dimension of the oak saplings obtained in the classical system and those obtained in the minimum tillage system.

Table 2

Statistical indexes regarding the dimension of oak saplings in Iarac nursery

Statistical indicator	Dimensions seedlings			
	Classical system		Minimum system	
	Diameter at collet, mm	Height, cm	Diameter at collet, mm	Height, cm
Mean	2.12	10.64	3.63	22.25
S.E.M. (Average standard error)	0.06	0.15	0.08	0.33
Standard deviation	1.03	2.71	1.52	6.06
Coefficient of variation	0.49	0.26	0.42	0.27
Minimum	0.40	4.80	1.21	8.00
Maximum	8.83	18.00	6.98	39.00
The number of feature values (N)	342	342	342	342
Skewness	1.31	0.21	0.81	0.11
Curtosis	7.75	-0.41	-0.33	-0.51
Mean Deviation	0.81	2.21	1.19	5.00
Median	2.50	10.50	3.43	22.00
Range	8.43	13.20	5.77	31.00
Confidence Level(0,95)	0.11	0.29	0.16	0.64
Lower Confidence Limit	2.07	10.49	3.55	21.92
Upper Confidence Limit	2.18	10.78	3.71	22.58

Even though there is a very strict law governing in relation with the elements measured, the excess of the experimental distributions are, in general, platicurtic for the minimum tillage system, at the two dimensional elements measured and leptokurtic for the diameter at collets in the classical tillage system.

Table 3

Statistical indexes regarding the dimension of ash tree saplings in Iarac nursery

Statistical indicator	Dimensions seedlings			
	Classical system		Classical system	
	Diameter at collet, mm	Height, cm	Diameter at collet, mm	Height, cm
Mean	5.75	25.18	7.53	43.66
S.E.M. (Average standard error)	0.08	0.30	0.11	0.71
Standard deviation	1.35	5.12	1.88	12.18
Coefficient of variation	0.24	0.20	0.25	0.28
Minimum	2.20	12.00	2.00	18.00
Maximum	9.60	39.00	18.00	86.00
The number of feature values (N)	292	292	292	292
Skewness	0.11	-0.07	1.17	0.75
Curtosis	-0.04	-0.39	3.78	0.56
Mean Deviation	1.09	4.20	1.42	9.67
Median	6.00	25.00	7.30	42.00
Range	7.40	27.00	16.00	68.00
Confidence Level(0,95)	0.16	0.59	0.22	1.40
Lower Confidence Limit	5.67	24.88	7.42	42.95
Upper Confidence Limit	5.83	25.48	7.64	44.38

CONCLUSIONS

The most important observations regarding the usage of the soil tillage systems in the forestry nurseries, with direct influences on the growth of the saplings can be synthesized as follows:

1. Technologies modify the physical-chemical and biological properties of the measured soil according with the intensity of the system applied.
2. The system of deep soil dislocations contributed to the aeration of the sub-arable strata, enlarging the permeability for water and the increase of the volume of the root system of the saplings;
3. The aeration works determine reduced and on the short-term modifications, of the soil physics;
4. The system of soil alternation of the working depth determines an improvement in the conditions of development of the saplings and a lot of fuel savings.

5. The unconventional system of soil tillage modifies the physical-chemical properties, which allowed for the listing of its advantages and disadvantages according to the soil type and the culture zone;
6. The values of the dimensional elements (diameter at collets and height) analyzed in both species in the experiment recommend the usage of the minimum tillage system in the case of this nursery.

REFERENCES

1. Boja N., F. Boja, A. Teuşdea, 2008. *Influence of minimum tillage systems upon the soil physical properties and the reduction ratio*. International Symposium Trends In European Agriculture Development, Publishing House Agroprint, Timişoara, vol. 40 (2) (pp. 25-30).
2. Boja N., F. Boja, 2009. *Determination of soil reduction ratio level after its processing in classical tillage system and in minimum tillage system*. Scientific Session Proceedings „Studia Universitas", Series of Engineering Science and Agro-Tursim, 4/2009, University Press „Vasile Goldiş" Arad (pp. 27-34).
3. Boja N., F. Boja, 2010. *The influence of tillage system on soil compactation*. International Symposium Trends in European Agriculture Development, Ed. Agroprint, Timişoara, vol. 42 (1) - 908 (pp. 31-37).
4. Boja N., F. Boja, 2010. *Aspects regarding the soil compaction in the forestry nurseries: requirements, means, technology*. International Scientific Conference Durable Agriculture - Present and Perspectives, University of Agricultural Sciences and Veterinary Medicine Iasi, Faculty of Agriculture, vol. 53/2010 (pp. 64-65).
5. Guş P., 1983. *Agrotechnics and experimental techniques*. Publishing House Agronomia Cluj-Napoca.
6. Guş P., T. Rusu, S. Stănilă, 2003. *Unconventional Soil Exploitation and the Machinery System*. Risoprint Publishing House, Cluj-Napoca.
7. Nedeff V., 2006. *Qualitative Work Indexes of the Technical Equipments carried out by Mecanica Ceahlău*. Mecanization of agriculture, nr. 9/2006 (pp. 2-5).
8. Şarpe, N., Şt. Poienaru, 2004. *Crop technology in minimum tillage system, no-tillage and chemical weed control strategies in conditions in Romania*. Agro-Terra Publishing House. Bucharest (p. 323).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

INFLUENCE OF SOIL TILLAGE SYSTEM ON WEEDING DEGREE AND CORN YIELD

A.I. POP, P. GUŞ, T. RUSU, ILEANA BOGDAN, PAULA MORARU, P. CÎMPEAN

University of Agricultural Science and Veterinary Medicine of Cluj-Napoca

Keywords: *soil tillage, weed control, production*

Abstract

In every culture there are certain characteristic weeds which are adapted to the biological particularities of the cultivated plant and to the specific technology. The most representative and common species of weeds which infest the maize culture on the argic-stagnic faeoziom soil are: Setaria sp., Echinochloa crus-galli, Digitaria sanguinalis, Agropyron repence, Amaranthus retroflexus, Chenopodium album, Sinapis arvenis, Raphanus sativus, Xantium strumarium, Polygonum sp., Galinsoga parviflora, Hibiscus trionum, Matricaria sp., Capsela bursa pastoris, Lepidium draba, Cirsium arvense, Convolvulus arvensis, Sonchus sp., Rubus caesius. The production achieved in the maize culture varies according to the soil tillage system with productions of 6327-6412 kg/ha in conventional variants, as compared to unconventional variants in which productions of 6121-6322 kg/ha have been obtained. With variants of soil tillage with disk and rotary harrow and rotary harrow, there have been noted significantly distinct negative differences and significantly negative ones, with a production between 6121-6196 kg/ha in comparison with the witness variant of 6327 kg/ha.

INTRODUCTION

Soil tillage is the oldest method of fighting weeds, but it is also very important in the present.

Soil tillage works in the following manner concerning weed fighting: the seeds in the superficial layer are pushed to the depth where from it is difficult for them to spring or where from they don't spring at all.

By soil tillage, perennial weeds are partially destroyed, especially the suckered ones (*Cirsium, Sonchus, Convolvulus*). A large part of the underground organs mass is brought to the surface of the soil and destroyed by drying in the summer and by freezing in the winter.

Worldwide, the research concerning the influence of soil tillage on the production has been an essential aim. The results obtained in the most diverse pedoclimatic conditions and cultures are generally encouraging for applying the minimum soil tillage system or the no tillage one, considering the effect of soil conservation, too.

Straw cereals are plants which display the highest success rate when this system is applied, followed by maize and bean vegetables.

When elaborating alternative systems of soil tillage, not only immediate effects (large productions) should be considered, but even more the long term ones, which should provide durability to the system in time.

The research conducted during fifty years of use confirms that the unconventional system guarantees to the maize culture productions which are close to those obtained in the classic system.

Synthesizing the data published in expert literature comparatively between the two systems, classic and unconventional similar production levels are achieved [1, 2, 3, 4, 5, 6, 7].

MATERIAL AND METHODS

The results presented in this paper have been obtained in the experimental fields of the Agriculture Faculty in Cluj-Napoca, the Agrotechnical Department, on an argic-stagnic Faeoziom type of soil, with a humus content of 3.8% and 6.5 pH. From the climatic point of view, the hilly area where the experiments have been taking place is characterized by average multiannual values, with precipitations between 550-650 mm a year. The thermal regime of the area is characterized by average multiannual temperatures between 8.0 and 8.2°C.

The aim of this research was to determine the influence the soil tillage systems have on the weed growing and the production achieved in the maize culture.

The experimental alternatives were these:

Conventional system:	V_1 – conventional plough + disk (2 times)
	V_2 – reversible plough + rotative harrow
Minimum system:	V_3 – disk+ rotative harrow
	V_4 – rotative harrow
	V_5 – paraplow + rotative harrow
	V_6 – chisel + rotative harrow

RESULTS AND DISCUSSION

By the nature of their biology, the maize plants are characterized, in the first stages of vegetation, by the total lack of the ability to compete with weeds. Due to the slow growing in the first 4-6 weeks and to the reduced thickness (5-8 maize plants/m^2), a competition is created from the beginning for space, food and water, in favor of the weeds, producing great damage to the maize culture. The damage varies in the 30-90% limits and they depend on the degree of infestation, the frequency and domination of the weeds, as well as the ratio between monocotyledons and dicotyledons (which also depend on the pedoclimatic conditions of the area). Both the degree of infestation and the ratio between multiple types of weeds are influenced by the soil tillage system.

The weed control strategy when applying minimal systems must be first priority and different from the one used with the classic system. Special attention should be given to indirect methods and especially to crop rotation. The soil tillage elements and the measures for fighting weeds have an important role in the case of hoeing crops for the control of weed growth in the first vegetation stages, periods during which these cultures are very sensitive to the vivacity of the weeds.

When ploughing with the mouldboard plough, the weed seeds are spread in the entire ploughable layer, their germination being spaced out, while the deeply buried ones lose their vitality. With unconventional processing, the seeds are concentrated in the first 10 cm and they germinate explosively during the first year, causing excessive weed growth. The diversity of seed reserve grows from the mouldboard plough ploughing to minimal tillage varieties. The unconventional systems change, in the first place, the floral composition of the weeds, by increasing the percentage of monocotyledonous weeds and decreasing annual dicotyledons (which are easier to fight), and secondly, a general increase of weed growth in the first years of applying.

Table 1

Weeding in corn depending on soil tillage system

Segment of weeds	**Medium number of weeds/m^2, crop harvesting**					
	Conventional plough + disk (2 times)	Reversible plough + rotative harrow	Disk + rotative harrow	Rotative harrow	Paraplow+ rotative harrow	Chisel + rotative harrow
M*	17.3	17.6	21.3	22.6	19.5	20.3
DA**	41.3	40.2	39.6	40.6	44.3	42.6
DP***	6.3	5.9	17.6	18.6	9.5	12.9
Total (weeds/m2)	64.9	63.7	78.5	81.8	73.3	75.8
Total (%)	100.00 (Mt)	98.1	120.9	126.0	112.9	116.8

*M-monocotyledonates, **DA-dicotyledonate annuals, ***DP-dicotyledonate perenial

When harvesting the maize culture, the medium weed growth data obtained on argic-stagnic faeozom shows a number of 63.7-64.9 weeds/m² with conventional tillage, and 73.3-81.8% weeds/m² with the unconventional variants. The weed growth degree is 12.9-26% higher in systems with minimal tillage. The differences occur especially concerning the weed growth degree and the percentage of perennial dicotyledons. Thus, the medium number of monocotyledons was 17.3-17.6 weeds/m² with the plough variants and 19.5-22.6 weeds/m² with the variants with minimum tillage. The average number of dicotyledonous weeds was 40.2-41.3 weeds/m² with the plough variants and 39.6-44.3 weeds/m² with the minimum tillage variants. The differences between the perennial dicotyledonous weeds growth were significative, as 5.9-6.3 weeds/m² have been noted with the plough variants and respectively 9.5-18.6 weeds/m² with the minimum tillage variants.

Table 2

Influence of soil tillage system on corn yield

Specification	Technological variant					
	Conventional plough + disk (2 times)	Reversible plough + rotative harrow	Disk + rotative harrow	Rotative harrow	Paraplow + rotative harrow	Chisel + rotative harrow
STAS (kg/ha) grain production	6327 (Control)	6412	6121	6196	6322	6310
Relative production (%)	100.00	101.4	96.7	97.9	99.9	99.7
Difference in production (kg/ha)	-	+ 85	- 206	- 131	- 5	- 17
Differences significance	-	-	00	0	-	-

LSD 5% = 119.54 kg/ha, LSD 1% = 169.93 kg/ha, LSD 0.1% = 246.05 kg/ha

The soil tillage system has influenced the productions obtained in the maize culture, of 6121-6412 kg grains/ha on the argic-stagnic faeozom with a standard humidity of 15.5.

The largest productions have been noted in ploughed variants: 6327-6412 kg grains/ha. Compared to these, the unconventional tillage varieties productions represented 96.7-99.9% with negative differences of 5-137 kg grains/ha. The analysis of the significance of the differences between the tested variants shows that as compared to the witness: classical plough + disk 2x, the productions are distinctively significantly negative with the disk + rotary harrow tillage variants, significantly negative with the rotary harrow tillage variant, and practically equal with the paraplow + rotary harrow and chisel + rotary harrow tillage variants.

CONCLUSIONS

1. The unconventional soil tillage systems will be applied only on field from which the weeds have been removed using proper technology, or by applying total action herbicides on the stubble. The soil tillage elements and

the measures for fighting weeds have a crucial role in the case of hoeing cultures for the weed growth control in the first stages of vegetation, periods in which these cultures are very sensitive to the vivacity of the weeds.

2. When harvesting the corn culture, the average weed growth data obtained in the argic-stagnic faeozom shows a number of 63.7-64.9 weeds/m² with the conventional tillage variants, and 73.3-81.8% weeds/m² with the unconventional tillage variants.With unconventional processing, the seeds are concentrated in the first 10 cm, they germinate explosively in the first year of applying, determining excessive weed growth. The diversity of the seed reserve grows from the mouldboard plough variety to the minumim tillage varieties. Unconventional systems change, in the first place, the floral composition of the weeds, by an increase in the percentage of monocotyledonous weeds and a decrease of annual dicotyledons (which are easier to fight), and secondly, a general increase of weed growth in the first years of applying.
3. The largest productions have been achieved with the ploughed variants: 6327-6412 kg grains/ha, and compared to this, the productions obtained with unconventional tillage variants represented 96.7-99.9%, with negative differences of 5-137 grains/ha.

REFERENCES

1. Guş P., A. Lăzureanu, D. Săndoiu, G. Jităreanu, I. Stancu, 1998. *Agrotechnique*. Print House Risporint, Cluj-Napoca.
2. Guş P., T. Rusu, Ileana Bogdan, 2003. *Agrotechnique-Practical aspects book*. Second edition, Print House Risoprint, Cluj-Napoca.
3. Guş P., T. Rusu, Ileana Bogdan, 2004. *Agrotechnique*. Print House Risoprint, Cluj-Napoca.
4. Bogdan Ileana, 2003. *Herbology*. Print House Risporint, Cluj-Napoca.
5. Marin D.I., C. Bolohan, M. Roşu, A. Heroiu, 2008. *Research on weed seed reserve in soil according to basic soil tillage following winter wheat crop*. Scientific papers, Series A, Vol LI, Faculty of Agriculture, UASVM Bucharest.
6. Pop A.I., 2009. *Establishing the influence of soil works and crop rotation upon soil, production and profit in the Somesan plateau*. Phd Thesis, USAMV Library, Cluj-Napoca.
7. Săndoiu I.D., 1999. *Problems regarding introducing of alternative soil tillage in Romanian Plateau*. International Symposion, 'Minimum soil tillage systems', UASMV Cluj, Faculty of Agriculture, 21-22th of October, Cluj-Napoca.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

INFLUENCE OF SOIL TILLAGE SYSTEM AND CROP ROTATION ON SOIL AND WHEAT PRODUCTION

PAULA IOANA MORARU, T. RUSU

University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca

Keywords: *soil tillage, crop rotation, wheat production*

Abstract

Soil tillage system influences the soil fertility features and determins changes in field cultural stage, which imposes technological difference for wheat culture. Soil tillage system modifies first of all physical and chemical features, and then the biological ones. Compared to the control variant - reversible plough, the level of stability was higher in unconventional systems with: 1.6-5.6% on 0-10 cm depth, 1.1-3.5% on 10-20 cm depth and with 5-6% on 20-30 cm depth. Bulk density was identified with values which are framed in the limits of the optimal ones of 1.18-1.34 g/cm^3, appreciated as average, for this type of soil. Water reserve of soil for the first 50 cm is within 1329-1693 m^3/ha, being dependent on the soil tillage system applied. Conventional soil tillage system and unconventional systems, where soil tillage is made with paraplow, chisel and rotary harrow, influence in a different way production features and wheat crop production. Number of plants is between 490 and 510 on m^2. The highest thickness was registered in the plough variant, being of 510 plants/m^2, and the lowest values were registered at the variants worked with rotary harrow with 490 plants/m^2 and chisel, respectively paraplow with 500 plants/m^2. The production of wheat achieved by using unconventional soil systems with chisel and paraplow are close to the ones obtained in the classical system, being at the level of 97.8-98.2% compared with the control variant, with reversible plough.

INTRODUCTION

By analyzing conventional tillage systems, we can ascertain that the largest amount of work and energy are consumed by carrying out the basic works and preparing the seedbed [1, 2, 6]. Delivering a successful culture depends mostly on optimal conditions of plants growth - established density and time of sowing [3, 7]. Tillage systems have given most attention to this end by plough depth, its quality, and retention of soil humidity in the superficial layer with numerous works of preparing the seedbed, so that the seed could benefit from the contribution of capillary rise of water from deeper layers, all for a more uniform growth. In order to achieve accuracy and uniformity, sowing machines were thus set so as to incorporate as deeply as possible the plant residues of the previous culture, an exaggerated mincing of the soil layer on the seedbed level, and the leveling and compaction of this volume according to the optimal working parameters of the machine.

The minimum soil tillage systems as a possible alternative to be practiced and expanded, conditioned by soil characteristics, climate and crop structure [4, 5, 8]. Minimum soil tillage systems have as main feature soil conservation, maintaining a proper balance between the soil organic matter and microorganisms activity improvement [8, 10, 11]. Extension of minimum tillage systems entails agro-technical, economic and organizational advantages.

MATERIAL AND METHODS

In order to consider the influence of soil tillage systems and crop rotation upon soil and wheat production, there was organized a bifactorial experience, on a clay soil profile, in Frata, Cluj County. The experimental field was built by a bifactorial experiment A x B - R (4 x 3 - 3) type, placed after the subdivided plots method, in three replications, on the clay soil profile. Soil is luvic phaeozem (SRTS, 2003), specific to the area in discussion, and the filed presents technological and pedological homogenous features.

Experimental factors were the following:

Factor A - Soil tillage system: a_1 - reversible plough (22-25 cm) + disk 2x (8 cm); a_2 - rotary harrow (10-12 cm) (2x); a_3 - chisel (18-22 cm) + rotary harrow (8-10 cm); a_4 - paraplow (18-22 cm) + rotary harrow (8-10 cm).

Factor B - Cultivated plant (crop rotation): b_1 - soybean; b_2 - wheat; b_3 - maize.

The surface of the experience was of 3360 m^2, split in large plots, of 840 m^2, on which soil tillage were applied (the same in each year). Over large plots, worked in the same system, the cultures were supra cultivated, resulting small experimental plots, of 280 m^2. Each variant is represented in experimental field of 3 replications. The results were analyzed using ANOVA and Duncan's test (PoliFact, 2002).

RESULTS AND DISCUSSION

The effects of unconventional soil tillage systems upon soil and production at wheat crop are pointed out with the help of the research results, as follows:

The structure of soil analyzed under the aspect of structural agregate stability, at the end of the third experimental year, it is framed in a variation domain of 72.4-81.0% macro hydro stable agregate (table 1). Compared to the control variant - reversible plough + disc-2x the level of stability was higher at unconventional systems with: 1.6-5.6% on 0-10 cm depth, 1.1-3.5% on 10-20 cm depth and with 5-6% on 20-30 cm depth. The incorporation of all the vegetal waste in soil, at 20-25 cm depth, in the case of arable field and about 50-60% in the case of worked variants with rotary harrow, chisel and paraplow and deep, mainly only on the marks of the active equipment of chisel and paraplow determines difference in the modification of the structure quality. Within the crop rotation, winter wheat had the best influence upon the hydric stability of the soil structure, so that the hydro stability level has the highest values in the experience (up to 83.5%), especially at 10-30 cm depth, by applying unconventional soil tillage systems. This motivates wheat crop in crop rotations, even when the unconventional soil tillage systems are used.

Bulk density was identified with values which are framed in the limits of the optimal ones of 1.18-1.34 g/cm^3 (appreciated as average) for this type of soil. Still there are several differences, in all experimented years, respectively at all three crops, a well loose on 0-20 cm depth (arable layer) at the variant worked annual with plough (1.13-1.23 g/cm^3) and values of 1.18-1.38 g/cm^3 at the variants worked after unconventional soil tillage system. Under this deep the soil remains low rammed, the values being average at the variant worked with conventional variant (1.40-1.47 g/cm^3) and values of 1.39-1.46 g/cm^3 at variants worked after unconventional system. On the profile of the soil tillage after the conventional tillage there is pointed out a stratification from the placement point of view, due to the existence of a arable layer more loose (through energetically tillage) and a more compact soil in the under arable layer.

Total porosity, compaction degree and resistance to penetration, at unconventional soil tillage systems with rotary harrow, chisel and paraplow there are adequate for autumn wheat cultivation. Also, on soybean-maize crop rotation, the evolution of soil compaction degree and resistance to penetration is maintained in normal limits.

Table 1

Evolution of the hydro stability soil structure at luvic phaeozem depending on the tillage system

Variant	**Depth (cm)**	**Reversible Plough + disc-2x**	**Rotary harrow**	**Chisel+ rotary harrow**	**Paraplow + Rotary harrow**
		Level of hydro stability (%)			
Year - I: Soybean	0-10	68.2	69.4	69.6	69.0
	10-20	70.2	79.2	79.0	79.5
	20-30	71.6	78.5	79.4	79.6
Year - II: Wheat	0-10	73.8	76.8	77.4	77.4
	10-20	74.4	80.4	80.6	80.6
	20-30	75.5	83.5	81.5	82.4
Year - III: Maize	0-10	72.4	78.0	77.5	74.0
	10-20	76.0	79.5	78.0	77.1
	20-30	73.5	79.5	79.2	78.5

Porosity of luvic phaeozems compared to the clay texture and clay content of about 43.5%, in all the variants, both the unconventional ones as well as conventional ones, it is maintained at equal values or over minimum limit, respectively on 0-10 cm depth, values of 55-57% at the variant worked after the conventional tillage system and values of 50-55% at the variants worked after the minimum soil tillage system. On 10-20 cm depth the values are within 53-55% at the conventional variants and 48-50% at the variants worked with minimum soil tillage system. The highest values were registered in the first 10 cm, of 56-57% at the variant worked in the conventional system.

The compaction degree confirms the maintained soil loose level in an according to the interval in all variants. The values determined on 0-20 cm depth characterize a low rammed soil (7.7%) - with moderate loose level (-9.6%). The determinations made confirm the moderate loose soil level at the conventional variant. The values are from - 1.9% up to - 9.6% on 0-20 cm depth. It is to mention that at all variants worked in the unconventional system, up to 30 cm depth, the ramming level is under 9.6%, being within average values specific for clay soil profile .

Soil resistance to penetration is significantly influenced, on 0-10 cm depth, at the usage of rotary harrow, where no matter what the base tillage is, the values registered are very close. Soil tillage system, no matter on the crop, influenced the resistance to penetration up to maximum depth of 40 cm, over which the values remain the initial ones in all the tillage systems, with limits between 2082 and 3244 kpa at soybean crop, 2115-3581 kpa at wheat crop and 2341-2540 kpa at maize crop. Regarding soil unconventional tillage systems at wheat crop, on 0-10 cm depth, in the variants worked with chisel and paraplow, even if the values of the resistance to penetration are a little higher compared to the classical variant, at 10-20 cm depth, the values are practically the same as in the case of classical variant.

Soil humidity is between 18.1-27.15%g with values generally low, lower at the surface of soil, which are higher towards depth and decrease near 50 cm. Water reserve of soil for the first 50 cm is within 1,329-1,693 m^3/ha, being dependent on the soil tillage system applied (table 2).

Soil permeability for water is different from a plot to other depending on the soil tillage system and crop. In the variant worked with paraplow + rotary harrow and chisel + rotary harrow the permeability is maximum, the quantity of filter water, l/mp/minute was of 8.55, respectively 8.88. At control variant worked with reversible plough + disc-2x, the quantity of water filtered was of 7.15 l/m^2/minute. The lowest value (6.22 l/m^2/minute) was registered at the variant worked with rotary harrow. This thing shows a better continuity on vertical for soil porosity, in the superior part of soil profile, when the loose level is made with no furrow turning. An increase filtration leads on one hand at a better entrance of water in soil and a better air circulation, and on the other hand, this can be a way to increase the water evaporation level at the surface of soil if it is not protected by a layer of mulch.

The content in humus of the soil registers, by applying soil unconventional systems a tendency to increase. This is due, on one hand, to the higher vegetal waste quantities (minimum 30%) in different decomposing phases, left on the surface of the soil and in first 10-20 cm, and on the other hand to the balancing of report between mineralization/humification, achieved with the help of a physical, thermal and biological specific regime. Determining humus content, after 3 years, it is registered a tendency to increase by applying unconventional systems. The values registered were of 4.93% at the variant worked with plough and 4.93-4.95% at variants worked in unconventional system.

Table 2

Water reserve (R.a., m^3/ha, 0-50 cm) for luvic phaeozem depending on the soil tillage system and rotation culture

Variant	Depth (cm)	Year - I: Soybean			Year - II: Wheat			Year - III: Maize		
		I	II	III	I	II	III	I	II	III
Reversible plough + disc-2x	0-50	1,449	1,624	1,508	1,369	1,505	1,335	1,506	1,538	1,359
Rotary harrow	0-50	1,566	1,686	1,566	1,553	1,509	1,432	1,522	1,494	1,456
Cizel+ rotary harrow	0-50	1,546	1,621	1,556	1,521	1,329	1,484	1,509	1,434	1,385
Paraplow +rotary harrow	0-50	1,553	1,693	1,593	1,452	1,386	1,430	1,515	1,485	1,376

I - Sowing 1-5 May; II - Vegetation 25-30 May; III - Harvest 25-30 August

Content of soil in phosphorus and mobile potassium changes significantly under the influence of soil tillage system, within a crop rotation of three years, in the way that the fertilizers administrated are localized at different depth. So, tillage with rotary harrow localizes large quantities with mobile phosphorus in the first 10 cm of worked soil, and paraplow with does the same, mentioning that phosphorus reaches in equal quantities with the classical tillage with plough, at the 10-20 cm depth. The intensity of aeration and a grater thickness of plants motivate lower mobile phosphorus content in the variant with reversible plough.

Soil reaction and level of saturation in bases remain practically the same no matter on soil tillage. It is noticed on unconventional systems a tendency of decreasing pH-and soil acidification, due to the increasing hydrolitic acids and decreasing the base sum. The tendency of pH changing is justified by phosphorus stratification at the surface of soil, but also the intensification of biological activity, including fungus activity.

Crop rotation in concordance with soil tillage system has different effects upon the cultural soil stage.

In the four crop rotation the ramming level - soil loose, expressed by the bulk density values determined at the beginning of rotation and after winter wheat harvest, in the same points confirms the existence of a tendency of evolution of the oil ramming system, depending on the soil tillage system and the depth of sample harvest. Soil tillage in a different system from the classical one, with plough land, leads to a slice increase of bulk density on 10-20 cm depth, with values between 0.03-0.07 g/cm^3, but without outrunning 1.32 g/cm^3. On 0-10 cm depth, after 4 years of cultivation, the soil is more rammed in the variants worked with cizel and paraplow and it is maintained in the initial phase at the variants which were plough, respectively with rotative harrow.

Crop rotation for here years of soybean-maize-wheat is more labile compared to the four years crop rotation, pointing out a greater influence of the soil tillage system upon the changes of ramming level. In unconventional variants there are maintained the evolution tendencies for bulk density as in the case of four year crop rotation, in the way of increasing soil ramming level at the surface and loose in depth, for 25-35 cm.

In the monoculture for wheat, the ramming level of soil increases, no matter the tillage system and the depth we refer to (0-10, 10-20, 20-30 cm). The explanation is due to the vegetable lack and plant in the rotation. Changing the apparent density has different values from one year to another, with low variation limits, being obviously the ramming at the variant with rotary harrow.

At wheat crop, the tillage system has a direct and indirect influence upon seeds germination level, wheat springing and finally upon production. Following the effect of soil tillage, there can be noticed differences regarding the development of plants and their thickness. So, the number of plants is between 490 and 510 on m^2. The highest thickness was registered at plough variant, being of 510 plants/m^2, and the lowest values were registered at the variants worked with rotary harrow with 490 plants/m^2 and chisel, respectively paraplow with 500 plants/m^2. Tillering at wheat plants is correlated also with soil tillage. So, the number of plants with tiller is maximum in tillage variants with rotary harrow, of 372 plants/m^2 and minimum in the variant with reversible plough + disc (2x) de 357 plants/m^2, in the other variants there are registered intermediary values. Regarding the number of plants with two tilers it can be noticed that this is higher in the case of plough variant, at which there is registered a plus of 10-15 plants/m^2, compared with the other variants. The percentage of brotherhood plants is between 76-80%, the maximum number being in the case of variant with rotary harrow and minim in reversible variant with reversible plough + disc (2x). It can be seen, in the same time, a percentage of brother plants of 77% lat the variants with chisel and paraplow.

The production of wheat achieved by using unconventional soil systems with chisel and paraplow are close to the ones obtained in the classical system, being at the level of 97.8-98.2% (table 3), compared with the control variant, with reversible plough. Differences towards the control variant are insignificant. The difference of production is significant negative in the case of the variant with rotary harrow.

Table 3

Influence of soil tillage system upon wheat production

Soil tillage system	Wheat production kg/ha	%	Difference ± (kg/ha)	Difference significance
Reversible plough + disc 2x	4263	100	Mt.	Mt.
Rotary harrow	4150	97.3	- 113	0
Chisel + rotary harrow	4189	98.2	- 74	-
Paraplow + rotary harror	4170	97.8	- 93	-
DL p 5% = 108 q/ha; DL p 1% = 164 q/ha; DL p 0.1% = 263 q/ha				

CONCLUSIONS

1. Soil tillage system, through direct action and indirect effects, influence the fertility features of luvic phaeozem profile and determine changes in field cultural stage, which impose technological difference for wheat culture. Soil tillage systems modify first of all physical and chemical features, and then the biological and sanitary ones. Conventional soil tillage system and unconventional systems, where soil tillage is made with the help of paraplow, chisel and rotary harrow, influence in a different way production features and wheat crop production.
2. In wheat crop, the tillage system has a direct and indirect influence upon seeds germination level, wheat springing and finally upon production. Following the effect of soil tillage, there can be noticed differences regarding the development of plants and their thickness. The production of wheat achieved by using unconventional soil systems with chisel and paraplow are close to the ones obtained in the classical system, being at the level of 97.8-98.2% compared with the control variant, with reversible plough.

ACKNOWLEDGEMENTS

The research was supported by CNCSIS-UEFISCSU, project number PN-II-RU 273/2010.

REFERENCES

1. Feiza V., I. Deveikyte and D. Simanskaite, 2005. *Soil physical and agrochemical properties changes, weediness and yield of crops in long-term tillage experiment in Lithuania*. Scientific publication, vol. 48, Agronomy, USAMV Iasi.
2. Jitareanu G., C. Ailincai and D. Bucur, 2006. *Influence of Tillage Systems on Soil Phsical and Chemical Caracteristics and Yield in Soybean and Maize Grown in the Moldavian Plain (North-Eastern Romania)*. In Soil Management for Sustainability (pp. 370-379).

3. Moraru P. I. and T. Rusu, 2010. *Soil tillage conservation and its effect on soil organic matter, water management and carbon sequestration*. Journal of Food, Agriculture & Environment, vol. 8(3-4/2010) (pp. 309-312), http://www.world-food.net/scientficjournal/2010/issue3/.
4. Riley H.C.F., M.A. Bleken, S. Abrahamsen, A.K. Bergjord and A.K. Bakken, 2005. *Effects of alternative tillage systems on soil quality and yield of spring cereals on silty clay loam and sandy loam soils in the cool, wet climate of central Norway*. Soil and Tillage Research, volume 80, Issues 1-2 (pp. 79-93).
5. Romaneckas K., V. Pilipavičius, E. Šarauskis and A. Sakalauskas 2009. *Effect of sowing depth on emergence and crop establishment of sugar beet (Beta vulgaris L.)*. Journal of Food, Agriculture & Environment, Vol. 7 (2) (pp. 571-575).
6. Rusu T. 2001. *The influence of Minimum Soil Tillage upon the soil, yield and efficiency*. PhD Thesis, University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca.
7. Rusu T., P. Gus, I. Bogdan, P.I. Moraru, A.I. Pop, D. Clapa, I.M. Doru, I. Oroian and Pop, L.I. 2009. *Implications of Minimum Tillage Systems on Sustainability of Agricultural Production and Soil Conservation*. Journal of Food, Agriculture & Environment, vol. 7(2/2009) (pp. 335-338), http://www.world-food.net/scientficjournal/2009/issue2/pdf/agriculture/a9.pdf.
8. Sarauskis E., K. Romaneckas and S. Buragiene, 2009a. *Impact of conventional and sustainable soil tillage and sowing technologies on physical-mechanical soil properties*. Environmental Res, Engineer Management 49(3) (pp. 36-43).
9. Sarauskis E., E. Vaiciukevicius, K. Romaneckas, A. Sakalauskas and R. Baranauskaite, 2009b. *Economic and energetic evaluation of sustainable tillage and cereal sowing technologies in Lithuania*. Rural Development 4(1) (pp. 280-285).
10. Teixeira L.G., A. Lopes and N. La Scala, 2010. *Temporal variability of soil CO_2 emission after conventional and reduced tillage described by an exponential decay in time model.* Eng. Agric. Vol. 30, no. 2. Saboticabal Mar./Apr. 2010.
11. Ulrich S., B. Hofmann, S. Tischer and O. Christen, 2006. *Influence of Tillage on Soil Quality in a Long Term Trial in Germany*. In Soil Management for Sustainability (pp. 110-116).
12. PoliFact, 2002. ANOVA and Duncan's test pc program for variant analyses made for completely randomized polifactorial experiences. USAMV Cluj-Napoca.
13. xxx, 2003. *Romanian System of Soil Taxonomy*. Ed. Estfalia, Bucharest.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

NEW RESULTS REGARDING MAIZE CROPS CULTIVATED IN THE CONVENTIONAL AND NO-TILLAGE SYSTEMS AT "AGRODELTA" TULCEA AGRICULTURAL COMPANY

N. ŞARPE*, T. RECE, MARIANA RECE**, I. ANTOHI*****

*Academy of Agricultural and Forestry Sciences of Bucharest
**"Agrodelta" Tulcea Agricultural Company 3
***"Agrisol" Pesticide Company of Focşani

Keywords: *Agrodelta, conventional and no-tillage systems, Gaspardo, Regina model*

Abstract

In Romania, maize is the main cultivated plant and maize crops are extremely important from an economical point of view. Research with the no-tillage system applied to maize crops were made in the Romanian Plain, Sarpe (1968,1987, 2000, 2008, 2009), in Banat, Motiu (2004) and in the Flood Plain of the Danube River, Sarpe (2004, 2005, 2007,2008). The results obtained in Romania confirm the results of the research made in other countries: Philips and Young (1973), Koller (1999), Derpsch (2001).

"Agrodelta" is the first agricultural company from Tulcea 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 recorded 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 Moțiu (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 "Agrodelta" agricultural company will be a good example and reference for all the similar companies from Tulcea County as well as for companies from neighbouring counties.

MATERIAL AND METHODS

The experiments with maize cultivated in the conventional and no-tillage systems were carried out at the "Agrodelta" Agricultural Company situated in the Danube Delta on an alluvial soil, which contains in the arable layer a + 30 cm humus 2-4%, clay 20- 30%. The following weed species were identified on the plot where the respective experiment was made: *Chenopodium album, Xanthium italicum, Amaranthus retroflexus, Sativia glauga, Sorghum halepense, Cirsium arvense.* In the plot cultivated by the conventional system, the maize was sowed by means of an SPC-8 Romanian made sowing machine, and in the plot cultivated by the no-tillage system the maize was cultivated by a Regina model sowing machine manufactured by the Italian company Maschio-Gaspardo.

In the plot cultivated by the no-tillage system, the weeds which were 20-50 cm tall before the maize was sowed were treated by the Roundup applied in doses of 5 liters/hectare. In the plot cultivated by the conventional system, the land was ploughed in the autumn, then in was submitted to a disking operation in the spring and laboured by combinatory before sowing.

RESULTS AND DISCUSSION

Table 1 presents 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 Pioneer hybrid "Agrodelta" Tulcea Agricultural Company, 2010

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	Time of appl.	Selectivity (EWRS grades)	Weed control (%)	Yield	
					kg/ha	%
Conventional system						
1. Not hoed	-	-	1.0	0.0	700	10
2. Hoed 3 times (manually and mechanically)	-	-	1.0	94.0	6,500	100
No-tillage system						
3. Untreated	-	-	1.0	0.0	790	12
4. Ceredin Super + Merlin Duo	3.5 1.0	preem. postern.	1.0 1.0	98.0	6,680	103
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 hybrid tolerated very well the Merlin Duo and Ceredin Super herbicides. As regards the weed control in the conventional 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 1/ha after sowing and respectively the Ceredin Super in a dose of 1 1/ha in the vegetation stage, when the maize plants were in the 3-5 leaf-stage, the level of weed control amounted to 98%.

A grain yield of 6,500 kg/ha was recorded in the conventional system and respectively of 6,680 kg/ha in the no-tillage system, so the grain yields recorded in the two systems were practically equal. As regards the not hoed variant in the conventional system, the grain yield was very small, amounting to only 700 kg/ha, and in the untreated variant in the no-tillage system it amounted to 790 kg/ha.

However, there were big differences in terms of fuel consumption, as it stands out from table 2.

As illustrated by the table hereinabove, the fuel consumption in the conventional system from maize sowing to the maize 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 hereinbelow.

Table 2

Fuel consumption in litres/hectare "Agrodelta" Tulcea Agricultural Company, 2010

CONVENTIONAL SYSTEM Mechanical and manual works	**Fuel consump. (litres/ha)**	**NO-TILLAGE SYSTEM Mechanical works**	**Fuel consump. (litres/ha)**
1. Autumn ploughing +	30.0	1. –	–
harrowing		2. –	–
2. Disk	8.0	3. –	–
3. Combinator	7.0	4. Sowed by Gaspardo, Regina	7.0
4. Sowing by SPC-8	6.0	5. Appl. of herbicides before sprouting	1.5
5.1st mechanical hoeing	4.0	6.	–
6.1st manual hoeing	-	7. Appl. of herbicides on	1.5
7. 2nd mechanical hoeing	4.0	vegetation	–
8. 2nd manual hoeing	-	8. –	–
9.3rd mechanical hoeing	4.0	9. –	–
10. 3rd manual hoeing		10. –	15.0
11. Harvesting by Claas combine	15.8		
TOTAL CONSUMPTION	**78.0**	**TOTAL CONSUMPTION**	**25.0**

According to the data presented in table 3 hereinabove, maize cultivation costs from the ploughing to the harvesting stage amounted to RON 2,350 in the conventional system and only to 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 analyzed the profit obtained from a hectare of maize cultivated in the conventional and respectively no-tillage system.

Based on the relevant results obtained at the “Agrodelta” Tulcea Agricultural Company, we have elaborated the following strategy for the control of annual and perennial weeds.

Table 3

Cost of maize cultivation incurred for mechanical and manual works "Agrodelta" Tulcea Agricultural Company, 2010

CONVENTIONAL SYSTEM Mechanical and manual works	Cost (RON/ha)	NO-TILLAGE SYSTEM Mechanical works	Cost (RON/ha)
1. Autumn ploughing + harrowing	270	1. –	–
2. Disking	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	11. Harvesting	300
TOTAL RON	**2,350**	**TOTAL RON**	**610**

Table 4

Profit in RON/hectare of maize cultivation in the conventional and no-tillage systems "Agrodelta" Tulcea Agricultural Company, 2010

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	3,380	- 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/kq). Agricultural Profit, issue No. 33 of September 2009

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 who 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 oficinale* and *Convolvulus arvensis* to spring in mass. The plot must be then treated by glyphosate-based herbicides such as Roundup, Cosmic, Dacglisat, Dominator, Gallup, Glifotim, Glyphogan 480, Glyphostock, Sanglypho and Rocco. All theses herbicides contain 360 g/1 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 liters per hectare.

Application of glyphosate-based herbicides is strictly forbidden after the maize has sprung, because the crops will be "burnt" by these herbicides.

One of the following herbicides shall be applied together (tankmix) with the glyphosate- besed 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 1.0 1/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.

REFERENCES

1. Derpsch R., 2001. *Conservation tillage, no-tillage and related technologies.* World Congress on Conservation Agriculture (pp. 161-170).
2. Koller R., 1997. *Optimierung von siver Ritungen fur die Directsaat von Getreide.* International Symposium Soil Tillage Alternatives, University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca (pp. 107-114).
3. Philips S.N., H.M. Young, 1973. *No-tillage Farming*. Publish Remain Associated Inc., Milwakee, Visconsin (pp. 1-124).
4. Şarpe N., 1968. *Cercetări privind cultura porumbului fără arătură*. Revista "Ferma şi întreprinderea Agricolă de Stat", Bucureşti (pp. 5-7).

5. Şarpe N., 1984. *Perspectiva sistemului no-tillage pentru agricultura României şi strategiile de combatere chimică a buruienilor*. National Symposium of Herbology, Bucharest (pp. 123-144).
6. Şarpe N., 1986. *Cercetări privind cultivarea porumbului în sistem minimum şi zero-tillage şi unele modificări flzico-chimice ale cernoziomului cambic de la Fundulea după 18 ani de monocultură*. In "Probleme de agro-fitotehnie teoretică si aplicativă", Vol. VIII (I), Fundulea (pp. 31-50).
7. Şarpe N., M. Andru, D. Motiu, 2000. *Efficacy of various herbicides when applied in no-tillage maize and spring barley in Romania*. 52nd International Symposyum on Crop Protection, Med. Fac. Landth, Gent University, Belgium (pp. 99-166).
8. Şarpe N., 2004. *Primele rezultate cu sistemul no-tillage la cultura porumbului în condiţiile din Lunca Dunării*. Revista Agro-Tera nr. 1, Bucureşti (pp. 42-44).
9. Şarpe N., Şt. Poienaru, 2004. *Tehnologia culturilor agricole în sistemul minimum tillage, no-tillage şi strategiile de combatere chimică a buruienilor în condiţiile din România*. Ed. Agro-Terra, Bucureşti (pp. 1-323).
10. Şarpe N., 2004. *Perspectiva sistemului no-tillage pentru agricultura României şi strategiile de combatere chimică a buruienilor.* 14th National Symposium of Herbology, Bucharest (pp. 123-144).
11. Şarpe N., Şt. Poienaru, 2005. *Experimental results with genetically modified soybean cultivated in the no-tillage system in the Danube Meadow - Romania*. International Symposium, State Agricultural University, Chişinău (pp. 219-222).
12. Poienaru Şt., N. Şarpe, M. Maschio, 2006. *Economical efficiency of classical and no-tillage system at genetically modified soybean in the conditions of Romania.* 58th International Symposium on Crop Protection, Biol. University Gent, Belgium (pp. 209-213).
13. Şarpe N., 2007. *No-tillage system for the cross-breed vineyard.* Bulletin of University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca (pp. 44-49).
14. Şarpe N., 2008. *Multiannual study of the no-tillage system applied to maize crops in the pedoclimatic conditions.* Bulletin of University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca (pp. 44-49).
15. Şarpe N., M. Maschio, Şt. Poienaru, 2008. *New results regarding the no-tillage system applied to winter barley cultivated in the flood plain of the Danube river*. Annals of the University of Craiova (pp. 511-515).
16. Şarpe N., 2008. *Patruzeci de ani de cercetare privind sistemul no-tillage la porumb, în condiţiile din România*. Analele ICNA Fundulea, Vol. LXXVI.
17. Şarpe N., 2009. *Sistemul no-tillage la semănatul porumbului*. Revista "Profitul Agricol" nr. 5, Bucureşti (pp. 21-22).
18. Şarpe N., Şt. Poienaru, M. Maschio, 2009. *Maize cultivation in the no-tillage system by using the Regina Model of the Gaspardo sowing machine*. Scientific Papers, Series A LII Agronomy. Univeristy of Agronomic Sciences and Veterinary Medicine, Bucharest (pp. 277-284).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222 - 5339

RESEARCH ON REDUCTION OF HERBICIDE RATES IN FIELD CROPS ECO-MEDIUM

N. IONESCU

Agricultural Research and Development Station of Pitesti

Keywords: *weeds covered degrees (CD), herbicide rates, field crops*

Abstract

We are in a time when herbicide application must take into account both environmental and economic aspects [2]. The first step in expressing the maximum effectiveness of the herbicide is the correlation between the level of weed encrachment and the applied rates, then reverse to try to optimize rates of herbicides. The success of reducing herbicide rates will be provided only by applying integrated weed management (IWM). In this case several issues should be kept in mind: appropriate crop rotation, cultural practices, specific flora inventory, choosing herbicides. Herbicides in rates: 0-25-50-75-100% of normal were applied in winter wheat, maize, sunflower and soybean crops. The results highlighted specific situations, with important agricultural practice. Thus, in the winter wheat crop with a high degree of competition, herbicides can be reduced by 25%, while the multi-row hoe (maize, sunflower and soybean) to reduce specific herbicides will be made with caution, with maximum 25% of the normal rates.

INTRODUCTION

The practical application of herbicides is aimed for the best, not necessary total [1] of weeds from each field crop. To achieve this control, farmers use the recommended rates, sometimes over the legal limits. It guarantees the removal of weeds in the crop. In addition, the company shall include recommendations on rates of herbicide for the most difficult situations of infestation with weeds that will be in control. Reducing the normal rate of herbicides appeared in the last decade [9] mainly for total environmental protection, but also for economic reasons and lower costs. In the conditions we agreed, it is necessary that weeds be controlled on a whole complex of measures called integrated [3]. Integrated weed management (IWM) is already successfully applied since the beginning of the phases [5], namely: using crop rotations, cultural practices, weed mapping, the correct choice and dosage of herbicide application. At present, there are practical solutions for the implementation of crop rotations, cultural methods, proper herbicides and their best suitability to reduce weeds encroachment degrees [4, 7]. It remains to be seen to what extent herbicides can be applied in smaller rates, reduced, considering the integrated control. Of course, each particular herbicide chosen for weed control would need to follow practical performance. The factors that directly influence the effectiveness of a herbicide [6, 8] are: the structure of weed flora, their stage of development, soil type, climate conditions, crop type and competitiveness. In the present research common herbicides, known by farmers were used, in several rates, both compared with the untreated control and normal rates. The results encourage the promotion in conjunction with the IWM in which specific crop conditions could promote adequate rates of herbicides to crop plants.

MATERIAL AND METHODS

In 2008 many experiments were carried out with such subdivided parcels, with two factors, in: winter wheat, maize, sunflower and soybean. The A Factor was herbicide - were applied by two items for each crop, and rate of herbicides factor B: 0% (untreated control plot and no-hoed), 25%, 50%, 75% and 100% of normal rate recommended for each herbicide and plant separately. Each variants area was 25 m^2 in four replications. Soil surveys were conducted on the type of clay podzolic (luvosoil), pH 5.14, humus content of 2.02% and 29% clay, all arable horizon. The four plants were grown after station technology and application of herbicides was made with manual pump type Solo 456, with 1100 nozzle type Teejet dispersion angle. The amount of water was 300 $l.ha^{-1}$, both applied in preemergency and post ememergency periods. Herbicide active ingredients are used both as a different action spectrum as well as control (Table 1).

Table 1

Herbicides applied in differing rates for weeds control in field crops

Crop	Herbicides, a.i.	Rates		Application
		CP $g,l.ha^{-1}$	a.i. $g,kg.ha^{-1}$	
Winter wheat	Chlorsulfuron	20	15	Postem.
	2.4 D acid	1.0	0.66	Postem.
Maize	Acetochlor	2.0	1.68	Preem.
	Acetochlor+ atrazine	2.0 +2.0	1.68 +1.0	Preem.
Sunflower	Acetochlor	1.75	1,51	Preem.
	Acetochlor+ oxyfluorfen	1.75 +1.0	1.51 +0.24	Preem.
Soybean	Acetochlor	2.0	1.68	Preem.
	Imazethapyr	0.75	75	Postem.

During plant vegetation, observations were made on the degree of weed control. Of these, effectiveness control was expressed in covered degrees (CD) of weeds remaining uncontrolled, as well as weed biomass formed and grain yields (grains) as a result of reduced rates of the herbicides. The mean values obtained were statistically processed by the Anova test (analysis version) and the Excel program.

RESULTS AND DISCUSSION

Influence of climatic factors on the evolution of plant vegetation. As known, both crop plants and weeds need favorable climate evolution, starting from the first moments of come out to maturity. For the crop year 2008, values were found both temperatures and rainfall and favorable enough for the entire cover namely vegetable crops (Figure 1). The data are part of the period between April and August. Minimum and maximum temperature evolutions followed relatively close to normal growth. Sporadic fluctuations were recorded as generally favorable.

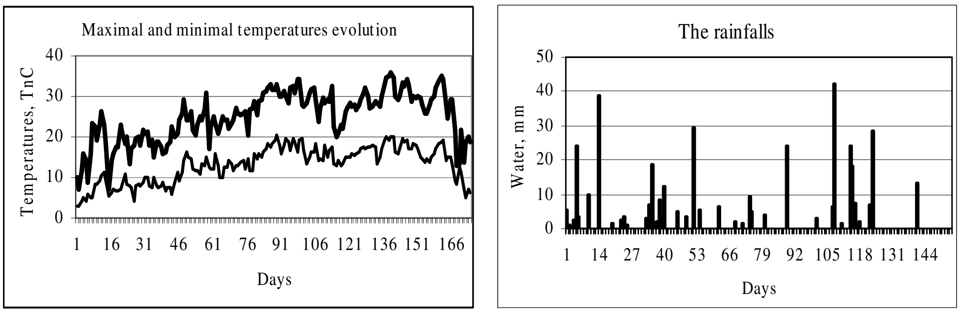


Fig. 1. Evolution of temperatures and rainfalls for plant vegetation

In winter wheat, the first 90 days of continous graphic shows increasing values. April-May to June is the most important vegetation growth because there is intense (straw elongation), flowering and deposition of nutrients in the grains. Spring crops (sunflower, maize and soybeans), starting with the 40-day (May) and autumn temperatures have been favorable to growth and development. Precipitations, except that they were periodically heavy (30-40 mm each), provided this factor in the entire range of vegetation, both in the early and intensive period of plant growth. In general, the state created favorable climate and good conditions to express the effectiveness of the herbicide rates tested.

Weed natural encroachment of four crop plants. In the plot the weeds sprang up, grew and produced specific biomass at various levels, depending on the crop plants (Figure 2). The dominant species were part of three groups of weeds. Thus, winter wheat dominated the annual dycots (AD), less perrenial dycots (PD) and almost no annual monocots (AM). Their average amount stood at 6.1 t.ha^{-1}-a total biomass. In the maize crop AM were dominant, followed by AD and PD. In sunflower and soybeans this structure remained approximatively in the same proportions. Generally, maize occured 16.6 t.ha^{-1} - total biomass, in sunflower 11.6 t.ha^{-1} total biomass and in soybean crop 17.6 t.ha^{-1} total vegetation mass. The values obtained are similar to the multi-media driven and characterized in this regard by the specific levels of weed encroachment from our station eco-medium.

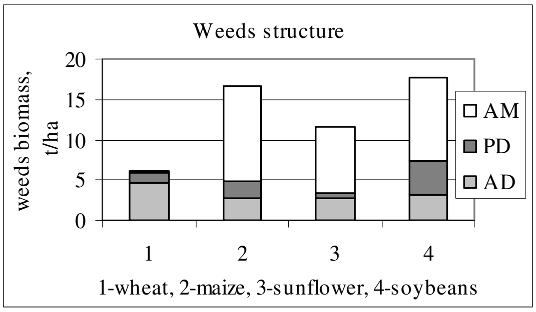


Fig. 2. Weeds species structure in control plot

Effectiveness of different herbicides on weed control. By reducing the rate of herbicides we created conditions that decrease their effectiveness. The extent in wicch the weed flora was not controlled demonstrates practical situations. In winter wheat (Figure 3) chlorsulfuron inhibited ALS enzyme, while 2.4 D acid was a hormone herbicide. Effectiveness depending on the rate was completely different. Fighting the good was obtained between 75 and 100% for chlorsulfuron and 100% for 2.4 D acid. According to these results and grain followed the same features. It is also noticeable that the control had uncontrolled CD between 80 and 90% and grain production stood at 3.2 t.ha^{-1}. Rates lower than less than 5.1 t.ha^{-1} ensured the formation of wheat grain.

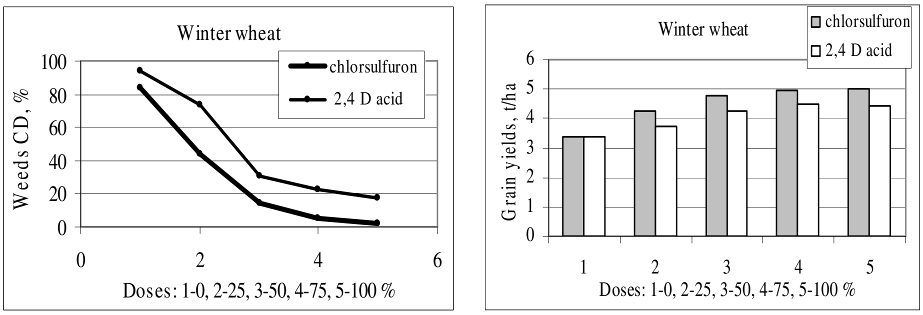


Fig. 3. Efficacy of herbicide rates in wheat crop

Maize was treated with acetochlor, an inhibitor of cell division and by its combination with atrazine, an inhibitor of PS II (photosynthesis), efficiency was increased (Figure 4). Acetochlor cannot reduce the normal rate, and by complexation with atrazine may be a 25% reduction in rate, but with restrictions. Grain production by herbicide saved was between 2.2 t.ha^{-1} in the check plot and 7.1 t.ha^{-1} in normal rates.

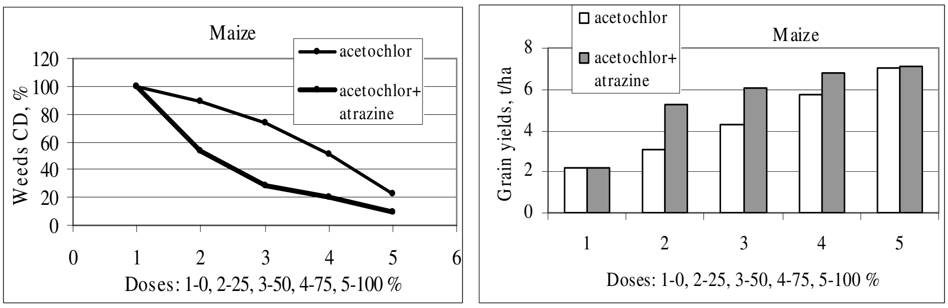


Fig. 4. The efficacy of herbicides rates from maize crop

In the sunflower crop acetochlor was used, as well as a combination of this with oxyfluorfen, a Protox herbicide inhibitor. This combination of two herbicides had a better efficacy. Weeds were well controlled both rate reduced by 25% and the normal rate (Figure 5). Formed grains were located between 1.2 t.ha^{-1} in the untreated control and 2.9 t.ha^{-1} in a culture without weeds.

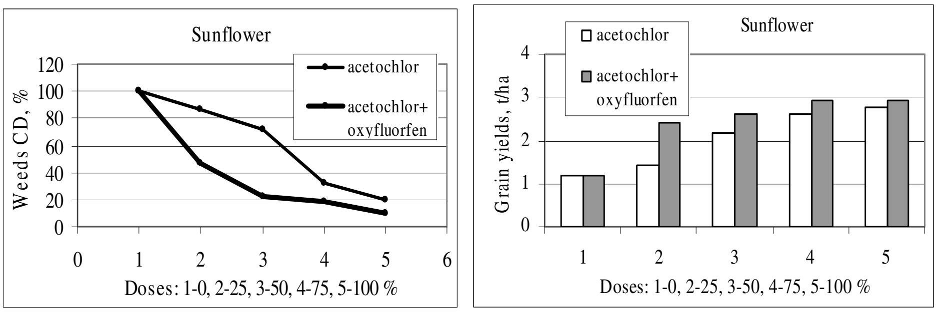


Fig. 5. Efficacy of herbicides rates in sunflower crop

Soybean had high levels of weeds encroachment and herbicide used posed a major problem: to keep a clean culture. The experiment used acetochlor and imazethapyr.

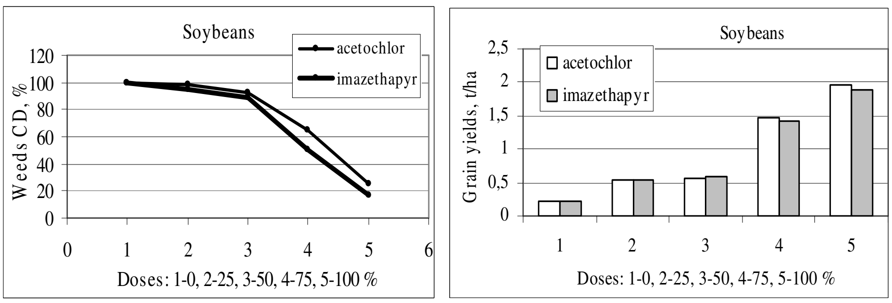


Fig. 6. Efficacy of herbicides rates in soybean crop

The latter is a known inhibitor of ALS enzyme. Their small rates did not achieve control in good conditions (Figure 6) so that soybean was only recommended rates to normal concentrations. Grain production was fluctuated between 0.2 t.ha^{-1} in the control plot and 2.0 t.ha^{-1} in the variants treated properly.

CONCLUSIONS

1. The weed encroachment levels in this area is very high, regardless of the culture year. Under natural conditions the yield recorded 6.1 t.ha^{-1} weeds in wheat, 16.6 t.ha^{-1} in maize, 11.6 t.ha^{-1} in sunflower and 17.6 t.ha^{-1} in soybean.
2. Rate reduction, regardless of herbicide use, should be made very carefully. Positive control was obtained under conditions favorable rate reduced by 25% of normal in case of chlorsulfuron in wheat crop, and combined products whithout reducing rates for maize, sunflower and soybean.
3. As appropriate control off all species of weeds and application of a suitable IWM, will be switched to the herbicide rate adjustments should be based on levels of specific weed encroachment.

REFERENCES

1. Ammon H.U., 1997. *Weed control in transition- from weed eradication to vegetation management.* 10th EWRS Symposium, Poznan Poland (pp.87-94).
2. Bostrom U. & S.H. Fogelfors, 2001. *Long-term trials with reduced herbicide rates.* Proceedings British Crop Protection Conference BCPC- weeds, Brighton UK (pp. 481-486).
3. Kempenaar C., R.M.W. Groeneveld, A.J.M. Uffing, R.Y. Wiede, J. Wevers, 2002. *New insights and developments in the MLHD- concept of weed control.* 12th EWRS Symposium, Wageningen The Netherlands (pp. 98-99).
4. Kudsk P., 1999. *Optimizing herbicide use- the driving force behind the development of the danish decision support system.* Proceedings BCPC Conference- weeds, Brighton UK (pp. 737-746).
5. Kudsk P., 2002. *Optimising herbicide performance- Weed Management Hand book.* Blackwell Publ., Oxford UK (pp. 323-344).
6. Kudsk P & J.C. Streibig, 2003. *Herbicides- a two-edged sword.* Weed Research, vol. 43 (pp. 90-102).
7. Salonen J., 1992. *Efficacy of reduced herbicide rates in spring cereals of different competitive ability.* Weed Research, vol. 32 (pp. 483-491).
8. Zhang Z.H., S.E. Weaver & A.S. Hamill, 2000. *Risks and reliability of using herbicides below-labelled rates.* Weed Technology, vol. 14 (pp. 106-115).
9. xxx, 2002. FAOSTAT, Rome.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

RESEARCH REGARDIG THE VIRULENCE OF BROOMRAPE PARASIT (*OROBANCHE CUMANA* WALLR.) IN SOUTHEASTERN OF ROMANIA

GEORGETA DICU, ELENA ANDREEA TEODORESCU, NICOLETA CLAUDIA DUMITRESCU, N. BOAGHE, MIHAELA IONITA

S.C. Procera Agrochemicals Romania S.R.L.

Keywords: *sunflower, Orobanche cumana, races, virulence*

Abstract

Broomrape (Orobanche cumana Wallr.) is becoming one of the most serious parasites for sunflower crop in Romania mainly in the south-eastern part of the country. During last two decades, the aggressivness of the parasite increased significantly the new physiological races appeared fast enough after a relative stable period of time on race E of broomrape. Research concerning races evolution carried out in different Institutes in Eastern Europe or Spain showed that the interaction host-parasite system the gene action was dominant type up to the level of race E beeing involved one single gene. Increasing the virulence of the parasite up to the race F or G, a new type of interaction was identified, being involved one or more genes for resistance dominant or recessive ones depending of the genetic material involved in the studies. This study carried out during 2009 and 2010 by Procera Agrochemicals in 5 location in South-eastern part of Romania identified the race G based on a differential set established on the characterization concerning the resistance of commercial hybrids available in commercial seeds catalog. It was included one hybrid without resistance genes (Performer), one race E resistant hybrid (PR64A89). The race F resistant hybrid was PRO229 (Procera) and the race G was PR64A71. This last one was characterized as „resistant against races more aggressive than E" in the Pioneer Hi-Bred-Seeds Agro.srl Romania" and as „resistant against race G" by Pacureanu [4].

Definitely the race G was identified in Tulcea and Constanta counties based on infestation values obtained after 2 years of trialing. In some locations (no 1, no 3, no 4 and no 5), virulence above race G was found because PR64A71 presented a very low number of strains. It seems to be a new race more aggressive than G and we named G+. The reason of infestation of PR64A71 could be the incomplete homozygocity of the hybrid compounds and in this situation broomrape shoots may appear. For the host spots infested with race G is not recommended to plant race E resistant hybrids because of the very high yield decrease. The hybrids race F resistant may register as well significant yield decreases in those areas.

INTRODUCTION

Broomrape parasite sunflower crops reduces significantly seed and oil production, depending on the population virulence and physiological races of parasite *Orobanche cumana*; production could decrease to 100%.

Because of the resistant genetic factors to broomrape in sunflower crops the first resistant hybrids were created. [8] noticed a form of resistance to broomrape of sunflower seeds with carbonogen protective coating.

During last two decades, the aggressiveness of the parasite increased significantly the new physiological races appeared fast enough after a relative stable period of time on race E of broomrape, especially around Black Sea, the virulence explosion have been identified in Trakia from Turkey, extending further in south-eastern part of Bulgaria and Romania, Moldova, Ukraine and Russia.

In Romania, research carried out by Procera Agrochemicals in 2009 and 2010 identified race G, during some experience in south-eastern part of the country, based on a differential set established on the characterization concerning the resistance over race E of commercial hybrids.

The objectives of this experiment is to establish the virulence of races for *Orobanche cumana* in south-eastern part of Romania based on a differential set established by Procera Agrochemicals.

MATERIAL AND METHODS

To determine the populations virulence of broomrape we used a differential set with commercial hybrids available in commercial seeds catalog:

- Performer-ICDA Fundulea-no resistance genes;
- PR64A89-Pioneer-race E resistance;
- PRO 229-Procera-race F resistance;
- PR64A71-Pioneer-race G resistance.

This study was carried out during 2009 and 2010 by Procera Agrochemicals in 5 location in Tulcea and Constanta county to identify the race more aggressive than E race.

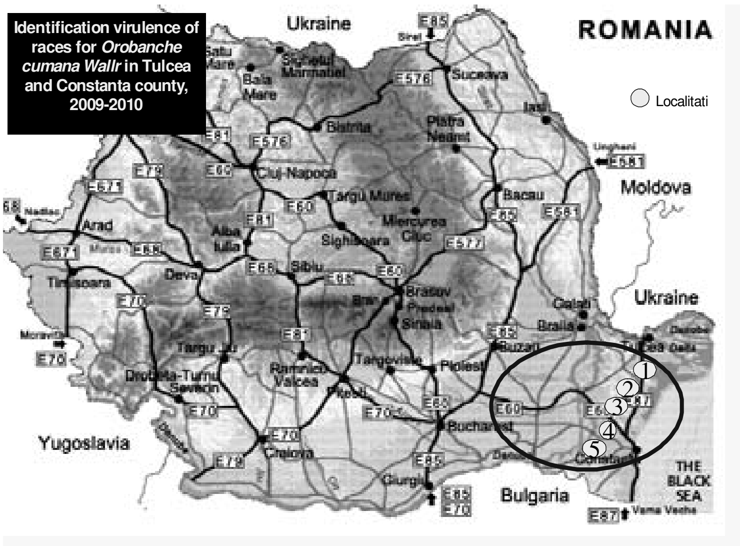
The susceptible control and the resistant one planted on the borders and in the middle of the field for a better tracking of field infestation. Two reps were planted for each differential in each location.

To establish the virulence of races for *Orobanche cumana,* it the following indicators were calculated:

- infestation frequency (F): number of infested plants with Orobanche on row/ total number of plants on row * 100

- infestation intensity (I): total number of Orobanche strains/total number of infested plants with *Orobanche* on row

- attack degree (GA): F*I/100



RESULTS AND DISCUSSION

In table 1 we can see that the resistant genes are different, depending by experiment and differential set established to analysis genetic determinism for *Orobanche cumana*.

Genetic conditioning of resistance to race A-E is made through only one dominant gene Or5, and for populations or physiological races more aggressive than race E genetic conditioning of resistance is more complicated, because must be used additivity or complementarity effects.

During research for race determination of *Orobanche cumana Wallr.* or resistance genes were used genetics systems for differentiation specifically every country or institution with specific.

In table 2 we can see accounted values for attack frequency, intensity and degree of attack for those 4 used differentiators hybrids.

PRO 229 hybrid registered values of attack degree between 0.1 and 0.44, the strongest infestation was in the first location. The hybrid could register in this location low productions because of the parasite. Based on frequency values, intensity and attack degree we could confirm the existence of race G in those five locations.

PR64A71 hybrid recorded the lowest infestation. Attack frequency was between 0 and 2.2% and degree attack was 0 in 4 locations and 2.2 in the first location. In locations 1,3,4,5 we found 1-2 parasites on the hybrid and we confirm the virulence populations of broomrape is over G.

Table 1

Genetic determinism of resistance/tolerance for *Orobanche cumana*

Resistance source	Race *Orobanche*	Resistance gene	Gene resistance type	Bibliographic reference
Krugklik-A-41	A-E	Or1	one dominant gene	Vranceanu and collaborators (1980)
Jdanov 8281	A-E	Or2	one dominant gene	Vranceanu and collaborators (1980)
Record	A-E	Or3	one dominant gene	Vranceanu and collaborators (1980)
S-1358	A-E	Or4	one dominant gene	Vranceanu and collaborators (1980)
P-1380	A-E	Or5	one dominant gene	Vranceanu and collaborators (1980)
SW501	unknown	unknown	one dominant gene	Ish-Shalom_Gordon and collaborator (1993)
NR-5	E	Or5	one dominant gene	Sukno and collaborators (1999)
R-41	E	unknown	one dominant gene	Dominguez (1996)
P-96	F (Mencia-Spania)	Or6, Or7	two recessive genes	Akhtouch and collaborators (2002)
P-96	E	unknown	one dominant gene	Perez-Vich and collaborators (2002)
KI-534	E	Or6, Or7	two recessive genes	Rodriguez-Odeja and collaborators (2001)
KI-534	F (EK23), Spania	Or6, Or8	two recessive genes	Rodriguez-Odeja and collaborators (2002)
J1 (BR4)	F (Mencia-Spania)	Or6	one dominant gene	Perez-Vich and collaborators (2002)
LC1093	F(Romania)	Or6	one dominant gene	Pacureanu and collaborators (2004)
J1 (BR4)	F (Mencia-Spania)	Or6, Or7	two partially dominant genes	Velasco and collaborators (2006)
	G (Spania)	unknown		Molinero,Ruiz and Melero-Vara (2005)
Commercial hybrid 6471	G (Romania)	unknown		Pacureanu and collaborators (2009)

Table 2

Differential sort for *Orobanche cumana* Wallr. races identification

Differential sort	Characterization	F (%)	I (%)	GA (%)
Performer	no resistance	79 -100	1.75-4	1.7- 4
PR 64A89	E, Or5	24 -79	0.7 - 2.33	0.2 - 1.59
PR0229	F, Or6	14 - 39	0.4 - 1.9	0.1 - 0.44
PR64A71	G, Or7	0 - 2.2	0 - 1	0 - 0.02

F=infestation frequency; I=infestation intensity; GA=attack degree

CONCLUSIONS

1. During the last two decades, the aggressivity of the parasite increased significantly the new physiological races in the southeastern part of Romania, especially in Tulcea and Constanta county and proximity of Black Sea from Turkey, Bulgaria, Ukraine and Russia
2. Research concerning races evolution is necessary establishment of a differentiating sort created with inbred lines or hybrids with resistance for broomrape parasite.
3. Based on frequency values, intensity and attack degree registered, we can establish the physiologically races of *Orobanche Cumana* Wallr. in those five locations.
4. In 2009 and 2010 in our locations we identified race G and in locations 1,3,4,5 virulence more aggressive than race G, because we found broomrape strains on the hybrid resistant for race G.
5. Broomrape reduced significantly seed and oil production. It is not recommended to cultivate sunflower hybrids with resistance genes for race E or F in locations infested with race G or G+.

REFERENCES

1. Buherovici P.G., 1967. *Viivalenie rasovogo sostava podsolnecinicoi zarazihi moldavskovo proishojdeniia.* Sb. Rabot Masl. Kult., Vip. 2, Krasnodar (pp. 68).
2. Kaya Y., Y. Demirci, G. Evci, 2004. *Sunflower (Helianthus annuus L.) breeding in Turkey for broomrape (Orobanche cernua Loeffl) and herbicide resistance*. Helia 27, Nr. 40 (pp. 199-210).
3. Molinero-Ruiz M., Melero-Vara, M. Jose, 2004. *Virulence and aggressiveness of sunflower broomrape (Orobanche Cumana) populations overcoming the Or5 gene.* Proc. 16th International Sunflower Conference, Fargo, ND USA.
4. Pacureanu Joita, M. Raranciuc, S. Sava, E. Stanciu, D. Nastase, 2009. *Virulence and aggressiveness of sunflower broomrape (Orobanche Cumana Wallr.) population in Romania*. Helia 32, Nr. 51 (pp. 111-118).
5. Pustovoit G.V., 1966. *Mejvidovaia ghibridizatia kak metod selectii podsolnecinika na grupovnoi imunitet Ghenetika*. 1 (pp. 59-69).
6. Rojkova V.T., R.M. Koseleva, 1987. *Izucenie na reaktii obraztov podsolnecinika mirovoi kolectii VIR na razlicinie populatii zarazihi*. In Selektiia I Ghenetika Tehniceskih Kultur. Sb. Naucinih Trudov po Prikl. Bot., Ghen. I Sel., VIR Leningrad, 113 (pp. 41-46).
7. Rotarenco V., 2010. *Unele aspecte morfo-fiziologice si genetice de interactiune gazda-parazit (Helianthus anuus L. - Orobanche Cumana Wallr.).* Autoreferatul tezei de doctorat, Universitatea de Stat din Moldova, Chisinau.

8. Satâperov F.A., 1913. *Opiti s podsolnecinikom*. Trudi Biuro Prikl. Bot., 6(4) (pp. 251-258).

9. Vasile T.A., 1981. *Studiul rezistentei florii-soarelui la atacul de lupoaie (Orobanche spp.).* Rezumat al tezei pentru obtinerea titlului stiintific de “Doctor in agronomie” Institutul Agronomic “N. Balcescu” Bucuresti.

10. Vranceanu A.V., V.A. Tudor, F.M. Stoenescu, N. Parvu, 1981. *Evolutii ale virulentei parazitului Orobanche Cumana Wallr. si gene corespunzatoare de rezistenta la floarea-soarelui.* Analele ICCPT Fundulea Vol. XLVIII (pp. 37-43).

11. Vranceanu A.V., J.M. Pacureanu, 1995. *Evaluation of an international set of sunflower hybrids in relation to broomrape (Orobanche Cumana Wallr.) resistance*. Helia 3 (pp. 19-24).

12. Vranceanu A.V., 2000. *Floarea - soarelui hibrida*. Ed. Ceres, Bucuresti (pp. 1445).

13. xxx, 2010. Pioneer Hi-Bred Seeds Agro. SRL Romania, commercial catalog.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222 - 5339

WEED CONTROL IN MAIZE CROP BY MECHANICAL AND MANUAL MANAGEMENT PRACTICES

A. DAMIAN

Limagrain Romania Company

Keywords: *maize, weeds number, mechanical and manual practices, yield quality*

Abstract

Mechanical and manual hoeing employed in weed control is an ecological alternative. This alternative could be easily adopted in an integrated weed management system owing to regional traditions and success all over the world [13]. We have studied a major crop: maize, in 11 types: mechanical hoeing, manual hoeing and a combination of both. The results are shown as weed evolution expressed by the species number, both on the interval between the rows and the maize rows, at intervals of 20, 40 and 60 days after the emergence (DAE), i.e. before the two types of works. Weed density in the interval between rows decreased in time after 20 DAE 40-50, from 40-50 total species 30-40 species, and dropped below 20 species at 60 DAE. The decrease in weeding level has increased the average grain yield of better quality. The correlations between different qualitative aspects of grain yielf (r = 0.704/protein, r = 0.454/oil, and r = 0.463/ash), recommend the promotion and implementation of this system of reducing weeding in maize.*

INTRODUCTION

As weed-susceptible plant, maize is strongly weeding irrespective of the crop area [2]. Its relatively wide nutrition area allows invasion by many weed species ever since the beginning of vegetation [3], resulting from both the sunlight falling directly on soil and humidity that is usually sufficient for seed emergence. The germination strength of different weed species is already known [12], as most grow much faster compared to maize. Weed emergence is slower [7], which leads to the emergence of a real weed-made green cover.

Mechanical and manual hoeing are applied for weed control worldwide [4, 14], and in Romania, as their positive effects are very important within a specific cultural system. There is a question, however, referring to whether such practices can control a sufficiently large number of weeds [11], so that their competition with maize (as species number) should not result in obvious/significant loss [5, 6]. Under some cultural conditions [8], weed control by mechanical means has proven successful, i.e. between 37-95% [4.15], irrespective of works number [5.10]. However, mechanical means is truly effective if applied together with other collateral factors that contribute effectively to weed control. Agricultural practice has proven that combining several measures with mechanical hoeing results in significant changes in weed populations [1]. Moreover, in today's promotion of integrated weed management, the use of complex weed control in maize, together with manual and mechanical means, may lead to the maintenance of a weeding level below the critical damage level.

This paper presents the results obtained from the combination of mechanical and manual means and in different rates, i.e. the number of works performed to the maize crop: between 1 and 3, for economic reasons. This type of study might find an answer to the environmental, and sustainable, requirements regarding weed control in this valuable crop: maize.

MATERIAL AND METHODS

Research was performed at the Caracal Agricultural Research and Development Station, under the influence of the 2010 climatic conditions, on rich carbonate-type soil. The LG 33.30 hybrid maize (of the FAO 330 group) was grown under normal conditions: soil was plowed in autumn, and 2-3 poly-disc works were performed in spring. Both works specifically decreased weeding [9]. The experiment included 11 variants of 28 m^2 each, in three repetitions (84 m^2 in total). The variants were placed according to the block method. Mechanical and manual hoeing were made in a characteristic structure/combination (Table 1).

Table 1

Combination between mechanical and manual hoeing

No. var	Treatments	Mechanical-DAE days			Manual-DAE days		
		20	40	60	20	40	60
1.	2 Mec (I,II) Control	yes	yes				
2.	2 man (I,II)				yes	yes	
3.	2 Mec (I,II)+1 man (II)	yes	yes			yes	
4.	1 Mec (II)+2 man (I,II)		yes		yes	yes	
5.	2 Mec (I,II)+1 man (I)	yes	yes		yes		
6.	1 Mec (I)+2 man (I,II)	yes			yes	yes	
7.	*2 Mec (1,2)+2 man (1,2)*	*yes*	*yes*		*yes*	*yes*	
8.	2 Mec (I,II)+2 man (I,II)	yes	yes		yes	yes	
9.	3 Mec +2 man (I,II)	yes	yes	yes	yes	yes	
10.	*3 Mec +3 man (1,2,3)*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
11.	3 Mec + 3 man (I,II,III)	yes	yes	yes	yes	yes	yes

yes – I, II, III = 20, 40, 60 days after emergence, DAE

yes – 1, 2, 3 = 15, 30, 45 days after emergence, DAE

The climatic conditions highlight slightly higher temperatures than the annual average, while precipitations were higher in the first part of the vegetation period and under the multi-annual average in the second part (Table 2).

Table 2

Climatic data specific to year 2010

Parameters	Average, total	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Temp. T^0C	2010	6.0	12.3	17.4	21.4	23.6	24.9	18.3
	Normal	4.8	11.2	16.6	20.5	22.7	21.9	17.6
Rainfalls, mm	2010	50.6	64.0	167.4	107.0	6.6	29.4	23.0
	Normal	34.9	43.6	64.9	67.0	52.9	50.7	39.6

RESULTS AND DISCUSSION

Observations performed over several years (in the station), including the research time length (2010), showed greater, strong maize weeding. The main causes are: the existence of flower diversity expressed by a large species number, the high density per unit area, the natural reserve (bankseed) of the cultivated land from which they emerge every year, and maize as a less competitive crop plant compared to weeds. The present research clearly shows the possibility to reduce maize weeding only by employing mechanical hoeing in combination with manual hoeing.

Weeding evolution during the vegetation period. The weed number measured on plant interval and row highlighted the actual maize weeding (Figure 1).

Thus, weed number varied significantly, i.e. around 40 species, on the interval between the lines before the first hoeing (after 20 DAE). Figure 1 shows the species grouped into four directions: yearly dicotyledons-YD at the base, yearly monocotyledons-YM and perennial dicotyledons-PD in the middle and perennial monocotyledons-PM at the top. Representative of these groups were the problematic weeda: YD: *Amaranthus retroflexus, Xanthium italicum, Solanum nigrum*, YM: *Setting glauca*; PD: *Convolvulus arvensis, Cirsium arvense, MP: Sorghum halepense*. The two works showed that before the third stage (60 DAE), the total number of weed species decreased from 10 to 15. There were structural changes between weed categories, as a result of hoeing. The weed number (same types) on rows was relatively constant, i.e. between 15-18 total species. In the seond stage, apart from mechanical (V1) and mechanical without manual (V3) hoeing, weeds decreased to approx. 10 species. For the third stage, manual hoeing, together with the mechanical ones (V5) was not sufficieny to reduce the weed number. The total weed number decreased under 10 species in the other variants. The hoeing combination resulted in densities between 3 and 8 species.

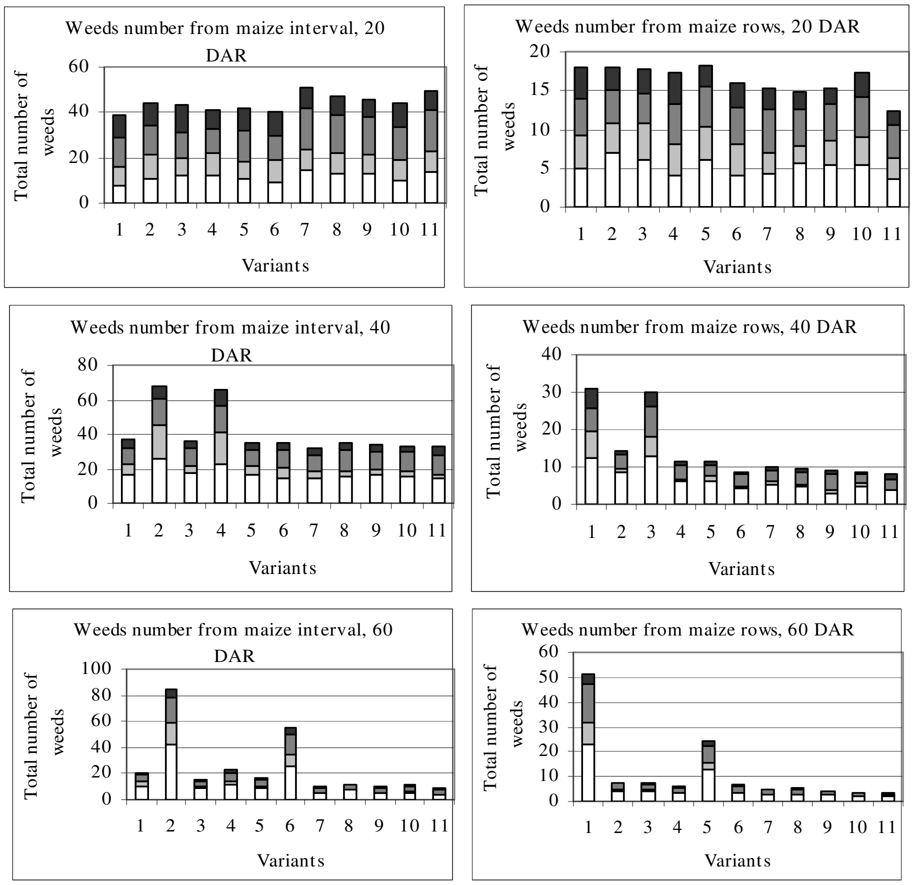


Fig. 1. Evolution of weed number (species) and plant on maize interval and rows in the three vegetation stages
(white-yearly dicotyledons, light grey-yearly monocotyledons, dark grey-perennial dicotyledons, black-perennail monocotyledons)

Correlations between weeding level and maize yield. By mechanical and manual hoeing, maize benefited from declining weed infestation. The average grain yields showed significant increases to multiple variants (Table 3).

Thus, if the mechanically-hoed control formed an average of 36.8 q. grains ha^{-1}, the variants 3+3 recorded over 80.0 - q. grain ha^{-1}. Qualitatively, a thousand grain weight (TGW) recorded a significant growth, and the protein content increased between 9.2 and 10.2%, oil increased between 3.28 and 4.00%, and ash ranged between 0.85 and 0.97%.

Table 3

Influence of experimental variants on maize grain yield and quality

Nr. crt.	Variants	Yield, q.ha^{-1}	TGW, g	Proteins, %	Oil, %	Ash, %
1.	2 Mec (I,II) Control	36.8	275	9.7	3.96	0.87
2.	2 man (I,II)	41.9**	300	9.3	3.28	0.85
3.	2 Mec (I,II)+1 man (II)	46.0***	282	9.2	3.75	0.79
4.	1 Mec (II)+2 man (I,II)	51.6***	294*	9.6	3.84	0.88
5.	2 Mec (I,II)+1 man (I)	57.2***	308**	10.0	3.74	0.93
6.	1 Mec (I)+2 man (I,II)	61.8***	303**	9.8	3.37	0.94
7.	*2 Mec (1,2)+2 man (1,2)*	74.9***	312***	10.1	3.88	0.89
8.	2 Mec (I,II)+2 man (I,II)	77.8***	315***	9.6	4.00	0.87
9.	3 Mec +2 man (I,II)	79.0***	315***	9.8	3.91	0.84
10.	*3 Mec +3 man (1,2,3)*	84.3***	323***	10.1	3.91	0.91
11.	3 Mec + 3 man (I,II,III)	88.2***	323***	10.2	3.94	0.97
	DL 5 % =	*3.44*	*16.6*	*0.73*	*0.534*	*0.357*
	DL 1 % =	*4.68*	*22.7*	*1.04*	*0.760*	*0.508*
	DL 0.1 % =	*6.34*	*30.7*	*1.50*	*1.100*	*0.735*

Maize grain quality. There was a strong correlation between the weed number and the grain yield (I = 0.822), which proves the need to reduce the weed number by applying these methods (Figure 2).

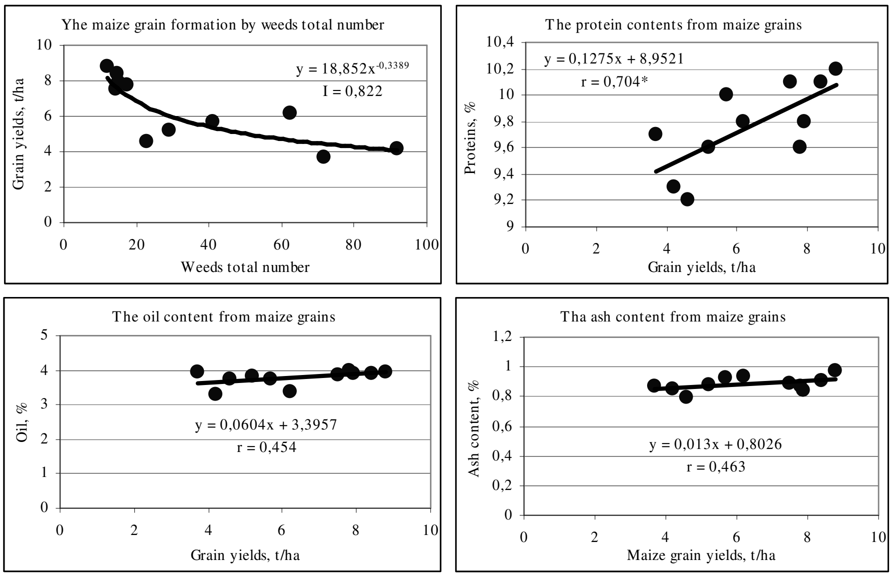


Fig. 2. Corelations between maize yield under weeding and grain qualitative indices

Protein content recorded a favourable increase: r = 0.704 *, with a growth rate of 0.1275% per grain tonne. Oil content increased slightly: r = 0.454, at a rate of 0.06% per tonne, and ash recorded a good evolution: r = 0.463, at a rate of 0.013% per tonne grain.

CONCLUSIONS

1. The initially high total number of weed: 40 per interval, 17 per row, demonstrates the need to reduce weed infestation. One method is mechanical and manual hoieng performed together, not separately. After 60 DAE, 20 species were found on the interval and 3-7 species per row.
2. In the Caracal area, the problematic weeds were: *Amaranthus retroflexus, Xanthium italicum, Solanum nigrum-YD*, *Convolvulus arvensis, Cirsium arvense*-DP, *Sorghum halepense*-PD and *Setaria glauca*-MP.
3. Yield grain increased significantly from 36.8 in the control to 88.2 $q.ha^{-1}$ in V_{11} – 3 mec + 3 man. (I,II,III). Maize grains have recorded better quality: TGW increased by 48 g, protein by 1%, oil by 0.72%, and ash by 0.18%.
4. The correlations between different grain measurements showed that yield formation depends on weed infestation, expressed as species number, as follows: r=0.704*, oil content r=0.454, and ash r=0.463, in grains.

REFERENCES

1. Albrecht H., 1995. *Changes in the arable weed flora of Germany during the last five decades.* 9th EWRS Symposium (pp. 41- 48).
2. Berca M., A. Ciorlaus, 1994. *Buruienile-un flagel indubitabil al agriculturii*. Simpozionul 9 SRSCB (Societatea Romana pentru Studiul si Combaterea Buruienilor), Constanta (pp. 11-15).
3. Courtney A.D., 1996. *Teoria si practica folosirii pragurilor de imburuienare*. Simpozionul 10 SRSCB, Sinaia (pp. 265- 273).
4. Derksen D.A., G.P. Laford, A.G. Thomas, H.A. Loeppky, C.J. Swanton, 1993. *Impact of agronomic practices on weed communities: tillage systems*. Weed Science, vol. 41 (pp. 409- 417).
5. Froud-Williams R.J., 1995. *Integrated weed management: the challenge for weed science into the 21st century.* 9th EWRS Symposium (pp. 491- 498).
6. Gus P., P.M. Sebok, 1995. *The impact of cultivation technologies on weed infestation and crop yield*. 9th EWRS Symposium (pp. 605- 609).
7. Hall, M.R., C.J. Swanton, G.W. Anderson, 1992. *The critical period of weed control in grain corn (Zea mays),* Weed Science, vol. 40 (pp. 441- 447).
8. Ionescu N., A. Perianu, A. Popescu, N. Sarpe, C. Roibu, 1996. *Weed control in corn and soybean crops by mechanical and manual practices.* Proceedings of 10th

Colloque International sur la Biologie des Mauvaises Herbes, Dijon, France (pp. 359- 365).

9. Lazauskas P., 1995. *Strategy of non chemical weed control*. 9th EWRS Symposium (pp. 571- 576).

10. Rasmussen J., 1992. *Testing harrows for mechanical control of annual weeds in agricultural crops*. Weed Research, vol. 32 (pp. 267- 274).

11. Richards M.C., 1989. *Crop competitiveness as an aid to weed control*. Brighton Conference- Weeds (pp. 573- 578).

12. Sagar G.R., 1968. *Weed biology-a future*. Netherlands Journal of Agricultural Science, vol. 16 (pp. 155- 164).

13. Swanton C.J., S.F. Weise, 1991. *Integrated weed management: The rationale and approach.* Weed Technology, vol. 5 (pp. 657- 663).

14. Townson J.K., A.R. Jutsun, K.A. Powell, 1995. *Impact of technology on weed control.* 9th EWRS Symposium (pp. 11- 20).

15. Van Der Wiede R., A. Krikke, F. Wijnands, 1995. *Technical and economic feasibility of mechanical weed control in arable farming in the Netherlands.* 9th EWRS Symposium (pp. 483- 490).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

EFFECT OF ROUNDUP® HERBICIDE ON PHYSIOLOGICAL INDICES IN MARSH FROG *PELOPHYLAX RIDIBUNDUS*

ALINA PĂUNESCU, CRISTINA MARIA PONEPAL

University of Piteşti

Keywords: *glyphosate, erythrocytes, leukocytes, hepatosomatic index, marsh frog*

Abstract

This study was carried out to evaluate the effect of Roundup® on physiological indices (number of erythrocytes, leukocytes, glycaemia, hepatosomatic index, and cholesterol and tryglicerides value) in marsh frog Pelophylax ridibundus. Adult male and female frogs were exposed to $0.138x10^{-3}$ ml Roundup®/g of body weight administrated by intraperitoneal injection, 1 injection at 2 days in a scheme of 3 weeks. The animals were kept at 4-6˚C, respectively at 22-24˚C in tap water tank. We observed a decreased number of erythrocytes and glycaemia, increased plasma cholesterol and triglyceride, increased number of leukocytes, and hepatosomatic index value. These changes were more powerful at 22-24ºC than at 4-6ºC.

INTRODUCTION

In human-dominated ecosystems, organisms can be confronted with multiple environmental stressors, of both natural and anthropogenic origins [12]. In this regard, considerable research efforts have focused on the stress factors contributing to the global decline of amphibian populations across the globe. Potential causes include habitat destruction or fragmentation, climate change, introduced predators or competitors, diseases, and the presence of chemical contaminants [3, 5, 6, 8, 14].

The indiscriminate use of herbicide, careless handling, accidental spillage, or discharges of treated effluents into natural waterways have harmful effects on the fish population and other forms of aquatic life and may contribute long term effects in the environment [2].

Herbicides are actively used in terrestrial and aquatic ecosystems to control weeds, and their use has generated serious concerns about the potential adverse effects of these chemicals on the environment and human health [11].

The formulation of Roundup® consists of the herbicide glyphosate as the active ingredient with polyethoxylene amine added as a surfactant. Glyphosate is a non-selective, systemic herbicide that can control most annual and perennial plants. It controls weeds by inhibiting the synthesis of aromatic amino acids necessary for protein formation in susceptible plants.

The acute toxicity of Roundup® (particularly of glyphosate) to animals is considered to be low according to the World Health Organization [15], but the extensive use of Roundup® may still cause environmental problems with negative impact on wildlife, particularly in an aquatic environment where chemicals may persist for a long time. Some surfactants that are included in some formulations of glyphosate, however, are highly toxic to aquatic organisms.

Therefore, in this paper we studied the effects of Roundup® on some hematological and biochemical parameters in marsh frog (*Pelophylax ridibundus*) at two thermic level (4-6ºC and 22-24ºC).

MATERIAL AND METHODS

In present study we used of *Pelophylax ridibundus*, adults of both sexes, captured in spring (April-May) from the surrounding areas of the city Piteşti (South Romania). The animals were kept in laboratory condition in aquaterrarios filled with tap water for five days to test their health and accommodate them for the experiment. The water was changed daily to avoid the accumulation of toxic substances.

After 10 days of adaptation in the lab, the frogs were separated in lots, which were used separately for the following experiments: two lots of control individuals, containing animals kept in laboratory at 4-6^{o}C, respectively at 22-24ºC with no treatment, in running water which was changed everyday, (1) one lot containing animals which were subjected to treatment with Roundup® herbicide in a dose of 0.138×10^{-3} ml/g of body weight and kept at 4-6ºC, (2) a second lot containing animals which were subjected to treatment with Roundup® herbicide in a dose of 0.138×10^{-3} ml/g of body weight and kept at 22-24ºC in a thermostatic chamber. Ten animals were used for each lot.

The toxic was administered by intraperitoneal shots, one shot every two days, in a scheme of 3 weeks. The administered dosage of toxic was not lethal as none of the subjects died through the experiment.

At the end of treatment blood specimens were withdrawn from the frogs by cardiac puncture after chloroform anesthesia. The values of operational factors under discussion were determined by using standard automated method: number of erythrocytes and leukocytes was microscopically determined with a Thoma cells numbering chamber [13]; the glycaemia, cholesterol and triglycerides level has been determinate using an Accutrend GCT.

The hepatosomatic index was calculated using formula:

$$HSI = \frac{liverweight}{bodyweight} \times 100$$

Hematological, biochemical and HIS results were expressed as means ± standard deviation (SD). Statistical analysis was performed as control lot versus treated lot using the Student's t-test. The chosen level of significance is $p<0.05$.

RESULTS AND DISCUSSION

Hematological and biochemical parameters are suitable tools for assessing environmental influences and stress effects of anthropogenic origin on the condition and health of aquatic vertebrates [7].

The action of Roundup® on the liver occurs primarily by increasing the value of hepatosomatic index for the two groups studied (Figure 1). In animals treated with these pesticide and kept at a temperature of 4-6ºC, the index value increased by 16.27% compared to the control value, while in animals kept at a temperature of 22-24ºC and treated with the same concentration of pesticide, the index value increased by 25%.

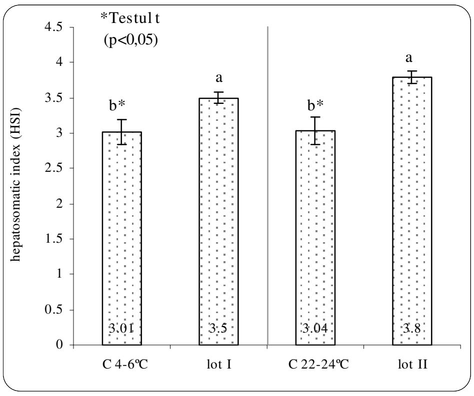


Fig. 1. The influence of Roundup® upon hepatosomatic index in marsh frog

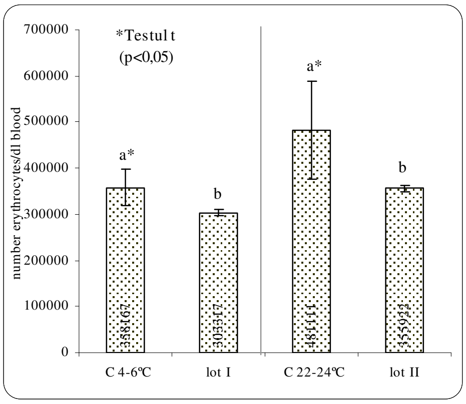


Fig. 2. The influence of Roundup® upon number of erythrocytes in marsh frog

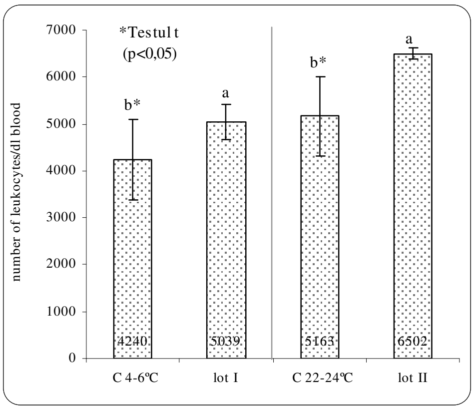
(b* $p<0.05$ vs control, a $p<0.05$ vs treated lot)

A slight increase in the HSI of exposed frog indicates that the liver cells were affected possibly causing an increase in the rate of production of endoplasmic reticulum for the synthesis of protein in liver tissue [4]. The liver is responsible for enzymatic decontamination process, production and storage of glycogen as energy reserves. Therefore, in the presence of stressors, these qualities are altered resulting in deleterious effect on the frog [1, 10].

Similar changes in the values of organosomatic indices (hepatosomatic index - HIS, cardiosomatic index - CSI, renatosomatic index - RSI and spleenosomatic index - SSI) was observed by Gabriel et al. [9] in *Clarias gariepinus* after administreted of aqueous extracts of leaves of *Lepidagathis alopecuroides.*

The hematological picture shows anemia associated with Roundup® administration in both groups of animals. Thus, there is a decreased number of red cells by 15.31% compared to control value for animals kept at a temperature of 4-6ºC, and 26.02% compared to control value for animals kept at 22-24ºC (Figure 2).

Increase in number of leukocytes (leukocytosis) may have resulted from the excitation of the defense mechanism to counter the effect of the toxicant (Figure 3). The analysis of this figure shows an increase by 18.86% in the number of white blood cells compared to control value in animals treated with Roundup® and kept at a temperature of 4-6ºC, while for animals treated with the same concentration of toxic and kept a temperature of 22-24ºC, the increase is 25.96% compared to the control value.



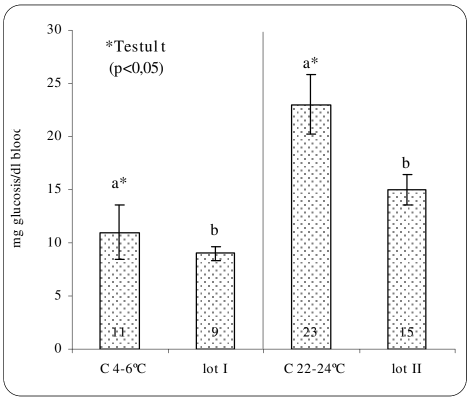


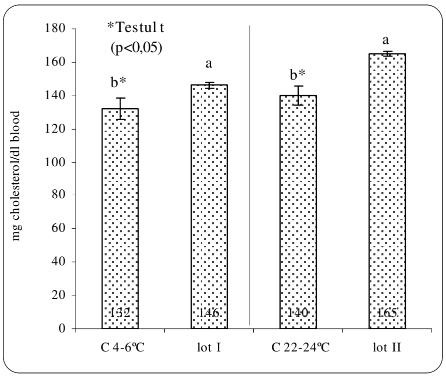
Fig. 3. The influence of Roundup® upon number of leukocytes in marsh frog

Fig. 4. The influence of Roundup® upon glycaemia in marsh frog

(b* p<0.05 vs control, a p<0.05 vs treated lot)

Biochemical diagnoses provided additional data that have completed the body damage picture induced by this toxic action. Thus, both studied groups show a decrease of blood glucose by 18.18% compared to control group for animals kept at 4-6ºC and 34.78% for animals kept at 22-24ºC (Figure 4).

The toxic substance also works by changing the quantity of plasma cholesterol (Figure 5) and triglycerides (Figure 6). Plasma cholesterol records an increased value by 10.60% compared to control group for animals treated with Roundup® and kept at a temperature of 4-6ºC, and 17.85% compared to control for animals kept at a temperature of 22-24ºC. In terms of triglyceride level, there was an increase of their value in both groups studied by 15.25% compared to control group for animals kept at 4-6ºC, and 25% for animals kept at 22-24ºC.



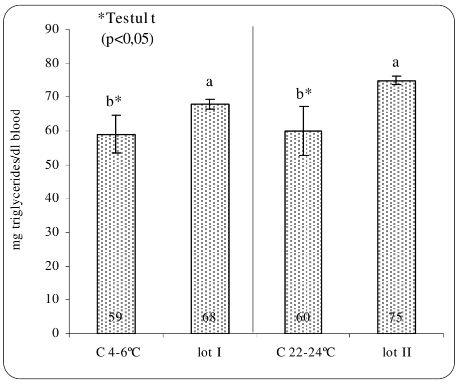


Fig. 5. The influence of Roundup® upon cholesterol level in marsh frog

Fig. 6. The influence of Roundup® upon triglycerides level in marsh frog

(b* $p<0.05$ vs control, a $p<0.05$ vs treated lot)

CONCLUSIONS

1. After 3 weeks of treatment with sublethal doses of Roundup® herbicide in marsh frog (*Pelophylax ridibundus*) we observed a decreased number of erythrocytes and glycaemia, increased plasma cholesterol and triglyceride, increased number of leukocytes, and hepatosomatic index value.
2. These changes were more powerful in animals treated with toxic substances and kept at 22-24ºC.

REFERENCES

1. Adams S.M., K.D. Ham, M.S. Greeley, R.F. LeHew, D.E. Hinton, C.F. Saylor, 1996. *Down stream gradients in bioindicator responses: point source contamination effects on fish health*. Can.J. Fish. Aquat. Sci. 53 (pp. 2177-2187).
2. Akhtar M.H., 1986. *The disposition of 14C agrochemical residues in plant and animal tissues when consumed by animals*. In: Green halgh, T. and Roberts, T, R., (eds). Pesticide Science and biotechnology. Proceedings of the 6th International congress of pesticide chemistry Ottawa, Canada, August 1986 (pp. 10-15).
3. Alford R.A., S.J. Richards, 1999. *Global amphibian declines: A problem in applied ecology*. Annu Rev Ecol Syst 30 (pp. 133-165).
4. Anderson T., L. Forlin, J. Hardig, A. Larsson, 1988. *Physiological disturbances in fish living in coastal water polluted with bleached kraft mill effluents*. Can. J. Fish Aquat. Sci. 45 (pp. 1525-1536).
5. Berger L., 1989. *Disappearance of amphibian larvae in the agricultural landscape*. Ecol Internat Bull 17 (pp. 65-73).
6. Blaustein A.R., J.M. Kiesecker, 2002. *Complexity in conservation: Lessons from the global decline of amphibian populations*. Ecol Lett 5 (pp. 597-608).

7. Celik E.S., 2004. *Blood chemistry (electrolytes, lipoproteins and enzymes) values of black scorpion fish (Scorpaena porcus) in the Dardanelles*. Turkey J. Biol. Sci. 4(6) (pp. 716-719).
8. Davidson C., H.B. Shaffer, M.R. Jennings, 2001. *Declines of the California red-legged frog: Climate, UV-B, habitat, and pesticides hypotheses*. Ecol. Appl. 11 (pp. 464-479).
9. Gabriel U.U., F.G. Obomanu, O.S. Edori, 2009. *Haematology, plasma enzymes and organ indices of Clarias gariepinus after intramuscular injection with aqueous leaves extracts of Lepidagathis alopecuroides.* African Journal of Biochemistry Research 3 (9) (pp. 312-316).
10. Jenkins J.A., 2004. *Fish bioindicators of ecosystem condition at the Caleasieu Estuary, Louisiana*. National Wetlands Research Center, USGS, Lafayette (pp. 54).
11. Lushchak O.V., O.I. Kubrak, J.M. Storey, K.B. Storey, V.I. Lushchak, 2009. *Low toxic herbicide Roundup induces mild oxidative stress in goldfish tissues.* Chemosphere 76 (pp. 932-937).
12. Mandrillon A.L. and P. Saglio, 2007. *Herbicide exposure affects the chemical recognition of a non native predator in common toad tadpoles (Bufo bufo).* Chemoecology 17 (pp. 31-36).
13. Picoş C.A., Gh. Năstăsescu, 1988. *Lucrări practice de fiziologie animală*. Tipografia Universităţii din Bucureşti, Bucureşti, 107 (pp. 122-123, 192-195).
14. Sparling D.W., G.M. Fellers, L.S. McConnell, 2001. *Pesticides and amphibian population declines in California, USA*. Env Toxicol Chem 20 (pp. 1591-1595).
15. WHO, 1994. *Glyphosate*. Environmental Health Criteria No. 159. World Health Organization, Geneva.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

RESULTS REGARDING BIOLOGICAL CHARACTERISTICS OF THE SPECIES *LALLEMANTIA IBERICA* IN THE SPECIFIC CONDITIONS FROM SOUTH ROMANIA

V. ION, A.GH. BĂŞA, D.I. SĂNDOIU, MIHAELA OBRIŞCĂ

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *Lallemantia, biology*

Abstract

Lallemantia iberica is a plant cultivated since antiquity, but which has not extended as cultivated crop during the time because of the small yielding capacity. Taken into account the specificity of the oil content in fatty acids, especially the high content in linolenic acid, it could become of interest for different purposes the lallemantia oil can be used. In the present paper, there are presented the main biological characteristics of the Lallemantia iberica species under the specific conditions from South Romania, respectively: setting up of pair leaves (fully developed leaves) on the main stem and the main processes during this period (branching, development of inflorescences); leafstalk length and leaf sizes; morphological characteristics of leaves, bracts, inflorescence, flowers, and seeds; plant high and plant biomass, as dry matter.

INTRODUCTION

Lallemantia iberica (Bieb.) Fischer & C.A. Meyer (sin. *Dracocephalum ibericum* M. Bieb.) also named „Dragon's head" is a crop cultivated from the prehistoric times in southwestern Asia and southeastern Europe. *Lallemantia iberica* is an annual plant belonging to the *Lamiaceae* family, this been cultivated for its seeds containing about 30% (even 35-38%) drying oil (siccative oil), with the iodic index between 163 and 203, and which is used in foods, but especially in dye and varnish industry.

Lallemantia iberica seeds have traditional uses as reconstitute, stimulant, diuretic and expectorant [3]. Also, it is considered as a linseed substitute in a number of applications including: wood preservative, ingredient of oil-based paints, furniture polishes, printing inks, soap making, and manufacture of linoleum [2].

Lallemantia oil content in fatty acid is the following: 6.5% palmitic acid, 1.8% stearic acid, 10.3% oleic acid, 10.8% linoleic acid, and 68.0% linolenic acid [3]. The high content in linolenic acid makes the lalemantia to be of high interest for different purposes. In fact, the high content in linolenic acid balances the little interest in Lallemantia due to low yields (usually up to 10 q/ha).

Lallemantia plants grow well in dry areas, which make the crop a potential alternative to the traditional crops in the arid zones, paying however attention to the fact that this species tends to become a weed outside its native territory. It requires a light well-drained soil, heavy clay soils been not well tolerated.

Lallemantia is a non traditional crop with low nitrogen, phosphorus and potassium consumption for 100 kg seeds [1], having a short growing period.

In a perspective of the development of lallemantia crop in different areas including South Romania, a well knowing of the biological characteristics of the plant represents a premise to be successfully.

MATERIAL AND METHODS

The biological characteristics of the species *Lallemantia iberica* (Bieb.) Fischer & C.A. Meyer were studied in a field experiment located on a reddish preluvosoil, 15 km faraway North-East from Bucharest, within Moara Domneasca Research Farm belonging to the University of Agronomic Sciences and Veterinary Medicine of Bucharest. In this area, the multiannual average temperature is 10.5^{o}C and the multiannual average rainfall is 614 mm.

The study were performed in 2009, when the sowing was carried out on 30th of March on a surface of 1.5 hectare, at a rate of 20 kg/ha, seed depth 2-3 cm and 12.5 cm between rows. The emergence took place on 12 of April.

The observations and determinations performed in the field were aimed to identify and quantify the main biological characteristics of the *Lallemantia iberica* species under specific local conditions, respectively: setting up of pair leaves (fully developed leaves) on the main stem and the main processes during this period (branching and inflorescences setting up); leafstalk length and leaf sizes (leaf length and leaf width); morphological characteristics of leaves, bracts, inflorescence, flowers, and seeds; plant high and plant biomass as dry matter.

For biometric determinations, a number of twelve plants were analysed in different periods of time according to the plant biology. Also, in view to determine the plant biomass as dry matter/plant at maturity stage, twelve plants were dried in air oven.

RESULTS AND DISCUSSION

The leaves develop in pairs at each stem node (opposite leaves), under a polynomial curve during the time (Figure 1). The total number of pair leaves on the main stem was in average 16 (with limits of variation between 14 and 17), this been reached at about 45 days after emergence. A pair of leaves where took into consideration when the leaves were completely unfolded. Above each pair of completely unfolded leaves there are a pair of leaves developing during the first part of vegetation and two pairs of leaves developing later in the vegetative phase.

The edge leaf is dentate (toothed) for the first four pairs of leaves, denticulate (finely toothed) for the next four pairs of leaves, and denticulate only for the upper pairs of leaves on the main stem.

The branches appear at the first six nodes on the main stem. Also, branches appear at the cotyledonal node, these been in fact the first branches developing. First branches appear quite early from the cotyledonal node, after the formation of the first pair of leaves (Figure 1). The branches are forming, as the leaves, in pairs (opposite branches), these been developing from the leaves axils.

At the seventh node, the inflorescence starts to develop in verticillus once the seventh pair of leaves is completely unfolded (Figure 1). Starting from the seventh node, the inflorescences are developing in verticillus at each node upwards. Once the 13th pair of leaves is completely unfolded, the first flowers are visible, the flowering process starting.

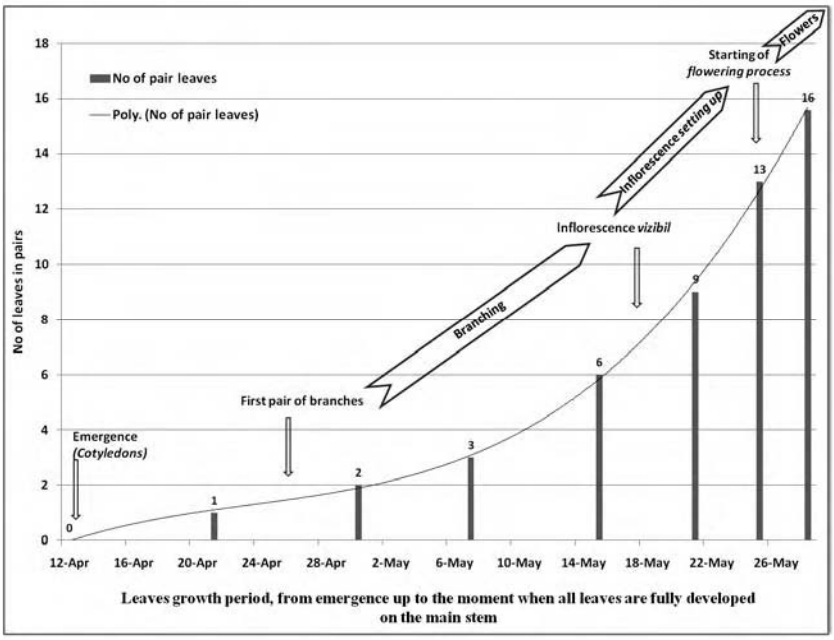


Fig. 1. Setting up of pair leaves (fully developed) on the main stem and the main processes during this period at *Lallemantia iberica* species

The first nine leaves have stalk with different length, this been decreasing upwards the stem. The longest stalk is present at the first leaf on the main stem (2.7 cm in average). The stalk is missing starting with the leaf 10 on the main stem, the leaves above been sessile. The ninth leaf on the main stem is stalkleaf on some plants while on others is sessile (Table 1, Figure 2).

The leaf length (table 1; figure 2) increases from bottom up to the leaf four on the main stem, which is the longest leaf on the plant (6.3 cm in average, with the highest recorded value of 7.3 cm). Starting from the leaf four on the main stem, the leaves length decreases upwards the stem, the leaves from the top of the stem having the length of 0.5 cm, in average (the smallest recorded value been 0.3 cm).

The leaf width (Table 1, Figure 2) increases from the first leaf to the second one, and then is decreasing upwards the stem. Thus, the second leaf on the main stem has the largest width (2.1 cm in average, with the highest recorded value of 2.4 cm), while the smallest width is recorded on the leaves from the top of the stem (0.2 cm in average, with the smallest recorded value of 0.1 cm).

Table 1

Leafstalk length and leaf sizes on the main stem at *Lallemantia iberica* species

Leaf on the main stem	**Leafstalk length**		**Leaf length**		**Leaf width**	
	Average values (cm)	Limits of variation (cm)	Average values (cm)	Limits of variation (cm)	Average values (cm)	Limits of variation (cm)
Leaf 1	2.7	*2.3-3.1*	3.7	*3.1-4.2*	2.0	*1.7-2.3*
Leaf 2	2.2	*1.4-3.0*	4.2	*3.4-4.8*	2.1	*1.6-2.4*
Leaf 3	1.6	*1.2-2.1*	5.7	*4.6-6.3*	2.0	*1.7-2.3*
Leaf 4	1.0	*0.7-1.3*	6.3	*5.1-7.3*	1.9	*1.6-2.2*
Leaf 5	0.7	*0.5-0.9*	5.7	*4.3-6.7*	1.5	*1.2-1.9*
Leaf 6	0.5	*0.4-0.7*	4.9	*4.1-5.5*	1.2	*1.0-1.5*
Leaf 7	0.4	*0.3-0.6*	4.3	*3.5-4.9*	1.1	*0.9-1.2*
Leaf 8	0.3	*0.2-0.4*	3.5	*3.0-4.2*	0.9	*0.7-1.1*
Leaf 9	0.3/sessile	*0.2-0.4 sessile*	3.1	*2.3-3.7*	0.8	*0.6-1.0*
Leaf 10	Sessile leaves		2.4	*1.8-2.9*	0.7	*0.5-.09*
Leaf 11			2.0	*1.5-2.6*	0.6	*0.5-0.8*
Leaf 12			1.7	*1.4-2.2*	0.5	*0.4-0.7*
Leaf 13			1.4	*0.8-1.8*	0.4	*0.3-0.5*
Leaf 14			1.0	*0.6-1.3*	0.3	*0.2-0.4*
Leaf 15			0.7	*0.3-1.0*	0.3	*0.2-0.3*
Leaf 16			0.5	*0.3-0.8*	0.2	*0.1-0.3*

Each leaf has at its base tow bracts, one on each side of the leaf (Figure 3). That means that at each node there are four bracts (two bracts for each of the two opposite leaves). The bracts from the bottom of the main stem have a stalk of 2 mm length and they have the length of 9 mm and width of 5 mm, in average; these bracts are ending in their superior part with a number of ten awns, the exterior ones having 5 mm of length while the middle ones having 1-2 mm of length. The bracts from the top of the main stem have a stalk of 2 mm length and they have the length of 4 mm and width of 2 mm, in average; these bracts are ending in their superior part with a number of six awns, the exterior ones having 3 mm of length while the middle ones having 1 mm of length.

The flowers are bisexual and form verticillus inflorescences placed in the leaf axils (Figure 3). The calyx has a tube of 9 mm of length and presents five triangular teethe with 3 mm of length and 2 mm of width at its base, among which two of them are inferiors, two of them are lateral and one of them are superior and more wide, with 3 mm of length and 3 mm of width at its base (Figure 4).

The corolla has white colour and has a structure specific for the *Lamiaceae* family (Figure 4). Thus, it presents a tube of 10-12 mm of length and two lips (labia). The upper lip has two lobes, and the lower lip consists of three lobes, out of which two of them are lateral and one of them are central and presents two small lobs at its turn. There are four stamens, two of them longer and two of them shorter. The pollination is accomplished by insects (entomophylus allogam pollination).

At maturity stage, the plant high was in average of 40.8 cm, with limits of variation between 36.0 and 46.7 cm, and the plant biomass was of 3.7 g dry matter/plant, with limits of variation between 3.35 and 4.05 g dry matter/plant. The seeds are small, with one thousand seeds weigh of 4.7 g, in average.

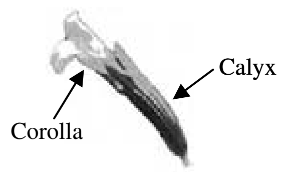


Fig. 4. The flower at *Lallemantia iberica*

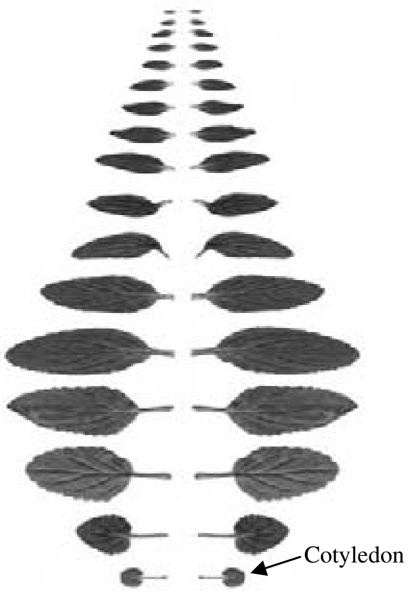


Fig. 2. The pair of leaves on the main stem at *Lallemantia iberica*

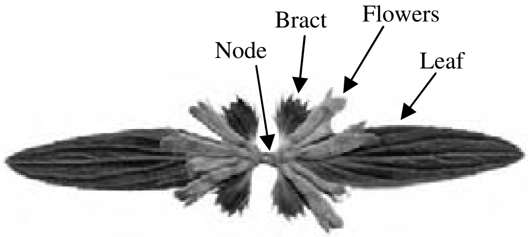


Fig. 3. The inflorescence at *Lallemantia iberica*

CONCLUSIONS

1. The leaves are disposed in pairs on each stem node (opposite leaves), the average number of pair leaves on the main stem been 16.
2. The leaves on the main stem are fully developed at about 45 days after emergence.
3. The first nine leaves have stalk with different length, which decreases upwards the main stem, the stalk been missing starting with the 10^{th} leaf upwards (sessile leaves).
4. The leaf length on the main stem increases from bottom up to the leaf four, then decreases upwards.
5. The leaf width on the main stem increases from the first leaf to the second one then is decreasing upwards.
6. Each leaf has tow bracts, one on each side of the leaf, each bract having a stalk of 2 mm length and the edge with awns.
7. The branching process takes place at the first six nodes on the main stem, the branches developing from each leaf axils (opposite branches).
8. The inflorescence starts to develop in verticillus from the seventh node upwards the stem, once the seventh pair of leaves is fully unfolded.
9. The flowering process starts once the 13^{th} pair of leaves is fully unfolded.
10. The flowers are disposed in verticillus placed in the leaf axils.
11. The main characteristics of the flowers are the following: calyx presents five triangular teethe, among which two are inferiors, two lateral, and one superior; corolla has white colour and presents two lips, the upper lip with two lobes, and the lower lip with three lobes; there are four stamens, two of them longer and two of them shorter.
12. At maturity stage, the plant high was of 40.8 cm, the plant biomass was of 3.7 g dry matter/plant, and one thousand seeds weigh of 4.7 g, in average.

REFERENCES

1. Nikolova M., N. Valeva, J. Stamenov. *Nutrient Consumption of Some Non-Traditional Energy Crops*. University of Forestry – Agronomy Faculty, Sofia, Bulgaria (http://www.ipipotash.org/udocs/Non-traditional_energy_crops.pd).
2. Shafiee S., Modares Motlagh A., Minaee S., Haidarbigi K., 2009. *Moisture Dependent Physical Properties of Dragons Head Seeds (Lallemantia iberica)*. The CIGR Ejournal. Manuscript 1192, Vol. XI, June.
3. Soheila Samadi, Masoud Khaiyamiand and Abdollah Hasanzadeh Goorut Tappe, 2007. *A Comparison of Important Physical and Chemical Characteristics of Six Lallemantia iberica (Bieb.) Fisch. and Mey. Varieties*. Pakistan Journal of Nutrition, 6 (4), Asian Network for Scientific Information (pp. 387-390).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

MODEL FOR PREDICTING THE FLOWERING STAGE AND HONEY POTENTIAL YIELD OF SUNFLOWER AND RAPESEED CROPS

V. VLAD*, V. ION, V. ŞTEFAN**, NICOLETA ION***, D.M. MOTELICĂ*, G. COJOCARU***

*National Research and Development Institute for Soil Science, Agrochemitry and Environmental Protection of Bucharest
**University of Agronomic Sciences and Veterinary Medicine of Bucharest
***Institute for Beekeeping Research and Development of Bucharest

Keywords: *sunflower, rapeseed, prognosis model, flowering stage, honey potential yield*

Abstract

This paper describes a model for predicting the dates of the beginning and end of flowering stage and the honey potential yield of sunflower (Helianthus annuus L.) and rapeseed (Brassica napus L. ssp. oleifera) crops. The prognosis of flowering stage is based on "thermal time" (TT) measured in "growing degrees-day" (GDD), determined by the daily biologically active temperature that is related to "base temperature" (species parameter) and "corrected" average daily temperature. The prognosis parameters (crop stage TT thresholds and honey potential yield) are specific to each variety, maturity class (four classes for each species) and climatic type of crop year (four types). The (re-) calibration of the prognosis parameters is performed by averaging the crop historical data that are accumulated during model use ("self-improving" model). Four calibration methods of different accuracy are used for that, depending on available data. The prognosis of meteorological data is performed based on the historical data of the years of the given climatic type estimated by user for the prognosis year. The prognoses of the flowering stage and honey potential yield are based on the calibrated parameters, estimated meteorological data for the prognosis year, and sowing data specified by user. Some results concerning model calibration and validation are also presented in the paper.

INTRODUCTION

Prognosis of flowering stage and honey yield of crops is important for beekeepers aiming at scheduling in time and space the emplacement of their beehives to flowered fields.

This paper describes a model for predicting the dates of the beginning and end of flowering stage and the honey potential yield of sunflower (*Helianthus annuus L.*) and rapeseed (*Brassica napus* L. ssp. *oleifera*) crops. The prognosis principles, method and algorithms presented for sunflower in a previous paper [7] are improved and applied also to rapeseed crops. Some results concerning model calibration and validation are also presented in this paper.

MODEL DESCRIPTION

The method used to estimate the plant development is based on “thermal time” (**TT**) measured in “growing degrees-day” (GDD, °**C-d**) [6, 7]. Plants require a specific amount of heat to develop from one point in their life-cycle to another and, in the same time, development occurs if air temperature exceeds a minimum limit, named “base temperature” ($\mathbf{T_b}$). The daily biologically active temperature ($\mathbf{T_{BA}}$) is a measure of the daily plant development based on the heat used and is usually calculated as the difference between the average daily air temperature and T_b. There is an optimum average daily temperature for plant development ($\mathbf{T_o}$) and an upper limit of developmental temperature ($\mathbf{T_u}$), above which the plant development drastically diminishes or stops. The T_b , T_o and T_u are specific for each species. The TT obtained by summing the T_{BA} of the days of a period gives an estimate of the heat accumulated by plant, respectively of the "amount" of plant development in that period. The TT that plants need for developing from a stage to another is specific to each species and each stage.

The following improved algorithm of the T_{BA} calculation is proposed:

$T_{BA} = 0$, if: $T_{max} \leq T_b$, or $T_{max} \geq T_u$,
$T_{BA} = ((T_{max} - T_b) / 2) * (T_{max} - T_b) / (T_{max} - T_{min})$, if: $T_{min} < T_b < T_{max} < T_u$,
$T_{BA} = (T_{max} + T_{min}) / 2 - T_b$, if: $T_{min} \geq T_b$ and $(T_{max} + T_{min}) / 2 < T_o$ and $T_{max} < T_u$,
$T_{BA} = T_o - T_b$, if: $T_{min} \geq T_b$ and $(T_{max} + T_{min}) / 2 \geq T_o$, and $T_{max} < T_u$.

where: T_{max} and T_{min} are daily maximum, respectively, minimum air temperatures (in the day period – between the hours 00:00 and 24:00).
T_b = 6.7 °C for sunflower [7], and 5 °C for rapeseed [3, 5, 6],
T_o = 20 °C for both sunflower and rapeseed [4, 5, 6],
T_u = 40 °C for sunflower [7], and 35 °C for rapeseed [6].

Because in Romania during the flowering stage of rapeseed and sunflower, usually, the maximum temperatures are not higher than 35 °C, respectively 40 °C, and the average temperature are not higher than 22 °C, respectively 27 °C, a correction of T_{BA} calculation for upper temperatures was not taken into consideration and a simplified formula was used for that.

Three thermal time thresholds for the interested crop stages are defined [7]: the TT that plants need for reaching the emergence from the sowing date ($\mathbf{TT_E}$), the TT that plants need for reaching the beginning of flowering stage from the emergence date ($\mathbf{TT_{FB}}$), and the TT that plants need for reaching the end of flowering stage from the beginning date of flowering stage ($\mathbf{TT_{FE}}$).

Most of the works use TT thresholds not variety specific. Experiments carried out in Southern Romania with 24 sunflower hybrids [2, 7] showed significant differences both between the measured TT thresholds of different sunflower hybrids and between the TT thresholds of the same hybrids measured in different years types from meteorological point of view (2006: normal, 2007: excessive droughty). Lower variation was observed in the same maturity class (**MC**). Doyle (1975), Miller et al. (2001) and Rossi (2002), cited by [7], also reported MC-specific TT thresholds. Consequently, the prognosis model uses different TT thresholds for different climatic types of years (**CT**) for each sunflower/rapeseed variety [7]. In the case of lack of data, the three TT thresholds are estimated by averaging the data regarding the varieties of the same MC, respectively regarding the years of adjacent CT's. The model uses four MC's of sunflower varieties and four MC's of rapeseed varieties (early, semi-early, semi-late, and late), and four CT's of years (excessive droughty, droughty, normal, and wet).

The honey potential yield of crops [1, 4] (determined by the nectar secretion of flowers and the sugar concentration of nectar) is influenced mostly by variety biological characteristics and meteorological conditions (especially air temperature). Experiments carried out in Southern Romania with 33 sunflower hybrids under different meteorological conditions of the period 2002-2007 emphasised these conclusions [1, 4]. Consequently, the prognosis of honey potential yield is based on the statistically-determined honey potential yield (**HPY**) for each sunflower/rapeseed variety for each of the four year CT's [7]. The same, in the case of lack of data, the HPY is estimated by averaging the data regarding the varieties of the same MC, respectively regarding the years of adjacent CT's.

The prognosis model consists of three main submodels (phases):

(i) Submodel for calibration of prognosis parameters (TT thresholds and HPY's)

Historical measured/observed data are assumed to be recorded and stored: data on crops (year, geographical area, variety, date of sowing, date of emergence, date of beginning of flowering, date of end of flowering, and honey yield) and meteorological data on geographical areas (year, year CT, daily T_{max} and T_{min}). From these data the "measured" values of the TT thresholds and HPY are calculated for each historical crop. For each variety, a set of prognosis parameters (the three TT thresholds and the HPY) is estimated for each of the four year CT's, by averaging appropriate historical measured values.

Four estimation methods can be used [7]. In the decreasing order of accuracy (corresponding to the historical data availability), they are: (1) averages on the cases of the given variety and the given year CT, (2) averages on the cases of the given variety and the adjacent year CT's with the given year CT, (3) averages on the cases of the varieties of the same MC with the given variety, and the given year CT, and (4) averages on the cases of the varieties of the same MC with the given variety, and the adjacent year CT's with the given year CT.

(ii) Submodel for prognosis of meteorological data

The daily T_{max} and T_{min} for the prognosis year are estimated by averaging the historical meteorological data regarding the requested geographical area and the years of the same year CT as that of the prognosis year, which is estimated by user (or obtained from meteorological services estimates).

(iii) Submodel for prognosis of flowering stage and honey potential yield

The dates of emergence, beginning of flowering and end of flowering are predicted by matching the estimated TT's to the corresponding TT thresholds calibrated for the given variety, plant stage and the year CT of the prognosis year, supposed to be estimated by user. The estimated TT for a plant stage is the summation of the T_{BA} calculated day by day from predicted T_{max} and T_{min} , beginning with the day after the previous plant stage. The sowing dates are supposed to be estimated by user.

During the crop year, the crop development and the meteorological evolution up to the moment of prognosis request can be recorded and the prognosis for the remained period of the crop year is improved by using actual data instead of predicted data.

The predicted honey potential yield is assumed to be the calibrated parameter HPY for the given variety and the year CT of the prognosis year (estimated by user).

MODEL CALIBRATION AND VALIDATION

Experiments carried out on three years (2006, 2007 and 2008) in the Experimental Farm Moara Domnească (15 km NE of Bucharest, Romania) with 24 hybrids of sunflower (each of the four MC's was represented) provided measured/observed crop data [1, 2, 4, 7]. Local meteorological equipment provided data for the experimental years. Other historical meteorological data (1961-2005) were obtained from a near meteorological station.

The three experimental years were meteorologically different: 2006 - normal, 2007 - excessive droughty and 2008 - normal to droughty.

Experimental data from the years 2006 and 2007 were used to calibrate the model. The prognosis provided by the model for the year 2008 was compared with the measured data and proved to be good enough:

Figure 1 shows the predicted daily biologically active temperatures (T_{BA}) for sunflower crops in comparison with those calculated from the measured daily temperatures, beginning with the 12 April, in the experimental location.

Figure 2 shows the predicted thermal time (TT) for sunflower crops comparatively with that calculated from the measured daily temperatures. After a thermal time of 700 °C-d, corresponding to a time of 65 days (12 April – 15 June), the cumulated deviations are about of 50 °C-d (6.7%), respectively 3.5 days (5.4 %).

On the end of May and on June and July the measured temperatures were higher than in a normal year (as 2008 was supposed in the prognosis scenario) and, consequently, the predicted T_{BA} and TT was slightly underestimated for that period of the year 2008.

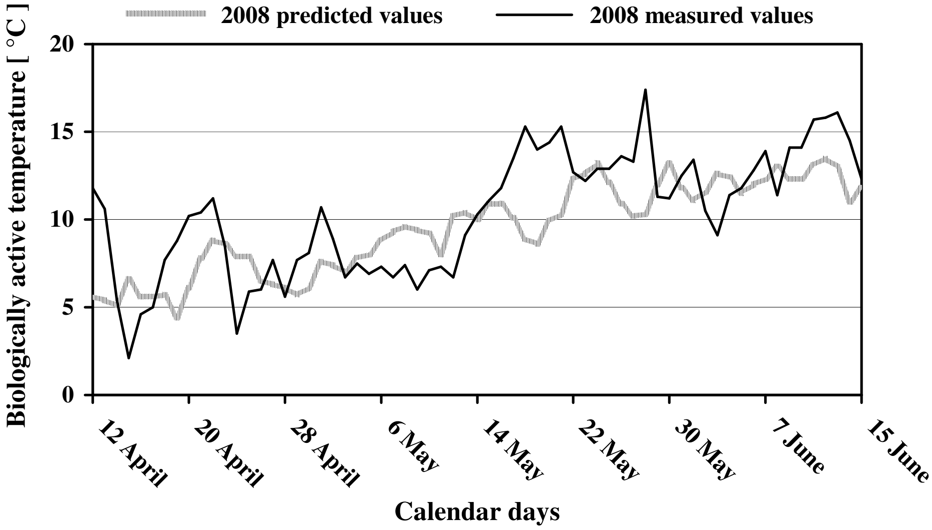


Fig. 1. Predicted daily biologically active temperatures (T_{BA}) for sunflower comparatively with those calculated from the measured daily temperatures (2008, Moara Domnească, 15 km NE of Bucharest, Romania)

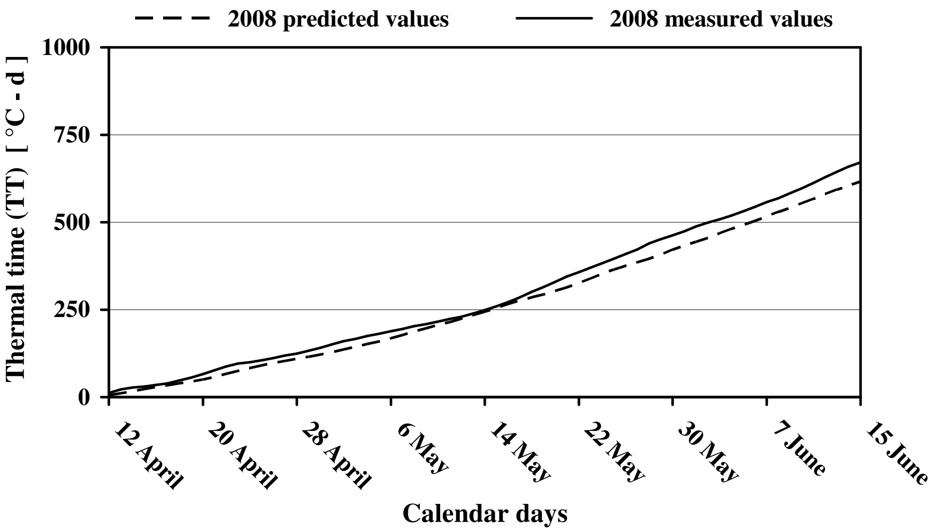


Fig. 2. Predicted thermal time (TT) for sunflower comparatively with that calculated from the measured daily temperatures (2008, Moara Domnească, 15 km NE of Bucharest, Romania)

CONCLUSIONS

1. Because TT calculation based on the standard definition of GDD is of low accuracy, a better algorithm is proposed. It can be further improved based on appropriate research.
2. Experiments carried out in Southern Romania with sunflower crops showed significant variability of TT thresholds for crop flowering stage and HPY's related to different hybrids and meteorological years. By using prognosis parameters specific to variety, MC's and year CT's, the influences on crop development of other factors than air temperature (especially precipitations and photoperiod length) are acceptable-well taken into consideration.
3. Four calibration methods of different accuracy are proposed, in order to completely use the available historical data.
4. Recalibration can be performed each time new historical data are available. Thus the model could be a "self-improving" one, because more is used more it could be enriched with new data, so the statistical support could be better and the estimates (prognosis parameters) could be more and more improved.

ACKNOWLEDGEMENTS

Research was supported by the Romanian Research Programs CEEX (Project MAFS, 2005-2008) and PN-II (Project STUPAS, 2008-2011).

REFERENCES

1. Ion Nicoleta, V. Stefan, V. Ion, G. Fota, R. Coman, 2007. *Results concerning the melliferous characteristics of the sunflower hybrids cultivated in Romania*. Scientific Papers Zootechny and Biotechnologies, Timisoara, v.40 (2) (pp.80-90).
2. Ion V., V. Stefan, Nicoleta Ion, 2007. *Results on the flowering stage in the Romanian-grown sunflower hybrids*. Scientific Papers Zootechny and Biotechnologies, Timisoara, v.40 (2) (pp.91-100).
3. Sidlauskas G., C. Rife. 1999. *Environmental and agronomic factors affect on the growth of rape leaves in autumn.* 10^{th} Int'l Rapeseed Congress (1999, Canberra, Australia). The Regional Institute Ltd. (pp 7).
4. Ştefan V., V. Ion, Nicoleta Ion, M. Dumbravă, V. Vlad. 2008. *Floarea-Soarelui*. Ed. Alpha MDN, Buzău (pp. 266).
5. Tesfamariam E.H., 2004. *Modelling the soil water balance of canola Brassica napus L.* Thesis. University of Pretoria etd., South Africa (pp. 120).
6. Thomas P., 2003. *Canola Growers Manual, Chapter 5 - Temperature, Frost, Hail*. 2003 Ed. Canola Council of Canada, http://www.canolacouncil.org/chapter5.aspx.
7. Vlad V., V. Ştefan, V. Ion, Nicoleta Ion, D.M. Motelică, 2008. *Researches regarding the prognosis of the flowering stage and honey potential yield of sunflower crops.* Bulletin UASVM-CN, Agriculture, 65(1) (pp. 339-344).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

EVOLUTION OF MAIZE BIOMASS IN A CRUDE OIL POLLUTED SOIL ACCORDING TO THE TREATMENT APPLIED

MARIANA MARINESCU, M. DUMITRU, ANCA LĂCĂTUŞU, M. MARINESCU

National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection of Bucharest

Keywords: *polluted soils, crude oil, maize, biodegradation, treatment*

Abstract

There are many hydrocarbon-contaminated sites today due to the incorrect use of oil products. The hydrocarbon-degrading microorganisms occur in most environments, where hydrocarbons may serve as organic carbon sources. Bioremediation is based on the use of microorganisms or microbial processes to degrade environmental contaminants, and offers several advantages over the conventional chemical and physical technologies. It can be a cost effective, environmental friendly technology. The aim of this study is to develop and test artificially an improved technology for bioremediation of crude oil polluted soils. The soil artificially polluted with crude oil will be treated with a natural biodegradable product and bacterial inoculum. The plant used in the greenhouse experiment is maize. The paper presents the resulted obtained in two experimental years regarding the following parameters of plants growth: the number of plants/pot, the plant height, the leaves number and the biomass. It will be shown the influence of crude oil on plant growth in a soil treated with a natural biodegradable product. According with the results obtained, this method could be used in field for rehabilitation and reuse in agriculture of polluted soils with crude oil.

INTRODUCTION

The most important classes of organic pollutants in the environment are mineral oil constituents and halogenated products of petrochemicals. Therefore, the capacities of aerobic microorganisms are of particular relevance for the biodegradation of such compounds and very good described with reference to the degradation of aliphatic and aromatic hydrocarbons [5].

Moreover, low biodegradability and bioavailability of the contaminants may limit the biodegradation in a contaminated site. During remediation can enhance the biodegradation by adjustment of optimal technological parameters. The intensity of biodegradation is influenced by several environmental factors, such as quality, quantity and activity of the indigenous microbial populations, levels of nutrients, aerobic conditions, pH, temperature, water content and other soil properties [5].

Phytoremediation of organics, like petroleum hydrocarbons, is applicable in case of non-phytotoxic contamination levels. Phytoremediation, the use of higher plants for decontamination of soil, water and sediments, is a cost-effective technique that, at the same time, is non-destructive and even has a rehabilitating effect on soil structure and ecology [1].

Plants are designed to increase the activity of microorganisms in rhizosphere by optimizing the parameters of the environment, such as moisture, soil reaction. Further, roots growth involves the penetration of needed oxygen for contaminant/ pollutant oxidation process [3, 4]. Although hydrocarbons biodegradation around rhizosphere are known, still have not been clarified the mechanisms that influence the microorganisms growth and activity [2, 6].

MATERIAL AND METHODS

The main objective of this research is testing the natural hydrocarbon absorbent named ECOSOL. To achieve data concerning the bioremediation of polluted soil with petroleum hydrocarbons was realized a greenhouse experiment. The soil used for this experiment was a cambic chernozems.

The experimental variants were:

- ✓ V_1, control (unpolluted soil);
- ✓ V_2, polluted soil with 5% crude oil;
- ✓ V_3, polluted soil with 10% crude oil;
- ✓ V_4, polluted soil with 5% crude oil + 1 kg ECOSOL/m^2 polluted soil;
- ✓ V_5, polluted soil with 5% crude oil + 1 kg ECOSOL/m^2 polluted soil + bacterial inoculum;
- ✓ V_6, polluted soil with 5% crude oil + 2 kg ECOSOL/m^2 polluted soil;
- ✓ V_7, polluted soil with 5% crude oil + 2 kg ECOSOL/m^2 polluted soil + bacterial inoculum;
- ✓ V_8, polluted soil with 10% crude oil + 2 kg ECOSOL/m^2 polluted soil;
- ✓ V_9, polluted soil with 10% crude oil + 2 kg ECOSOL/m^2 polluted soil + bacterial inoculum;
- ✓ V_{10}, polluted soil with 10% crude oil + 4 kg ECOSOL/m^2 polluted soil;
- ✓ V_{11}, polluted soil with 10% crude oil + 4 kg ECOSOL/m^2 polluted soil + bacterial inoculum.

Sowing was done in April in every experimental year, at 8-10 cm depth with a total of 5 seeds in each pot. In the first experimental year with plant, the first seedlings have sprung in control, with a delay in pots with soil polluted with 5% crude oil and none in the pots with soil polluted 10% crude oil, because of the pollution degree. In the second experimental year with plant, the first seedlings have sprung in control, with a delay in pots with soil polluted with 5% crude oil and 10% crude oil.

During 5 month of experiment in every year, soil was kept clean by weeds and in an optimal state of moisture (approximately corresponding with water capacity in field).

RESULTS AND DISCUSSION

Tables 1 and 2 present the characteristcs of plants 5 months after seedling, in the first and second experimental years with plant.

The number of plant/pot, the plant height, the leaves number and the biomass are proportional with the treatment. As it can be observed, in the first experimental year with plant the control presents very high values for all the analysed parameters, the pots with soil polluted with 5% crude oil have lower values then control and the pots with soil polluted with 10% crude oil have no value because the plants did not rise up.

In the second experimental year with plant, in the pots were the soil was polluted with 5% and 10% crude oil the plants rise up with delay, the differences between the treatments can be observed compared with the first experimental year with plant.

The number of plant/pot, the height of plants, the number of leaves and the biomass are increasing with the applied treatments.

Financial cost of this type of remediation is estimated through consultations among all partners involved in various stages of remediation chain. The costs of monitoring and control stages of remediation are taken into account not only the intrinsic costs of remediation. It takes into account also the costs necessary to achieve the final balance of remediation.

It must be noted that estimates costs with adequate technology is difficult, because few cases can be determined with precision of remediation efficiency and time required to achieve the objectives initially set. So it is preferable to a cost estimate for a certain period of time (weeks, months, quarters, etc.) or mass per unit volume or area of environmental treaty.

The cost of remediation evolving demands increase exponentially as the degree of pollution. Moreover, it was found that the incidence degree of accuracy and diagnostic phase is considerable detail on the cost of remediation. A significant reduction in total cost and the rehabilitation costs can be achieved by a relatively moderate increase in the cost of diagnosis. An investigation with high precision, it will be sufficient expenditure required to offset much lower cost of rehabilitation.

Table 1

Evolution of plants in experimental variants according to applied treatment in the first year with plant

No.	Experimental variant	Plants/plot (number)	Height (cm)	Leaves (number)	Biomass (g)
1	V_1, control (unpolluted soil)	5	139	12	106.33
2	V_2, polluted soil with 5% crude oil	4	62	8	5.83
3	V_3, polluted soil with 10% crude oil	-	-	-	-
4	V_4, polluted soil with 5% crude oil + 1 kg ECOSOL/m^2 polluted soil	5	43	7	5.17
5	V_5, polluted soil with 5% crude oil + 1 kg ECOSOL/m^2 polluted soil + bacterial inoculum	4	38	8	5.17
6	V_6, polluted soil with 5% crude oil + 2 kg ECOSOL/m^2 polluted soil	5	62	8	6.67
7	V_7, polluted soil with 5% crude oil + 2 kg ECOSOL/m^2 polluted soil + bacterial inoculum	5	55	8	6.50
8	V_8, polluted soil with 10% crude oil + 1 kg ECOSOL/m^2 polluted soil	-	-	-	-
9	V_9, polluted soil with 10% crude oil + 1 kg ECOSOL/m^2 polluted soil + bacterial inoculum	-	-	-	-
10	V_{10}, polluted soil with 10% crude oil + 4 kg ECOSOL/m^2 polluted soil	-	-	-	-
11	V_{11}, polluted soil with 10% crude oil + 4 kg ECOSOL/m^2 polluted soil + bacterial inoculum	-	-	-	-

Table 2

Evolution of plants in experimental variants according to applied treatment in the second year with plant

No.	Experimental variant	Plants/plot (number)	Height (cm)	Leaves (number)	Biomass (g)
1	V_1, control (unpolluted soil)	5	122	14	177.35
2	V_2, polluted soil with 5% crude oil	5	56	8	28.76
3	V_3, polluted soil with 10% crude oil	5	80	9	77.19
4	V_4, polluted soil with 5% crude oil + 1 kg ECOSOL/m^2 polluted soil	5	66	8	45.57
5	V_5, polluted soil with 5% crude oil + 1 kg ECOSOL/m^2 polluted soil + bacterial inoculum	5	89	9	68.76
6	V_6, polluted soil with 5% crude oil + 2 kg ECOSOL/m^2 polluted soil	5	83	8	64.22
7	V_7, polluted soil with 5% crude oil + 2 kg ECOSOL/m^2 polluted soil + bacterial inoculum	5	114	9	109.09
8	V_8, polluted soil with 10% crude oil + 1 kg ECOSOL/m^2 polluted soil	5	83	8	62.23
9	V_9, polluted soil with 10% crude oil + 1 kg ECOSOL/m^2 polluted soil + bacterial inoculum	5	88	8	109.13
10	V_{10}, polluted soil with 10% crude oil + 4 kg ECOSOL/m^2 polluted soil	5	79	8	71.50
11	V_{11}, polluted soil with 10% crude oil + 4 kg ECOSOL/m^2 polluted soil + bacterial inoculum	5	87	8	67.81

CONCLUSIONS

1. In the first experimental year, in the pots where the soil was polluted with 5% crude oil the plants rise up with delay, the plant are at least two times lower than control, and differences between treatments can be observed after an experimental year. In all the pots where the soil was polluted with 10% crude oil, the plants haven't rise up even the treatment was applied.
2. In the second experimental year, in the pots were the soil was polluted with 5% and 10% crude oil the plants rise up with delay, the differences between the treatments can be observed compared with the first experimental year with plant.
3. The number of plant/pot, the height of plants, the number of leaves and the biomas are proportional with the treatment. For all the parameters analysed the control presents values very high, the pots with soil polluted with 5% crude oil have values lower then control, proportionaly with the treatment applied and the pots with soil polluted with 10% crude oil have no value because the plants did not rise up.

REFERENCES

1. Cunningham S.D., T.A. Anderson, A.P. Schwab, F.C. Hsu, 1996. *Phytoremediation of soils contaminated with organic pollutants*. Advances in Agronomy 56 (pp. 55-113).
2. Hutchinson S.L., A.P. Schwab, M.K. Banks, 2001. *Bioremediation and biodegradation: phytoremediation of aged petroleum sludge: effect of irrigation techniques and scheduling.* Journal of Environmental Quality 30 (pp. 1516-1522).
3. Joner E.J., C. Leyval, 2003. *Phytoremediation of organic pollutants using mycorrhizal plants: a new aspect of rhizosphere interactions*. Agronomie 23 (pp. 495-502).
4. Lin Q., I.A. Mendelssohn, 1998. *The combined effects of phytoremediation and biostimulation in enhancing habitat restoration and oil degradation of petroleum contaminated wetlands*. Ecological Engineering 10 (pp. 263-274).
5. Pepper I.L., C.P. Gerba, L.M. Brusseau, 1996. *Pollution Science*. Academic Press.
6. Wiltse C.C., W.L. Rooney, Z. Chen, A.P. Schwab, M.K. Banks, 1998. *Greenhouse evaluation of agronomic and crude oil-phytoremediation potential among alfalfa genotypes*. J. Environ. Qual. 27 (pp. 169-173).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

CHEMICAL COMPOSITION AND NUTRITIONAL VALUES OF SOME ALTERNATIVE CROPS PROMOTED IN ORGANIC AGRICULTURE

MARIA TOADER, GH.V. ROMAN, ALINA-MARIA IONESCU

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *alternative crops, chemical composition, nutritional values*

Abstract

The paper present the results of the research made in 2007-2009 period regarding chemical composition and nutritional value of some alternative crops promoted in organic agriculture: pseudocereals (amaranthus, quinoa, and buckwheat), grain legumes (faba bean, chickpea, and lentil) and oil seeds (safflower, camelina, and oil flax).

In average, the chemical composition of these crops cultivated in Moara Domneasca Training and Experimental Farm was the following: for pseudocereals – 64.32-66.87% glucides; 16.03-16.71% proteins; 3.53-4.91% lipids; 2.31-2.89% minerals; for grain legumes – 33.29-63.90% glucides; 21.23-22.18% proteins; 3.03-4.40% lipids; 3.41-5.85% minerals; for oil crops – 26.41-36.27% glucides; 12.60-22.56% proteins; 28.38-34.10% lipids; 3.60-5.25% minerals. It is important to point out the nutritional values of tested alternative crops as mean to supplement and to diversify the common human diet: pseudocereals as sources rich in glucides and proteins (and lipids too); the grain legumes as sources rich in proteins, glucides (and minerals too); oil crops as sources rich in lipids and proteins (and glucides too).

INTRODUCTION

Some various factors have stimulated interest of specialists in crop diversification in recent years: instability of commodity prices decreased or eliminated farm subsidies, increased pesticide-resistance in damaging organisms, and losses in genetic biodiversity. At the same time, consumer dietary changes have generated new markets for alternative food products [2].

Risk reduction through diversification (related to climatic and biotic factors, particularly in fragile ecosystems and commodity fluctuations) by expanding locally adapted or introducing new species and related production systems, will contribute to improved food security and income generation for resource poor farmers and protect the environment.

To increase income the farmer needs a higher value product that can be obtained by adding value to primary or secondary products. Fruits, vegetables, herbs and spices, flavourings, natural colourants, medicinal plants and others all offer an opportunity for farmers to produce higher value products. Nevertheless, introducing new crops on their own is unlikely to be successful as the whole technological and commercial package needs to be introduced at the same time.

Alternative field crops are categorized as: pseudocereals and less common cereals (amaranth, quinoa, buckwheat, teff, finger millet, pearl millet, foxtail millet, wild rice); grain legumes (varieties of dry beans and dry peas, faba bean, chickpea and lentils); oilseeds (camelina, canola, crambe, cuphea, jojoba, lesquerella, meadowfoam, perilla, sesame, safflower); industrial crops (euphorbia, fanweed, gopher plant, vernonia); and fiber crops (kenaf, milkweed) [2].
Feasibility of a specific crop depends on a number of factors including the suitability of the crop for local growing conditions. Climate, soil characteristics, and pest problems affect crop productivity.
Alternative crops could play a huge role in the world's food supply. They may be less important in comparison to the major crops but they offer much needed nutritional value and variety needed in the diet. Studying of nutritional value of the alternative crops in organic farming conditions arising from the very special role it occupies at present this system of agriculture and these plants in the world, Europe and Romania, both in the development of biodiversity, environmental protection, and food diversification.

MATERIAL AND METHODS

The alternative crops that have been investigated are the following: pseudocereals (amaranthus, quinoa, and buckwheat), grain legumes (faba bean, chickpea, and lentil), oil seeds (safflower, camelina, and oil flax).
The biologic material for studies comes from Moara Domneasca Experimental Field in the years 2007-2009.
The biochemical compounds (glucides, starch, proteins, lipids and minerals) have been determinated by using the common chemistry laboratory methods: for glucides, Bertrand Method; for proteins, Kjeldahl Method; for lipids, Soxhlet Method; for minerals, Spectrophotometrie Method.

RESULTS AND DISCUSSION

After their role in metabolism, useful substances in food, the human body needs, is divided into several groups: substances with energy by oxidation in the body which provide necessary heat and energy expenditure due to life processes work, such substances are mainly fat and glucides; substances with plastic, regenerative cells and tissues, such as proteins; substances with a catalytic role, such as vitamins and minerals; substances sensory role, which impresses the senses.
In the scientific literature in the fields of biochemistry and food hygiene, food technology and merceology, nutritional value is often presented as percentage of chemical composition, underlining the presence of one or other of component (glucides, proteins, lipids, minerals, etc.) or/and sometimes accompanied by the potential energy expressed in kcal/100 g product [5].

Chemical composition and nutritional value of pseudocereals. The glucides content of pseudocereals grains oscillated between 64.32% at quinoa and 66.86% at amaranthus. On protein content, as can be seen in table 1, all three crops had similar content, over 16%, higher content in comparison with safflower (12.6%). There are remarked the higher values of lipids content (over 3.5%) and over 5% for the best variants, in comparison with grain legumes (3-4%). The average energy value of pseudocereals was around 376 kcal/100 g, similar with the grain legumes (340 kcal/100 g).

Table 1

Nutritional values of alternative crops
(Moara Domneasca Experimental Field, 2007-2009)

Alternative crops	Species	Glucides (g/100g)	Proteins (g/100g)	Lipids (g/100g)	Minerals (g/100g)	Energy value (kcal/100 g)
Pseudocereals	Amaranthus spp.	66.87	16.47	4.91	2.61	389.97
	Quinoa	64.32	16.71	5.80	2.89	389.06
	Buckwheat	65.50	16.03	3.53	2.31	351.05
Grain legumes	Faba bean	63.90	21.50	4.40	5.85	396.58
	Chickpea	56.20	21.23	4.31	3.41	360.95
	Lentils	33.29	22.18	3.03	4.00	259.60
Oil crops	Safflower	26.41	12.60	28.38	3.60	426,73
	Camelina	36.27	20.43	31.75	4.28	532.02
	Oil Flax	27.73	22.56	34.10	5.25	528.56

Chemical composition and nutritional value of grain legumes. About content in glucides, lower content was analyzed at lentils, only 33.23% compared with the other two legumes species, faba bean and chickpea, which had 63.90%, respectively 56.20%. Protein contents were around 21%, comparatively with two alternative oil crops, flax and camelina. The lipids content oscillated between 3.03% at lentil and 4.40% at faba bean. The highest minerals content was analyzed at faba bean (5.95%), and the lowest at chickpea (3.41%). According with these results, the highest energy value registered at faba bean, with 396.58 kcal/100 g.

Chemical composition and nutritional value of oil crops. After analyzing the chemical composition of oilseed species, lowest glucides content was recorded in the safflower (26.41%), and higher values were determined at camelina (over 36%). The highest proteins content found at flax seeds with 22.56% and lowest values were determined at safflower seeds with 12.60%. Camelina had

intermediate contents of 20.43%. The lipid content varied between 28.38% and 34.10%, the average being 31.24%. The lowest content was indentified at safflower, and the higher at flax. Minerals content varied between 3.60% at safflower and 5.25% at oil flax.
The nutritional value of oil crops seeds was as follows: 426.73 kcal/100 g at safflower, 528.56 kcal/100 g at camelina and 532.02 kcal/100 g at oil flax.

CONCLUSIONS

1. After research carried on Moara Domneasca Farm, the results of pseudocereals chemical composition are as follows: 64.32-66.87% glucides; 16.03-16.71% proteins; 3.53-4.91% lipids; 2.31-2.89% minerals.
2. For grain legumes were recorded following data: 33.29-63.90% glucides; 21.23-22.18% proteins; 3.03-4.40% lipids; 3.41-5.85% minerals.
3. In the sames conditions, the chemical composition of oil crops was: 26.41-36.27% glucides; 12.60-22.56% proteins; 28.38-34.10% lipids; 3.60-5.25% minerals.
4. The study of the nutritional value of alternative crops in organic farming conditions evidenced the very special role which should they occupy in the development of biodiversity, environmental protection, and diversification of food.
5. Organic agriculture could ensures that agriculture's natural base remains productive and agricultural production can be competitive in the future and that farming works to promotes positive environmental impact.

REFERENCES

1. Belton P. S., J. R. N. Taylor, 2002. *Pseudocereals and Less Common Cereals – Grain Properties and Utilization Potential*. American Association of Cereal Chemists, SUA.
2. Sauer Patricia, P. Sullivan, 2000. *Alternative Agronomic Crops*. NCAT Agriculture Specialist, Agronomy Series, USA.
3. Toader Maria, 2008. *Research regarding chemical composition and yield quality of cereals and pseudocereals under influence of natural and technological factors.* PhD Thesis, Faculty of Agriculture, UASMV Bucharest.
4. Truta Alina Maria, 2009. *Research regarding alternative crops in the ecological agriculture system for the Southern part of Romania.* PhD Thesis, Faculty of Agriculture, UASMV Bucharest.
5. ***WHO regional publications, European series No. 96: *Food and health in Europe: a new basis for action.* WHO Regional Office for Europe.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

RESEARCH ON *AMARANTHUS CRUENTUS* L. AND *AMARARANTHUS HYPOCHONDRIACUS* L. SPECIES GROWN IN SOUTH-EASTERN ROMANIA *(MOARA DOMNEASCĂ – ILFOV)*

D.I. MARIN*, C. BOLOHAN*, M. MIHALACHE*, T. RUSU**

*University of Agronomic Sciences and Veterinary Medicine of Bucharest
**University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca

Keywords: *Amaranthus sp., alternative crops, adaptability*, *production*

Abstract

The Amaranthus species have been grown for food and non-food purposes for at least 5,000 years; in 1967, Calen called Amaranthus ''The first grain of the New World''.

This paper presents the results obtained under the growing conditions provided by the Didactic Farm of Moara Domnească – Ilfov. Research includes 12 varieties of species A. cruentus and A. hypochondriacus. Between 2008 and 2010, the average fresh biomass production was 332.38 q/ha for a density of 70,000 plants/ha and 390.82 q/ha for a density of 100,000 plants/ha whereas seed production was 36.533 q/ha for the first density and 40.235 q/ha for the second.

INTRODUCTION

Given the global climate change, Romanian climate is characterized by increasing average temperatures, low amount and uneven distribution of rainfalls, and an increasing frequency of extreme climatic events.

Consequently, in order to provide food resources, it has become paramount to diversify the crops that can respond favourably to different ecological conditions.
Some plant species that were grown for food thousands of years ago (*Amaranthus, Quinoa, Buckeat*, etc.) have become important again for the agro-food production and non-food sectors (biomass, biofuels, natural dyes, medicines, etc.), [4].
Among the alternative crops, *Amaranthus* is a very well represented plant of high genetic and specific diversity, and is grown for food (as a pseudocereal plant), feeding and ornamental purposes.

The genus *Amaranthus* includes a large number of species (over 60) that are spread worldwide in the temperate, subtropical and tropical areas.

The *Amaranthus* genus has three species that are important to agricultural production (pseudocereals): *Amaranthus caudatus* L., *Amaranthus hypochondriacus* L. and *Amaranthus cruentus* L.

The interest in these species results from their seed quality, comparable and even superior to cereals owing to their high content in carbohydrates, proteins, fats, fibers and essential aminoacids [3, 7, 8].

MATERIAL AND METHODS

Research was performed within the PN-II-Project No. 51-018/2007-2010, and was carried out in three pedoclimatic areas in Romania (Ilfov, Cluj-Napoca, Călăraşi).

This paper includes the results achieved during 2008-2010 by the project coordinator UASVM Bucharest under the growing conditions provided by the Didactic Farm of Moara Domnească – Ilfov.

The material analyzed consisted of 12 varieties belonging to the species *A. cruentus (*V_1-Alegria, V_2-Amont, V_7-Chihuahuan, V_9-MT3) and *A. hypochondriacus* (V_3-Plaisman, V_4-Golden, V_5-Mercado, V_6-Hopi Red Dye, V_8-Opopeo, V_{10}-Plenitude, V_{11}-Intense purple, V_{12}- Burgundy).

Soil type: reddish preluvosoil.

Pre-emergent plant: wheat.

Tillage consisted of summer plowing at 18-20 cm, autumn disc harrowing, spring preparation of the germination bed by using the pre-sowing combinator and three hoeings during the vegetation season.

Fertilization by N:P complex fertilizers in rates of 70 kg a.s./ha each, applied during the preparation of the germination bed.

Sowing was performed at a depth of 1 cm between 25th April and 3rd May, depending on the crop year.

Crop harvest was performed according to variants and repetitions at the end of September.

RESULTS AND DISCUSSION

The climatic conditions recorded at the Moara Domnească area between 2008 and 2010 are characterized by deviations from the typical average multiannual values of the area (table 1).

Between 2008 and 2009, the average temperature during the vegetation period of the *Amaranthus* plants (May-September) was 20.86^{o}C, exceeding the normal thermal values by 1.24^{o}C. Within the same time length, the average amount of rainfalls was 259 mm, i.e. 42.6 mm under the multiannual values.

The analysis of the data regarding the development of the *Amaranthus* plants (table 2) shows a rapid growth towards the middle of the vegetation period (July-August).

The growth stages recorded differences of up to 7 days between the varieties under analysis. However, plant maturation was uniform within each variety.

Table 1

Climatic conditions of Moara Domnească (2008-2009)

Month	Average temperature (^{0}C)				Rainfalls (mm)			
	2008	2009	2010	Normal	2008	2009	2010	Normal
X	12.3	13.0	12.1	11.0	5.1	32.8	33.8	35.8
XI	5.1	5.7	9.8	5.3	8.8	35.8	10.8	40.6
XII	2.8	2.3	0.8	0.4	4.2	29.4	46.6	36.7
I	-2.4	-0.4	-3.2	-3.0	31.2	58.6	34.6	30.0
II	3.2	2.6	0.7	-0.9	0.5	20.4	31.4	32.1
III	8.8	6.3	5.5	4.4	16.4	26.4	31.2	31.6
IV	13.3	12.0	12.3	11.2	63.2	5.4	29.8	48.1
V	**17.4**	**17.8**	**17.3**	**16.5**	**44.6**	**44.2**	**49.6**	**67.7**
VI	**22.1**	**21.6**	**21.6**	**20.3**	**29.0**	**96.2**	**67.4**	**86.7**
VII	**22.4**	**23.7**	**23.3**	**22.1**	**52.4**	**163.2**	**58.4**	**63.1**
VIII	**21.5**	**23.1**	**25.8**	**21.7**	**8.4**	**22.4**	**27.6**	**50.5**
IX	**17.8**	**18.6**	**18.9**	**17.5**	**63.2**	**31.4**	**21.8**	**33.6**
Average (^{0}C) Sum (mm)	12.0	12.2	11.98	10.5	327.0	566.4	443.0	556.1

Table 2

Vegetative development of *Amaranthus* plants under the conditions of Moara Domnească (average 2008-2010)

Date of measurements	30 May	15 June	30 June	15 July	30 July	15 August	30 August
Plant height (cm)	8-12	21-24	34-58	68-112	76-130	81-167	85-196
No. of leaves/ plant	7-12	12-16	18-23	24-30	27-34	28-37	28-39
Fresh biomass g/plant	30-39	72-186	110-225	140-288	202-367	288-564	391-475
Occurrence time of inflorescences: 26 June-4 July							
Flowering time: 1-10 July							
Flowerinf time length: 1-25 July							
Harvest time: 24 -29 September							

On an average for the 2008-2010 period, **green biomass production** (table 3) resulted from the *Amaranthus* varieties was 332.38 q/ha for a density of 70,000 plants/ha (D_1), and 390.82 q/ha for a density of 100,000 plants/ha (D_2). The highest production achieved was 467.31 q/ha, recorded in the *Amaranthus cruentus* species - MT 3 variety in D_2.

Seed production (table 4) in D_1 varied between 28.289 q/ha in V_{11} - Intense purple and 42.804 q/ha in V_7-Chihuahuan while the average production for the 12 varieties was 36.533 q/ha. In a density of 100,000 pl/ha (D_2), the average production was 40.235 q/ha while the highest was 46.088 q/ha in V_7 – Chihuahuan belonging to the *A. cruentus* species.

Table 3

***Amaranthus* biomass production depending on variety and density, average for 2008-2010**

Plants density/ha	Varieties	Green biomass (q/ha)	%	Difference (q/ha)
70,000 (D_1)	Average V_1-V_{12}	332.38	100	Control
	V_1 -Alegria	330.34	99.4	-2.04
	V_2-Amont	353.64	106.4	21.26
	V_3-Plaisman	283.64	86	-48.74
	V_4-Golden	358.23	107.8	25.85
	V_5-Mercado	222.42	66.9	-109.96
	V_6-Hopi Red Dye	358.51	107.9	26.13
	V_7-Chihuahuan	377.45	113.6	45.07
	V_8-Opopeo	375.18	112.9	42.80
	V_9-MT3	381.01	114.6	48.63
	V_{10}-Plenitude	311.19	93.6	-21.19
	V_{11} - Intense purple	310.67	93.5	-21.71
	V_{12}- Burgundy	324.25	97.6	-8.13
100,000 (D_2)	Average V_1-V_{12}	390.82	100	Control
	V_1 -Alegria	341.52	87.4	-49.30
	V_2-Amont	399.24	102.2	8.42
	V_3-Plaisman	350.90	89.8	-39.92
	V_4-Golden	415.62	106.3	24.80
	V_5-Mercado	271.68	69.5	-119.14
	V_6-Hopi Red Dye	431.09	110.3	40.27
	V_7-Chihuahuan	427.17	109.3	36.35
	V_8-Opopeo	432.08	110.5	41.26
	V_9-MT3	467.31	119.6	76.49
	V_{10}-Plenitude	408.58	104.5	17.76
	V_{11} - Intense purple	362.74	92.8	-28.08
	V_{12}- Burgundy	378.85	96.9	-11.97
	DL 5%=20.64 q/ha; DL 1%=29.79 q/ha; DL 0.1%=36.50 q/ha			

The analysis of the climate conditions during the experimental period, in relation with the production achieved, shows that, for each 1 mm of rainfalls during the vegetation period, the *Amaranthus* plants recorded an average green biomass production of 1.283 q/ha/mm in D_1 and 1.509 q/ha/mm in D_2, while seed production was 0.141 q/ha/mm in D_1 and 0.155 q/ha/mm in D_2.

Table 4

Amaranthus seed production depending on variety and density, average for 2008-2010

Plants density/ha	Varieties	Seed production (q/ha)	%	Difference (q/ha)
70,000 (D_1)	Average V_1-V_{12}	36.533	100	Control
	V_1 -Alegria	40.458	110.8	3.925
	V_2-Amont	38.877	106.4	2.344
	V_3-Plaisman	31.914	87.4	-4.619
	V_4-Golden	35.015	95.8	-1.518
	V_5-Mercado	28.538	78.1	-7.995
	V_6-Hopi Red Dye	35.408	96.9	-1.125
	V_7-Chihuahuan	42.804	117.2	6.271
	V_8-Opopeo	38.841	103.3	2.308
	V_9-MT3	39.082	107	2.549
	V_{10}-Plenitude	41.499	113.6	4.966
	V_{11} - Intense purple	28.289	77.4	-8.244
	V_{12}- Burgundy	38.647	105.8	2.114
100,000 (D_2)	Average V_1-V_{12}	40.235	100	Control
	V_1 -Alegria	43.769	108.8	3.534
	V_2-Amont	41.477	103.1	1.242
	V_3-Plaisman	35.075	87.2	-5.160
	V_4-Golden	39.506	98.2	-7.290
	V_5-Mercado	32.276	80.2	-7.959
	V_6-Hopi Red Dye	38.886	96.6	-1.349
	V_7-Chihuahuan	46.088	114.5	5.853
	V_8-Opopeo	43.367	107.7	3.132
	V_9-MT3	42.321	105.2	2.086
	V_{10}-Plenitude	45.763	113.7	5.528
	V_{11} - Intense purple	31.222	75.6	-9.013
	V_{12}- Burgundy	43.078	107.1	2.843
	DL 5%=1.99 q/ha; DL 1%=2.85 q/ha; DL 0.1%=4.05 q/ha			

CONCLUSIONS

1. Green biomass production was higher in D_2, with an average of 390.82 q/ha and the highest production of 467.731 q/ha in V_9-MT3.
2. Seed production recorded an average of 36.533 q/ha for a density of 70,000 plants/ha, and 40.235 q/ha for a density of 100,000 plants/ha.
3. Between 2008 and 2010, out of the 12 *Amaranthus* varieties studied, 7 recorded seed productions over 40 q/ha in D_2 (4 varieties belonging to *A. cruentus* L. and 3 varieties of *A. hypochondriacus* L.).

4. To achieve a high productions, both of seeds and green biomass, the best density was 100,000 plants/ha.
5. The results of the research on the *Amaranthus cruenthus* and *Amaranthus hypochondriacus* species show their high adaptability to the ecological conditions of south-eastern Romania. Therefore, these species are highly recommended for agricultural production in the respective area.

Fig. 1. Photographs taken at Moara Domnească - Experimental Field

ACKNOWLEDGEMENTS

Research was supported by the Romanian Research Programs PN - II - Project No. 51-018/2007-2010*''Alternative crops with adaptative potential for different ecological conditions and complex valorification there of through biotechnologies''*.

REFERENCES

1. Calen E.O., 1967. *The first New World cereal. American antiquity*, 32.
2. Endres C., 1986. *Influence of production practices an yield and morphology of Amaranthus cruentus and A. hypochondriacus.* Dept. of Agronomy, Univ Arkansas, USA.
3. Kauffman C.S., P.W. Haas, 1983. *Grain amaranth: A crop with low water requirements and high nutritional value.* In "Environmentally Sound Agriculture" Ed. W. Lokeretz, Praeger Press, New York.

4. Marin D.I., N.E. Băbeanu, O. Popa, 2008. *Biodiversity conservation by promoting alternative crops.* Proceeding of the International Symposium on New Research in Biotechnology, Series F, USAMV Bucharest.
5. Popa G., P. Cornea, M. Ciuca, N. Băbeanu, O. Popa, D. Marin, 2010. *Studies on genetic diversity in Amaranthus species using the RAPD Markers,* Analele universitatii din Oradea. Fascicula de Biologie, XVII, Univ. Oradea.
6. Rusu T., D.I. Marin, Paula Ioana Moraru, Mara Lucia Sopterean, 2010. *Influenţa agrotehnicii aplicate asupra dezvoltării vegetative şi a produţiei de seminţe la unele varietăţi de Amaranthus în condiţiile Podişului Şomeşan*. Analele Universităţii din Craiova, Seria Agricultură-Montanologie-Cadastru, Vol. XL., Craiova.
7. Svirskis, A.,2003. *Investigation of amaranth cultivation and utilization in Lithuania*. Agronomy Research 1(2).
8. Toader Maria, Gh.V. Roman, 2009. *Experimental results regarding morphological, biological and yield quality of Amaranthus hypochondriacus* L. species under the Central part of Romanian Plain conditions. Res. J. Agric. Sci. nr. 41(1), USAMVB - Timişoara.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

STUDIES ON MEDICINAL AND AROMATIC PLANTS USED IN THE THERAPEUTIC RECIPES IN THE BUCHAREST UNIVERSITY HOSPITAL

LENUȚA IULIANA EPURE*, GH.V. ROMAN*, ROXANA MĂRĂCINEANU**

*University of Agronomic Sciences and Veterinary Medicine of Bucharest
**Bucharest University Hospital

Keywords: *medicinal and aromatic plants, therapeutic recipes, hospital*

Abstract

Investigation have been carried aut the Bucharest University Hospital in order to collect information on the utilization of medicinal and aromatic plants in therapy to this hospital, for getting a real view on the present status of the importance of plant species and their utilization in therapeutics. The pharmaceuticals have been analysed interms of composition in vegetal material or substances extracted from vegetal material and the recommendation for use. Also, discussions were held with medical staff in view of obtain certain details concerning recommendations of usage, specific reactions of practic to treatmens, etc. Herbal remedies are present in therapeutic recipe of Bucharest University Hospital in very different forms of preparation: 37 proper medicines (products of pharmaceutic industry), 19 preparations for internal use (6 teas, 6 syrups, 7 tinctures), 18 preparations external use (5 cosmetics, 7 gels, 2 lotions, and 4 ointments). Those preparations contains vegetal material from 76 plant species belonging to 42 botanical families. The best represented are the following botanical families: Asteraceae (12 species); Lamiaceae (7 species); Apiaceae (7 species), Fabaceae (4 species); Liliaceae (3 species), Rosaceae (3 species); Solanaceae (3 species); Moraceae (2 species); Polygonaceae (2 species); Fagaceae (2 species); Salicaceae (2 species). As a general conclusion, it can be stated that medicinal and aromatic plants are very present in the recipe used therapeutically in the University Hospital of Bucharest, which proves the importance given to medicinal and aromatic vegetal species in therapy practiced at the highest level of medicinal act.

INTRODUCTION

Phytotherapy in the form of preparations with curative intent or nutritional supplements has taken a large scale worldwide, representing an inexpensive alternative medicine allopathic. Especially today, when all States of the world struggle to reduce the costs of the medical system, the use of variants offered by alternative to medicine represents a preferred choice.

Phytotherapy has the huge advantage of the reduced adverse reactions or absent and a small number of contraindications, compared with preparations of chemicals synthesis and semi-synthesis of allopathic medicine. The two types of therapy may be associated with much success, having synergistic effect of medication or diminishing allopathic needs.

On the general recognition of the importance of aromatic and medicinal plants in therapeutics, there are few concrete data on the extent of their use in current therapeutics in Romania. This was the starting point of the study carried out in a representative hospital unit for our country.

MATERIAL AND METHODS

Studies have been carried out in the Bucharest University Hospital, a medical unit with modern equipment and modern technologies of investigation and treatment, with personnel of high qualification, recognized by the professionalism and devotion in the exercise of the medical act. In this context, it was appreciated as an investigation on the utilization of medicinal and aromatic plants in therapy to this hospital can give a correct view of the actual dimensions of the utilization of vegetal material in modern therapeutics. In order to achieve the study was carried out investigations at the level of the whole hospital, and in all specialized departments pharmaceuticals used in various forms: proper medicines; preparations for internal use (teas, syrups, tinctures); preparations for external use (cosmetic, gels, lotions, ointments). These pharmaceuticals have been analysed in terms of composition in vegetal material or substances extracted from vegetal material, the recommendations for use and any contraindications. Also, discussions were held with medical staff in view of certain details concerning recommendations of usage, specific reactions of patients to treatments, etc. The goal of this investigation was to get a real picture of the importance of plant species and their utilization in therapeutics.

RESULTS AND DISCUSSION

Following the investigation conducted has resulted that in the University Hospital of Bucharest are used currently 74 pharmaceuticals containing aromatic and medicinal plants, of which: 37 proper medicines, 6 teas, 6 syrups, teas, 7 tinctures, 5 cosmetics, 7 gels, 2 lotions, and 4 ointments.

The 37 medicines identified are based on vegetable material coming from 58 vegetal species, belonging to 37 botanical families. Best represented are the botanical families: *Asteraceae* (10 species); *Lamiaceae* (5 species); *Apiaceae* (3 species); *Fabaceae* (3 species); *Liliaceae* (3 species); *Moraceae* (2 species); *Solanaceae* (2 species) (Table 1).

Table 1

Medicines on the basis of the plant material used in the Bucharest University Hospital

Medicines	Species
ACTIVMOD PLUS	*Sambucus nigra*; *Hypericum perforatum*; *Daucus carota*; *Apium graveolens*; *Glycyrrhiza glabra*; *Ulmus glabra*
ALITENSIN	*Viscum album*; *Crataegus oxyacantha*; *Allium sativum*
ANGHIROL	*Cynara scolymus*
ANTISTRES	*Humulus lupulus*; *Crataegus oxyacantha L.; Leonurus cardiaca*; *Tilia*
API URSOMAX	*Taraxacum officinalis*; *Urtica dioica*; *Ranunculus ficaria*; *Rumex alpinus*; *Allium ursinum*
ASCOTENSIN	*Viscum album*; *Hippophae rhamnoides*; *Humulus lupulus*; *Vaccinium myrthillus*; *Valeriana officinalis*; *Allium sativum*
BRANHOPLANT	*Inula helenium*; *Cetraria islandica*
BRANHOSAN	*Echinaceea angustifolia*; *Salix alba*; *Eucalyptus globules*; *Centraria islandica*
CA+COADA CALULUI	*Equisetum arvense*
CALMHART	*Valeriana officinalis*; *Humulus lupulus*
CALMHART PLUS	*Valeriana officinalis*; *Lavandula angustifolia*
CARBUNE MEDICINAL (Medicinal coal)	*Quercus robur*
CICOBIL	*Cynara scolymus*; *Cichorium intybus*
CLAROVEG	*Inula helenium*; *Salvia officinalis*; *Malva glabra*; *Thymus*; *Foeniculum vulgare*
DENOXINAL	*Chlorella*; *Arctium lapa*; *Rhamnus purshianus*; *Taraxacum officinalis*; *Trifolium partense*; *Allium sativum*; *Silybum marianum*
DEPUREX	*Arctium lapa*; *Cichorium intybus*; *Viola arvensis*
DIFABIOL	*Vaccinium myrthillus*
DIFEBIOM	*Vaccinium myrthillus*
DIOHEM	*Urtica dioica*
EXTRAVERAL	*Valeriana officinalis*
FOLADON	*Atropa belladonna*
GALOV G.	*Calendula officinalis*; *Hypericum perforatum*; *Origanum vulgare*; *Simphytum officinalis*; *Foeniculum officinalis*
GERIFORTE	*Glycyrrhiza glabra*; *Cichorium intybus*; *Solanum nigrum*; *Achillea millefolium*
GIMBIR SI SALVIE	*Zingiber officinale Roa*; *Salvia officinalis*
GINGKO BILOBA	*Gingko biloba*
GinkgoPrim	*Gingko biloba*
HEPATOBIL	*Chelidonium majus*; *Hypericum perforatum*; *Cynara scolymus*; *Humulus lupulus*; *Valeriana officinalis*

HEPATO-DRAINOL	*Silybum marianum*; *Juglans regia*; *Chelidonium majus*; *Berberis vulgaris*
HEPATOFALK	*Silybum marianum*; *Chelidonium majus*
LIV.52	*Cichorium intybus*; *Achillea millefolium*; *Solanum nigrum*
MEGAVITAL	*Urtica dioica*; *Gingko biloba*; *Rozmarinus officinalis*
MemoPlus	*Gingko biloba*; *Echinaceea*
MEMO URSOMAX	*Allium ursinum*; *Gingko biloba*; *Ranunculus ficaria*; *Rumex alpines*; *Urtica dioica*; *Taraxacum officinalis*
NORMODIAB	*Vaccinium myrthillus*; *Morus alba, Morus nigra*; *Phaseolus vulgaris*; *Betula verrucosa*; *Juglans regia*
SILIMARINA	*Silybum marianum*
TANAKAN	*Gingko biloba*
VERIXINAL GEL	*Aesculus hippocastanum*; *Vaccinium myrthillus*; *Ruscus aculeatus*

Among the preparations for internal use (Table 2), teas are containing vegetal material from six plant species, namely: *Hypericum perforatum* (hardhay tea); *Matricaria chamomilla* (chamomile tea); *Mentha piperita* (peppermint tea); *Achillea millefolium* (milefoil tea); *Cynara scolymus* (artichoke tea); *Calendula officinalis* (marigold tea). These species belong to the following botanical families: *Lamiaceae* (1 species); *Asteraceae* (4 species); *Hypericaceae* (1 species).

Syrups are made from vegetal material from 14 species of plants, which belong to the following botanical families: *Lamiaceae* (2 species); *Asteraceae* (1 species); *Ericaceae* (1 species); *Apiaceae* (2 species); Cannabaceae (1 species); Rosaceae (1 species); *Tiliaceae* (1 species); *Elaeagnaceae* (1 species); *Araliaceae* (1 species); *Parmaliaceae* (1 species); *Plantaginaceae* (1 species). Species existing in syrups composition are: *Vaccinium myrthillus*, *Daucus carota* (blueberry syrup with carrots and propolis); *Humulus lupulus*, *Crataegus oxyacantha*, *Leonurus cardiaca*, *Tilia* (anti-stress syrup); *Mentha piperita*, *Thymus*, *Levisticum officinalis* (carminative syrup); *Hippophae rhamnoides*, *Panax ginseng* (underbrush+Siberian ginseng syrup); *Cetraria islandica*, *Echinaceea* (Cetraria+Echinaceea syrup); *Plantago lanceolata* (plantain syrup plus).

The third type of preparations for internal use - tinctures, contains vegetal material from eight species of plants, which belong to the following botanical families: *Lamiaceae* (1 species); *Asteraceae* (4 species); *Hypericaceae* (1 species); *Papaveraceae* (1 species). The species present in the composition of tinctures are: *Arctium lapa*, *Hypericum perforatum* (burdock tincture); *Achillea millefolium* (milefoil tincture); *Calendula officinalis* (marigold tincture); *Lavandula angustifolia* (lavender tincture); *Matricaria chamomilla* (chamomile tincture); *Taraxacum officinalis* (dandelion tincture); *Chelidonium majus* (common celandine tincture).

Table 2

Preparations for internal use, derived from vegetal material, used in the Bucharest University Hospital

Preparations	Species / Family	Composition
TEAS		
Harday tea	*Hypericum perforatum (Hypericaceae)*	Hyperici Herba
Chamomile musetel	*Matricaria chamomilla (Asteraceae)*	Chamomilla Flos
Peppermint tea	*Mentha piperita (Lamiaceae)*	Menthae Folium
Milefoil tea	*Achillea millefolium (Asteraceae)*	Millefolii Flos
Artichoke tea	*Cynara scolymus (Asteraceae)*	Cynare Folium
Marigold tea	*Calendula officinalis (Asteraceae)*	Calendula Flos
SYRUPS		
Blueberry and carrot syrup with propolis	*Vaccinium myrthillus (Ericaceae)* *Daucus carota (Apiaceae)*	Blueberry juice, carrot juice, propolis tincture
Anti-stress syrup	*Humulus lupulus (Cannabaceae)* *Crataegus oxyacantha (Rosaceae)* *Leonurus cardiaca (Lamiaceae)* *Tilia (Tiliaceae)*	Hops cones, hawthorn, Leonurus cardiaca, linden flowers
Carminative syrup	*Mentha piperita (Lamiaceae)* *Thymus vulgaris (Lamiaceae)* *Levisticum officinalis (Apiaceae)*	Peppermint, savory, lovage, syrup
Underbrush+Siberian ginseng syrup	*Hippophae rhamnoides (Elaeagnaceae)* *Panax ginseng (Araliceae)*	Hydro-alcoholic solution of underbrush and Siberian ginseng, sodium benzoat
Cetraria+Echinacseea syrup	*Cetraria islandica (Parmeliaceae)* *Echinaceeea (Asteraceae)*	*Cetraria islandica* extract, *Echinaceea* extract, propolis tincture
Plantain syrup plus	*Plantago lanceolata (Plantaginaceae)*	Hydro-alcoholic extracts of plantain, thirtle, and savory
TINCTURES		
Burdock tincture	*Arctium lapa (Asteraceae)* *Hypericum perforatum (Hypericaceae)*	30 g Arctium Radix, 70 g ethylic alcohol 30%
Milefoil tincture	*Achillea millefolium (Asteraceae)*	30 g Achilleae Flos, 70 g ethylic alcohol 30%
Marigold tincture	*Calendula officinalis (Asteraceae)*	30 g Calendulae Flos, 70 g ethylic alcohol 30%
Lavender tincture	*Lavandula angustifolia (Lamiaceae)*	30 g Lavandulae Flos, 70 g ethylic alcohol 30%
Chamomile tincture	*Matricaria chamomilla (Asteraceae)*	30 g Chamomille Flos, 70 g alcool etilic 30%
Dandelion tincture	*Taraxacum officinalis (Asteraceae)*	30 g Taraxaci Flos, 70 g alcool etilic 30%
Common celandine tincture	*Chelidonium majus (Papaveraceae)*	30 g Chelidonii Herba, 70 g alcool etilic 30%

Identified preparations for external therapeutic recipe in the Bucharest Municipal Hospital were the cosmetics, gels, lotions, and ointments. It was found that the cosmetic products (Table 3) were obtained from vegetal material from 10 species of plants, which belong to the following botanical families: *Lamiaceae* (3 species); *Asteraceae* (2 species); *Rosaceae* (2 species); *Apiaceae* (1 species); *Fabaceae* (1 species); *Eleagnaceae* (1 species). The species are: *Salvia officinalis*, *Mentha piperita*, *Pimpinella anisum*, *Lavandula angustifolia* (mouth rinses); *Amygdali dulcis*, *Hippophae rhamnoides*, *Mentha piperita* (baby-oil); *Calendula officinalis*, *Hippophae rhamnoides* (heel cream); *Matricaria chamomilla* (chamomile cream); *Amygdali dulcis*, *Mellilotus officinalis*, *Rosa damascena* (night cream with almonds, melilot, and rose petals). By comparison, gels are based on vegetal material obtained from 20 plant species belonging to the botanical family: *Lamiaceae* (3 species); *Asteraceae* (5 species); *Rosaceae* (2 species); *Apiaceae* (3 species); *Fabaceae* (1 species); *Eleagnaceae* (1 species); *Hypericaceae* (1 species); *Liliaceae* (1 species); *Vitaceae* (1 species); *Myrthaceae* (1 species); *Polygonaceae* (1 species); *Fagaceae* (1 species); *Poaceae* (1 species); *Salicaceae* (1 species); *Lauraceae* (1 species). Species that have provided raw material for gels are: *Aesculus hippocastanum*, *Vaccinium myrthillus*, *Ruscus aculeatus* (Verixinal Gel); *Calendula officinalis*, *Hypericum perforatum*, *Aloe vera*, *Hippophae rhamnoides*, *Lavandula angustifolia*, *Centella asiatica* (scar gel); *Vitis vinifera*, *Vaccinium myrthillus*, *Fagopyrum sagittatum*, *Castanea sativa*, *Triticum aestivum* (Venoforte gel); *Castanea sativa*, *Calendula officinalis*, *Matricaria chamomilla*, *Hypericum perforatum* (Veno-tonic gel); *Arnica montana*, *Salix*, *Thymus*, *Lavandula angustifolia*, *Mentha piperita* (Kinetic gel); *Echinaceea*, *Arctium lapa*, *Calendula officinalis* (Myco-el); *Arnica montana*, *Mentha piperita*, *Lavandula angustifolia*, *Cinnamomum camphora* (Herbal gel with arnica).

A third type of preparation for external use - lotions, are containing vegetal material from six species of plants from the botanical families: *Asteraceae* (3 species); *Malvaceae* (1 species); *Solanaceae* (1 species). The species present in the lotions composition are: *Calendula officinalis*, *Matricaria chamomilla*, *Malva* (Toning Lotion with plant extracts for normal skin); *Zingiber officinale*, *Arctium lapa*, *Capsicum annuum* (lotion, hair tonic).

Finally, ointments are based on vegetal material from six plant species, namely: *Hippophae rhamnoides* (underbrush ointment); *Hippophae rhamnoides*, *Calendula officinalis*, *Populus* (underbrush, marigold, and poplar buds ointment); *Hypericum perforatum*, *Calendula officinalis*, *Matricaria chamomilla* (hardhay, marigold and chamomile ointment); *Chelidonium majus* (common celandine ointment). They are representatives of botanical families: *Asteraceae* (2 species); *Elaeagnaceae* (1 species); *Hypericaceae* (1 species); *Salicaceae* (1 species); *Papaveraceae* (1 species).

Table 3

Preparations for external use derived from vegetal material, used in the Bucharest University Hospital

<table>
<tr><th>Preparations</th><th>Species / Family</th><th>Composition</th></tr>
<tr><td colspan="3">COSMETICS</td></tr>
<tr><td rowspan="4">Mouth rinse</td><td>Salvia officinalis (Lamiaceae)</td><td rowspan="4">Extracts from: common sage, peppermint, anise, clamomile, lavender</td></tr>
<tr><td>Mentha piperita (Lamiaceae)</td></tr>
<tr><td>Pimpinella anisum (Apiaceae)</td></tr>
<tr><td>Lavandula angustifolia (Lamiaceae)</td></tr>
<tr><td rowspan="3">Baby–oil</td><td>Amygdali dulcis (Rosaceae)</td><td rowspan="3">Sweet almonds oil, underbrush oil, peppermint oil, and A and E vitamins</td></tr>
<tr><td>Hippophae rhamnoides (Elaeagnaceae)</td></tr>
<tr><td>Mentha piperita (Lamiaceae)</td></tr>
<tr><td rowspan="2">Heel cream</td><td>Calendula officinalis (Asteraceae)</td><td rowspan="2">Propylenglycol extract of marigold, underbrush oil, propolis tincture</td></tr>
<tr><td>Hippophae rhamnoides (Elaeagnaceae)</td></tr>
<tr><td>Chamomile cream</td><td>Matricaria chamomilla (Asteraceae)</td><td>Chamomile extract</td></tr>
<tr><td rowspan="3">Night cream with almonds, melilot, and rose petals</td><td>Amygdali dulcis (Rosaceae)</td><td rowspan="3">Almond oil, melilot and rose petals</td></tr>
<tr><td>Mellilotus officinalis (Fabaceae)</td></tr>
<tr><td>Rosa damascena (Rosaceae)</td></tr>
<tr><td colspan="3">GELS</td></tr>
<tr><td rowspan="3">Verixinal Gel</td><td>Aesculus hippocastanum Hippocastanaceae</td><td rowspan="3">Water; extracts from: Ruscus aculeatus, Aesculus hippocastanum, Centella asiatica, Vaccinium myrtilus, dextran, Carbomer, triethanoamine methylcloroisotasolinone, methylisotasolinone</td></tr>
<tr><td>Vaccinium myrthillus (Ericaceae)</td></tr>
<tr><td>Ruscus aculeatus (Liliaceae)</td></tr>
<tr><td rowspan="6">Scar Gel</td><td>Calendula officinalis (Asteraceae)</td><td rowspan="6">Calendulae Flos, Hyperici Herba, Aloe vera herba, Hippophae Fructus, Lavandulae Flos, Centella Herba</td></tr>
<tr><td>Hypericum perforatum (Hypericaceae)</td></tr>
<tr><td>Aleo vera (Liliaceae)</td></tr>
<tr><td>Hippophae rhamnoides (Elaeagnaceae)</td></tr>
<tr><td>Lavandula angustifolia (Lamiaceae)</td></tr>
<tr><td>Centella asiatica (Apiaceae)</td></tr>
<tr><td rowspan="5">Venoforte Gel</td><td>Vitis vinifera (Vitaceae)</td><td rowspan="5">Vitis vinifera Oil, Vaccinii Folium, Fagopyrum Sumitates, Castaneae Fructus, Triticum Semen</td></tr>
<tr><td>Vaccinium myrthilus (Myrthaceae)</td></tr>
<tr><td>Fagopyrum sagittatum (Polygonaceae)</td></tr>
<tr><td>Castanea sativa (Fagaceae)</td></tr>
<tr><td>Triticum aestivum (Poaceae)</td></tr>
<tr><td rowspan="4">Veno-tonic Gel</td><td>Castanea sativa (Fagaceae)</td><td rowspan="4">Castaneae fructus, Calendulae Flos, Chamomillae Flos, Hyperici Herba</td></tr>
<tr><td>Calendula officinalis (Asteraceae)</td></tr>
<tr><td>Matricaria chamomilla (Asteraceae)</td></tr>
<tr><td>Hypericum perforatum (Hypericaceae)</td></tr>
</table>

Kinetic Gel	*Arnica montana (Asteraceae)*	*Arnicae Herba, Salix Gemmae, Thymi Herba, Lavandulae Oil, Menthae piperitae Oil*
	Salix (Salicaceae)	
	Thymus vulgaris (Lamiaceae)	
	Artemisia absinthium (Asteraceae)	
	Lavandula angustifolia (Lamiaceae)	
	Mentha piperita (Lamiaceae)	
Myco-gel	*Echinaceeea (Asteraceae)*	*Echinaceeae Herba, Arctium lapae Herba, Calendulae Flos*
	Arctium lapa (Asteraceae)	
	Calendula officinalis (Asteraceae)	
Herbal Gel with arnica	*Arnica montana (Asteraceae)*	*Arnicae Herba, Menthae piperitae Oil, Lavandulae Oil, Cinnamomum camphorae Oil*
	Mentha piperita (Lamiaceae)	
	Lavandula angustifolia (Lamiaceae)	
	Cinnamomum camphora (Lauraceae)	
LOTIONS		
Toning lotionwith plant extract for normal skin	*Calendula officinalis (Asteraceae)*	extract de galbenele, musetel, nalba, hamei
	Matricaria chamomilla (Asteraceae)	
	Malva glabra (Malvaceae)	
Lotion, hair tonic	*Zingiber officinale Roa (Zingibe-raceelor)*	extract de ghimbir, brusture, ardei iute, vitaminele A si E
	Arctium lapa (Asteraceae)	
	Capsicum annuum (Solanaceae)	
OINTMENTS		
Underbrush Ointment	*Hippophae rhamnoides (Elaeagnaceae)*	Underbrush extract, vaseline, wax, lanoline
Underbrush, marigold, and poplar buds Ointment	*Hippophae rhamnoides (Elaeagnaceae)*	Marigold extract, underbrush, and poplar buds, lanoline, vaseline, wax, camphor
	Calendula officinalis (Asteraceae)	
	Populus sp. *(Salicaceae)*	
Hardhay, marigold, and chamomile Ointment	*Hypericum perforatum (Hypericaceae)*	Hardhay, marigold, and chamomile extracts, vaseline, wax, lanoline
	Calendula officinalis (Asteraceae)	
	Matricaria chamomilla (Asteraceae)	

CONCLUSIONS

Studies carried out in Bucharest University Hospital on herbal remedies used in medicinal therapy led to these conclusions:

1. Herbal remedies are present in therapeutic recipe of Bucharest University Hospital in very different forms of preparation: 37 proper medicines (products of pharmaceutic industry), 19 preparations for internal use (6 teas, 6 syrups, 7 tinctures), 18 preparations external use (5 cosmetics, 7 gels, 2 lotions, and 4 ointments).

2. Those preparations contains vegetal material from 76 plant species belonging to 42 botanical families. The best represented are the following botanical families: *Asteraceae* (12 species); *Lamiaceae* (7 species); *Apiaceae* (7 species), *Fabaceae* (4 species); *Liliaceae* (3 species), *Rosaceae* (3 species); *Solanaceae* (3 species); *Moraceae* (2 species); *Polygonaceae* (2 species); *Fagaceae* (2 species); *Salicaceae* (2 species).
3. The *Asteraceae* family is represented by 12 species, contained in 50 preparations, namely: *Cichorium intybus* (4 pharmaceuticals, medicines); *Silybum marianum* (4 pharmaceuticals, medicines); *Cynara scolymus* (4 pharmaceuticals - 3 medicines, 1 tea); *Taraxacum officinalis* (4 pharmaceuticals - 3 medicines, 1 tincture); *Inula helenium* (2 pharmaceuticals, medicines); *Arctium lapa* (5 pharmaceuticals - 2 medicines, 1 tincture, 1 gel, 1 lotion); *Achillea millefolium* (6 pharmaceuticals - 2 medicines, 1 tea, 1 tincture, 2 ointment); *Calendula officinalis* (8 pharmaceuticals - 1 medicine, 1 cosmetic, 3 gels, 1 tea, 1 tincture, 1 lotion); *Echinaceea* (5 pharmaceuticals - 3 medicines, 1 syrup, 1 gel); *Matricaria chamomilla* (6 pharmaceuticals - 1 tea, 1 lotion, 1 gel, 1 tincture, 1 cosmetic, 1 ointment); *Artemisia absinthium* (1 gel); *Arnica montana* (2 gels).
4. The *Lamiaceae* family is represented by seven species, which are included in the composition of 22 pharmaceuticals, namely: *Salvia officinalis* (3 pharmaceuticals - 2 medicines, 1 cosmetics); *Leonurus cardiaca* (2 pharmaceutics - medicine, 1 syrup); *Lavandula angustifolia* (6 pharmaceutics - medicine, 1 cosmetic, 1 tincture, 3 gels); *Origanum vulgare* (1 medicine); *Thymus* (3 pharmaceutics - 1 medicine, 1 syrup, 1 gel); R*ozmarinus officinalis* (1 medicine); *Mentha piperita* (6 pharmaceutics - 1 tea, 1 syrup, 2 cosmetics, 2 gels).
5. The *Apiaceae* family is represented by six species contained in the seven pharmaceuticals, namely: *Foeniculum vulgare* (2 medicines); *Apium graveolens* (1 medicine); *Daucus carota* (2 pharmaceuticals - 1 medicine, 1 tea); *Levisticum officinalis* (1 syrup); *Pimpinella anisum* (1 cosmetic); *Centella asiatica* (1 gel).
6. The *Fabaceae* family is represented by four species contained in five pharmaceuticals, namely: *Glycyrhhiza glabra* (2 medicines); *Trifolium pratense* (1 medicine); *Phaseolus vulgaris* (1 medicine); *Mellilotus officinalis* (1 cosmetic).
7. The *Liliaceae* family is represented by three species contained in seven pharmaceuticals: *Allium sativum* (3 medicines); *Allium ursinum* (3 medicines); *Ruscus aculeatus* (1 medicine).
8. Families *Araliaceae, Berberidaceae, Betulaceae, Boraginaceae, Cannabaceae, Caprifoliaceae, Elaeagnaceae, Equisetaceae, Ericaceae,*

Fagaceae, Gingkoaceae, Hippocastanaceae, Hypericaceae, Juglandaceae, Laurantaceae, Loranthaceae, Malvaceae, Myrthaceae, Papaveraceae, Parmaliaceae, Plantaginaceae, Poaceae, Ranunculaceae, Rhamnaceae, Tiliaceae, Ulmaceae, Urticaceae, Valerianaceae, Violaceae, Vitaceae, are represented by a single species.

As a general conclusion, it can be stated that medicinal and aromatic plants are very present in the recipe used therapeutically in the University Hospital of Bucharest, which proves the importance given to medicinal and aromatic vegetal species in therapy practiced at the highest level of medicinal act.

REFERENCES

1. Bojor O., M. Alexan, 1981. *Plantele medicinale - izvor de sanatate*. Ed. Ceres, Bucuresti.
2. Bojor O., M. Alexan, 1995. *Plantele medicinale si aromatice de la A la Z.* Ed. Ulpia Traiana, Bucuresti.
3. Bojor O., O. Popescu, 2001. *Fitoterapie traditionala si moderna*. Ed. Fiat Lux, Bucuresti.
4. Ciocarlan V., 2000. *Flora ilustrata a Romaniei*. Ed. Ceres, Bucuresti.
5. Cociu E., G. Racz, 1962. *Plante medicinale si aromatice*. Ed. Academiei, Bucuresti.
6. Epure Lenuta Iuliana, 2007-2011. *Producerea si valorificarea plantelor medicinale si aromatice.* Notite de curs, USAMV Bucuresti.
7. Maracineanu Roxana Constanta, 2006. *Studii privind plantele medicinale si aromatice existente in retetarul terapeutic de la spitalul universitar Bucuresti.* Lucrare de licenta. USAMV Bucuresti, Facultatea de Agricultura, specializarea Biologie.
8. Roman Gh. V., Maria Toader, Lenuta Iuliana Epure, V. Ion, Gh.A. Basa, 2008. *Cultura plantelor medicinale si aromatice in sistem ecologic*. Ed. Ceres, Bucuresti.
9. ***, 2006. *Agenda medicamentelor din Spitalul Universitar Bucuresti.*

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

RESEARCH REGARDING THE INFLUENCE OF THE CALIBRES AND THE SEEDS TREATMENT ON THE SEEDS GERMINATION IN INTERACTION WITH THE GENOTYPE

CAMELIA F. TODORAN, G. MORAR, TEODORA FLORIAN, CRISTINA MOLDOVAN

University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca

Keywords*: germination, hybrid, calibre, treatment*

Abstract

This paper deals with the study of the calibration influence and the treatment of the Topsin 70 product on seeds germination at the main hybrids cultivated in Transylvania.
The determination of the germination that aim to the establishment of the seeds number , expressed in percents of pure seed, capable to produce some normal germs in lab condition , was appreciated through 2 indices: the germinative capacity and the germinative energy..
The determination of the germinative faculty and energy was made in 4 repetitions of 100 seeds and germination layer was the paper of industrial filter, made from cellulose 100%.
The determinations were made twice, after 4 days for the determination of germinative energy and after 7 days for the one of germinative capacity..
In order for the germination to derive normally it was followed the fact that the humidity of the germination layer should be sufficient in every moment without being in excess.
*The research was made within the field crops productin laboratory of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca in 2007 and 2008 and the biological material taken for study was created at SCDA Turda from hybrids that were in production and in perspective, namely: **TURDA 201** - triliniary hybrid, semiearly created at SCDA Turda, group FAO 340, **TURDA 200** - hybrid double early, registered in 1976,rewritten in the Official Cataloque in 2000 and **TURDA 165** - triliniary hybrid, early belonging to the group FAO 270.*
The obtained results show us that for the same calibre of the seed the germinative energy presents significant differences during the years with favourable conditions of plants maturation and values significantly higher at the seed treated with the fungicid Topsin

INTRODUCTION

Germination is a succession of phenomena and morphological, physiological and biochemical processes that have as a result the transformation of the embryon in germs.The formation of the organs of the future plants like leaves,strain and root takes place as a consequence of the division and the growth of the embryon cells and it is based on series of chemical and physical transformations of a superior

level of organization and integration. The germination process is characterized as being „genetically programmed and modulated by the environment” [2].
The seed size is a syntetic indicator depending on the genotype, on the conditions of vegetation where it was formed and on the position of the beans on the cob..
The value of the corn seeds obtained in seeds lots don't allow us to give up to the big grains or those that were on different position on the cob, that's why for a better uniformity of the seeds used for cultivation,it was made their calibration.
The seeds size has a significant importance for the agricultural practice because, compared to the middle seeds and especially to those big ones, having a higher content of nutritive substances and embryos better developed, they succeed to produce plantules with a better start, with a superior power of crossing, better growing and development, and through this, a faster development of the vegetative apparatus, what finally results in a better production (Bucurescu et colab., 1992).
The treatment of the corn seeds is one of the prophylactic and curative measures important for the prevention and control of the diseases caused by pathogens agents that were in seeds in the soil. Through this measure it is assured the protection of the seeds that are going to rise and also the reduction of the infectious potential for some pathogens that affect the plants during the period of vegetation [1].

MATERIAL AND METHODS

The biological material studied was created at SDCA Turda from the hybrids that were in production and on perspective,namely: Turda 201 - trilinear hybrid, semi early, created at SCDA Turda, group FAO 340, Turda 200 double hybrid, early, registered in 1976, put back in The Official Catalogue in 2000 and Turda 165-trilinear hybrid, early, belonging to group FAO 270.

The calibres used within the present study are those used in selection and sorting stations for corn in Romania.

LL- large wide ML – average wide
LR – large round MR – average round

Determination of capacity of energy and germination was performed in four repetitions of 100 seeds and germination layer of filter paper industry was white, made from 100% cellulose.
Measurements were perfomed twice in four days to determine the capacity and energy of germination in seven days.
From germination to flow normally to follow the germination moisture layer is sufficient at any time, without excess.

RESULTS AND DISCUSSION

The energy and the germinative capacity of the hybrids studied in interaction with the treatment with Topsin at seed in those two experimental years emphasis the fact that in lab conditions, the differences between the values of the hybrids are significant (figures 1 and 2).

In the case of experimental year 2006 the appreciation of the differences of the germinative energy and capacity according to Duncan test show us significant differences between hybrids, the highest values being met at hybrid Turda-200, followed by hybrids Turda-201 and Turda -165 and in the case of the experimental year 2007 the highest values are met at the hybrid Turda -201 followed by Turda -165 and Turda -200 both at treated and untreated seeds.

At all the determinations, both at germinative energy and faculty, the values of hybrid Turda -165 are significantly lower compared to those determined at hybrids Turda -201 and Turda -200. This repetitive evidence could have only genotype causes, fact that makes us propose recommendations full of attention at the seeding period but also at the depth and the density of cultivation.

The germinative capacity appreciated after a supplementary time of 3 days from the date when the germinative energy was written ,modifies the germination values for hybrids in both experimental years in condition of constant temperature in fitotron.

The values of germinative faculty of over 90% near the germination at the untreated seed to that treated in both experimental years , the exception being the hybrid T-165 at which the values of the germinative faculty get down under 90% in both experimental years for all the proveniences from 2005, 2006, 2007 (figures 1 and 2).

Both the year of seed production and the interaction of the experienced hybrid with the seed calibre may significantly influence the germinative faculty (figures 3 and 4)

In the interaction between the treatment factors , the corn hybrid and the seed calibre we notice the superiority of the germinative capacity of hybrid Turda -201 both at treated and untreated seeds from both years of production , followed by the hybrids Turda -200 and Turda -165 , the values of this last hybrid being under 90% in average for all calibres both at treated and untreated seed.

We can notice at Turda -200 at the seeds from both years of production in the case of the seeds treatment with Topsin, as a rule, a raising of the values of the germinative faculty at all calibres.

An interesting conclusion may be drawn from this chart, that the values of the germinative capacity at almost all the calibres in both experimental years are higher at the seeds treated with Topsin than at those untreated.

We can conclude that Topsin can have a slight stimulative effect on the seeds germination (figures 1 and 2).

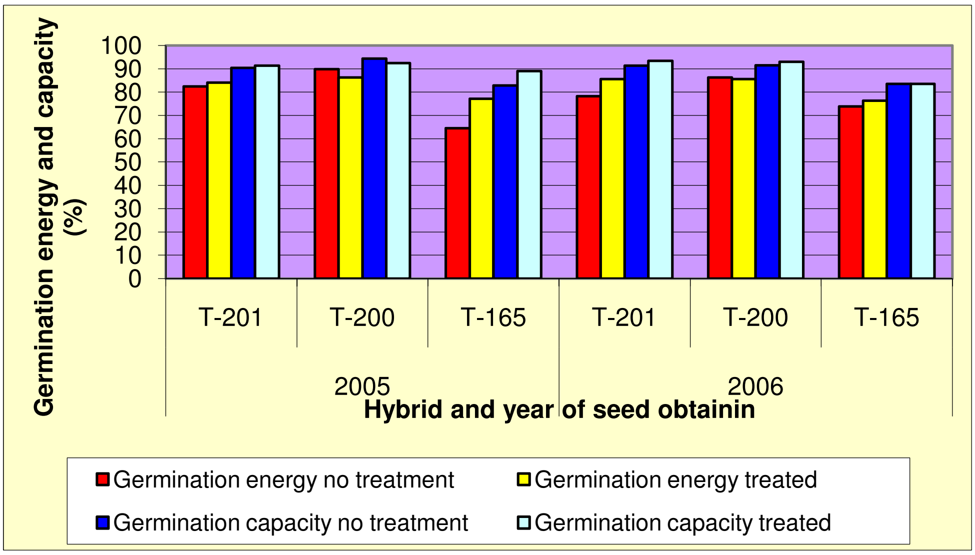


Fig. 1. Influence of treatment at seeds from different years of production in interaction with the genotype upon the germination energy and capacity

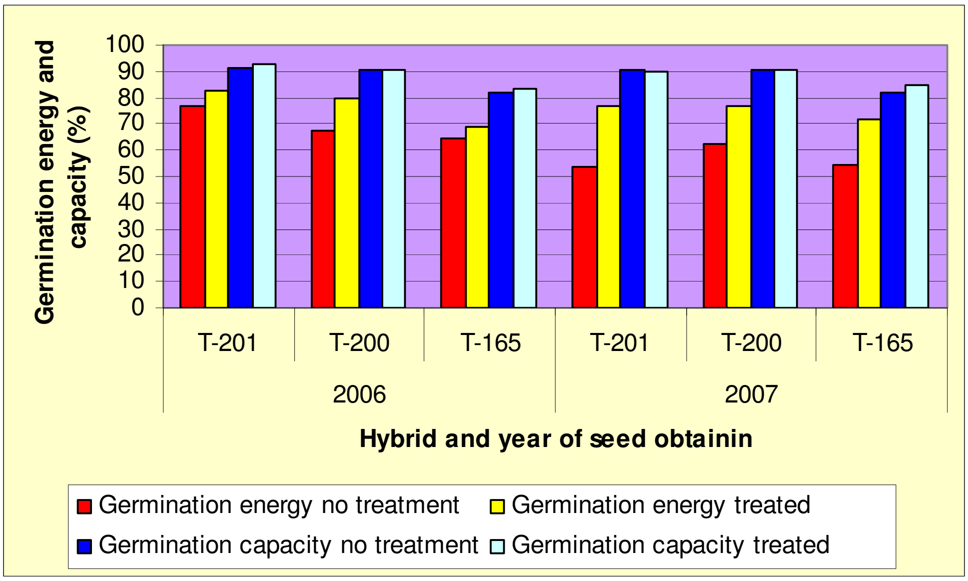


Fig. 2. Influence of treatment at seeds from different years of production in interaction with the genotype upon the germination energy and capacity

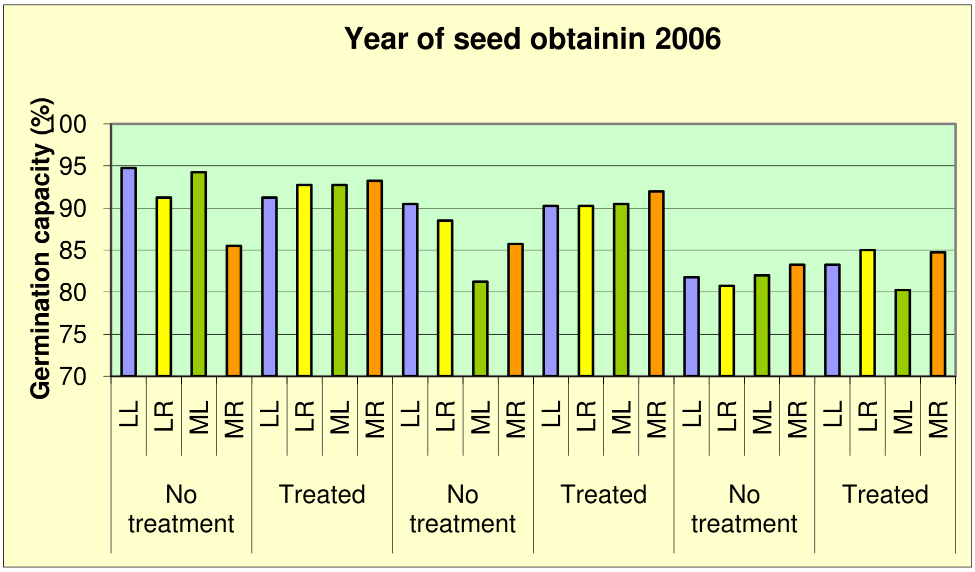


Fig. 3. The influence of seed age upon the germination capacity in the interaction between these factors: treatment x maize hybrid x seed size

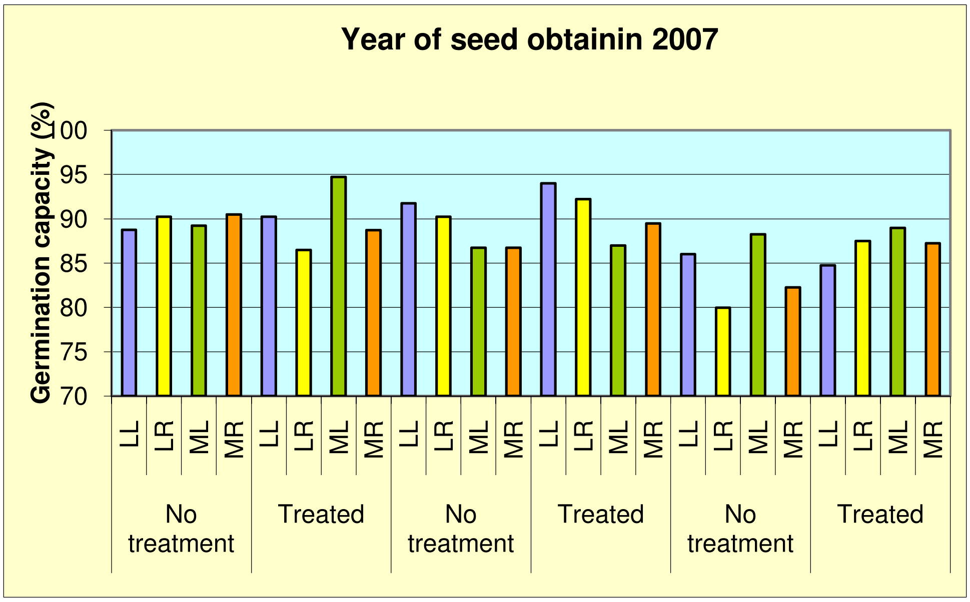


Fig. 4. The influence of seed age upon the germination capacity in the interaction between these factors: treatment x maize hybrid x seed size

CONCLUSIONS

1. The bigger calibres and the fitosanitary treatments at the seed are stimulative elements for the germinative energy and faculty at the hybrids and for the seeds kept 1 or 2 years.
2. For the same calibre of the seed , the germinative energy as the first indicator of the vigour of the seeds shows significant differences in the years with favourable conditions of maturation of the plants and and values significantly higher at the seeds treated with Topsin.
3. Treatment of seeds with increased Topsin noteworthy differences into account energy values and experimental germination in most sizes.

REFERENCES

1. Morar G. Algaia Mogârzan, Ş. Marin,2004 – *Fitotehnie*, Ed. „ Ion Ionescu de la Brad” Iaşi.
2. Mureşan T., N.P. Pană, Zoia Cseresnyes, 1986 – *Producerea şi controlul calităţii seminţelor agricole*, Ed. Ceres, Bucureşti.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

STUDY OF PHYSIOLOGICAL REACTIONS PARTICULARIES OF LEAF APPARATUS OF MAIZE HYBRIDS AND ITS PARENTAL FORMS IN DROUGHT CONDITIONS

A. MIHALACHI*, A. ROTARI, A. PALII*, GALINA COMAROVA***

*State Agricultural University of Moldova
**Institute of Crop Production "Porumbeni"

Keywords: *maize, water regime of the leaf, heterosis*

Abstract

The paper presents the results of the studies, that allows to compare specificity of manifestation of water regime parameters of leaf at 15 registered hybrids and 30 parental lines of maize, which has been grown in field conditions with contrast temperature regime (drought/norm). For the first time, in a physiological aspect, the level of heterosis manifestation has been studied according to three parameters of water regime of maize leaf.

Experimentally, has been proof, that undergoing of physiological diagnosis of water regime of maize leaf apparatus (water-holding capacity, electrical resistance of leaf tissues and coefficient of leaf thickness stability), in conjunction with interpretation of heterosis effect manifestation according to mentioned above parameters is sufficiently sensitive methodology to identify not only contrast forms, but also drought tolerant hybrid forms of maize. On a comprehensive assessment of all three studied parameters of water regime of leaf, registered hybrid of maize Porumbeni 359 AMRf and its parental form Flavia M are recommended as the genotypes with high tolerance to drought.

INTRODUCTION

In the list of potential problems of global warming, climate change impact on global agriculture become one of the most important [1]. In last decades, increased frequency of drought vegetation period is distinguished both, globally and in Republic of Moldova [3].

In this regard, the problem of creating of drought-tolerant maize hybrids for Republic of Moldova is one of the biggest priorities for autochthon plant breeders. The optimal criterion for selecting of drought-tolerant forms of maize is the level of grain yield under drought conditions for the appropriate selected sample. However, the climatically conditions of the alternating seasons of vegetation are not identical. Therefore, every year, regardless of condition of vegetation seasons, laboratory of biochemistry and physiology of Institute of Crop Production "Porumbeni" perform intermediately diagnosis of potential for drought-tolerance of

experimental breeding samples and competitive maize hybrids – in laboratory conditions, accordingly to parameters of water regime [4]. So far, studies that could allow us to compare specificity of manifestation of water regime parameters of maize samples, grown in field conditions with contrast temperature regime (drought/norm) has not been performed.
Due to mentioned reasons, the purpose of this study was to perform experimental development of declared problem. Moreover, analysis of water regime condition of maize leaf apparatus has not been limited at physiological assessment of just registered hybrids. Also, we set the aim to perform analysis of parental forms of these hybrids, which would allow for the first time in physiological aspect, to study the level of manifestation of heterosis effect accordingly to water regime parameters at maize leaf.

MATERIAL AND METHODS

In experiment were used 57 genotypes of maize, including: 30 inbreed parental lines, 12 hybrid parental combinations (9 simple hybrids participating as maternal parental forms and 3 as paternal parental forms) and 15 registered maize hybrids (6 simple hybrids, 1 simple modificate hybrid, 5 triple hybrids and 3 double hybrids).
The experiment was carried out within two years with contrast environmental.
conditions in maize pollination period:

- year 2007 – drought conditions, in July amount of rainfall compared with multiannual average has decreased by 60 mm;
- year 2008 – normal conditions, in July amount of rainfall compared with multiannual average has decreased by 8,4 mm

During the experiment, a physiological method has been used for determination of water regime of leaf tissue: determination of water-holding capacity (WHC), assessment of electrical resistance of leaf tissues (ERLT) and determination of coefficient of leaf thickness stability (CLTS). Assessment of drought-tolerance has been calculated by mark system for complex estimation of drought-tolerance of hybrids and its parental forms after water regime parameters of maize leaf [4]. Estimation of manifestation of heterosis effect level was performed through methods of calculation and expressed by H_{hyp} – hypothetical heterosis value [2].

REZULTS AND DISCUSSION

The results of physiological assessment of water regime parameters (table 1) testify that water-holding capacity (WHC) of maize leaf for 92% of the total studied genotypes samples increase in drought conditions. When comparing the absolute values of the limits of variation of WHC parameter, were noted that in conditions of thermal stress, the range of variation of this parameter is expanding for both parental lines, as well as for hybrids, compared to normal environment conditions of 2008 year.

Evaluation of maize hybrids and its parental forms on electrical resistance of leaf tissues (ERLT) indicates that for 93% of studied genotypes drought conditions reinforce this biophysical parameter. Other the range of variation of absolute values of ERLT can judge about the differences between genotypic reaction of studies maize hybrids and its parental lines at drought conditions: at hybrids, compared with the lines, limits variations of ERLT parameter presents more range of variations.

One of the most interesting parameters of complex assessment of water regime of maize leaf is the coefficient of leaf thickness stability (CLTS). In contrast to the earlier discussed parameters of water regime (WHC and ERLT), by initial values of the CLTS coefficient were revealed the following groups of specific response of different genotypes of maize at drought conditions:

- for 79% of the studied hybrids and lines, drought conditions determine an increase of this coefficient;
- for 8% of the samples, were marked the significant genotypic tolerance to this type of stress ($-0{,}009 < CLTS < +0{,}0009$);
- for 13% of samples, were established that increase of temperature in environment has an inhibiting effect at CLTS coefficient.

In accordance with generally accepted methodology of integrated assessment of tolerance potential of maize breeding forms at drought conditions on the mentioned above water regime parameters the evaluation has been made on a five-point system of average drought-tolerance degree for each from 27 hybrid forms of maize (table 1).

In the dry condition of 2007 year the most drought-tolerant registered hybrid as a result of physiological assessment was Porumbeni 359 AMRf and its parental form Flavia M (3.7 points), in the second category (3.0 points) entered registered hybrids Porumbeni 457 MRf, Chişiniovschi 401 L, Moldavschi 425 AMRf and its parental hybrid form Lada C.

In the stress period of plant growing in 2007 year evaluation of water regime parameters in laboratory condition has allowed to classify the studied hybrids into three groups:

1. Medium drought-tolerant – 2 genotypes (registered hybrid Porumbeni 359 AMRf and its parental hybrid form Flavia M);
2. Low drought-tolerant – 5 genotypes (registered hybrids Porumbeni 457 MRf, Chişiniovschi 401 L, Moldavschi 425 AMRf, and their parental hybrid forms Braila and Lada C);
3. Not resistant at drought conditions – 18 genotypes (11 registered hybrids and 9 parental hybrid forms)

In 2008 year – the season favourable on temperature factor, the highest mark on a comprehensive assessment of drought-tolerance were characterized registered hybrids Porumbeni 457 MRf, Chişiniovschi 297 wx, Chişiniovschi 401 L, Moldavschi 425 AMRf and its parental hybrid form Lada C.

Table 1

Characteristics of drought-tolerance according to physiological parameters of water regime of maize leaf at registered hybrids and their parental forms under thermal contrast conditions

Group	Hybrid	WHC, %		ERLT, kom		CLTS, mkm		Mean (in points)		Drought-Tolerance *	
		2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
I (SH)	Moldavschi 291 MRf	75.0	31.3	651	355	0.74	0.72	2.7	4.0	NR	MR
	Moldavschi 450 MRf	37.1	32.2	576	300	0.68	0.77	2.3	4.0	NR	MR
	Porumbeni 457 MRf	52.4	28.4	571	471	0.99	0.86	3.0	4.7	LR	R
	Chişiniovschi 307 PL	85.2	30.3	530	385	0.68	0.79	2.3	4.0	NR	MR
	Chişiniovschi 297 wx	41.8	28.9	516	358	0.68	0.81	2.3	4.7	NR	R
	Chişiniovschi 401 L	62.1	31.2	474	303	0.82	0.72	3.0	4.3	LR	R
II (SMH)	Moldavschi 425 AMRf	73.5	28.6	527	264	0.81	0.76	3.0	4.3	LR	R
III (TH)	Porumbeni 212 CRf	62.5	29.2	520	258	0.73	0.82	2.7	4.7	NR	R
	Moldavschi 257 CRf	69.4	25.9	465	163	0.76	0.80	2.7	4.3	NR	R
	Porumbeni 351 AMRf	54.9	27.9	523	454	0.74	0.73	2.7	4.3	NR	R
	Porumbeni 359 AMRf	53.5	29.7	50	385	0.75	0.66	3.7	4.0	MR	MR
	Moldavschi 411 MRf	54.5	34.7	670	423	0.74	0.66	2.7	3.7	NR	MR
IV (DH)	Bemo 182 CRf	53.6	28.9	528	257	0.75	0.75	2.7	4.3	NR	R
	Moldavschi 215 MRf	58.8	25.6	517	356	0.66	0.72	2.3	4.3	NR	R
	Nemo 216 CRf	48.6	27.0	470	433	0.79	0.77	2.7	4.3	NR	R
V (♀SH)	Drujba C	86.2	31.0	486	324	0.75	0.75	2.7	4.0	NR	MR
	Liana M	66.7	29.4	520	364	0.74	0.65	2.7	4.0	NR	MR
	Braila	69.7	31.8	462	368	0.81	0.77	3.0	4.0	LR	MR
	Lara	58.8	26.0	568	461	0.74	0.75	2,7	4.3	NR	R
	Flavia	46.5	27.4	55	395	0.75	0.66	3.7	4.0	MR	MR
	Lavanda C	60.7	31.8	473	399	0.77	0.74	2.7	4.0	NR	MR
	Lada C	46.7	27.8	520	420	0.82	0.75	3	4.3	LR	R
	Ladia M	37.0	27.9	515	356	0.78	0.75	2.7	4.3	NR	R
	Muza M	94.7	31.2	435	312	0.75	0.72	2.7	4.0	NR	MR
VI (♂SH)	Landîş CB (Bemo)	50.0	26.4	147	433	0.69	0.78	2.7	4.3	NR	R
	Lion (Nemo)	50.0	28.6	147	319	0.69	0.68	2.7	4.0	NR	MR
	Lion (M215 AMRF)	48.7	28.6	145	320	0.67	0.68	2,.7	4.0	NR	MR

*:**R**- Resistant; **NR** – Not Resistant; **M** – Medium resistant; **L** – Low resistant

In the performed experiment of 2008 year studied hybrids were classified just into two groups:

1. High drought-tolerant – 10 registered hybrids (among them, distinguished in 2007 in group of low drought-tolerant, Porumbeni 457 MRf, Chişiniovschi 401L, Moldavschi 425 AMRf), and also 4 parental hybrid forms;
2. Low drought-tolerant – 5 registered hybrids and 8 parental hybrid combinations.

Extremely interesting is the fact that in the latter group were included registered hybrid Porumbeni 359 AMRf and its parental hybrid form Flavia M. Both of these genotypes in the drought conditions of 2007 year on water regime of leaf apparatus were classified in a similar Medium drought-tolerant group, which allows concluding about high tolerance at drought conditions of mentioned genotypes according to water regime of leaf.

As been remarked in the introductory part of this study, in addition to the direct physiological assessment of 27 maize hybrids and their parental hybrid forms and inbreed lines, for the first time were studied manifestation of hypothetical heterosis effect ($H_{hyp)}$ according to water regime of maize leaf.

Were established that according to water regime of leaf apparatus at maize level of manifestation of heterosis effect in contrasting conditions of temperature factor of the environment, primarily is determined by the genetic nature of the studied genotypes. This conclusion is based on performed analysis data of H_{hyp}, which allows to distribute the studied hybrids combinations into three groups with high level of hypothetical heterosis effect, adaptive nature of heterosis effect and partial blocking of heterosis manifestation at studied hybrids, taking into consideration the specifics of the growing period in drought conditions in 2007 year and under normal conditions in 2008 year.

Similar dependences are traced also during the performing of the analysis of hypothetical heterosis according to electrical resistance of leaf tissues.

In drought conditions has been marked the highest hypothetical heterosis effect for 8 registered hybrids, adaptive nature of heterosis effect according to ERLT ($-3\% < H_{hyp} < +3\%$) is set for 2 registered simple hybrids Moldavschi 450 MRf and Chişiniovschi 401 L and 1 parental hybrid form Lion. The negative impact of drought conditions on the expression of a hypothetical heterosis according to ERLT is set for 5 registered hybrids and almost for the whole samples of parental simple hybrid forms (with the exception of genotype Lara).

Thus, the readout of ERLT according to two contrasting climatic conditions of the growing season allows to clarify the role of genotypic potential of water regime in manifestation of heterosis effect of corresponding hybrid combination.

A comparative evaluation of the level of heterosis expression according to coefficient of stability CLTS again, and even in more pronounced form, confirms the leading role of genotype in the specificity of heterosis manifestation among the 27 studied hybrid forms. This affirmation can be justified by the following facts. In drought conditions the effect of hypothetical heterosis increases at 3 registered hybrids and their 5 parental hybrid forms according to CLTS. Tolerant nature of heterosis effect according to CLTS (-3% < H_{hyp} < +3%) is set for 7 registered hybrids and 4 simple parental hybrid forms under two contrasting growing seasons. The remaining 8 registered hybrids and hybrid combinations from studied samples expressed an inhibited reaction of its heterosis potential during the drought conditions of 2007 year.

CONCLUSIONS

1. The direct physiological assessment for the majority of maize genotypes at high temperatures allows:
   a) to ascertain the tendency to maximal mobilization of genotype physiological responses at drought stress accordingly to water regime parameters;
   b) to use physiological coefficient of leaf thickness stability (CLTS) for the detection of restricted complexes (in our experiment – 8%) among the studied genotypes, that manifest tolerance reaction at drought conditions;
   c) to recommend (according to comprehensive assessment of all three studied parameters of water regime) registered hybrid Porumbeni 359 AMRf and its parental hybrid form Flavia M as genotypes with high tolerance to drought conditions.
2. Using the value, characterizing the level of hypothetical heterosis manifestation according to studied physiological parameters, in contrast temperature factor conditions, reveals greater opportunities in maize breeding for drought-tolerance based on:
   a) assessment of heterosis effect according to water regime of leaf apparatus (water-holding capacity and coefficient of leaf thickness stability);
   b) study of genotipical specificity of response reaction of studied maize hybrids on the physiological heterosis, which allows identification of genotypes with positive, tolerant and negative reaction of H_{hyp} at drought conditions.
3. Performing of physiological diagnosis of water regime of maize leaf apparatus combined with interpretation of heterosis effect on these parameters is sufficiently sensitive methodology for identifying not only contrast, but also drought-tolerant hybrids of maize.

REFERENCES

1. Cline W. R., 2008. *Global warming in agriculture*. Finance and development, March, (pp. 23-27).
2. Comarova G., A. Palii, A. Rotari, 2005. *Protein Polymorphism and Heterosis*, Ştiinţa Agricolă, Chişinău, № 2, (pp.3-7).
3. Duca Gh., T. Furdui T., S. Andrieş, şi al., 2007. *Agricultura durabilă – necisitate şi obiectiv prioritar*, Moldova-Suverana, Chişinău, Nr. 116.
4. Rotari A., 1993. *Metodele genetice şi biochimice pentru ameliorarea porumbului la calitate*. Autoreferatul tezei de doctor habilitat în ştiinţe biologice, Chişinau, 48 p.

Scientific Papers, UASVM Bucharest, Series A, Vol.LIV, 2011, ISSN1222-5339

PARTIAL EXPERIMENTAL RESULTS REGARDING THE INFLUENCE OF CORN HYBRID ON GRAINS YIELD IN THE ROMANIAN PLAIN UNDER CLIMATIC CHANGES

L.F. SCHITEA
Golden West Company

Keywords: *corn, hybrids, yielding, adaptability*

Abstract

The researches had as main aim the knowledge of both yielding potential and adaptability under Romanian Plain conditions, of five corn hybrids. The generic material originates from Greek Golden West concern. These hybrids are known for their resistance to drought under Greece conditions.

The experiment was performed in 2010, at ARDS Caracal, ARDS Braila and ARDS Valu lui Traian.

On average experiments, the semi-early hybrid GW 480001 emphasized by yield, achieving 9503 kg grains/ha, being, as earliness, at middle level of hybrids Organza şi GW 480002. The highest yield was achieved by the hybrid Konsur, with an average of 10569 kg grains/ha.

The water utilization degree during the entire vegetation period was different at all five hybrids as well as from a location to another. On the three testing centers, the first place was occupied by the hybrids Konsur and GW 480001 with 28,4, and 25,4 kg grains/mm water, respectively. The highest utilization degree was registered during june-August, at ARDS Caracal, with an average of 49 kg grains/mm water.The results are part of Ph.D. thesis.

INTRODUCTION

The cultivation of the most adequate hybrids, with superior yielding ability, adapted to specific conditions of the main Romania agricultural areas [1,2], with resistance to main abiotic (frost, drought) and biotic (pests and diseases) stresses frequent under different cultivation areas, and with qualitative traits required by market is recognized as major factor in obtaining some high economical performances of crops, especially corn [3,4].

According to European legislation, Romania allows the commercialization on its territory of any corn hybrid registered in EU countries, even if it has not been tested under Romanian conditions and registered in Romanian Official Catalogue [6]. Following these circumstances, Romanian farmers are not covered by the risks arising from the cultivation of some hybrids un-adapted to specific conditions or exceeded by the new ones [6].

The aim of the research was to bring a contribution to obtaining some yielding superior performances, quality and stability of corn yields, with a view to meet the general and specific market requirements, by introduction of some hybrids with resistance to drought.

MATERIAL AND METHODS

The experiments were performed in three localities, namely ARDS Caracal, ARDS Valu lui Traian and ARDS Brãila in 2010, as randomized blocks, in three replication, with a sowing area of 20 m^2, of which 15 m^2 harvested ones.

The applied technology: the sowing was done on Aprilie, 18^{th} at ARDS Braila, May, 3^{rd} at ARDS Valu lui Traian and May, 5^{th} at ARDS Caracal. The complex fertilizers (30:15:0) were used in rates of 350 kg/ha. The weeds control was performed with Acetogan 2.2 l/ha, after sowing and with Calisto+Mistral 0.3 l/ha+1 l/ha, during 5-6 leaves stage. The following determinations were made: emergence time, silking time and physiological maturity time, sum of useful unit degree, plant height, height of ear insertion, resistance to drought, lodging (%), breaking (%), resistance to diseases (rot and smut), to *Ostrinia,* "stay green" feature, grains yield, number of grains/ear ratio, moisture to harvesting, TGW, TW.

As regards the average monthly temperatures, the agricultural year 2009 – 2010 was warmer than multiannual average, in all testing centers.

Pluviometrically, during the agricultural year 2009 – 2010, there were registered 729 mm at ARDS Caracal, 715 mm at ARDS Braila and 707 mm at ARDS Valu lui Traian, exceeding multiannual average with 192, 268 and 192, in each testing center respectively.

RESULTS AND DISCUSSION

Generally, the agricultural year 2009-2010 was favorable to corn, fact that led achieving high yields, which, on testing center average were between 7372 kg grains/ha at ARDS Caracal and 11844 kg kernels/ha at ARDS Brãila. At ARDS Valu lui Traian, 9686 kg grains/ha were achieved.

The yield level was strongly influenced by the way of rainfall repartition, so figure 1 shows that the rainfall quantity/total agricultural year was very close, such as 729 mm at ARDS Caracal, 715 mm at ARDS Brãila and 707 mm at ARDS Valu lui Traian.

As regards the soil water reserve in early spring, it had close values at Caracal and Valu lui Traian and was of 332 mm at ARDS Caracal, 330 mm at ARDS Valu lui Traian and 360 mm at ARDS Brãila. Based on analysis of rainfall during the vegetation period, Aprilie – September, one can ascertain that the highest quantity was registered at Caracal, of 397 mm, followed by Valu lui Traian, of 377 mm and Braila, of 355 mm, the last station registering the highest yield.

The large yield differences were determined by the rainfalls registered during June-August, period of maximum consumption for corn. At ARDS Caracal, the total rainfall, of 143 mm, was distributed as follows: 107 mm in June, 6.6 mm in July and 19 mm in August, while in the other two stations, the rainfall quantity was double/total period, of which in July, 88 mm at Braila and 200 mm at Valu lui Traian.

Under these conditions, at both ARDS Braila and Valu lui Traian, selection regarding the tolerance to drought could not be performed, although in August and September, the rainfall was slightly low, between 19 and 35 mm.

An obvious difference regarding the tolerance to drought could be only performed at ARDS Caracal, so that, the best behaviour was registered by the semi-early hybrid GW 480001. This earliness trait help this hybrid to avoid the drought during June and to achieve an yield of 8236 kg grains/ha, exceeding the experiment average with 11.2%, followed by the hybrid Konsur, with 7955 kg grains/ha and a gain of 8% vs. experiment average.

At ARDS Valu lui Traian, these two hybrids have achieved 10190 and 10730 kg grains/ha respectively, exceeding the tested hybrid average with 5-11%, plus the hybrid GW 480002 with an yield equal with that of GW 480001 one.

Under ARDS Braila conditions, the rainfalls during vegetation period, as repartition, better met the hybrid requirements and have allowed beside the semi-early hybrid GW 480001(10083 kg grains/ha) the obtainment of high yield of the hybrid Konsur, of 13021 kg/ha, exceeding the experiment average with 10%. Under ARDS Braila conditions, very good results gave the hybrid Organza, with 12572 kg grains/ha, distinctly significant gain statistically ensured.

On experiment average of the three locations placed under different climatic conditions of Romanian Plain, one can highlight the semi-early hybrid GW 480001, with an average yield of 9503 kg grains/ha, being, as earliness, at middle hybrid level, Organza and GW 480002. The highest yield was achieved by the hybrid Konsur, with an average yield of 10569 kg grains/ha. The data presented in figures 1 and 2 emphasize the way of water utilization by the tested hybrids, expressed by the achieved grain yield, kernel/mm water. The report depends on total rainfall, rainfall registered during vegetation period or maximum consumption one.

On the three testing center average (figure 2), the hybrid Konsur was firstly placed as regards the water utilization capability (14,9; 28,4; 47 kg grains/mm water), followed by the hybrid GW 480001, with 13,4; 25,4; 43,4 kg grains mm water and the hybrids GW 480002 and Organza, with 13,45; 25,75; 42,2 kg grains/mm water.

Table 1

Grains yield achieved by corn hybrids tested at ARDS Caracal, ARDS Valu lui Traian and ARDS Braila

Nr. crt.	Hybrid	Braila		Valu-Traian		Caracal		Average	
		t/ha	%	t/ha	%	t/ha	%	t/ha	%
1	Konsur	13021	110**	10730	111*	7955	108*	**10569**	**110***
2	GW 480001	10083	85^{000}	10190	105	8236	112**	**9503**	**99**
3	Organza	12572	106*	9210	95	6955	94^{0}	**9579**	**99**
5	GW 480002	11738	99	10190	105	6746	92^{0}	**9558**	**99**
6	Status	11808	100	8110	84^{00}	6968	95^{0}	**8962**	**93^{0}**
	Average	**11844**	**100**	**9686**	**100**	**7372**	**100**	**9634**	**100**
	LSD 5%	*710*	*6*	*969*	*10*	*369*	*5*	*683*	*7*

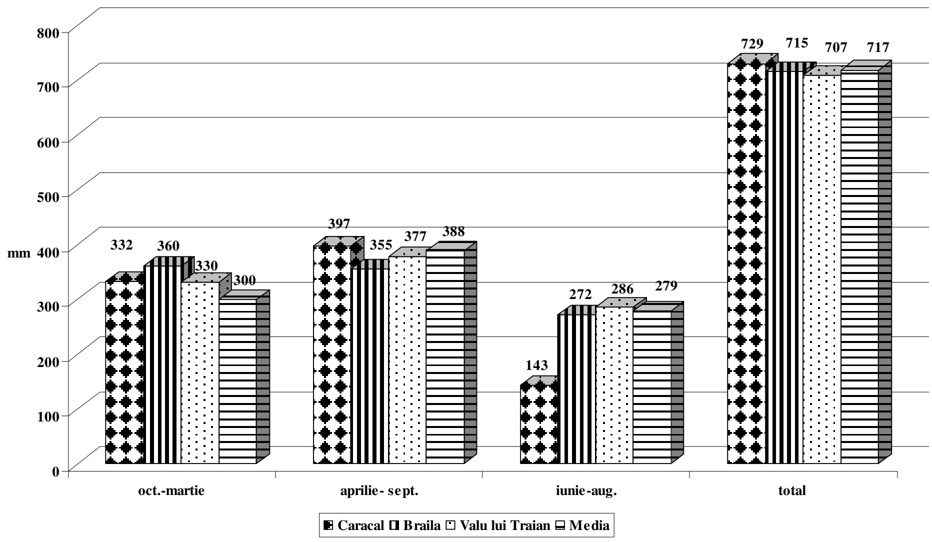


Fig.1- Rainfall registered under different periods of agricultural year 2009-2010

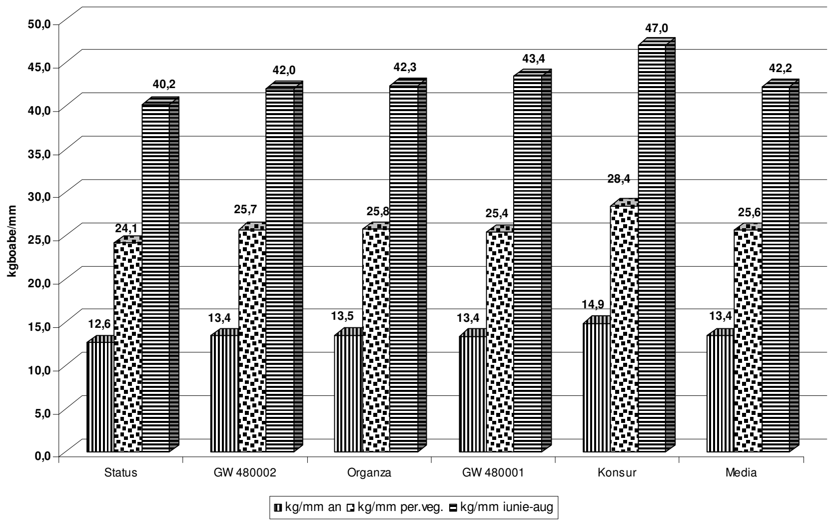


Fig. 2- The water utilization degree in hybrids tested under different Romanian Plain areas

The physiological maturity was achieved after accumulation of 1146.2^{0}C in the case of the semi-early hybrid GW 480001 and of 1217.9^0 – 1336.1^{0}C at the middle hybrids GW 480002, Konsur, Status and Organza, in the second half of August (table 2).

There were no significant differences between hybrids as regards the resistance to ear rot, shrivelling and drought.

The kernel moisture to harvesting ranged between 21.1% at GW 480001 hybrid and 29% at GW 480002 one.

Table 2

Observation and determinations performed at corn hybrids. Average - 2010

Hybrid	Date of physical-logistical material	Resistance to drought*	Resistance to la breaking (%)	Resistance to rot *	Resistance to smut*	Resis-tance to *Ostrinia* *	Moisture to harve-sting (%)	% kernels	Sstay green
Konsur	25.08	7	0.0	9	9	8	29.0	83.0	4.7
Organza	25.08	7	1.2	8	9	8	26.8	79.8	2.2
Status	24.08	8	1.8	8	9	8	25.8	81.6	4.3
GW-48002	15.08	8	1.1	8	9	8	24.0	84.5	3.4
GW-48001	14.08	7	0.0	8	9	8	21.1	83.8	1.1

*) = quotation 1-9, in which, 1=very weak and 9 =very good

CONCLUSIONS

1. The tested hybrids emphasized by a high degree of water utilization;.
2. The hybrids Konsur, GW 480001 and Organza revealed by yields ranging between 9505 and 10569 kg grains/ha;
3. Under drought and heat conditions, during June-August, at ARDS Caracal, the semi-early hybrid GW 480001 has achieved an yield of 8236 kg/ha.

ACKNOWLEDGEMENTS: Gh. Motca (Professor, UASVM Bucharest), Golden West Company, E. Constantinescu (PhD, ARDS Caracal), Ioana Stere (PhD, ARDS Valu lui Traian), R. Cosoveanu (PhD, ARDS Braila).

REFERENCES

1. Bîlteanu, Gh.,1998.*Fitotehnie,* vol.1, Ed. Ceres, (pp.187-309).
2. Căbulea, I., T. Sarca, M.Cristea, 2004- *Porumbul studiu monografic,* Ed. Academiei Române, (pp. 207-296).
3. Sin, Gh., 2005 – *Managementul tehnologic al culturilor de câmp*. Edit. Ceres, Bucureşti.
4. Tollenaar, M., and J. Wu. 1999.*Yield improvement in temperate maize is attributable to greater stress tolerance.* Crop Sci. 39:1597–1604
5. www.madr.ro .2009.Cercetare, P.S. 2.1.1.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

GENETIC VARIABILITY, HERITABILITY AND EXPECTED GENETIC ADVANCE AS INDICES FOR YIELD AND YIELD COMPONENTS SELECTION IN COMMON BEAN (*PHASEOLUS VULGARIS* L.)

B. NECHIFOR, RALUCA FILIMON, LIZICA SZILAGYI

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *common bean, coefficients of variation, heritability, genetic advance*

Abstract

The present study was conducted at the University of Agronomic Sciences and Veterinary Medicine Bucharest, during the 2009 growing season and were evaluated four hybrid population: (Ami x SEA13)F2, (Starter x SEA13)F2, BC1 -1(F1 x Ami), BC –2(F1 x Starter). The aims of this work were to estimate the variance components, phenotypic and genotypic coefficients, heritability for seed yield and its components (pods number per plant, seeds number per pod, 1000-seed weight, seed yield per plant) and expected genetic advance as indices for yield selection in common bean. The highest proportion of genetic variance presented a number of seed per pod in both crosses (crosses 1 V_g = 40%; crosses 2 V_g = 50%). Amongst the yield characters, a very small difference between GCV% and PCV% was observed for the character seeds number per pod in both crosses and both generations. Large difference between GCV% and PCV% was observed for the number of seed characters per plant, 1000-seeds weight and seed yield per plant. This indicated the role of environmental influence on this characters. Moderate heritability coupled with high genetic advance were observed for pod number per plant, seed number per pod and seed yield per plant in both generations and both crosses.

INTRODUCTION

Yield is the principal factor for determining improvement of a crop. Like other legumes, seed yield in common bean (*Phaseolus vulgaris* L.) is a quantitative character and influenced by a number of yield contributing traits. The selection of desirable types should therefore be based on yield as well as on other yield components. Information on mutual association between yield and yield components is necessary for efficient utilization of the genetic stock in crop improvement program of this crop.

Seed yield in common beans is a complex trait with three components: number of pods per plant, number of seeds per pod, and mean seed weight [8]. Heritability, or the degree of genetic control associated to some interest trait, is one of the most important parameters within the breeding context. Heritability indicates how much of the phenotypic variability has a genetic origin, and gives objective information for the genetic selection process [6]. For any planned breeding programs aimed to improve grain yield potentials of crops, it is necessary to obtain adequate information on the magnitude and type of genetic variability and their corresponding heritability. This is because selection of superior genotypes is proportional to the amount of genetic variability present and the extent to which the characters are inherited. Heritability for example, is used to indicate the relative degree to which a character is transmitted from parent to offspring. The magnitude of such estimates also suggests the extent to which improvement is possible through selection. The present study was undertaken to estimate the variance components, heritability for seed yield and its components and expected genetic advance.

MATERIAL AND METHODS

This research work was carried out at University of Agronomic Sciences and Veterinary Medicine Bucharest during the 2009 growing season. We included in this study two hybrid combinations for each population: F2-1 = Ami x SEA 13, F2-2 = Starter x SEA 13; BC1-1 = F1-1 x Ami; BC1-2 = F1-2 x Starter. The initial breeding material (F1, F2, BC1), using three parents: SEA 13, Ami, Starter, was achieved with cyclical and backcross hybridations in the 2007-2008 period under greenhouse conditions. The genotypes for crosses were selected based on variability for growth habit, maturity, seed size and resistance to drought (Table1).The populations F2, BC1, were studied in the field in 2009 year. Sowing was done manually in the bean breeding field. The experimental design was random blocks, in three replications. Each single row was 4 m long, spaced 65 cm apart and with 6 cm between plants within row. It represented single plant selection. Number of pods per plant, number of seeds per pod, 100-seeds weight and seed yield per plant were determined.

Statistical analysis

Phenotypic variance (V_P), genotypic variance (V_G), and environmental variance (V_E) were determined by formulas proposed by Brewbaker [3]. Broad sense heritability (H_{bs}) was calculated using the formula proposed by Mahmud şi Kramer [7]. Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PGV) were estimated by the formula suggested by Burton [4]: GCV = $\sigma^2 g/\bar{X}$ x 100; PCV = $\sigma^2 p/\bar{X}$ x 100, were $\sigma^2 g$, $\sigma^2 ph$ are standard deviation of the genotypic and phenotypic variances and $\bar{X}$ is the mean performance of each trait. The genetic advance (GA) was calculated according to Allard's [1], and was estimated from the following formula: GA = K x σ_P x h^2_b , were K-the selection differential in standard units in the present study and it was 2.06 at 5% level of selection; σ_P - standard deviation of the phenotypic variance of F2; h^2_b–heritability in broad sense. Genetic advance expressed as percentage of mean (GA%) was measured by the following formula: GA% = GA/$\bar{X}$ x 100.

Table 1

Characteristics of parents used in crosses: origin country, growth habit (GH), seed size (SS), seed color (SC), maturity (M) and other features

Cultivars	Origin*	GH**	SS***	SC	M	Features
SEA 13	Colombia CIAT	III	Small	Cream	80	Drought resistance
AMI	Romania NARDI Fundulea	III	Medium	White	76	Low maturity Rust resistance
STARTER	Romania NARDI Fundulea	II	Small	White	82	*Xanthomonas* sp. resistance

**ICTA-International Centre of Tropicale Agriculture, NARDI - National Agricultural Research and Development Institute; ***Size according with Singh et al.(1991a) weight of 100 seeds in grams (Small – 100 seeds <25 g; Medium – 100 seeds ≥ 25 g to ≤ 40 g; Large – 100 seeds > 40 g); II - indeterminate upright bush; III - indeterminate semi-viney prostrate.*

RESULTS AND DISCUSSION

Means and variances

The mean values as well as phenotypic, genotypic and environmental variances of the characters studied are presented in Table 2. Analysis of main values for the characters pod number per plant, seed number per pods, 1000-seeds weight and seed yield per plant, highlights that a wide variability between genitors used in hybridization exists for these traits. Analysis of genotypic and environmental variances resulted in differential contribution of genotypes in hereditary character, expressed by weighting different genotypic variance in the phenotypic variance, from a cross to another. Also resulted importance of environmental variance in phenotypic expression of characters analyzed. The highest proportion of genetic variance in penotypic variance presented seed number per pod, environment having less influence in the expression of this character, unless phenotypic expression of the other characters studied. Characters are influenced differently by environmental conditions. Its variations caused substantial changes in expression of the characters "pod number per plant", "1000-seeds weight" and therefore "seed yield per plant" and changes were less pronounced for "seed number per pods".

Coefficients of variation

The comparison of characters as regards to the extent of genetic variation could be better judged by the estimation of genotypic coefficient of variation (GCV) in relation to their respective phenotypic coefficient of variation (PCV). Amongst the yield characters very small difference between GCV and PCV was observed for the character like seed number per pod in both crosses and both generations (Table 3).

It indicates that the observed variations for the trait were mostly due to genetic factors. However, the environment played a little role on the expression of this trait.

Table 2

Mean ($\bar{X}$), phenotypic and genotypic variance (V_P ,V_G), genotypic variance express as percentage of phenotypic variance (V_G %), environmental variance (V_E), environmental variance (V_E) express as percentage of phenotipic variance (V_E %) in two crosses of common bean - F2, BC1

Crosses	Genetic parameters	Traits			
		Pods per plant	Seeds per pod	1000-seeds weight (g)	Seed yield per plant (g)
Ami x SEA 13	$\bar{X}_{F2}$	21.90	4.39	230.8	19.55
	$\bar{X}_{BC1}$	21.15	4.34	250.3	22.67
	V_P	2.73	0.05	42.25	4.92
	V_G	1.00	0.02	16.35	1.59
	V_G %	36.63	40.00	38.69	32.30
	V_E	1.73	0.03	25.90	3.33
	V_E %	63.37	60.00	61.31	67.70
Starter x SEA 13	$\bar{X}_{F2}$	23.26	4.53	249.8	20.16
	$\bar{X}_{BC1}$	20.33	4.45	261.0	29.16
	V_P	3.06	0.08	64.92	4.33
	V_G	1.26	**0.04**	28.30	1.05
	V_G %	41.17	50.00	43.59	24.25
	V_E	1.80	0.04	36.62	3.28
	V_E %	58.83	50.00	56.41	75.75

On the other hand, large difference between GCV and PCV was observed for the characters pod number per plant, 1000-seeds weight and seed yield per plant. This indicated the role of environmental influence over this characters (Table 3).

In this experiment, high GCV was observed in character like seed yield per plant. The high GCV for this trait indicated further selection could improve the genotypes.

Heritability and genetic advance

Johnson et al. [5] reported that effectiveness of selection depends not only on heritability but also on genetic advance. Moderate heritability coupled with high genetic advance were observed for pod number per plant, seed number per pod and seed yield per plant in both generations and both crosses (Table 4). Similar results were reported by Asifa et al. [2], indicating that these traits are mainly controlled by additive type of genes. However, moderate heritability coupled with low genetic advance was observed for 1000-seeds weight in both generations, both crosses (Table 4). Thus this character is controlled by non-additive genes (dominance and epistasis). Our results agreed with those of Singh and Singh [9]. Therefore, judicious application of pure line selection may be effective for improving the characters with moderate or high heritability and with low genetic advance.

Table 3

Estimates to genotypic and phenotypic coefficients of variation (GCV - %, PGV - %) in two crosses of common bean F2, BC1

Crosses	Genetic parameters	Traits			
		No. pods per plant	No. seeds per pod	1000-seeds weight (g)	Seed yield per plant (g)
Ami x SEA 13	**GCV – F2**	4.56	3.18	1.75	6.44
	PCV – F2	7.53	5.01	2.81	11.35
	RD%	39.44	36.52	37.72	43.25
	GCV – BC1	4.72	3.22	1.61	5.55
	PCV – BC1	7.47	5.06	2.59	9.74
	RD%	36.81	36.36	37.83	43.01
Starter x SEA 13	**GCV – F2**	4.81	4.41	2.12	5.05
	PCV – F2	7.52	6.40	3.22	10.31
	RD%	36.03	31.09	34.16	51.01
	GCV - BC1	5.50	4.49	2.03	3.49
	PCV – BC1	8.55	6.29	3.08	7.13
	RD%	35.67	28.61	34.09	51.05

RD %: Relative difference between PCV% and GCV% = [100 (PCV-GCV)] / PCV

Table 4

Estimates of heritability in broad sense (H-bs), genetic advance (GA) and genetic advance express as percentage (GA%) mean of four quantitative characters in two crosses of common bean F2, BC1

Crosses	Genetic parameters	No. pods per plant	No. seeds per pod	1000-seeds weight (g)	Seed yield per plant (g)
Ami x SEA 13	**H-bs**	0.36	0.40	0.38	0.32
	GA – F2	1.22	0.18	5.09	1.46
	GA% - F2	**5.57**	**4.10**	**2.20**	**7.46**
	GA - BC1	1.17	0.16	4.73	1.36
	GA% - BC1	**5.53**	**3.61**	**1.89**	**6.00**
Starter x SEA 13	**H-bs**	0.41	0.50	0.43	0.34
	GA - F2	1.48	0.23	7.14	1.03
	GA% - F2	**6.36**	**5.07**	**2.85**	**5.10**
	GA – BC1	1.36	0.27	6.39	0.99
	GA% - BC1	**6.69**	**6.07**	**2.45**	**3.40**

CONCLUSIONS

1. The genetic parameters discussed here are functions of environmental variability, so estimates may differ in other environment. Based on the moderate heritability and high genetic advance shown by the different characters, especially, pod number per plant and seed number per pod, it could conclude that the determinant genetic effects of the phenotypic expression of these characters are fundamentally of the additive type. For this reason, a high response should be achievable after several selection cycles.

2. Seed yield can be improved in both crosses by selecting ideotypes having more number of pods per plant coupled with number of seeds per pod.

REFERENCES

1. Allard R.W., 1960. *Principles of Plant Breeding*. John Wiley and Sons, Inc., N.Y.
2. Asifa N., M.S. Sadiq, M. Hanif, G. Abbas and S. Haider. 2005. *Genetic parameters and path analysis in mutated generation of mungbean (Vigna radiata (L.) Wilczek).* J. Agric. Res. 43(4) (pp. 339-347).
3. Brewbaker J.L., 1964. *Agricultural genetics*. Printice Holl N.Y., Cap. IV.
4. Burton G. W. 1952. *Quantitative inheritance in grasses*. Proc. 6th Int. Grassld. Cong. 1 (pp. 277-283).
5. Johnson H.W., H.F. Robinson and R.E. Comstock, 1955. *Estimates of genetic and environmental variability in soya bean*. Agron. J., 47 (pp. 318-324).
6. Falconer D.S. (1981), *Introduction to quantitative genetics.* 2 ed. Longman, N.Y.
7. Mahmud I., H.H. Kramer, 1951. *Segregation for yield high and maturity fallowing a soybean cross*. Agricultural Journal 1 (pp. 505-509).
8. Nienhuis J. and S.P. Singh, 1986. *Combining ability analyses and relationships among yield, yield components and architectural traits in dry bean.* Crop Science, 26 (pp. 21-27).
9. Singh K.P. and V.P. Singh, 1995. *Comparative role of seed yield components in mungbean (Vigna radiata (L.) Wilczek).* Leg. Res. 18 (pp. 109-112).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

STABILITY ANALYSIS FOR SEED YIELD IN LENTILS (*LENS CULINARIS* MEDIK.)

LIZICA SZILAGYI, I. ALABBOUD, GH.V. ROMAN

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *lentil, Lens culinaris Medik., yield stability*

Abstract

The development of genotypes, which can be adapted to a wide range of diversified environment, is the ultimate goal of plant breeders in a crop improvement program. In this study, linear regression were used to analyze the response to environmental conditions of lentil (Lens culinaris Medik) genotypes taking as independent variable (X) the average yield of all lentil genotypes in four experiences (two locations and two years). Yield stability was assessed by determining the coefficients of variation. Seven lentil genotypes were tested for seed yield in two locations of Southern Romania environmental conditions during 2008 and 2009 growing seasons. On the basis of the regression coefficient genotypes Idlib-1, Idlib-2, Idlib-3, Hurani and Kurdi had general adaptability to over environments and genotypes Idlib-4 and Oana were suitable for favorable environments. The result of coefficient of variation indicated that the same genotypes were more stable. Among these Idlib-3 genotype was superior for stability and adaptation.

INTRODUCTION

Lentil (*Lens culinaris* Medik.) is the fourth most important pulse (legume) crop in the world after bean (*Phaseolus vulgaris* L.), pea (*Pisum sativum* L.), and chickpea (*Cicer arietinum* L.). Four major lentil producing countries in decreasing order are Canada, India and Turkey (FAO, 2009). At present in Romania lentils are grown on the lower areas, the only lentil Romanian cultivar being Oana. Lentil and other grain legumes are important dietary constituents worldwide even though their overall production lags far behind that of the cereals. Yields per unit area are generally less than one-half those of the major cereal grains. There are several reasons why grain legume yields in general and those of lentil (*Lens culinaris* Medik.) in particular have lagged behind: relegation of these crops to poorer soils, minimal research efforts until very recently, and various abiotic and biological limitations. Phenotypic yield stability is a trait of special interest for plant breeders. Several methods can be used for measuring crop yield stability. Among them, regression analysis is an important biometrical method of measuring a genotype's response (production response) to varying environmental condition [2]. The present research work was undertaken with a view to studying genotype-environment interaction and to identify stable and high yielding genotypes with greater seed production under changing cultural environments.

MATERIAL AND METHODS

This study was carried out during 2008 and 2009 growing seasons in two different locations from Southern Romania. Seven lentil genotypes were evaluated for seed yield in the experimental fields through University of Agronomic Sciences and Veterinary Medicine, Bucharest and Moara Domneasca research station. The characteristics and the location of the experimental environments are given in table 1 and table 2. The experimental seed material was from ICARDA lentil breeding program and from USAMV Iasi. Their name, pedigree, origin and some features are given in table 3. Experiments were monofactoriale such comparative cultures and experimental design was randomized complete block with four replications. Each genotype was sown in 6 rows; 2 m length with 25 cm inter-row spacing. Harvesting was done by hand. Grain yield was obtained by extrapolating plot grain yields on a hectare basis (kg/ha).

Table 1

Climatic characteristics of the environments tested in Romania

Year	Climatic factor	Month				
		March	April	May	June	July
USAMV Bucharest						
2008	Mean temperature ^{0}C	9.36	13.58	17.27	22.18	23.39
	Sum rainfall, mm	46.1	76.6	71.8	79.7	105.0
2009	Mean temperature ^{0}C	5.98	12.82	18.64	23.97	24.30
	Sum rainfall, mm	41.7	18.5	42.6	74.6	58.4
Moara Domneasca						
2008	Mean temperature ^{0}C	8.9	13.3	17.4	22.2	23.4
	Sum rainfall, mm	26.4	63.2	73.4	29.9	52.5
2009	Mean temperature ^{0}C	6.4	11.9	16.8	21.6	24.1
	Sum rainfall, mm	29.0	24.6	45.9	78.5	59.8

Table 2

Soil conditions of the environments tested in Romania

Location	Soil conditions		
	Texture	**Type**	**pH**
USAMV Bucharest	Clay-Loam	Chromic Luvisol	Medium alkaline
Moara Domneasca	Clay-Loam	Chromic Luvisol	Medium acid

Response to environmental conditions of each genotype was determined by regression analysis taking as independent variable (X) the average yield of all lentil genotypes in four experiences (two locations and two years). Yield stability was characteriyed by determining the coefficients of variation (CV%), described by Francis and Kannenberg [3]. Keim and Kronstand [6], using regression analysis suggested that a variety is adapted to adverse environmental conditions when b< 1 (regression slope subunitar) and “a” (constant regression) has positive values; adapted to favorable environmental conditions when b>1; widely adapted to different environmental conditions when b>1 and “a” has positive values.

Table 3

Characteristics of lentil genotypes used in the study

Genotype	Origin / Pedigree*	Maturity	Features
Idlib 1	Syria-ICARDA	Early	Lodging resistance
Idlib 2	Syria-ICARDA/ Single-plant selection from a Jordanian landrace, 74TA14	Early	Resistance to vascular wilt, semierect growth habit, lodging resistance
Idlib 3	Syria ICARDA /ILL 99♀Moroccan landrace x ILL5588♂ elite line from Jordanian landrace population	Early	Tolerant to drought, erect growth habit, resistance to vascular wilt, lodging resistance
Idlib 4	Syria-ICARDA / ILL5879♀ x ILL5714♂	Early	Erect growth habit, resistance to vascular wilt, lodging resistance
Hurani	Syria -ICARDA / local cultivar	Early	Susceptible to lodging
Kurdi	Syria- ICARDA / local cultivar	Late	Tolerant to drought, susceptible to lodging
Oana	USAMV Iasi Romania / Mutagenesis and selection from local landrace	Late	Resistance to vascular wilt, lodging resistance

*ICARDA - International Center for Agricultural Research in the Dry Areas, Allepo, Syria
USAMV - University of Agricultural Sciences and Veterinary Medicine, Iasi, Romania

RESULTS AND DISCUSSION

The average seed yield for 7 lentil genotypes tested across two locations over the two years are presented in table 4.

Because between the two locations tested are not large pedoclimatic differences, the significant influence on production occurred due to different climatic conditions in the two years of experimentation 2008, 2009.

Coefficients of variation values were higher in 2009 year when drought stress was severe compared with 2008 year, in both experimental locations.

In 2008 year the highest yield 1280 kg/ha were obtained from genotype Idlib-4 at USAMV Bucharest, while the lowest was 870 kg/ha from genotype Hurani at Moara Domneasca.

The best production results in dry conditions of 2009 year were recorded by Idlib-3 and the lowest by Romanian cultivar Oana. This could be explained by the fact that the Idlib-3 genotype is resistant to drought and Oana genotype has a late maturity. Stability parameters estimates for seed yield in 7 lentil genotypes are presented in

Table 5. Examining the linear regression lines it is found that for Idlib-1 and Hurani lentil genotypes correlated distribution of seed yield in four experiments compared to average genotypes, is discribed by a linear regression with slope (b) less than 1, which highlights a lack of response to environmental changes for yield. However, the results indicate seed yield of these 2 genotypes were lower than that of mean (Table 5).

Table 4

Seeds yield in 7 lentils genotypes - UASVM Bucharest, Moara Domneasca (2008, 2009)

No.	Genotype	Seed Yield (kg/ha)			
		USAMV Bucharest		Moara Domneasca	
		2008	2009	2008	2009
1	Idlib-1	1045	920	990	910
2	Idlib-2	1123	1007	1009	986
3	Idlib-3	1150	1125	1100	1008
4	Idlib-4	1280	1010	1150	997
5	Hurani	910	815	870	790
6	Kurdi	1115	982	1100	954
7	Oana	1147	785	1000	733
	Mean	**1110**	**949,14**	**1031**	**911.14**
	CV%	**10.09**	**12.43**	**9.11**	**14.48**

The genotypes with regression slope (b) less than 1, giving average stability, resisting fluctuations with good yields were Idlib-2, Idlib-3 and Kurdi (Table 5).

Table 5

Estimates of stability parameters for seed yield in 7 lentil genotypes

Genotype	Mean yield, kg/ha	Diff. to environments mean yield, kg/ha	Regression stability parameters			
			b	a	r^2	CV %
Idlib-1	966.25	- 34.07	0.711	254.6	0.987	6.56
Idlib-2	1031.25*	30.93	0.622	408.5	0.790	6.12
Idlib-3	1095.75***	95.52	0.527	568.5	0.567	5.65
Idlib-4	1109.25***	108.93	1.489	-380.7	0.980	11.99
Hurani	846.25	-129.07	0.608	237.1	0.995	9.60
Kurdi	1037.75**	37.43	0.879	158	0.912	7.86
Oana	916.25	-84.07	2.163	-1248	0.992	20.99
Mean	1000.32					9.75

LSD 5%= 27.44; LSD 1% = 36.12; LSD 0.1% = 46.06

The genotypes Idlib-4 and Oana had regression coefficients higher than 1, which indicates a very strong reaction of these genotypes to environmental conditions, so a lower yield stability. Idlib-4 lentil genotype recorded the highest gain of yield

(108.93 kg/ha) which shows the tendency of this genotype to achieve high yields in favorable growing conditions. Oana Romanian lentil genotype showed higher production normal growing conditions.

In addition to above mentioned stability parameters, genotypes indicating low coefficients of variation (CV) are also considered stable [5]. Low CV values were shown by Idlib-1, Idlib-2, Idlib-3, Hurani and Kurdi, confirming their high stability. The unstable cultivars, Idlib-4 and Oana had the highest CV values for seed yield (Table 4.)

According to Freeman [4] one of the main reasons for growing genotypes over a wide range of environments is to estimate their stability and adaptability.

The use of two stability parameters may be valuable for some purposes.

For a long time, most breeders used the term stability to characterize a genotype which always showed a constant yield, under variable environmental conditions. This idea of stability agrees with the concept of homeostasis widely used in quantitative genetics and may be considered as a biological (static) concept of stability [1]. Biological stability is not acceptable to most plant breeders, who prefer an agronomic concept of stability.

In this concept of stability, it is not necessary for the genotypic response to environmental conditions to be equal for all genotypes. Both yield and stability of performance should be considered simultaneously to exploit the useful effect of GE interactions and to make genotype selection more precise and refined. Genotype Idlib-3 can be recommended as the most stable genotype with regard to both stability and yield.

Genotypes Idlib - 4 and Oana can be recomanded as the most performed genotypes with regard the yield in favorable growing conditions.

CONCLUSIONS

1. In terms of yield stability, expressed as regression coefficient and coefficient of variation, Syrian genotypes Idlib-3, Idlib-2, Idlib-1, Kurdi and Hurani showed highest degree of adaptation to environmental conditions in four experiments, so a good production stability.
2. Genotypes Oana and Idlib-4 recorded values of the coefficients of variation much higher than the average and regression coefficients higher than 1, suggesting a stronger response of these genotypes to environmental conditions, so a lower stability of yield.
3. The average yield reporting to yield obtained in the most favorable conditions could find that genotype Idlib-4 made on average the highest yield during testing period. The biggest loss of seed yield in unfavorable condition compared with the average, has been registered at Oana genotype.

REFERENCES

1. Becker H.C., J. Leon, 1988. *Stability analysis in plant breeding*. Plant Breed 101 (pp. 1-23).
2. Eberhart S.A., W.A. Russel, 1966. *Stability parameters for comparing varieties*. Crop Science 6 (pp. 36-40).
3. Francis T.R., L.W. Kannenberg, 1978. *Yield stability studies in short-season maize*. 1. A descriptive method for grouping genotypes, Can. J. Plant Sci. 58 (pp. 1029-1034).
4. Freeman G.H., 1972. *Statistical methods for the analysis of genotype × environment interactions*. Heredity 29 (pp. 339-351).
5. Kakar K.M., S.Z. Kakar, M.I. Shawani, 2003. *Varietal dynamics of yield stability in wheat*. On-line J. of Biological Sci. 3 (2) (pp. 137-140).
6. Keim D.L., W.E. Kronstad, 1979. *Drought resistance and dryland adaptation in winter wheat*. Crop Sciences, 19 (pp. 574-576).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

MOLECULAR DIVERSITY OF COMMON BEAN (*PHASEOLUS VULGARIS* L.) CULTIVARS

RALUCA FILIMON, B. NECHIFOR, LIZICA SZILAGYI

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *Phaseolus vulgaris, RAPD markers, genetic diversity*

Abstract

RAPD markers were used to evaluate genetic diversity among 8 common bean cultivars (Phaseolus vulgaris L.) that included six developed in Romania and two in CIAT Colombia. Only 4 of all the 8 random primers used in RAPD reactions showed polymorphism acceptable for an effective characterization of bean cultivars. These four primers (OPD-08, OPG-03, OPG-12, OPY-20) generated 33 DNA bands, of which 17 bands showing polymorphism (48.84%). On average, each primer generated 8.25 bands, of which 4.25 were polymorphic.

Genetic distances were calculated using Nei&Li (1979) similarity coefficient, displayed in a dendrogram (UPGMA method).Cluster analysis based on RAPD amplification products divided genotypes in two main groups, according to their geographical origin. Genetic similarity vary greatly (60% - 96%), depending on the pairs of genotypes and on the groups.

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.; $2n = 2x = 22$) are New World crop with worldwide significance for human nutrition. Bean is a traditional grain legume cultivated and bred in Romania. The crop is consumed principally for its dry (mature) beans, shell beans (seeds at physiological maturity), and green pods. When consumed as seed, beans constitute an important source of dietary protein (22% of seed weight) that complements cereals.

Evidence based on allozymes [7], seed proteins [4]), morphological traits [7]) and DNA markers [6], [1] indicates that two major gene pools exist in cultivated common bean, one Middle American - MA (Mexico, Central America and Brazil) and one Andean South American - AA. Singh et al. (1991a) proposed that within each gene pool three races could be distinguished in plant and seed morphology and adaptation regimes [2]. Analysis of genetic relationships in crop species is an important component of crop improvement programs, as it serves to provide information about genetic diversity, and is a platform for stratified sampling of breeding populations. Polymorphisms represented by differences in DNA sequences. These methods are being used as complementary strategies to traditional approaches for assessment of genetic diversity, the major advantage being that they analyze the variation at the DNA level itself, excluding all environmental influences. The analysis can be performed at any growth stage using any plant part and it requires only small amounts of material. PCR-based techniques such as Random Amplified Polymorphic DNAs (RAPDs), Amplified Fragment Length Polymorphisms (AFLPs) and Simple Sequence Repeats (SSRs, microsatellites) have been used to characterize variability in *Phaseolus* spp.

The objective of this research was to analyze of eight bean cultivars by means of molecular markers (RAPD), in order to quantify and unveil the structure of their genetic diversity.

MATERIAL AND METHODS

Plant material

Eight commercial varieties of common bean (*Phaseolus vulgaris* L.): six developed in Romania and two in CIAT Colombia have been analyzed using RAPD markers (Table 1).

Molecular analysis

1. Isolation of plant DNA

The study was conducted in the greenhouse and Molecular Genetics laboratory from University of Agronomical Sciences and Veterinary Medicine Bucharest, Romania in 2008. The genomic DNA was isolated from young leaves of greenhouse - grown plants according to the CTAB procedure, after [3]. Genomic DNA was isolated from approximately 1 g of fresh leaves of 10 plants of each variety taken for the study.

2. Random Amplified Polymorphic DNA (RAPD) analysis

The 11 primers were used for genetic diversity evaluation of the 8 bean cultivars, but only 4 showed polymorphism (OP-A - 12, OP-G - 03, OP-D-08, OP-Y-20). DNA obtained was amplified by the RAPD procedure with decamer random primers from “Operon Technologies” (California, USA), that identified polymorphisms. Polymerase Chain Reaction (PCR) were achieved in a final volume of 25 μl, containing: 25 ng DNA, 0.1 mM of each dNTP, 2.0 mM $MgCl_2$, 10 mM Tris-HCl, pH 8.3, 50 mM KCl, 0.4 mM of one primer decamer (Operon Technologies, Alameda, CA, USA) and one unit of Taq DNA polymerase. The amplification was performed using a M.J. Research thermal cycler, programmed for 42 cycles, each consisted of: one denaturation step at 94 ^{0}C for 1 min., one annealing step at 36 ^{0}C for 1 min and one extension step at 72 ^{0}C for 2 min. The extension step in the last cycle was 7 min at 72 °C.

RAPD amplification products were evaluated by electrophoresis on 1.2% agarose gels in 0.5x TBE buffer stained with ethidium bromide.

Table 1

Name, origin, growth habit and seed morphological traits of eight bean commercial cultivars

No.	Cultivars	Origin*	Growth habit**	Seed size***	Seed color	Flower color
1.	**Delia**	Romania - NARDI Fundulea	II	Small	White	White
2.	**Lizica**	Romania - NARDI Fundulea	II	Small	White	White
3	**Florena**	Romania - NARDI Fundulea	II	Small	White	White
4.	**Avans**	Romania - NARDI Fundulea	III	Medium	White	White
5.	**Ami**	Romania - NARDI Fundulea	II	Medium	White	White
6.	**Starter**	Romania - NARDI Fundulea	II	Small	White	White
7	**SEA 5**	Colombia – CIAT	III	Small	Cream	Blue
8	**SEA 13**	Colombia – CIAT	III	Small	Cream	Blue

NARDI - National Agricultural Research and Development Institute; CIAT–International Centre of Agriculture Tropicale;II = indeterminate upright bush;III = indeterminate semi-viney prostrate; *** 100 seeds weight: small seeds, < 25 g; medium, 25-40 g; large, > 40 g.*

3. Statistical analysis

The genetic similarity (Sij) was estimated using the Nei & Li coefficient, by the expression: Sij = 2 Nij / (Ni + Nj), where Nij - the number of bands in common between accessions i and j; Ni and Nj - the number of bands for accession i and j, respectively.

Distance genetics was computed after Nei&Li (1979) formula, using TREECON 1.3 b software package. A cluster analysis was performed using the Unweighted Pair-Group Method using Arithmetic Average (UPGMA) and the dendrogram was obtained in order to visualize the relationship among common bean cultivars.

RESULTS AND DISCUSSION

RAPD analysis

Four decamer random primers were used to differentiate between the eight beans genotypes. A total of 33 bands were amplified in bean genotypes taken in study. Of the 33 total bands, 17 were polymorphic. On the average, each primer amplified 8.25 bands, of which 4.25 were polymorphic. The percentage polymorphic loci varied from 33.33% (OPY-20) to 63.63% (OPD-08) with an average of 48.84% bands/primer (Table 2).

Table 2

RAPD primers used to detect polymorphism, number of bands for polymorphism between bean genotypes per primer

RAPD Primer	Sequence	Number of bands	Number of polymorphic markers	Percentage polymorphism
OP-A – 12	5‘-TCGGCGATAG-3‘	9	5	55.55
OP-G – 03	5‘-GAGCCCTCCA-3‘	7	3	42.85
OP-D-08	5‘-GTGTGCCCCA-3‘	11	7	63.63
OP-Y-20	5‘-AAGCGGCCTC-3‘	6	2	33.33
	Total	33	17	
	Average per primer	8.25	4.25	48.84

Genetic distance and similarity

Pair–wise comparisons between the tested genotypes were used to calculate the genetic similarity.

The lowest value of genetic similarity was recorded among Romanian bean genotypes Lizica, Florena and SEA5 (60%), indicating that these genotypes are highly differentiated genetically (genetic distance = 0.40) (Table 3).

Table 3

Genetic similarity (below diagonal) and genetic distance values (above diagonal) in 8 beans genotypes

Genotype	Delia	Lizica	Florena	Avans	Ami	Starter	SEA 5	SEA 13
Delia	***	0.04	0.04	0.07	0.13	0.09	0.48	0.32
Lizica	96	***	0.04	0.10	0.10	0.12	0.40	0.28
Florena	96	96	***	0.10	0.16	0.06	0.40	0.34
Avans	93	90	90	***	0.07	0.15	0.38	0.32
Ami	87	90	84	93	***	0.15	0.38	0.32
Starter	91	88	94	85	85	***	0.38	0.32
SEA 5	62	60	60	62	62	62	***	0,11
SEA 13	68	72	66	68	68	68	89	***

On the other hand, the higher genetic similarity was recorded among Romanian bean genotypes, Delia and Lizica (96%), Delia and Florena (96%), Lizica and Florena (96%), which shows little genetic distance between these genotypes (0.04). The high similarity found among these bean genotypes indicates that genetic diversity between them is narrow and due to their common origin in the breeding program. Similar results were reported by Szilagyi al all. [5] concerning high similarity between Romanian genotypes.

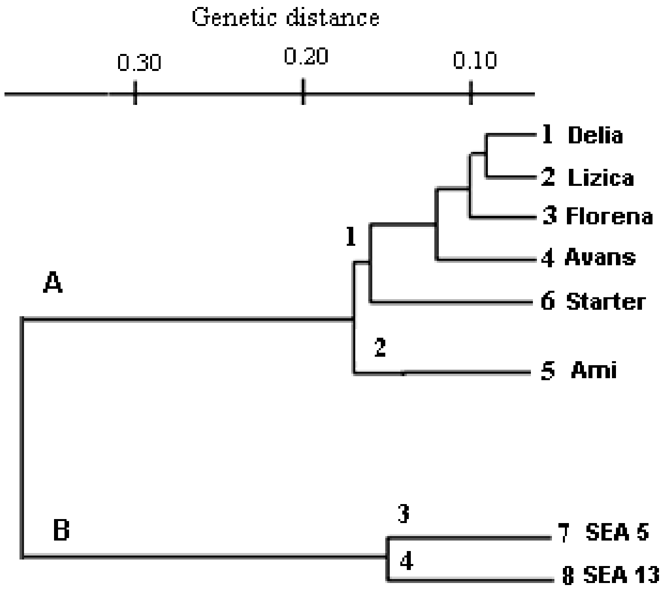


Fig. 1. Dendrogram of eight common bean genotypes based on RAPD data using UPGMA

Cluster analysis

The clustering obtained by UPGMA method is shown in Figure 1. The dendrogram divided the eight common bean cultivars in two **main clusters (A and B)**, according to their geographical origin.

Cluster A comprise all Romanian bean cultivars and cluster B contain all Columbian cultivars.

RAPD analysis detected in the branch **A** other two categories grouping five Romanian bean cultivars in the first subgroup: Delia, Lizica, Florena Avans, Starter and 1 Romanian bean cultivar – Ami in the second group.

Almost all cultivars included in cluster **A** have an indeterminate upright bush growth habit (type II), except Avans and Ami which have indeterminate semi-viney prostrate (type III) growth habit, seeds small to medium and white seeds color.

Cluster **B** includes 2 Columbian bean cultivar: SEA 5 and SEA 3 with indeterminate semi-viney prostrate growth habit (type III) with small beige-cream seeds.

CONCLUSIONS

1. The analyses performed in this study indicate that investigated common bean genotypes are genetically distinct. The eight bean genotypes formed two distinct groups according to their geographical origin.
2. Genetic similarity vary greatly (44%-96%), depending on the pairs of genotypes, on the groups and subgroups. It has lower values between genotypes from different clusters (A and B) and higher values between genotypes within each cluster. This suggests that there is a wide variation of DNA, larger between varieties from different groups and smaller between genotypes within groups.
3. Crosses between bean genotypes from these two major groups (A and B) might lead to high heterosis.

REFERENCES

1. Becerra Velasquez L., P. Gepts, 1994. *RFLP diversity of common bean (Phaseolus vulgaris) in its centers of origin*. Genome 37 (pp. 256-263).
2. Beebe S., P.H. Skrock, J. Tohme, M.C. Duque, F. Pedraza, J. Nienhuis, 2000. *Structure of genetic diversity among common bean landraces of Middle American origin based on correspondence analysis of RAPD*. Crop Sci. 40 (pp. 264-273).
3. Doyle J.J., L.J. Doyle, 1990. *Isolation of plant DNA from fresh tissue*. Focus., 12 (pp. 13-15).
4. Gepts P, F.A. Bliss, 1986. *Phaseolin variability among wild and cultivated common bean (Phaseolus vulgaris) from Colombia*. Econ. Bot. 40 (4) (pp. 469-478).
5. Lizica Szilagyi, Şemun Tayyar, Matilda Ciucă, 2011. *Evaluation of genetic diversity in common bean (Phaseolus vulgaris l.) using RAPD markers and morpho-agronomic traits.* Romanian Biotechnological Letters (ISI, F.I - 0,152), Vol. 16, No. 1, 2011, Supplement (pp. 98-105).
6. Nodari R.O., E.M.K. Koinange, J.D. Kelly, P. Gepts, 1992. *Towards and integrated linkage map of common bean:1. Development of genomic DNA probes and levels of restriction fragment length polymorphism*. Theor. Appl. Genet. 84 (pp. 186-192).
7. Singh S.P., R. Nodari, P. Gepts, 1991c. *Genetic diversity in cultivated common bean: I. Allozymes*. Crop Sci. 31 (pp. 19-23).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

RESEARCH ON THE BIOLOGICAL FEATURES OF *ALTERNARIA BRASSICAE* PATHOGEN ISOLATED ON RAPE

E. RADU, STELICA CRISTEA, C.R. ZALĂ

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *fungus, biology, conditions*

Abstract

Alternaria brassicae fungus is manifesting on every plant organ in every stage of plant development.

The abiotic factors play an important role during the fungus development and pathogenicity. The study must be done in order to establish its needs regarding certain abiotic factors such as: temperature, humidity, atmospheric pressure and light. The study is necessary in order to get to know the moment when the first infections occur.

Alternaria brassicae fungus is passed on from one year to another through the seed which comes from sick plants. Under laboratory condition, the phytopathogenic fungus Alternaria brassicae was isolated on potato-glucose agar. The sick biological material of rape, formed from leaves and stems with specific disease symptoms, was put in a wet room where the mycelium formation was observed after 3 days. The conidions germination is possible at 4°C, and 16 hours are necessary.

Alternaria brassicae fungus colonies developed extremely well in the presence of light. As relative atmospheric humidity value grows higher, the colony development is very good, and the vegetative mass is extremely dense, thick, grey in colour. Temperature, relative atmospheric humidity and light are important factors in the Alternaria brassicae fungus evolution.

INTRODUCTION

Alternaria brassicae fungus produces the black stain of rape leaves. The disease is manifesting on every plant organ in every stage of plant development.

The abiotic factors have an important role during the fungus development and pathogenicity. The fungi produce diseases on crop plants, these being very sensitive during their whole vegetation period.

Therefore, a certain biological study is necessary. The study concerns the research of the *Alternaria brasicae* pathogen fungus biology. The study must be done in order to establish its needs regarding certain abiotic factors such as: temperature, humidity, atmospheric pressure and light. The study is necessary in order to know the moment when the first infections occur. Also, the study is aimed at analysing the evolution of the infection in the field, depending on the climatic conditions during the year.

By knowing these elements, a prognosis can be made, and also a warning for the recommended treatment, in order to end the disease.

Alternaria brassicae fungus is passed on from one year to another through the seed which comes from sick plants. And it can also be passed on through the remains of the plants left over after harvesting.

The primary infections are made through conidions from the vegetal remains, which are left on the field, or through sick seeds. The plants' newly formed organs are infected all the time during the whole year. They are conditioned by: weather, pH value and applied fertility. The fungus nucleus invades the tissues. It migrates 3-10 mm from the stain border, invading the plant.

MATERIAL AND METHODS

In laboratory conditions, phytopathogenic fungus *Alternaria brassicae* was isolated on potato-glucose agar. The sick biological material of rape, which was formed from leaves and stems with specific disease symptoms was put in a wet room, where, the mycelium formation was observed after 3 days. Placed on CGA culture medium again, in Petri recipients, colonies were formed; after 6 days, they purified the *Alternaria brassicae* species.

The abiotic factor was established in laboratory conditions. They influenced the *Alternaria brassicae* fungus development, after Tuite's method, 1968.

RESULTS AND DISCUSSION

The influence of temperature upon *Alternaria brassicae* fungus colonies development. On CGA culture medium, the *Alternaria brasicae* fungus formed light-grey colonies, with silky aspect, and dark-grey on the back. After 8 days, it formed pluri-septate vertical and horizontal conidions, of brown colour. The conidions had the following dimensions: 67.9-96.9 x 16.8-19.2 µm. *Alternaria brassicae* fungus was placed on CGA culture medium again, in Petri recipients of 8 cm in diameter, and then each of them was placed in thermostates at temperatures of 2-40°C. At a 3 days interval, the constant colonies diameter growth was registered. Also, fructifications growth was registered. The observations lasted for 15 days.

The colonies growth and fructification of *Alternaria brassicae* fungus are influenced by the thermal values. As we can see (Table 1), the minimum temperature for the colony formation was 2°C; they occurred under the form of a lax mycelium, of light-grey colour, with a grey back. Fructifications were absent. The aspect was the same at higher temperatures as well, such as 4°C and 6°C. The 8°C temperature determined a better colony development, so that the mycelium was compact, with silky aspect, of grey colour, with alight-grey back. The conidions presence was registered. They were rare on the mycelium's surface. At

12°C and 14°C, colonies presented the same characteristics, and at 16°C colonies formed a good vegetative mass.

Table 1

Influence of temperature upon *Alternaria brassicae* fungus development

t°C/days	2	4	6	8	10	12	14	Observations after 14 days
	Colonies diameter (mm)							
2	0	0	0	0	2	4	10	Mv± Fr 0
4	0	0	1	8	11	13	14	Mv + Fr 0
6	0	0	1	8	11	13	14	Mv± Fr 0
8	0	0	2	8	12	16	15	Mv+ Fr ±
10	0	1	4	13	15	27	24	Mv + Fr +
12	0	4	13	17	31	33	30	Mv + Fr+
14	2	7	12	20	30	30	33	Mv ++ Fr +
16	2	9	12	20	24	32	38	Mv ++ Fr +
18	2	9	14	20	25	36	38	Mv ++ Fr +
20	2	10	15	23	27	37	40	Mv ++ Fr +
22	2	12	17	27	30	37	40	Mv++ Fr +
24	2	12	18	27	30	38	40	Mv + + Fr +
26	2	14	22	28	35	38	40	Mv ++ Fr +
28	3	17	30	40	70	70	70	Mv+++ Fr +++
30	3	19	35	45	70	70	70	Mv + ++ Fr +++
32	3	22	38	45	70	70	70	Mv +++ Fr +++
34	3	25	40	45	70	70	70	Mv +++ Fr +++
36	2	30	40	45	56	59	62	Mv +++ Fr +++
38	2	20	30	30	38	40	40	Mv ++ Fr +
40	0	10	15	16	18	18	18	Mv + Fr +
42	0	0	0	0	0	0	0	Stops growth

The optimum temperature which is necessary in order for the conidions to develop is between 28°C and 36°C degrees, when 50 mm colony diameter was registered, with silky aspect, dense, grey in colour, with the light-grey back. Fructification was very good, and the colony number was high.

Over 36°C, colony development was weaker, and also the number of formed conidions was smaller.

The maximum value of temperature can be considered to be at 42°C. The formed colonies have a weak aspect, and fructifications were not even formed any longer.

The influence of temperature upon the *Alternaria brassicae* fungus conidions germination (Figure 1). In order to analyse the influence of temperature upon the conidions germination, in Petri recipients and water-agar environment, the fungus conidions were arranged; they were placed in thermostates at temperatures between 2°C and 44°C, and kept for 24 hours in these conditions. At a 2 hours interval, germination was examined in 100 conidions for each variant. The first figure shows that conidions germination is possible at 4°C, as 16 hours are necessary the minimum threshold (value).

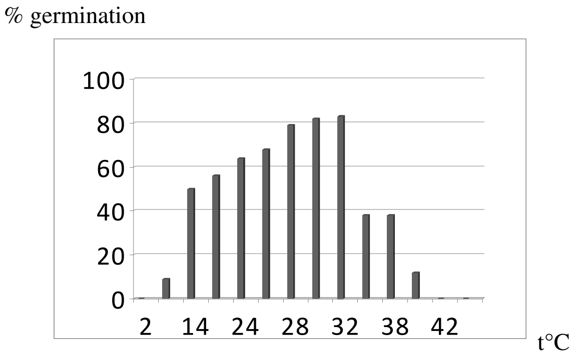


Fig. 1. ***Alternaria brassicae*** **conidions germination depending on temperature**

The optimum temperature can be considered the 28-32°C temperature interval, when 79-83% conidions germinated.

The maximum temperature was 40°C and letal temperature was identified at 42°C when conidions did not germinate even when the Petri recipient was further set to an optimum temperature of 32°C.

The influence of atmospheric relative humidity upon the *Alternaria brassicae* fungus colony development (Table 2). Different humidity values were created in exicators, from 15% up to 100%, using superconcentrated solutions of some salts. The Petri recipient with CGA environment, in which the fungus was placed again, was introduced in exicators, and kept for 21 days, without a Petri top. The atmospheric relative humidity represents an important factor in the fungus evolution. Table 2 shows that, at values of 15%, the colonies were not formed. At an atmospheric humidity of over 36.8% the formed mycelium was lax and conidions did not form. At values of 66-72%, the formed colonies had a thick-dark aspect, of grey colour, and fructifications did not form. From values of over 75.6% the formation of developed conidions was noted on the colony surface. As the relative atmospheric humidity grows higher, the colony development is very good, and the vegetative mass is extremely dense, think, grey in colour. Also, fructifications are abundant.

The influence of light upon the *Alternaria brasicae* fungus development (Table 3). Light recorded a different action on the *Alternaria brassicae* fungus colony development, as a result of the crop's constant light exposure, continuous darkness and also light/darkness alternation 8/16 or 12/12. The final observations were made after 15 days, when fungus growth and fructification was noted.

Table 2

Influence of relative atmospheric humidity upon *Alternaria brassicae* fungus colony development

Relative atmospheric humidity (RH%)	Colony diameter after 12 days	Observations
15	0	Colonies are not formed
36.8	20	Weak growth
43	32	Mv± Fr.0
56	37	Mv± Fr.0
66	70	Mv ++: Fr 0
72	70	Mv ++: Fr 0
75.6	70	Mv ++: Fr +
78.6	70	Mv+++ Fr++
82.9	70	Mv+++ Fr+++
88.5	70	Mv+++ Fr+++
90	70	Mv+++ Fr+++
92.7	70	Mv+++ Fr+++
96.1	70	Mv+++ Fr+++
98.5	70	Mv+++ Fr+++
99	70	Mv+++ Fr+++

Legend:

mv± = very weak vegetative mass
mv.+ = weak vegetative mass
mv ++ = good vegetative mass
mv +++ = very good vegetative mass
0 = fungus did not fructify
Fr ± =very weak fructification
Fr + = weak fructification
Fr.++ = good fructification
Fr+++ = abundent fructification

Alternaria brasicae fungus colonies developed extremely well in the presence of light, as it can be observed in table 3. On permanent or alternative light, the colony vegetative mass was rich, had a silky mycelium, of grey colour, and sporulation was abundant. Permanent darkness throughout the whole experiment led to a very weak vegetative mass, and conidions appeared very rarely on the mycelium surface.

Table 3

Influence of light upon *Alternaria barsicae* fungus development

Light	Colony development
Light 24 hours	Rich vegetative mass, thick-looking mycelium, grey in colour, rich sporulation
Light/Darkness alternation 12/12 hours	Rich vegetative mass, thick-looking mycelium, grey in colour, rich sporulation
Light/Darkness alternation 8/16 hours	Rich vegetative mass, thick-looking mycelium, grey incolour, rich sporulation
Permanent darkness	Very weak vegetative mass, weak fructifications

CONCLUSIONS

1. Temperature, relative atmospheric humidity and light are important factors in the *Alternaria brassicae* fungus evolution.
2. Concerning temperature, the minimum temperature for the colonies to be formed was 2°C, optimum necessary for the colonies to develop is 28°C and 36°C, and the maximum threshold (value) can be considered at 42°C when colonies formed have a weak-looking aspect, and fructifications do not form any longer. The optimum temperature for the conidions to germinate is between 28-32°C, when 79-83% of conidions germinated, while the lethal temperature was identified at 42°C.
3. Related to humidity, it was noted that on relative values of 15% colonies did not form, and as the relative atmospheric humidity values grow (superior to 75.6% value), colony development is very good, the vegetative mass is dense, thick-looking, and fructifications are abundant.
4. On permanent and alternative light, the vegetative mass of formed colonies was rich, the mycelium was silky, and sporulation was abundant.

REFERENCES

1. Constantinescu O., 1974. *Metode şi tehnici în micologie*. Ed. Ceres, Bucureşti.
2. Cristea Stelica, C.R. Zală, Mali-Sanda Manole, Florica-Fulvia Vlad, 2005. *Fitopatologie generală*. Lucrări practice, AMD USAMV Bucureşti.
3. Gheorghieş C., Stelica Cristea, 2001. *Fitopatologie*. Vol. 1, Ed. Ceres, Bucureşti.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

RESEARCH REGARDING BIOLOGY OF RAPE PESTS

ANDREEA BUCUR*, I. ROŞCA**

*BASF SRL
**University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *rape, harmful insects, biology of main pests*

Abstract

In the recent years, rape has become one of the most profitable crops, when yields are above 1200-1500 kg/ha, look what can be done easy when it is applied an appropriate technology, which can minimize the risks of culture, due to mainly pest occurrence. Economically speaking, from the total collected entomofauna, the most important species, due to both registered densities and attacks in rape, are: Phyllotreta spp., Psylliodes chrysocephala, Ceutorhynchus napi, Ceutorhynchus assimilis, Athalia rosae, Meligethes aeneus and Brevicoryne brasicae in the same time in particular years or places other pest can cause problems in rape culture, such as Entomoscelis adonidis, Epicometis hirta or Dasineura brassicae. In general, in Romania, very little is known about the biology of stem and pod rape weevils (Ceutorhynchus napi – stem weevil and Ceutorhynchus assimillis – pod's and seed's weevil) that may cause significant economic damage, from spring to harvesting. The purpose of this research was to identify the species of Ceutorhynchus of rapeseed crop agroecosystems in south-eastern Romania, their biology and damage caused by them.

INTRODUCTION

This year (2010-2011), as every year the last time, broke a new record for the rape of cultivated land, but keep in mind that with this growing pool of diseases and pests, according to the crop rotation (the recommended that the rape to get back on the same surface after at least three years) is harder. EU Directive 2003/30/EC promotes the use of renewable fuels, and by their obligations in Chapter 14, on energy, Romania has pledged that at least 2% of fuel used to transport either organic origin, is currently the most widely biodiesel made from rapeseed oil. 80% of rape production is exported and demand is very high. Rape is a valuable honey plant, which begins to be visited, bee pollen when the temperature exceeds 9^0C and when the temperature exceeds 14^0C nectar, so bees families grow stronger and earlier in a period when supply honey is still quite low. In recent years, rape has become one of the most profitable crops, but cost-effective when productions are over 1200-1500 kg/ha, look what can be done easily when applying appropriate technology that can minimize the risks of culture, due to mainly drought during the sowing, great temperature declines in winter, or its large fluctuations during the winter and early spring, possibly high temperatures in June-July mainly due to the occurrence of pest risk, etc.

MATERIAL AND METHODS

Collections of biological material were carried out in the field, on a two week basis, in a rape field near Moara Domneasca-Bucharest. Our objective was to establish the structure of main pests of canola crops in south-eastern Romania, the structure and biology of pests' population in rape agroecosystem, particularly of weevil's populations. Fauna was assessed monthly from April to early July, conducted in three repetitions, insects were collected with entomological net (sweeping the vegetation 30 doubles, equivalent to 10 m^2, total 30 m^2), till identifying captured insects, collected materials were kept in 70^0 alcohol and determined in the laboratory. Pest species collected with entomological net were separated and identified. 10 rape plants were analyzed, in three repetitions, where we watched the number of eggs deposited in strain by *C. napi*, and then through splitting stems was registered the number and length of their galleries. With the formation of pods, it was registered attack of *C. assimilis*, counting 100 pods, in 4 repetitions and registering percentage of attacked pods, the number of larvae/bean and percentage of seeds destroyed by pests. Complementary observations on the entire spectrum of rapeseed crop pests were done during the whole vegetation period.

RESULTS AND DISCUSSION

Table 1 is presents the structure and evolution of main pest populations during autumn of 2009' and 2010' spring and beginning of summer.

We know relatively little about the species structure of *Ceutorhynchus* in rape agroecosystem and especially about their biology [1-4], especially in Romania [5]. We have collected 1337 specimens of *Ceutorhynchus* of which 669 (53%) belong to *C. napi*, 539 (38%) belong to the species *C. assimilis* and only 129 (9%) species *C. picitarsis*. Data collected with entomological net indicates that the species *C. napi* occurs during April, extending her flight until the end of May, and *C. assimilis* species occurs along with formation of floral button at the end of April and is present in culture until beginning of changing into brown color of seeds. It should be noted the presence of species *C. picitarsis*, which develops during the winter as larvae that feed inside the stem and stem base of rapeseed plants, appearing as an adult in mid-May. We followed, from early April until late May, egg laying by *C. napi*, in the main stem tip under floral buttons or lateral shoots when plants have 40-50 cm high, registering the number of larvae/plant and length of larvae' tunnel carved in stem. Data are presented in table 2, distinguishing a very strong pest attack, evidenced by the number of larvae identified by splitting stems of canola, but also by the number of galleries dinged by the larvae of pests in plant stem and the length of these galleries.

Table 1

Structure of pest fauna (exemplare/m^2) from rape agroecosystem (2009-2010)

Pest species\Data	23 X	13 XI	02 IV	16 IV	30 IV	14 V	28 V	11 VI	25 VI	9 VII	24 VII
Phyllotreta atra	0	0	0	0	0	0	0	0	1.66	3	0.66
Phyllotreta nemorum	0	0	0	0	0	0	2.33	1	0	0	0
Psylliodes chrysocephala	1.33	2.66	0	0	0	0	0	0	0	0.33	0
Ceutorrynchus napi	0	0	1	12.66	4.66	2.66	1.33	0	0	0	0
Ceutorhyncus picitarsis	0	0	0	0	0	0.33	2.66	0.66	0.66	0	0
Ceutorrynchus assimilis	0	0	0	0	2.66	3.66	8.33	1.33	1.33	0.66	0.66
Meligethes aeneus	0	0	0	0	1.66	11.33	18.66	0.66	0	0	0
Athalia rosae	0.1*	0.1*	0	0	0	0.66	2.33	1.66	0	0	0
Pieris rapae	0.33*	0.66*	0	0	0	0	0	0.33	0	0	0
Colaphelus sophiae	0	0	0	0	0	0.66	0	2.33	0.33	0	0
Epicometis hirta	0	0	0	0	0	0.33	0	0.33	0	0	0
Entomoscelis adonidis	0.1	0.1	0	0	0	0	0	0	0	0	0
Brevicoryne brasicae	0	0	0	0	0	0	0	0	0	0.1^c	0.33^c

- =larvae; ^{c} =colony

Regarding the attack of *C. assimilis* is found by analyzing the pods that percentage of attacked pods is between 2.5% and 15.7% depending on the time and pod position. In terms of destroying of rape seeds in pod by attack *C. assimilis* larvae, it is found that the destruction of seeds gradually increases, registering a rate of compromised seeds ranging between 2.7 and 13.2%, depending on the position on the plant of pod which was analyzed and on the time, that of course is higher to end of period. As is known, in attacked pod were found only one *Ceutorhynchus* larvae, but sometime numerous larvae belonging to brassica pod midge (*Dasineura brassicae*). It were registered 1.25% pods attacked by *Dasineura brassicae* on 25 June, 5.75% on 9 July and only 0.25% on 24 July with an average number of larvae/attacked pod of 5.75, 9.5 respectively 1.5.

Table 2

Evolution of egg laying and attack of *Ceutorhynchus napi* in rape culture

Data of observation	02-IV	16-IV	30-IV	14-V	28-V
No. of eggs/plant	1.3	4.6	0.3	0	0
No. of lavae/plant	0	2.6	5.6	3.3	1.3
No. of tunnels/plant	0	1.3	5.6	6.3	6
Average lenght of tunnel (cm)	0	2.5	5.7	6.5	6.2

CONCLUSIONS

1. There is a rich pests fauna in the rape agroecosystem, the most important being species *C. napi* (53%), *C. assimilis* (38%), and *C. picitarsis* (9%).
2. The attack of *C. assimilis* on pods is between 2.5% and 15.7% and destruction of seeds gradually increases, registering a rate of compromised seeds ranging between 2.7 and 13.2%.
3. 1.25% pods attacked by *Dasineura brassicae* were registered on 25 June, 5.75% on 9 July and only 0.25% on 24 July with an average number of larvae/attacked pod of 5.75, 9.5 respectively 1.5.

ACKNOWLEDGEMENTS

We have to express all our gratitude to the second year students of the Agricultural Faculty for their labor regarding the collection of the fauna during April and May.

REFERENCES

1. Alford D.V., C., Nilsson, B. Ulber, 2003. *Insect pests of oilseed rape crops*. Biocontrol of Oilseed Rape Insect Pests (ed. by D.V. Alford), Blackwell Publications, U.K.
2. Ekbom B., 1995. *Insect Pests. Brassica oilseeds*. Production and Utilization (ed. by D.S. Kimber and D.J. McGregor), CAB International, U.K. (pp. 141-152).
3. Kelm M., Z., Klukowski, 2000. *The effect of stem weevil (Ceutorhynchus pallidactylus Marsh.) infestation on oilseed rape yield*. IOBC WPRS Bulletin, 23 (pp. 125-130).
4. Lerin J., 1993. *Influence of the growth rate of oilseed rape on the splitting of the stem after attack of Ceuthorhynchus napi Gyll.* IOBC WPRS Bulletin, 16 (pp. 160-163).
5. Roşca I., Rada Istrate, 2009. *Tratat de Entomologie (Agricultura, Horticultura, Silvicultura).* Ed. ALPHA MDN.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

RESEARCH REGARDING MORPHOLOGICAL ASPECTS OF *NAPOMYZA GYMNOSTOMA* LOEW.

MIHAELA COMAN*, I. ROŞCA**

*Central Phytosanitary Laboratory
**University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *Napomyza, invasive pest, morphology, diagnosis, Allium spp.*

Abstract

Napomyza gymnostoma Loew, 1858 is a leaf miner from Diptera: Agromyzidae which was originally described in 1858, in Poland. This leaf miner is a pest of Allium spp.*, particularly leek, onion, garlic, chive and also is a potential pest of ornamental Allium plants. At present, is widespread in most European countries. This species is invasive therefore it is a significant pest of Allium spp. Agromyzidae family is characterized by having a great morphological similarity between the sexes. For a correct species identification the most significant and stable structure in the male genitalia is the distal end of the aedeagus (distiphallus). In Romania, Napomyza gymnostoma was first recorded in 2007 and specimens were identified based on morphological characters.*

INTRODUCTION

The *Napomyza* leaf miner belong to *Agromyzidae* family which is one of the largest fly family, with more than 2790 valid species belonging to 27 genera worldwide [10, 13]. *Agromyzidae* is a strict phytophagous family of *Diptera*. They exhibit an array of different feeding habits such as leaf-mining, stem-mining and stem-tunneling, cambium-mining, and parasitism of flower heads and fruit. Leaf-mining is generally the most widespread feeding behavior among *Agromyzidae*. The great majority (99.4%) of the *Agromyzidae* species show a high degree of host specialization which makes these insects especially suitable for taxonomic-phylogenetic considerations [14].

Generally damages are detected visually in form of mines along leaves. Visual detection in stems, roots, floral heads, or fruit is more difficult. Mines in leafs reduces the photosynthetic capacity, the cambium area, the nutrient transport capacity, and the quality of commercial products. Development of secondary fungal pests in the galleries is subsequently produced. Damage is variable in function of the infestation. *Napomyza* (*Phytomyza*) *gymnostoma* Loew. differ from other *Phytomyza* in some characters (mainly of the male post abdomen) which led Spancer to remove it to *Napomyza*. In contrast, while acknowledging these plesiomorphic characters, Zlobin returned *Phytomyza gymnostoma* to *Phytomyza* because it lacks synapomorphies of his more precisely defined *Napomyza* [12, 15]. This species may deserve separate generic status once its phylogenetic position is more securely established. At the moment, in literature the recently expanding range and pest status of is *Phytomyza gymnostoma* [3, 6, 8, 13].

In spring 2007, an Allium leaf miner was recorded for the first time in non-commercial onion crops in Romania. Typical feeding symptoms were observed, caused by the mining behavior of larvae, producing the formation of descending galleries [4] (Figure 1).

Fig. 1. Onion leaves with feeding points

The pest was morphologically identified as *Napomyza* (*Phytomyza*) *gymnostoma* Loew. based on morphological characters of the adults**.** Following research (2009-2010) carried out by us found that the harmful damage to species: *Allium porrum, Allium cepa*, *Allium sativum* and even ornamental plants such as *Allium gygantheum*. In Romania the pest has two generation per year, one in spring and the other is autumn. The highest infestation was recorded at untreated leek, with 22 larvae and pupae per plant. Plants can be completely destroyed or reduced in market value [5]. The main goals of this work are to present some morphological characters useful for *Napomyza gymnostoma* identification.

MATERIAL AND METHODS

In 2008, some growers who produce onion and garlic crops on small surfaces observed that the plants were damaged by an unknown pest. Plants with symptoms were transported in the laboratory placed in good condition in order to obtain adults. To check the external characters, mainly the coloration, and the obtained adults were observed in water or glycerin. Since the male genitalia are important characters for identification of the leaf miners, slide preparations were made.

Usually the morphological interpretation of the genitalia requires extensive experience, and inexperienced entomologists make commonly systematic errors. This is the reason why usually the identifications are also confirmed by studying the external morphology, although in some cases is not enough. For an accurate identification the male genitalia should be examined. In this way, males were placed in 10% KOH solution and leave for 24 h for tissue maceration. After that the specimens were washed in distilled water and the abdomens were dissected under a Leica MZ 12_5 stereomicroscope. For microscopic examination the genitalia were mounted in Hoyer solution and observed at Zeiss Axio Imager. A1. microscope. In laboratory conditions were obtained adults, eggs and larvae from the second generation pupae. All stages were analyzed

RESULTS AND DISCUSSION

Agromyzidae family is considered the most taxonomically difficult between dipterans, due to the high degree of uniformity between species and the small size of specimens. Adults of *Napomyza gymnostoma* could be identified based on the following characters: small grayish, mat flies of 3 mm long, with a head largely yellow, wing length varied from 2.9 mm in male to 3.5 mm in female [2] (Figure 2).

Head with frons broad, three times width of eye; orbital setulae long, all proclinate; jowls deeply extended at rear, up to 2/3 height of eye. Third antennal segment rounded at end but elongate, broad epistoma present, palps broadening distally.

Third antennal segment black, first and second yellowish, palps black; mesonotum mat grayish black, sides of thorax uniformly dark. The legs are black, knees indistinctly yellowish. The halteres can be interpreted as atrophied second pair of wings although they have got an important sensual function. The coloration of the halteres is white. The abdomen consists of 5 pregenital segments in male and 6 in female. The first one is rather short and closely associated with the second tergite. It is only recognizable through an incomplete suture. Both the joints and the margins of the tergites are yellowish. As diagnostic character this coloration can be misleading because it often depends on the condition of the specimen. The tergites are covered with fine hairs (setulae) of different size. At the posterior margins the hairs are often longer than elsewhere.

Fig. 2. Adult male - *Napomyza gymnostoma*

Male genitalia: The current systematic diagnosis of the *Agromyzidae* family focuses on the study of the male genitalia to be unique for each species [7, 9, 11].
The genitalia structure of the male allows us to discriminate between species and clarify the relationship between the positions of the genera. The shape of the aedeagus somewhat resembles *Chromatomyia* species. The postgonites greatly enlarged ventrally, with a strong, curved spine at end, surstyli free, extending far into epandrium [12, 15]. Female genitalia are not usually used in identifying Agromyzidae, only in cases of the absence of the male.

Fig. 3. Male genitalia complex

The component parts of complex male genitalia is shown in (Figure 3) and distiphallus in (Figure 4).

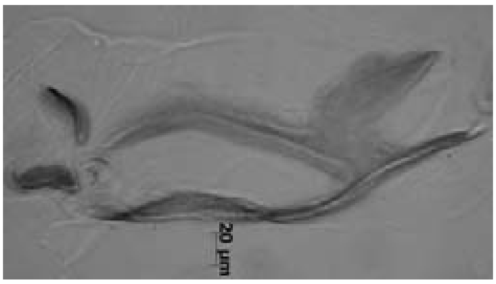


Fig. 4. Distiphallus

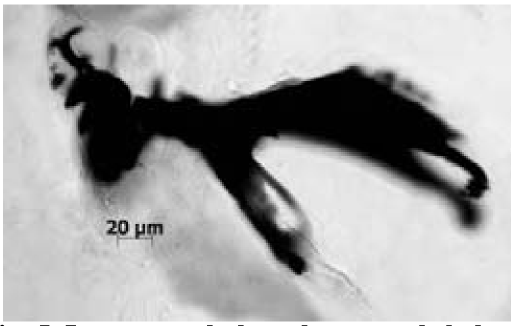


Fig. 5. Larvae-cephalo - pharyngeal skeleton

The eggs are milky white in color, translucent, elongated oval-shaped, sizes of 0.2 and x 0.5 mm.

The larvae reach 0.5-0.6 mm in the later stage of development [2]. Cephalo pharyngeal skeleton is black and consists of two mandibles or mouth hooks which bear strong teeth and some sclerites (Figure 5).

The back of the larvae is truncated and has two rear stigmas each with 30 pores. At the end of the abdomen have two black-colored lenticels. The larva has a similar spiracles in the anterior part of the body just behind the head, but slightly smaller. Numbers of pores at this point are 10-12 [1].

The pupae are reddish-brown and measures approximately 3.5 to 4 mm long [1]. It is dististinctly segmented, flattened ventrally. Posterior spiracles pairs have each 18 to 20 bulbs (Figure 6).

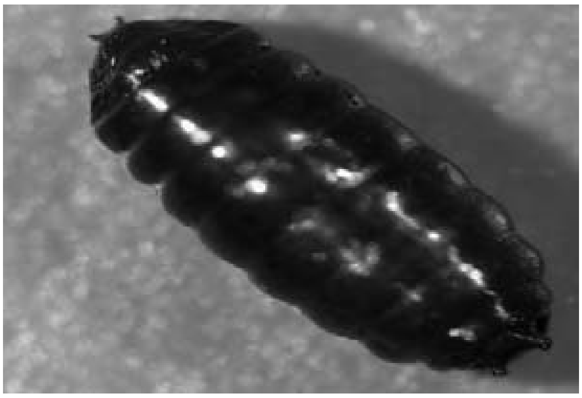


Fig. 6. Pupae

CONCLUSIONS

1. The male genitalia, in combination with the host plants (*Allium* spp.) are quite distinctive to separate *Napomyza gymnostoma* from other agromyzids of economic importance.
2. The genitalia structure of the male allows us to discriminate between species and clarify the relationship between the positions of the genera.
3. The most significant and stable structure in the male genitalia is the distal end of the aedeagus (distiphallus).

ACKNOWLEDGMENTS

We wish to express our sincere thanks to Mr. Michel Martinez for confirmation of the pests.

REFERENCES

1. Bouchery Y., 2005. *La mouche mineuse du poireau* (*Phytomyza gymnostoma*: *Biologie et lutte*. Journées Techniques Fruits & Légumes et Viticulture Biologiques (pp. 91-100).
2. Bouchery Y., Martinez M., 2004. *Un nouvel ennemi des Allium en France La mouche mineuse du poireau Phytomyza gymnostoma.* Phytoma la défense des végétaux, nr. 574 (pp. 5-7).
3. Collins D.W., Lole M., 2005. *Phytomyza gymnostoma Loew (Diptera: Agromyzidae), a leaf mining pest of leek and onion new to Britain.* Entomologist's Monthly Magazine,nr. 141 (pp. 131-138).
4. Coman M., Cean M., 2009. *Napomyza (Phytomyza) gymnostoma – un nou daunator al plantelor de Allium in Romania*, Jurnal Lucrari Stiintifice - Universitatea de Stiinte Agronomice si Medicina Veterinara Bucuresti. Seria B, Horticultura Nr. (pp. 83-85).
5. Coman M., Roşca I., 2010. *Biology and life-cycle of Leafminer Napomyza (Phytomyza) gymnostoma Loew., a new pest of Allium plants in Romania*. South-Western Journal of Horticulture, Biology and Environment (in press).
6. Dempewolf M., 2004. *Arthropods of economic importance: Agromyzidae of the World. Wokingham UK.* ETI Information Services, unpaginated.
7. Frick K.E., 1952. *A generic revision of the family Agromyzidae (Diptera) with a catalogue of New World species*. University of California Publications in Entomology Nr. 8 (pp. 339-452).
8. Kahrer A., 1999. *Biology and control of the leek mining fly, Napomyza gymnostoma.* Bulletin OILB/SROP, 22 (5) (pp. 205-211).
9. Sasakawa M., 1961. *A study of the Japanese Agromyzidae (Diptera), part 2.* Pacif. Ins., Honolulu, (3) (pp. 307-472).

10. Sasakawa M., 1997. *Lauxaniidae and Agromyzidae (Diptera) of the Ryukyus*. Esakia, (37) (pp.141- 148).
11. Spencer K.A., 1961. *A synopsis on the Oriental Agromyzidae (Diptera).* Transactions of the Royal entomological Society of London, 113(4) (pp. 55-100).
12. Spencer K.A., 1976. *The Agromyzidae (Diptera) of Fennoscandia and Denmark*. Fauna Entomologica Scandinavica, (5): (pp. 1-606).
13. Spancer K.A., 1989. *Family Agromyzidae*. Catalog of the Australasian and Oceanian regions (pp. 538-547).
14. Spencer K.A., 1990. *Host specialization in the world Agromyzidae (Diptera).* Series Entomologica 45.
15. Zlobin V.V., 1994. *Review of mining flies of the genus Napomyza Westwood (Diptera:Agromyzidae). V. Phytomyza species currently placed in the genus Napomyza Westwood.* International Journal of dipterological Research 5(4) (pp. 289-311).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

USEFUL AND HARMFUL MOBILE FAUNA STRUCTURE OF MAIZE CROP FROM STUDY AREA IN 2007

GEORGETA COSTEA*, I. ROŞCA, V. CIOCHIA*, G. MĂRGĂRIT*****

*University of Bucharest
**University of Agronomic Sciences and Veterinary Medicine of Bucharest
***Research and Development Institute of Plant Protection

Keywords: *useful fauna,harmful fauna, maize, Barber traps*

Abstract

The research was conducted in the village Clinceni - Ilfov, in order to assess the structure of phytophagous and entomophagous fauna of maize agroecosystems in 2007.

Entomophagous and phytophagous fauna was collected in 21 to 23 March and 16 to 18 April 2007 by means of Barber traps.

The material analyzed included a total of 398 individuals, of which 303 belonging to the harmful fauna and 95 individuals belonging to useful fauna.

Entomophagous fauna are represented by: Fam. Chironomidae, Fam. Formicidae, Ord. Collembola , Pleurophorus caesus Panz., Pterostichus cupreus L., Pterostichus niger Schall., Carabus canceollatus L., Nabis ferus L.Phytophagous fauna are represented by: Anthicus hispidus Ross., Zabrus tenebrioides Goeze., Drasterius bimaculatus Rossi., Harpalus pubescens Mull., Phyllotreta nemorum L., Agriotes pilosus Panz., Opatrum sabulosum L., Tanymecus dilaticollis Gyll.

INTRODUCTION

The research was conducted in the Clinceni village Ilfov County, in order to assess the structure of useful and harmful fauna of agroecosystems in 2007.

MATERIAL AND METHODS

Useful and harmful fauna was collected from 21 to 23 March and from 16 to 18 April 2007 by means of Barber traps.

The traps were filled with 4% formaldehyde for 48 hours open. Animals collected in traps soil were kept in a 70° solution of alcohol and were determined in the laboratory. Since not all specimens could be determined by the level of species, their classification was made on gender, family, order or class.

RESULTS AND DISCUSSION

The material analyzed included a total of 398 individuals, of which 303 belonging to the useful fauna and 95 individuals belonging to harmful fauna.

Useful fauna

The 303 samples taken in two periods - in March and April, belonging to 10 systematic units, grouped in a class-*Insecta*. Class *Insecta* is represented by five orders - *Collembola*, *Heteroptera* with Fam. *Nabidae*, with *Hymenoptera* Fam. *Formicidae*, *Coleoptera* with Fam. *Carabidae*, *Scarabaeidae*, *Staphilinidae* and *Diptera* with Fam. *Sciaridae* and *Chironomidae*.

Table 1

Relative numerical abundance of the useful mobile fauna from maize crop - Clinceni 2007

Ord. no.	Group and specie	21.03.2007 - 23.03.2007		16.04.2007 - 18.04.2007	
		No.	Ab. (%)	No.	Ab. (%)
CLASS *INSECTA*					
1	Ord. *COLLEMBOLA*	0	0.00	85	48.85
Ord. *HETEROPTERA* Fam. *NABIDAE*					
2	*Nabis ferus* L.	1	0.78	2	1.15
Ord. *HYMENOPTERA*					
3	Fam. *FORMICIDAE*	22	17.05	43	24.71
Ord. *COLEOPTERA* Fam. *CARABIDAE*					
4	*Pterostichus cupreus* L.	3	2.33	1	0.57
5	*Pterostichus niger* Schall.	5	3.88	1	0.57
Fam. *SCARABEIDAE*					
6	*Aphodius luridus* Fabritius	3	2.33	1	0.57
7	*Pleurophorus caesus* Panz.	4	3.10	4	2.30
8	Fam. *STAPHYLINIDAE*	5	3.88	3	1.72
Ord. *DIPTERA*					
9	Fam. *SCIARIDAE*	4	3.10	1	0.57
10	Fam. *CHIRONOMIDAE*	82	63.57	33	18.97
TOTAL USEFUL FAUNA		129	100.00	174	100.00

Table 2

Relative numerical abundance of the harmful mobile fauna from maize crop - Clinceni 2007

Ord. no.	Group and specie	21.03.2007 - 23.03.2007		16.04.2007 - 18.04.2007	
		No.	Ab. (%)	No.	Ab. (%)
CLASA *INSECTA* Ord. *ORTOPTERA* *Fam. GRYLLIDAE*					
1	*Gryllus desertus* Pall	2	4.35	3	6.12
Ord. *COLEOPTERA* Fam. *CARABIDAE*					
2	*Zabrus tenebrioides* Goeze.	5	10.87	7	14.29
3	*Harpalus aeneus* Mull.	1	2.17	4	8.16
4	*Harpalus distinguendus* Duft.	2	4.35	1	2.04
5	*Harpalus pubescens* Mull.	6	13.04	1	2.04
6	*Bembidion properans* Steph.	2	4.35	0	0.00
Fam. *ELATERIDAE*					
7	*Agriotes pilosus* Panz.	3	6.52	1	2.04
8	*Drasterius bimaculatus* Rossi.	5	10.87	11	22.45
Fam. *TENEBRIOIDAE*					
9	*Opatrum sabulosum* L.	2	4.35	4	8.16
Fam. *SCARABAEIDAE*					
10	*Pentodon idiota* Ross.	1	2.17	1	2.04
Fam. CHRYSOMELIDAE					
11	*Phyllotreta nemorum* L.	6	13.04	2	4.08
12	*Chaectonema tibialis* Illi.	2	4.35	2	4.08
Fam. *CURCULIONIDAE*					
13	*Tanymecus dillaticollis* Gyll.	1	2.17	1	2.04
Fam. *ANTHICIDAE*					
14	*Anthicus hispidus* Ross.	7	15.22	11	22.45
Ord. *DIPTERA* Fam. *BIBIONIDAE*					
15	*Bibio hortulanus* L.	1	2.17	0	0.00
TOTAL HARMFUL FAUNA		46	100.00	49	100.00

In March 2007 there were 129 specimens collected, and in April 2007 were 174 specimens collected.

Useful fauna has been revealed by Fam. Fam Chironomidae to 115 specimens, Formicidae with 65 specimens and 85 specimens Order Collembola.

The relative abundance order to:

- Fam. *Chironomidae* has 63.57% relative abundance in March and 18.97% in April;
- Fam. *Formicidae* has the relative abundance of 17.05% in March and 24.71% in April;
- Order Collembola has 0% relative abundance in March and 48.85% in April;
- *Pleurophorus caesus* Panz. has relative abundance 3.10% in March and 2.30% in April;
- *Pterostichus cupreus* L. has relative abundance in March 2.33% and 0.57% in April;
- *Pterostichus niger* Schall. has relative abundance 3.88% in March and 0.57% in April;
- *Carabus canceollatus* L. has in March relative abundance 2.35% and 3.37% in April;
- *Nabis ferus* L. has 0.78% relative abundance in March and 1.15% in April;
- Fam. *Sciaridae* has relative abundance in March 3.10% and 0.57% in April.

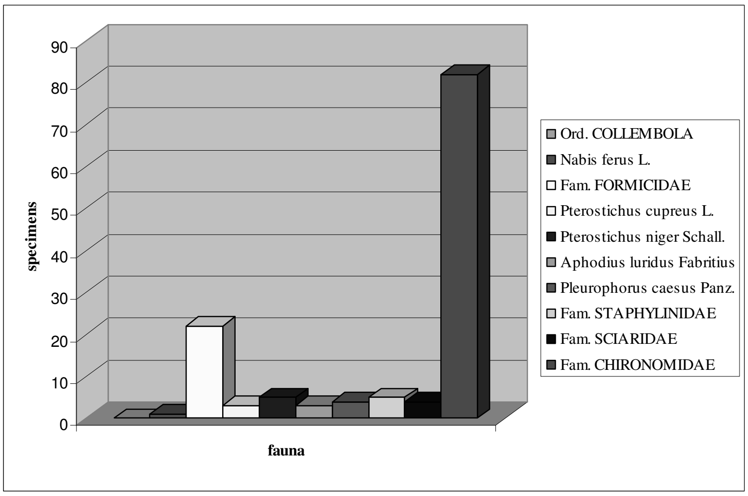


Fig. 1. Useful fauna of the mobile surface of maize crop Clinceni - March 2007

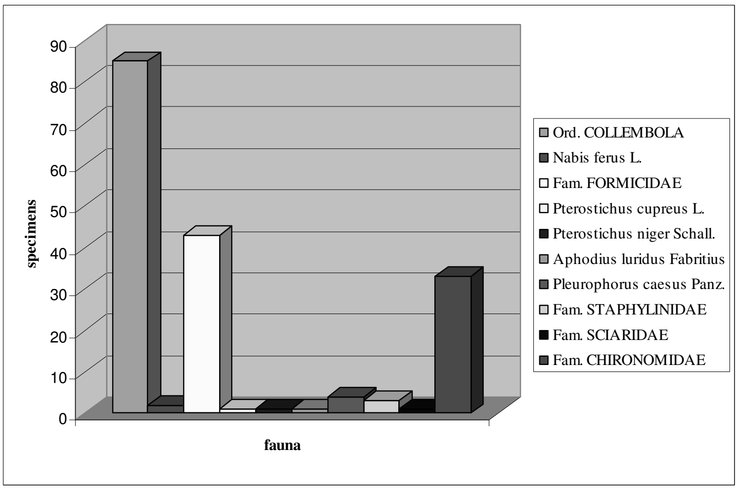


Fig. 2. Useful fauna of the mobile surface of maize crop Clinceni - April 2007

Harmful fauna

It included 15 taxons with a total of 95 specimens, grouped into one class - *Insecta*. Class *Insecta* was represented by three orders - the *Orthoptera* with Fam. *Gryllidae*, the Order *Coleoptera* with Fam. *Carabidae*, *Elateridae, Tenebrioidae, Chrysomelidae, Curculionidae* and *Anthicidae* and the Order *Diptera* with Fam. *Bibionidae.*

In March 2007, there were 46 specimens collected, and in April 2007 and 49 specimens were collected.

Harmful fauna is highlighted by *Zabrus tenebrioides* Goeze. with 12 specimens, *Harpalus pubescens* Mull. with 7 specimens, *Anthicus hispidus* Ross. with 18 specimens and *Phyllotreta nemorum* L. with 8 specimens collected.

The relative abundance order to:

- *Anthicus hispidus* Ross. has relative abundance 15.22% in March and 22.45% in April;
- *Zabrus tenebrioides* Goeze. has relative abundance 10.87% in March and 14.29% in April;
- *Drasterius bimaculatus* Rossi. has relative abundance 10.87% in March and 22.45% in April;
- *Harpalus pubescens* Mull. has relative abundance 13.04% in March and 2.04% in April;
- *Phyllotreta nemorum* L. has relative abundance 13.04% in March and 4.08% in April;

- *Agriotes pilosus* Panz. has relative abundance 6.52% in March and 2.04% in April;
- Opatrum sabulosum L. has relative abundance in March 4.35% and 8.16% in April;
- *Tanymecus dilaticollis* Gyll. has relative abundance 2.17% in March and 2.04% in April.

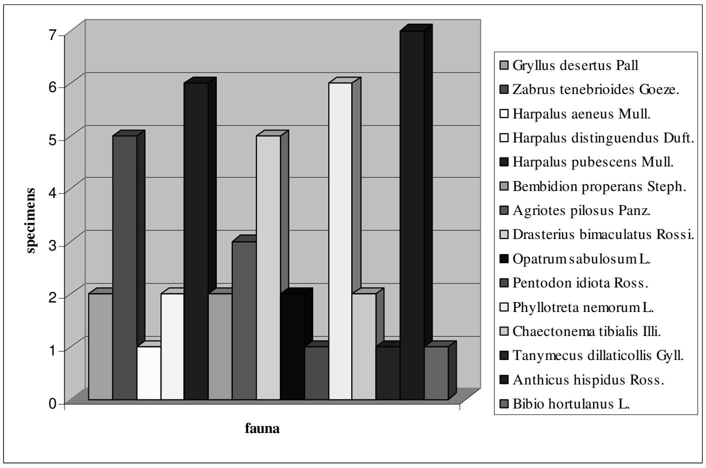


Fig. 3. Mobile harmful fauna on the soil surface of maize crop Clinceni - March 2007

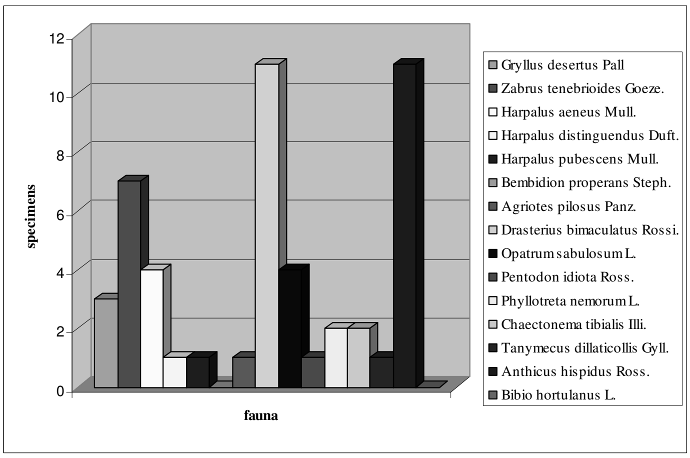


Fig. 4. Mobile harmful fauna on the soil surface of maize crop Clinceni – April 2007

CONCLUSIONS

1. Research was conducted Clinceni area in March and April in 2007, obtaining useful information on harmful fauna, by Barber traps method.
2. The useful fauna structure in March climate is favorable to *Chironomidae* which had an abundant number of 82 specimens and species *Pterostichus niger* Schall. the numerical abundance of five copies, and in April the climate is favorable to *Formicidae*, which had an abundant number of 43 specimens and to *Collembole* with numerical abundance of 85 specimens.
3. In the structure of harmful fauna, in March the climate is suitable species *Phyllotreta nemorum* L., which has an abundance of 6 numerical specimens, *Harpalus pubescens* Mull. 6 specimens and *Agriotes pilosus* Panz. 3 specimens and in April the climate is favorable for the species *Opatrum sabulosum* L. 4 specimens, *Drasterius bimaculatus* Rossi species with 11 specimens and species *Anthicus hispidus* Ross. 11 specimens.

REFERENCES

1. Iamandei Maria, Tr. Manole, Gr. Mărgărit, 1999-2000. *Spectrul şi răspândirea speciilor de Elateridae în România*. An. ICCP Bucureşti, Vol. XXX (pp. 89-99).
2. Manolache C., Gh. Boguleanu, 1997. *Entomologie agricolă*. Ed. Didactică şi Pedagogică, Bucureşti.
3. Mărgărit Gr., Tr. Manole, Maria Iamandei, Mariana Teleman, 1999. *Fauna spectrum and spreading of insects from Elateridae (Coleoptera) in Romania*. Romanian Agricultural Research, nr. 11-12.
4. Roşca I., T. Petrache, Gr. Mărgărit, 2007. *Biodiversitatea în agroecosistemele de porumb (entomofauna în câmpurile de porumb)*. Analele Institutului pentru Protecția Plantelor, vol. XXXX IV (pp. 7-19).
5. Popov C., 2004. *Cercetări privind protecția cerealelor, leguminoaselor pentru boabe, plantelor tehnice şi furajere față de agenții patogeni şi dăunători, efectuate în anul 2003*. Probl. De prot. Plant., XXXII, 2 (pp. 9-156).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

CONSTITUTION OF USEFUL AND HARMFUL FAUNA OF MAIZE CROP FROM CLINCENI, DOMNESTI, BRAGADIRU IN 2007

GEORGETA COSTEA*, G. MĂRGĂRIT, V. CIOCHIA*, I. ROŞCA*****

*University of Bucharest
**Research and Development Institute of Plant Protection
***University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *useful fauna, harmful fauna, maize, soil survey*

Abstract

The research aimed to know the structure of phytophagous and entomophagous fauna of maize crop from Clinceni, Domnesti, Bragadiru, Ilfov, 2007. The material analyzed comprises a total of 282 individuals, of which 138 belonging to the useful fauna and 144 individuals belonging harmful fauna. Entomophagous fauna are represented by species Allolobophora rosea L. si Fam. Formicidae. Phytophagous fauna are represented by species, Agriotes ustulatus Schall., Tanymecus dilaticollis Gyll., Opatrum sabulosum L.

INTRODUCTION

The research was conducted in Bucharest and the surrounding area in order to study the structure and biodiversity of harmful and useful fauna of maize agroecosystems in 2007.

MATERIAL AND METHODS

Harmful and useful fauna was collected in 12 to 13 March 2007 soil survey method (25x25x30 cm). The research points were located at Clinceni, Domnesti and Bragadiru (Ilfov).

RESULTS AND DISCUSSION

The material examined comprises 282 individuals, of which 138 belonging to the harmful fauna and flora belonging to 144 individuals useful fauna. Looking at the overall relative abundance, harmful fauna is 48.94% and 51.06% have useful fauna.

Table 1

Numerical abundance of the useful fauna of maize from Clinceni, Domnesti, Bragadiru - 2007

Ord. no.	**Group and specie**	**Clinceni**	**Domneşti**	**Bragadiru**	**Total fauna**
		Ab.no.	**Ab.no.**	**Ab.no.**	
CLASS *INSECTA* Ord. *HYMENOPTERA*					
1	Fam. *FORMICIDAE*	5	7	6	18
Ord. *COLEOPTERA* Fam. *CARABIDAE*					
2	*Pterostichus cupreus L.*	2	1	2	5
3	*Calosoma auropunctata* L.	2	1	3	6
Fam. *SCARABAEIDAE*					
4	*Pleurophorus caesus* Panz.	2	1	3	6
5	*Aphodius luridus* Fabritius	1	2	2	5
CLASS *MYRIAPODA* Fam. *LITHOBIIDAE*					
6	*Lithobius forficatus* L.	1	2	3	6
7	Fam. *GEOPHILIDAE*	2	3	0	5
CLASS *ARACHNIDA* Ord. *ARANEAE*					
8	*Fam. LYCOSIDAE*	7	6	4	17
CLASS *OLIGOCHAETA* Fam. *LUMBRICIDAE*					
9	*Lumbricus terrestris* L	6	2	4	12
10	*Allolobophora caliginosa* L.	7	6	11	24
11	*Allolobophora rosea* L.	5	7	10	22
Fam. *ENCHYTRAEIDAE*					
12	*Fridericea bulbosa Rossa.*	3	1	5	9
13	*Fridericea bistosa Levester*	0	1	2	3
TOTAL USEFUL FAUNA		43	40	55	138

Table 2

Numerical abundance of the harmful fauna of maize from Clinceni, Domnesti, Bragadiru - 2007

Ord.No.	Group snd specie	Clinceni	Domneşti	Bragadiru	Total fauna
		Ab.no.	Ab.no.	Ab.no.	
CLASS *INSECTA*					
Ord. *ORTHOPTERA*					
1	*Gryllus desertus* Pall.	2	1	2	5
Ord. *HETEROPTERA*					
2	*Tritomegas bicolor* L.	3	2	1	6
Ord. *COLEOPTERA*					
Fam. *CARABIDAE*					
3	*Zabrus tenebrioides* Goeze.	5	4	6	15
4	*Harpalus pubescens* Mull.	4	4	5	13
5	*Harpalus distinguendus* Duft.	4	3	6	13
6	*Harpalus aeneus* Mull.	2	3	3	8
7	*Bembidion properans* Steph.	2	3	2	7
Fam. *ELATERIDAE*					
8	*Agriotes ustulatus* Schall.	4	3	5	12
9	*Agriotes obscurus* L.	2	4	4	10
Fam. *TENEBRIOIDAE*					
10	*Opatrum sabulosum* L.	4	3	4	11
Fam. *ANTHICIDAE*					
11	*Anthicus hispidus* Ross.	7	6	11	24
Fam. *CURCULIONIDAE*					
12	*Tanymecus dillaticollis* Gyll.	5	4	3	12
Ord. *LEPIDOPTERA*					
13	Fam. *NOCTUIDAE*	1	2	1	4
Ord. *DIPTERA*					
14	*Bibio hortulanus* L.	3	0	1	4
CLASS *ARACHNIDA*					
15	*Trombidium holosericeum* F.	6	3	1	10
TOTAL HARMFUL FAUNĂ		54	45	55	144

Useful fauna

The 138 samples taken in three villages belonging to 13 systematic units, grouped into four classes - *Insecta, Myriapoda, Arachnida*, and *Oligochaeta*. Class *Insecta* is represented by two orders - *Hymenoptera* with Fam. *Formicidae* and *Coleoptera* with Fam. *Carabidae* and *Scarabaeidae*. Class *Myriapoda* has two families: *Lithobiidae* and *Geophilidae*. Class *Arachnida* Ord. *Araneae* is the Fam. *Lycosidae*. Class *Oligochaeta* has two families: *Lumbricidae, Enchytraeidae*.

Among the towns, the first place is Bragadiru with 55 individuals caught, Clinceni with 43 individuals and Domnesti with 40 individuals. In Clinceni, Domnesti and Bragariru are present species *Allolobophora rosea* L., a significant numerical abundance of 5 individuals, 7 individuals and 10 individuals, respectively.

In Clinceni and Domnesti the presence of Fam. *Geophilidae* are observed with an abundant number of 2 and 3 individuals, respectively.

The arrangement to the numerical abundance of the useful fauna is:

- *Allolobophora caliginosa* L. has overall numerical abundance 7 in Clinceni, 6 in Domnesti and 11 in Bragadiru;
- *Allolobophora rosea* L. has overall numerical abundance 5 in Clinceni, 7 in Domnesti and 10 in Bragadiru;
- Fam. *Formicidae* has overall numerical abundance 5 in Clinceni, 7 in Domnesti and 6 in Bragadiru;
- Fam. *Lycosidae* has overall numerical abundance 7 in Clinceni, 6 in Domnesti and 4 in Bragadiru;
- *Pleurophorus caesus* Panz. has overall numerical abundance 2 in Clinceni, 1 in Domnesti and 3 in Bragadiru;
- *Calosoma auropunctata* L. has overall numerical abundance 2 in Clinceni, 1 in Domnesti and 3 in Bragadiru.

Harmful fauna

It includes 15 taxons with a total of 144 specimens, grouped into two classes - *Insecta* and *Arachnida*. Class Insecta is represented by six orders - *Orthoptera* with Fam. *Gryllidae, Heteroptera* with Fam. *Cydnidae*, the Order *Coleoptera* Fam. *Carabidae, Elateridae, Tenebrioidae, Scarabaeidae, Curculionidae* and *Anthicidae*, Order *Lepidoptera* with Fam. *Noctuidae* and the Order *Diptera* Fam. *Bibionidae*. Class is subclass *Arachnida Acari*.

Among the towns, Bragadiru is in first place with 55 specimens, Clinceni second with 54 specimens and third, with 45 specimens Domnesti.

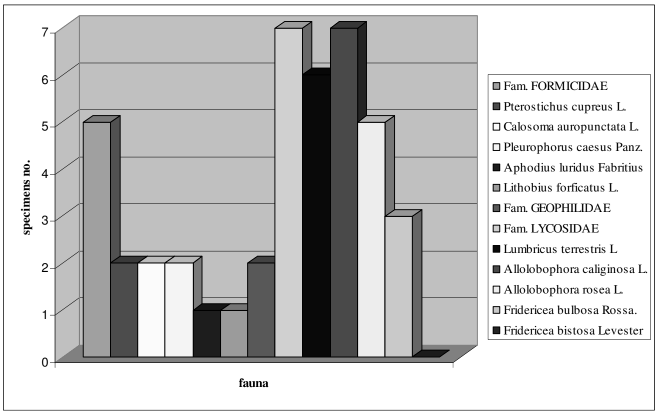


Fig. 1. Useful fauna of maize crop from Clinceni 2007

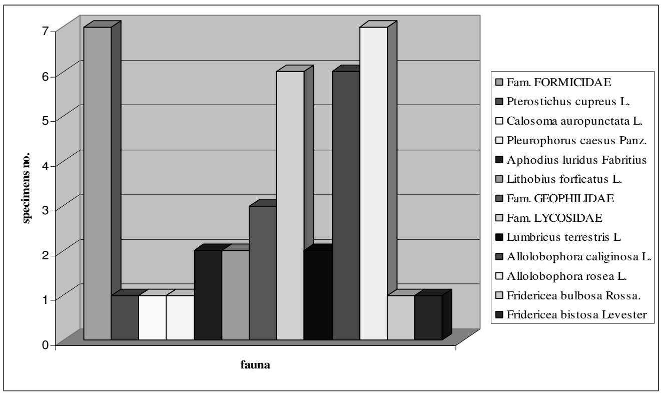


Fig. 2. Useful fauna of maize crop from Domnesti 2007

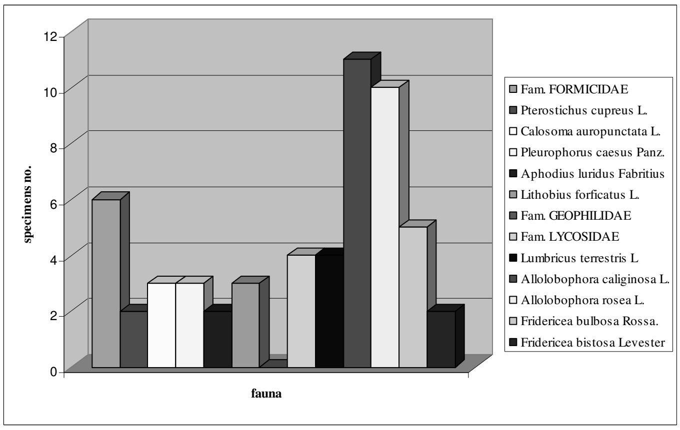


Fig. 3. Useful fauna of maize crop from Bragadiru 2007

In Clinceni, Domnesti and Bragadiru *Anthicus hispidus* Ross specie are present, with a significant numerical abundance of 7 specimens, 6 specimens respectively 11 specimens, and *Agriotes ustulatus* Schall species. with a significant numerical abundance of 4 specimens, 3 specimens and respectively 5 specimens.

The arrangement to the numerical abundance of the harmful fauna is:

- *Anthicus hispidus* Ross. has overall numerical abundance 7 in Clinceni, 6 in Domnesti and 11 in Bragadiru;
- *Zabrus tenebrioides* Goeze. has overall numerical abundance 5 in Clinceni, 4 in Domnesti and 6 in Bragadiru;
- *Harpalus pubescens* Mull. has overall numerical abundance 4 in Clinceni, 4 in Domnesti and 5 in Bragadiru;
- *Harpalus aeneus* Mull. has overall numerical abundance 2 in Clinceni, 3 in Domnesti and 3 in Bragadiru;
- *Agriotes ustulatus* Schall. has overall numerical abundance 4 in Clinceni, 3 in Domnesti and 5 in Bragadiru;
- *Tanymecus dilaticollis* Gyll. has overall numerical abundance 5 in Clinceni, 4 in Domnesti and 3 in Bragadiru;
- *Opatrum sabulosum* L. has overall numerical abundance 4 in Clinceni, 3 in Domnesti and 4 in Bragadiru;
- *Agriotes obscurus* L. has overall numerical abundance 2 in Clinceni, 4 in Domnesti and 4 in Bragadiru.

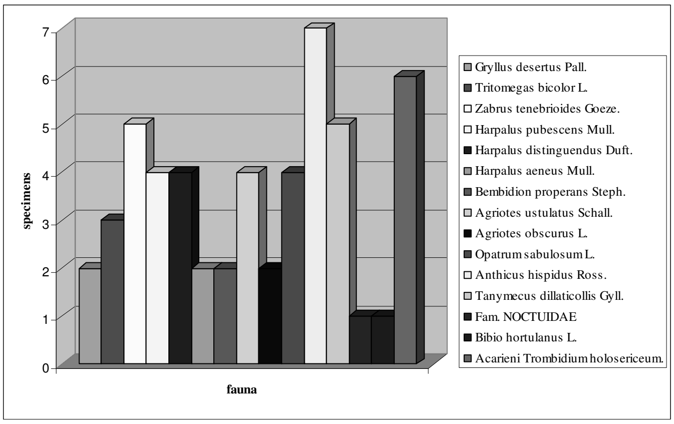


Fig. 4. Harmful fauna of maize crop from Clinceni 2007

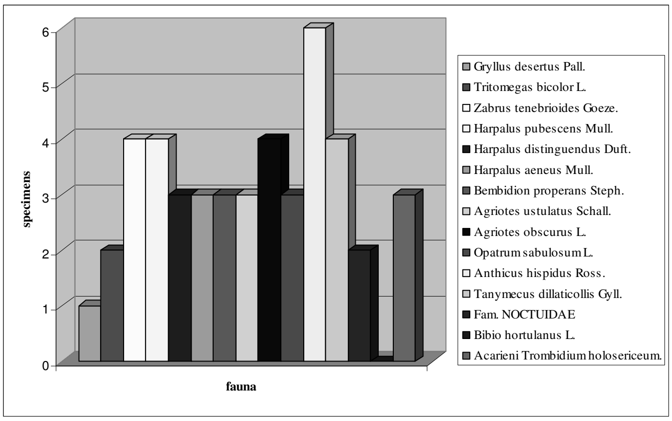


Fig. 5. Harmful fauna of maize crop from Domnesti 2007

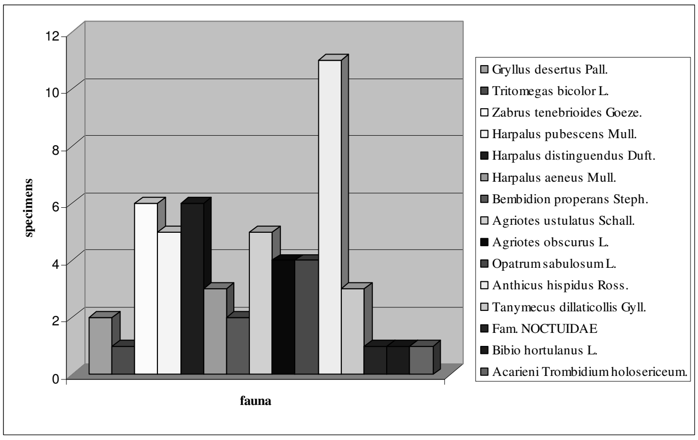


Fig. 6. Harmful fauna of maize crop from Bragadiru 2007

CONCLUSIONS

1. Research was conducted in Clinceni, Domnesti and Bragadiru in 2007, obtaining data on the useful and harmful fauna by the soil survey method.
2. Into the useful fauna structure was observed the presence of the Fam. *Formicidae* with numerical abundance in Clinceni 5, in Domnesti 7 and in Bragadiru 6, *Pleurophorus caesus* Panz. species is the numerical abundance of 2 in Clinceni, 1 in the Domnesti, 3 in Bragadiru.
3. Into the harmful fauna structure was observed the presence of the species *Zabrus tenebrioides* Goeze. with numerical abundance in Clinceni 5, in Domnesti 4, in Bragadiru 6, *Tanymecus dilaticollis* Gyll species with

numerical abundance in Clinceni 5, in Domnesti 4 and 3 in Bragadiru, next Opatrum sabulosum L., species with numerical abundance in Clinceni 4, 3 in Domnesti and 4 in Bragadiru.

REFERENCES

1. Galani G., Ileana Bucur, Elena Trotuş, N. Vilau, Ana-Maria Andrei, Lucia Sandu, Elena Hera, Maria Tudorache. *Cercetări preliminare privind protecția integrată a culturii de porumb*. Analele Institutului pentru Protecția Plantelor, vol. XXXIV (pp. 129-141).
2. Manolache C., Gh. Boguleanu 1997. *Entomologie agricolă*. Ed. Didactică şi Pedagogică Bucureşti.
3. Mărgărit Gr., Tr. Manole, M. Berchez, Chireceanu Hondru, Manuela Constantina Dănulescu, 1993. *Spectrul speciilor de insecte din familia Elateridae şi răspândirea acestora în unele zone şi culturi agricole*. An. ICCP Bucureşti, Vol. XXVI (pp. 65-71).
4. Roşca I., T. Petrache, Gr. Mărgărit, 2007. *Biodiversitatea în agroecosistemele de porumb (entomofauna în câmpurile de porumb).* Analele Institutului pentru Protecția Plantelor, vol. XXXXIV (pp. 7-19).
5. Roşca I., Rada Istrate, 2001. *Prognoza, avertizarea şi carantina fitosanitară a dăunătorilor din agricultură.* Ed. Universității de Ştiințe Agronomice şi Medicină Veterinară, Bucureşti, Curs.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

RESEARCH REGARDING BIOLOGY OF WESTERN MAIZE ROOTWORM (*DIABROTICA VIRGIFERA VIRGIFERA* LE CONTE) IN SATU MARE COUNTY

N. GOGA*, I. ROŞCA**

*Agricultural Research and Development Station of Livada
**University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *Western Maize Rootworm, maize, biology*

Abstract

In Romania, the pest Diabrotica virgifera virgifera (Western Maize Rootworm) was spread, from the first recorded in the country (1996) from Arad Country, toward East and North-East, being recorded damages in maize fields. Experiments and surveys were conducted in maize field in Pir village, Satu Mare County, where the population of Diabrotica virgifera virgifera was increased during the last 3 years through adult attraction in maize monoculture field, following the globally used method. First the land was divided into 36 plots each plot was examined spread in field of Diabrotica virgifera larvae populations. Sowing was done on April 28, 2010. We followed the appearance of the pest, the larva and adult stage, in maize monoculture, to determinate the flight of adults, larvae hatch, registering the presence of larvae in the soil and then around plant roots, evolution of the number of adults/plant, as well as production data. Researches which were done have the aims to give more knowledge about the biology of pest in North-Western Romanian conditions. There are no differencence between pest biology in Satu Mare County with data known from literature in Romania and any else in the world.

INTRODUCTION

Pest, *D. virgifera*, native of Central America, from its entry into Europe in 1992 [1], is widespread at present an area of 500,000 km^2, and in Romania, from reporting in 1996, it has expanded gradually throughout the western half [3,2], to the east and northeast, and if in the south-west of Romania, the populations gradually declined, now known pest population growth in Satu Mare County. Research undertaken has sought to further clarification of a series of data on the biology of this dangerous pest, date of occurrence and duration of larvae in the field, their position in relation to roots, adults on the occurrence and during the flight, the potential harmful pests to become a key part of culture in terms of finding new host plants. Presentation works, or evaluation of estimating potential pest in the conditions in Romania have managed to attract the attention of the scientific world on this important pest. The research undertaken has sought to clarify a series of data on the biology of this dangerous pest, date of occurrence and duration of larvae in the field, their position in relation to roots, occurrence of adults and duration of the flight, the potential for pests to become a key pest of the crop in terms of finding new host plants. It is the time and place to show that the pest has received a relatively low interest from the scientific community, being the subject of several PhD theses completed research programs through grants awarded by the National Council of Scientific Research from Consiliul National al Cercetarii Stiintifice din Invatamantul Superior (CNCSIS), or programs funded by the Ministry of Agriculture and Rural Development are sporadic and under funded and perhaps most importantly are not valued at their end.

MATERIAL AND METHODS

Experiments and surveys were conducted in a maize field in the Pir village, Satu Mare County, where the population of *Diabrotica virgifera virgifera* was increased during the last 3 years through attraction of adult in maize monoculture field, with methods used globally. Given that the pest is not uniformly spread in field, the experimental field was divided into 36 plots of 10 m long and 4.2 m wide (six rows maize), in four repetitions and was examined in field spreading of *Diabrotica virgifera* populations' larvae and adults. Sowing was done on April 28, 2010. We observed the appearance of the pest, the larva and adult stage, in maize monoculture from May to the end of the flight of adults, hatching of larvae was registered by analysis of 15 maize plants in 4 repetitions, then noting the presence of larvae in the soil around plant roots or in surrounding area, registering also the evolution of the number of adults/plant, as well as effects on maize plant (goose neck).

RESULTS AND DISCUSSION

Larvae surveys were made of the entire experimental field on 15 June and 6 July, the first evaluation of the pest was done on June 15, taking into account the number of WCR larvae on first and second age/plant. It were examined 15 plants/plot, by taking a sample of soil of 20/20/20 cm around the plant and shaking the earth, and identified larvae and counted the pest density. There are relatively few larvae of WCR/plant to Pir. Larvae, on first and second age, which were identified, has to be considered that are close to the roots when they are take off with plant. A second evaluation of the pest was done on July 6. Larvae, on second and third age and pupae, which were identified, have to be considered that are spread a little bit further on plant roots. The results presented in table 1 and 2 show first that there is a no uniform spread of the pest larvae in field and on the other hand that the number of larvae tends to decrease with time, probably because part of them they pass from first stage to 2^{nd} and 3^{rd}, even in pupae stage and part of new hatched larvae does succeeded to arrive maize roots being higher and therefore more visible. Number of WCR larvae was between 0 and 22/plant in June 15 and between 1.33 and 6.6 in July 06, the economic threshold of the pest (2 larvae/plant) was recorded in 27 plots on 15 June and 24 plots in July 06. Number of registered larvae decreased with 39.44%. In the same plots the number of larvae can grow up to 5.5 larvae/plant or fall by up to 17.8 larvae/plant. Regarding the date of apparition of the first larvae, in the year 2010 found an earlier eggs hatch, as if in 2008 the first larvae appeared in the second decade of June, and in 2009 in the first decade, in 2010 appeared probably in late May, beginning of June. Larvae attack on the roots was examined in 30 July, according to scale (Oleson and Tollefson), taking into account the root lesions. Were examined 15 plants/plot, registering pest damage caused on roots. The data presented in table 3, shows that the WCR attack was in general low, averaging 1.31 on a scale of assessment taken into account. On 30 July was made a survey on the number of adult WCR/plant (all plants from a row were examined first and second ear in each plot), the data presented in table 4 shows that there were 1.78 adult WCR/first cob (from 1.64 to 1.9), table 4 and 0.35 for the second cob which has just started silk (from 0.21 to 0.49), table 5, it has to be underline that economic threshold level of pest, for next year (one adult/cob), are recorded referring WCR adults, which impose for the next year a careful survey of larvae. Symptoms of roots attack (goose neck) were measured at harvest, October 04, all plants are appreciated in a row in each plot (table 6). It is found that 14.96% of plants have recorded a variable degree of attack due to the WCR larvae attack on roots. There is no uniformity in the spread of WCR in the field, as larvae or adults, as well as the damages.

Table 1

Number of larvae/plant (15 June 2010)

1	0	12	3	0	0	0	2	12
1	4	19	16	3	12	2	1	3
2	1	6	3	2	4	5	22	8
2	3	4	2	7	5	6	7	0

Table 2

Number of larvae/plant (06 July 2010)

1.87	2.8	1.33	3.13	2.67	1.4	1.33	1.93	2.33
5.93	1.67	5.87	3.07	1.47	5.33	4.07	6.6	1.73
1.47	0.93	1.53	2.27	3.67	2.2	2.4	4.2	3.27
3.6	1.47	3	4.2	5.53	2.07	5.53	2.93	4.67

Table 3

Note of attack (Oleson Tollefson scale) (30 July 2010)

1.5	1	1.5	1.75	0.75	1	1.25	2.75	0
0	1.25	2	1.75	1.5	2.5	1.25	0.75	1.5
1	1	1.75	0	1.5	1.75	1	1.5	2
2.25	1.75	1	1	0.5	1.5	0	1.75	1.75

Table 4

Number of adults on 1st ear (30 July 2010)

1.86	1.86	1.8	1.88	1.9	1.87	1.88	1.7	1.8
1.88	1.69	1.72	1.68	1.65	1.7	1.64	1.85	1.81
1.88	1.72	1.74	1.85	1.73	1.71	1.83	1.84	1.77
1.8	1.75	1.76	1.85	1.8	1.79	1.76	1.69	1.78

Table 5

Number of adults on 2nd ear (30 July 2010)

0.47	0.47	0.41	0.44	0.25	0.45	0.42	0.35	0.41
0.37	0.3	0.32	0.28	0.21	0.31	0.29	0.34	0.34
0.4	0.25	0.49	0.26	0.25	0.43	0.33	0.3	0.33
0.33	0.44	0.33	0.4	0.4	0.32	0.29	0.39	0.37

Table 6

Percentage of plants with goose neck symptom (04 October 2010)

20.6	11.8	1.7	0	18.2	7	0	9.7	0
2.3	2.3	0	0	68.7	0	0	1.5	3
58.8	28.8	28	51.7	0	58.8	0	0	6.7
0	12.9	80	2.1	51.5	0	0	12.5	0

CONCLUSIONS

1. There is no uniformity in the spread of pests in the field, taking into consideration the larvae or adults and damages on roots or plants whose roots have been attacked by larvae.
2. There are no significant differences related to the biology of the pest in the north west of Romania and the rest of the country or other countries where the pest is present.

ACKNOWLEDGEMENTS

The research was supported by the ALCEDO S.R.L.

REFERENCES

1. Baca F. et all, 1995. *Western maize rootworm Diabrotica virgifera virgifera Le Conte.* In: Kukuruzna zlatica *Diabrotica virgifera* Le Conte, Drustvo za zastitu bilja Srbije, Beograd.
2. Valsan Dacia, Florica Gogu, 2002. *Monitoring of Diabrotica virgifera virgifera Le Conte in Romania, in 2002*. In: IWGO-Newsletter, XXIII, 2 (pp. 24).
3. Vonica I., 1996. *Monitoring for Diabrotica virgifera in Romania*. In: IWGO – Newsletter, XVI, 2 (pp. 15-16).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

HARMFUL INVERTEBRATE FAUNA OF HOP IN CLUJ-NAPOCA AREA

H. BUNESCU*, A. DINUȚĂ, TEODORA FLORIAN*, I. OLTEAN*, ILONKA BODIŞ***

*University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca
**Regional Environmental Protection Agency of Cluj-Napoca

Keywords: *invertebrate, harmful, fauna, hop*

Abstract

The research concerning the hop's harmful invertebrate fauna was carried out between 1995-2010 in the ecological conditions of Cluj-Napoca, on the cultivated hop, in the Hop's Collection of Discipline of Field Crop and on spontaneous hop. The aim of the research was to study the harmful invertebrate fauna of hop (Humulus lupulus L.), following a classicalmethodology. The determination of the biological collected material was made in the Laboratory of Entomology/Zoology of USAMV Cluj-Napoca.

INTRODUCTION

Although the cultivated hop surface has strong by decreased in Romania during the last years, hop remains the main raw material for beer industry [6].

Research concerning the harmful invertebrates of hop gardens was performed, both in different countries [3, 4] and in Romania [1, 2, 5, 6], which revealed the presence of some harmful species, on the subterranean and superterrestrial plant organs. Some species are specific to hops (ex. *Phorodon humuli*) while others are polyphagous.

Our research aimed to reveal, by particular methods of zoological/entomological investigation, the harmful invertebrate fauna structure and morphology, also the harmful potential in the studied ecosystems. The structure of harmful invertebrate complex was studied, respectively the population species in these ecosystems.

MATERIAL AND METHODS

The research concerning the harmful invertebrate fauna of hop, was carried out between 1995-2010, in the Collection of Hop at Discipline of Filed Crop at UASVM of Cluj-Napoca and on spontaneous hop. Following a standard methodology, observations and sample collectings were made. Every year there were made observations by visual control on the species from hop gardens. The biological material was collected both from the plants and soil.

To collect the superterrestrial biological samples, two methods were used: the direct collect of species by hand, using delicate brushes or fine pincers, from the different organs (offshoots, stems, leaves, flowers, cones) of hop infected plants and the shaking-down of the host-plants on a tarpaulin, for a better objectiveness, by random collecting from plants, pursuiting hereof and noting the observations. Often, the presence of pests was signaled by pronounced damages.

The invertebrates from soil were collected by assaying of soil samples, extracting the biotic part from a pail or a vase with water in which the sample was introduced.

The collected material was introduced in small bottles (with etilic alcohol 70% or formol 4%) or different bags, boxes (plastic, paper) which has been labeled and the identifying of the material was made in the Laboratory of Entomology-Zoology from Faculty of Agriculture at USAMV of Cluj-Napoca.

After the species identification, the collected material was prepared and conserved. The species identification was made aiding by literature descriptions, comparing with images and aiding by identification keys.

RESULTS AND DISCUSSION

a) PESTS OF SUBTERRANEAN ORGANS

After the analysis of collected material from the studied ecosystems, there were identified the following 8 species (Table 1):

❖ **Phyll.** ***ARTHROPODA***

- **Cls.** ***INSECTA***

➢ **Ord.** ***COLEOPTERA***

- Fam. ***MELOLONTHIDAE*** **-** *Melolontha melolontha* Linné (larvae - white worms)

- **Fam.** ***CURCULIONIDAE*** - *Otiorrhynchus ligustici* Linné (alfalfa scout beetle)

- **Fam.** ***ELATERIDAE*** - *Agriotes* spp. (wireworms)

➢ **Ord.** ***LEPIDOPTERA***

- **Fam.** ***HEPIALIDAE*** - *Triodia sylvina* Linné (the orange swift)

- **Fam.** ***NOCTUIDAE*** - Agrotis (*Scotia*) *segetum* Denis et Schiffermüller (the turnip moth); *Hydraecia micacea* Esper (the rosy rustic)

➢ **Ord.** ***ORTHOPTERA***

- **Fam.** ***GRYLLOTALPIDAE*** - *Gryllotalpa gryllotalpa* Linné (the mole cricket)

➢ **Ord.** ***DIPTERA***

- **Fam.** ***ANTHOMYIDAE*** - *Delia platura* Meigen (the seedcorn maggot)

Table 1

Harmful invertebrate fauna of hop's subteranean organs in studied ecosystems (Cluj-Napoca, 1995-2010)

Phyllum	Class	Order	Family	Species
ARTHROPODA	INSECTA	COLEOPTERA	MELOLONTHIDAE	*Melolontha melolontha* Linné
			CURCULIONIDAE	*Otiorrhynchus ligustici* Linné
			ELATERIDAE	*Agriotes* spp.
		LEPIDOPTERA	HEPIALIDAE	*Triodia sylvina* Linné
			NOCTUIDAE	Agrotis (*Scotia*) *segetum* Denis et Schiffermüller (the turnip moth); *Hydraecia micacea* Esper
		ORTHOPTERA	GRYLLOTALPIDAE	*Gryllotalpa gryllotalpa* Linné
		DIPTERA	ANTHOMYIDAE	*Delia platura* Meigen

b) PESTS OF SUPERTERRESTRIAL ORGANS

The study by analysis of collected material from cultivated and spontaneous hops, showed that the following 11 species were identified (Table 2):

❖ **Phyll.** ***MOLLUSCA***

- **Cls.** ***GASTROPODA***

➢ **Ord.** ***STYLLOMATOPHORA***

- **Fam.** ***AGRIOLIMACIDAE*** - *Deroceras agreste* Linné (the field slug)

- **Fam.** ***HELICIDAE*** - *Helix pomatia* Linné (the Roman snail)

❖ **Phyll.** ***ARTHROPODA***

- **Cls.** ***ARACHNIDA***

➢ **Ord.** ***ACARI***

- **Fam. *TETRANYCHIDAE* -** *Tetranychus urticae* Koch (the red spotted spider mite)

- **Cls. *INSECTA***

➢ **Ord. *HOMOPTERA***

- **Fam. *APHIDIDAE* -** *Phorodon humuli* Schrank (the damson-hop aphid)

- **Fam.** ***ALEYRODIDAE*** - *Trialeurodes vaporariorum* Westwood (the greenhouse whitefly)

➢ **Ord. *COLEOPTERA***

- **Fam. *HALTICIDAE*** - *Psylliodes attenuata* Koch (the hemp flea beetle)

➢ **Ord. *LEPIDOPTERA***

- **Fam. *NOCTUIDAE*** - *Mamestra persicariae* Linné (the dot moth); *Hypena rostralis* Linné (the buttoned snout moth)

- **Fam. *PYRALIDAE*** - *Ostrinia nubilalis* Hübner (the European corn borer)

- **Fam. *TORTRICIDAE*** - *Adoxophyes reticulana* Hübner (the summer fruit tortrix moth)

- **Fam. *GEOMETRIIDAE*** - *Operophtera brumata* Linné (the winter moth)

➢ **Ord. DIPTERA**

- **Fam. *CECYDOMYIDAE*** - *Contarinia humuli* Theobald (the hop strig maggot)

CONCLUSIONS

1. After the developed research between 1995-2010 on cultivated and spontaneous hops, in ecological area of Cluj-Napoca, it has been observed that the complex of harmful invertebrate fauna of these ecosystems is represented by 19 different species.
2. Following the observations made on the biological material, it found out the presence of some harmful species belonging to the Phyllum **MOLLUSCA** and **ARTHROPODA**.
3. The most large harmful species are the insects (orders **HOMOPTERA**, **ORTHOPTERA**, **COLEOPTERA**, **LEPIDOPTERA**, **DIPTERA**), being separated in 2 categories: the pests of subterranean organs (8 species) and the ones of superterrestrial hop organs (8 species).

Table 2

Harmful invertebrate fauna of hop's superterrestrial organs in studied ecosystems (Cluj-Napoca, 1995-2010)

Phyllum	Class	Order	Family	Species
MOLLUSCA	GASTROPODA	STYLLOMATO-PHORA	AGRIOLIMACIDAE	*Deroceras agreste* Linné
			HELICIDAE	*Helix pomatia* Linné
ARTHROPODA	ARACHNIDA	ACARI	TETRANYCHIDAE	*Tetranychus urticae* Koch
	INSECTA	HOMOPTERA	APHIDIDAE	*Phorodon humuli* Schrank
			ALEURODIDAE	*Trialeurodes vaporariorum* Westwood
		COLEOPTERA	HALTICIDAE	*Psylliodes attenuata* Koch
		LEPIDOPTERA	NOCTUIDAE	*Mamestra persicariae* Linné; *Hypena rostralis* Linné
			PYRALIDAE	*Ostrinia nubilalis* Hübner
			TORTRICIDAE	*Adoxophyes reticulana* Hübner
			GEOMETRIIDAE	*Operophtera brumata* Linné
		DIPTERA	CECYDOMYIDAE	*Contarinia humuli* Theobald

REFERENCES

1. Bunescu H., 1998. *Cercetări privind morfologia, bioecologia şi combaterea păduchelui verde al hameiului, Phorodon humuli Schrank. Elaborarea unui sistem de combatere integrată*. USAMV Cluj-Napoca, Teză de doctorat.
2. Bunescu H., I. Oltean, M.M. Duda, D. Vârban, Ilonka Bodiş, Oana Pop, A. Dinuță, 2008. *Entomofauna din plantațiile de hamei în condițiile ecologice de la Cluj-Napoca (Entomofauna of hop gardens in Cluj-Napoca area)*. Al VI-lea Simpoz. "Actualități şi perspective în cultivarea şi valorificarea hameiului şi plantelor medicinale" (27-28.06.2008), Rev. Hameiul şi plantele medicinale, Anul XVI, Nr. 1-2 (31-32), Ed. AcademicPres, Cluj-Napoca (pp. 92-95).
3. Burgess A.H., 1964. *Hops. Botany, cultivation and utilization*. Leonard Hill, London (pp. 300).
4. Kohlman H., A. Kastner, 1975. *Der Hopfen*. Hopfen Verlag, Wolnzach (pp. 388).
5. Perju T., I. Ghizdavu, 1979. *Études sur la faune autochtone nuisible au houblon et sur les méthodes de lutte contre les principaux ravageurs de houblonnieres*. Bul. Institutului Agronomic Cluj-Napoca, Seria Agr., 33, Cluj-Napoca (pp. 87-122).
6. Salontai A.L. (coord.), Sevastița Muste, Maria Tofană, Carmen Puia, H. Bunescu, 2002. *Cultura Hameiului*. Ed. Risoprint, Cluj-Napoca (pp. 344).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

RESULTS OBTAINED IN THE BIOLOGICAL CONTROL OF *DIABROTICA VIRGIFERA VIRGIFERA* LARVAE

TEODORA FLORIAN, I. OLTEAN, H. BUNESCU, C.V. FLORIAN, ILONKA BODIS

University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca

Keywords: *pest, western maize root worm, biological control, bioproduct, maize*

Abstract

To establish a pest control strategies in an agroecosistem, the first requirement is the correct diagnosis and identification. In the literature there is much information about the chemical control of the species Diabrotica virgifera virgifera Le Conte. In biological control, which is the subject of the present article, we used the bioproduct "BIOBIT" based on Bacillus thuringiensis either as seed treatment or treatments on the vegetation.

In the experimental period, the larvae attack symptoms were manifested by the appearance of "goose neck", in control plot, the attack frequency being about 15.46% in 2008, 25.33% in 2009 and 26.88% in 2010. Biobit bioproduct applied only to the seed reduced the incidence of attack to 5.76% in 2008 (about 63% less compared to the control), 8.12% in 2009 (about 68% less compared to the control) and 6.23% in 2010.

INTRODUCTION

The pest *Diabrotica virgifera virgifera* Le Conte was accidentally introduced in Europe (1992) in Yugoslavia (Serbia) [8].

The Western maize root worm (*Diabrotica virgifera virgifera* Le Conte) has in his origin country, U.S.A., 1-2 generations per year and in Europe, the investigations of Camprag (1993 to 1994 in Yugoslavia) and Ioana Grozea (1998-2002 in Timis District - Romania) has established a generation per year [2, 3, 5].

Research on the biology, morphology and ecology of insects, in the ecological conditions of our country, have concluded that the species is monovoltine, wintering on egg stage [6].

The use of pathogenic organisms (viruses, bacteria, fungi) that cause illness and death of the insect is one of biological control methods. To control the maize pest *Diabrotica virgifera virgifera* Le Conte, was used bacterium *Bacillus thuringiensis* [4]. Of the 350 species of entomopathogenic fungi, *Beauveria bassiana* is the most important, parasitizing over 100 species of pests [6].

MATERIAL AND METHODS

To determine the efficacy of the bioproduct against the western maize root worm, since the spring of 2007 was organised an experimental field in the area Tărtăria, Alba County (Romania). The experiments were made according to the experimental technique. It should be noted that they were located in an area where the pest has been reported since 2002, under monoculture.

The total area of the experimental field is about 900 square meters. Sowing was performed manually using special planting tools; the distance between rows was of 70 cm and of 20 cm between plants per row, plant density of around 7 per square meter.

A variant has an area of 10.5 square meters, and within it, the plants are arranged in three rows of 5 meters long each. Sowing date varied from year to year depending on climatic factors and weather conditions. In 2008 sowing took place on April 21, May 1 in 2009, and April 30 in 2010.

Tracking the attack frequency produced by adult pest, both on the leaves and maize silk was made in two periods: first in late July and second in August 1 to 15 taking into account the two treatments applied on vegetation with the bioproduct BIOBIT.

In the experimental plot the efficacy of bioproduct BIOBIT was tested, fighting against larvae and adults of *Diabrotica virgifera virgifera* Le Conte. BIOBIT is a product that has the active ingredient *Bacillus thuringiensis* bacterium. The product is approved in dose of 40 ml/1 kg to the seed, and 3.5 l/ha on vegetation applies. Treatments with the tested product were applied to seed and vegetation. The product was applied to seed on sowing day.

RESULTS AND DISCUSSION

In 2008, using Biobit product applies only to the seed reduced the incidence of attack by 63% compared to the control, and the number of plants being attacked by 5.76%. In the variant where the bioproduct was applied in two stages, to the seed and on vegetation, the percentage of attacked plants was reduced by 4.49%, with an efficacy of 71% (Table 1).

Table 1

Efficacy of products used in the prevention and biological control of *Diabrotica virgifera virgifera* larvae (Tărtăria - 2008)

Variant	Attack frequency, %	% of control	Difference to control	Significance of difference
Control	15.46	100.0	0.00	Control
Biobit (seed)	5.76	37.3	-9.70	ooo
Biobit (vegetation)	7.62	49.3	-7.84	oo
Biobit (seed + vegetation)	4.49	29.0	-10.97	ooo

LSD (p 5%) = 4.68; LSD (p 1%) = 6.23; LSD (p 0.1%) = 8.07

In 2009, using Biobit product applied only to the seed, there was reduced the incidence of attack at 8.12%. In the variant where the bioproduct was applied in two stages, to the seed and on vegetation, the percentage of attacked plants was reduced by 5.62%, with an efficacy of 77.8% (Table 3).

Table 2

Efficacy of products used in the prevention and biological control of *Diabrotica virgifera virgifera* larvae (Tărtăria - 2009)

Variant	Attack frequency, %	% of control	Difference to control	Significance of difference
Control	25.33	100.0	0.00	Control
Biobit (seed)	8.12	32.1	-17.20	ooo
Biobit (vegetation)	13.47	53.2	-11.86	ooo
Biobit (seed + vegetation)	5.62	22.2	-19.71	ooo

LSD (p 5%) = 4.68; LSD (p 1%) = 6.23; LSD (p 0.1%) = 8.07

In 2010, the use of the product Biobit significantly reduced the attack frequency. Applied only to the seed reduced the incidence of attack by 76.8% compared to the control. In this variant the number of plants being attacked was 6.23%. In the variant where the bioproduct was applied in two stages, to the seed and on vegetation, the percentage of attacked plants was reduced up to 4.28%, with an efficacy of 84.1%. This version has increased the efficacy by 7.3% compare to applying only to the seed (Table 3).

Table 3

Efficacy of products used in the prevention and biological control of *Diabrotica virgifera virgifera* larvae (Tărtăria - 2010)

Variant	Attack frequency, %	% of control	Difference to control	Significance of difference
Control	26.88	100.0	0.00	Control
Biobit (seed)	6.23	23.2	-20.65	ooo
Biobit (vegetation)	12.79	46.7	-14.09	ooo
Biobit (seed + vegetation)	4.28	15.9	-22.60	ooo

LSD (p 5%) = 4.68; LSD (p 1%) = 6.23; LSD (p 0.1%) = 8.07

Table 4

Efficacy of products used in the prevention and biological control of *Diabrotica virgifera virgifera* larvae (Tărtăria - 2008-2010)

Variant	Attack frequency, %	% of control	Difference to control	Significance of difference
Control	22.56	100.0	0.00	Control
Biobit (seed)	6.70	29.7	-15.86	ooo
Biobit (vegetation)	11.29	50.0	-11.27	ooo
Biobit (seed + vegetation)	4.80	21.3	-17.76	ooo

LSD (p 5%) = 2.70; LSD (p 1%) = 3.60; LSD (p 0.1%) = 4.66

Using the product Biobit, the average frequency of attacks in the three years of experimentation, was lower than control, which is between 6.70% (applied to seed) and 11.29% (applied to vegetation) (Table 4). Best efficacy was recorded when the product was applied in two stages, to the seed and on vegetation, this being 78.7%.

CONCLUSIONS

1. The best results in the fight against larvae and adults were obtained with the bioproduct Biobit applied to seed and vegetation.
2. In the variant with the bioproduct applied in two rounds to sow and growing, percentage of plants attacked by larvae was reduced to 4.49% in 2008 (an efficacy of 71%), at 5.62% in 2009 (an efficacy of 78%) and 4.28% in 2010 (84% efficacy).

ACKNOWLEDGEMENTS

Research was supported by the Research Program PD-PN II, Contract no. 186/2010.

REFERENCES

1. Bača, F.,1994. *New member of the harmful entomofauna of Yugoslavia, Diabrotica virgifera virgifera Le Conte (Coleoptera, Chrysomelidae).* Zastita Bilja 45 (pp. 125-131).
2. Camprag D., R. Sekulić, 1994. *Diabrotica virgifera virgifera kukuruza jugoslavz, revija agronomska saznaja*.
3. Camprag D., F. Baca, R. Sekulić, 1995. *Diabrotica virgifera virgifera kukuruza zlatic.* Revija Drustvo za zastitu biljua Srbije, Beograd.
4. Părău (Florian) Teodora, 2009. *Cercetări privind răspândirea, morfologia, biologia şi combaterea dăunătorului Diabrotica virgifera virgifera Le Conte în condiţiile ecologice din Transilvania şi influenţa acestuia asupra infecţiilor cu unele boli parazitare*. Teză de Doctorat.
5. Grozea Ioana, 2003. *Diabrotica virgifera virgifera Le Conte, viermele vestic al rădăcinilor de porumb*. 184, Ed. Mirton, Timisoara.
6. Grozea Ioana, 2003. *Some aspects of maize plants damaged by Diabrotica virgifera virgifera Le Conte species*. USAMVB Lucr. St. Agricultura, Ed. Agroprint Timisoara, XXXV (pp. 503-507).
7. Oltean I., Teodora Părău, Anca Preja, V. Inoaş, Maria Telegaru, N. Voichin, 2004. *Monitorizarea speciei de Diabrotica virgifera virgifera Le Conte, în judeţul Alba*. Rev. Protecţia Plantelor XIV/55-56, ISSN-1453-2271 (pp. 23-28).
8. Pălăgesiu I., 1995. *Diabrotica virgifera virgifera Le Conte un dăunator potenţial al porumbului în ţara noastră*. Agricultura Banatului II, 6: 2.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

OBSERVATIONS REGARDING THE DEVELOPMENT STAGES OF THE APPLE MINING CARTEPILLAR (*LEUCOPTERA MALIFOLIELLA* COSTA.)

ALEXANDRA NICOLAE, IONELA DOBRIN, DUMITRA MIRELA CAPATANA

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *mining moth, adult, larva, chrysalis*

Abstract

Fruit tree culture has been a basic concern to mankind since ancient times, due to the special role occupied by fruit in human nutrition, because their complex nutrient content. Apple takes the third place in the world's production after banana and orange fruit growing, and in temperate areas constitutes the main species.

A number of pests cause damage to the apple crops, mining moths being one of them. Observations on the mining moth, conducted in the Romanian orchards, have shown that their distribution is different from one area to another. Scientific analyses showed increasing attack developed over time since the first records.

INTRODUCTION

Apple culture presents a great significance for our country, because this species finds the favorable growing and developing conditions, in most of the regions, ensuring an increase in the quality and quantity of the production.

Many decades ago, groups of mining moths were signalled in the fauna. Those groups have spreaded massively, and have raised some issues of phytosanitary practice.

Apple mining cartepillar (*Leucoptera malifoliella* Costa.) is found in all the areas of our country.

In a relativelly short period of time, due to the high biological potential of the specie, and to the lack of measures, meant to prevent this pest from spreading, in the apple plantations, pear, cherry and sour cherry from Arad, Timiş, Hunedoara, Alba, Sibiu, Bihor, Satu-Mare, Maramureş, Sălaj, Cluj, Bistriţa-Năsăud, Mureş, Caraş-Severin, Mehedinţi, Dolj, Olt, Gorj, Argeş, Vâlcea, Vrancea, Buzău, Dâmboviţa, Suceava, Călăraşi, have recorded a series of attacks of large frequency and intensity.

MATERIAL AND METHODS

The scientific experiments, conducted in 2009-2010, were located at farm no.1 in S.C Pomicola Strejesti-Olt, in an intensive plantation of 12 years old, summer apple, from the PRIMA variety, at planting distances of 3.5/2 m. Here had been signaled a very important population of mining moth.

The study of the external morphology of the development stages, for the apple mining moth (adult, egg, larvae, chrysalis) was determined through observation studies and biometrical determinations, carried out with the binocular magnifier. Examined: 100 butterflies, 50 eggs, 100 mature larvae and 50 chrysalises.

In order to observe and describe the stages of egg, larvae and chrysalis, were collected from the fields. attacked shoots.

The shoots were isolated in growing cylinders. Their turgor was kept, in order to maintain the viability of the development stages within the galleries.

The observation studies, carried out regarding the developement stages (adult, egg, larvae and stern) and on generations, were conducted in natural conditions, in orchards and in controlled laboratory conditions. For this research technique, growing cages, gauze sleeves (Figure 1), trap belts (Figure 2), and pheromone traps were used.

Fig. 1. Gauze sleeve

Fig. 2. Belt trap fixed on the three

RESULTS AND DISCUSION

Adult stage

Butterfly has a wingspan arround 5.7-7.7 mm (in average 6.6 mm) (Table 1). The anterior wings have a silver metalic colour, and their distal half has a characteristic drawing with dark color stripes, which are bordering black and white spots, separated by bright colored spaces in ocher. All over the distal edge it presents fringes. The posterior wings have a maroon colour and presents very long fringes, on the entire lenght of the edge. These values correspond to those cited in literature [4].

Table 1

Variations of wingspan in the big minier of apple (*Leucoptera malifoliella* Costa)

No. of analysed adults	Length (mm)
7	5.7
15	5.9
32	6.3
26	6.8
15	7.3
5	7.7
Average of 100 butterflies	**6.6**

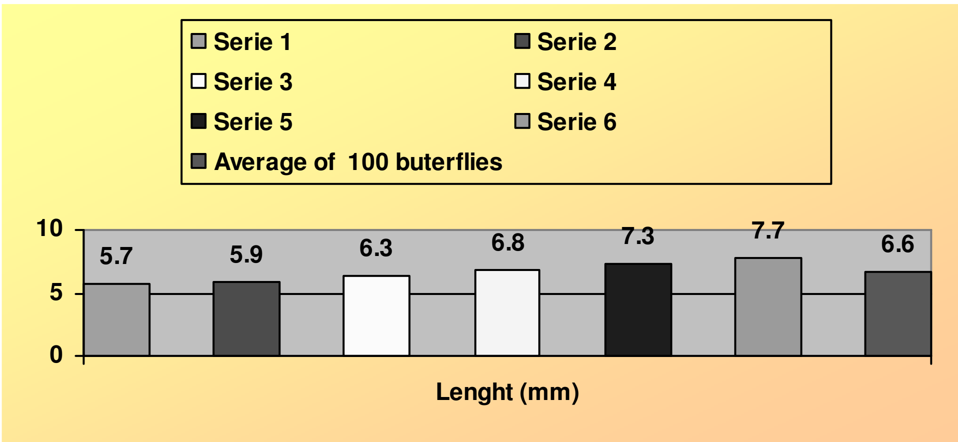


Fig. 3. Variations of wingspan in the big minier of apple (*Leucoptera malifoliella* Costa.)

Egg stage

The egg of the big minier of apple (*Leucoptera malifoliella* Costa.), has an ellipsoidal shape, with a dirty-white color, which has greenish tint when it is layed. The length of the *Leucoptera malifoliella* Costa. eggs, varied between 0.21 and 0.31 mm, an average of 0.258 mm (Table 2, Figure 4), in the conditions of the Strejesti-Olt fruit-growing area.

Table 2

Length variation in the apple big minier caterpillar
(*Leucoptera malifoliella* Costa)

No. of analysed eggs	Lengths (mm)
3	0.21
17	0.23
15	0.25
11	0.29
4	0.31
Average of 50 eggs	**0.258**

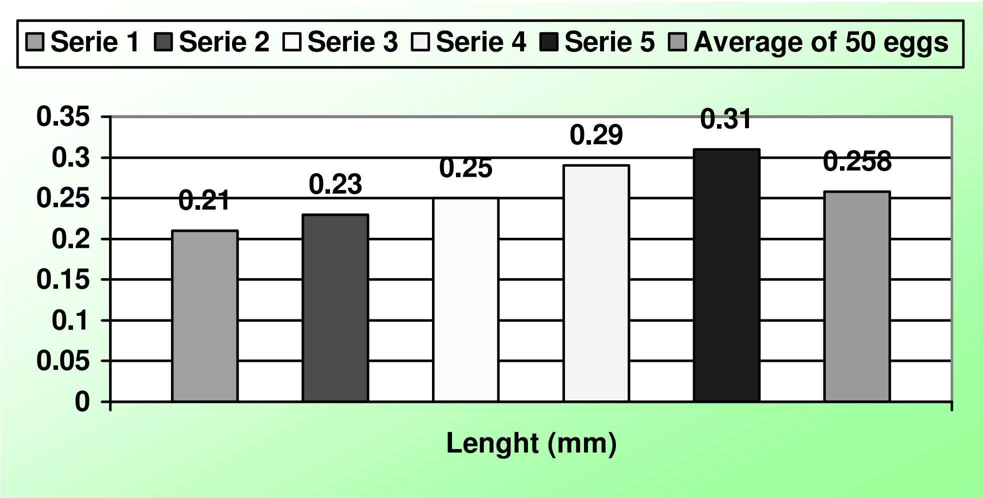


Fig. 4. Length variation in the apple big minier caterpillar
(*Leucoptera malifoliella* Costa.)

Larvae stage

The studies conducted in the climateric conditions found at the Strejesti-Olt fruit-growing area, revealed that the larvae of *Leucoptera malifoliella* Costa, have a dark-green colour, based on the larvaes age, and their dimension are between 32.4-5.00 mm, with an average of 4.22 mm (Table 3 and Figure 5).

Table 3

Length variation of the apple big minier (*Leucoptera malifoliella* Costa.) în the climateric conditions of the SCPP Strejeşti-Olt area

No. of studied larvae	Length (mm)
6	3.4
34	3.8
30	4.1
22	4.8
8	5.0
Average of 100 larvae	**4.22**

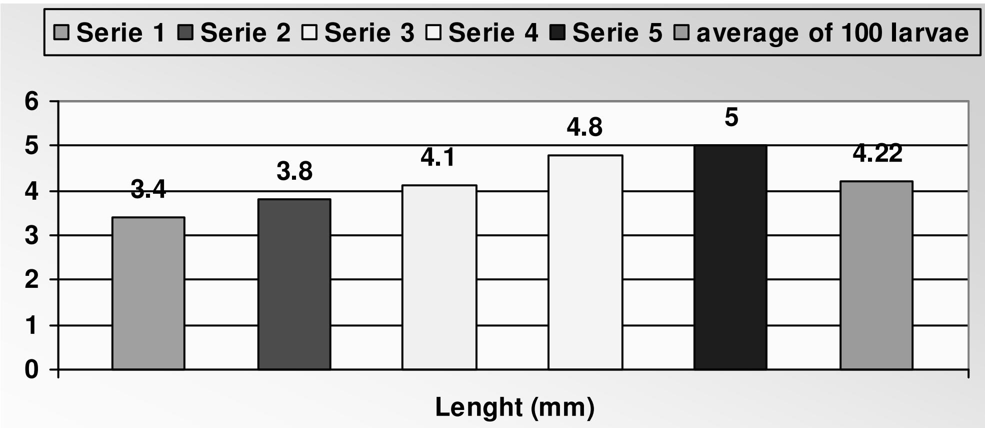


Fig. 5. Length variation in the apple big minier (*Leucoptera malifoliella* Costa.)

Chrysalis stage

The chrysalis of the apple big minier (*Leucoptera malifoliella* Costa.) has a reddish - brown colour, of approximately 3 mm. This chrysalis can be found in an cocoon made out of silky threads, which is fusiform and slightly opened at both ends, in a „X" form, through which is fixed on the substrate.

In the climatic conditions of the Strejesti-Olt area, the length of the *Leucoptera maliofoliella* Costa chrysalises, varied between 2.9 - 3.5 mm (Table 4, Figure 6).

Tabelul 4

Length variations in the *Leucoptera malifoliella* Costa chrysalis

No. of chrysalis studied	Length (mm)
4	2.9
8	3.1
16	3.2
19	3.4
3	3.5
50	3.22

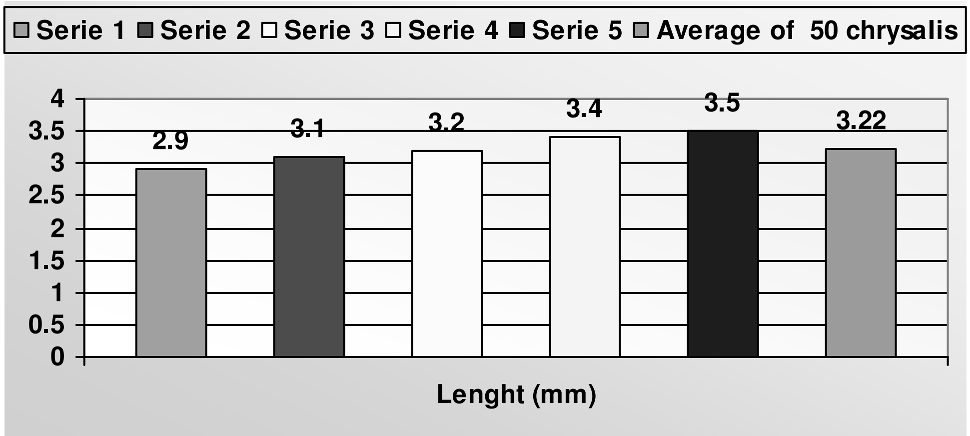


Fig. 6. Length variations in the *Leucoptera malifoliella* Costa. chrysalis

CONCLUSIONS

1. On the experience, placed in the apple plantation from SC Pomicola Strejesti-Olt, it has been identified the mined moth, species ***Leucoptera malifoliella*** Costa.
2. The morphological research regarding the stages of this species, confirms the data found in literature, and contributes to it by bringing new information regarding description, adult dimensions and development stages, as follows:

- adults wingspan can reach about 5.7-7.7 mm (in average 6.6 mm) The anterior wings have a silver metalic colour, and their distal half has a characteristic drawing with dark color stripes, which are bordering black and white spots, separated by bright colored spaces in ocher. All over the distal edge it presents fringes. The posterior wings have a maroon colour and present very long fringeon the entire lenght of the edge. These value correspond with the discription that exists in literature.

- the length of the ***Leucoptera malifoliella* Costa.** eggs, varies between 0.21 and 0.31 mm, an average of 0.258 mm (Table 2, Figure 4), in the conditions of the Strejesti-Olt fruit-growing area.
- the larvae of *Leucoptera malifoliella* Costa., have a dark and green colour, based on the larvae age, and their dimension are between 32.4-5.00 mm, with an average of 4.22 mm.
- in the climatic conditions of the Strejesti-Olt area, the length of the *Leucoptera maliofoliella* Costa chrysalises, varied between 2.9-3.5 mm, with an average of 3.22 mm.

REFERENCES

1. Alvare J., 1966. *Notas sobre orugas minadoras foliares de arboles frutales*. Blon. Patol. Veg. Ent. aric. 29 (pp. 63-87).
2. Andriescu I., 1986. *Complexul de entomofagi ai microleptidopterelor miniere dăunătoare mărului în Moldova şi Oltenia*. Raport la contract de cercetare.
3. Andriesc I., 1989. *Entomofagi paraziţi ai spciei Leucopthera scitella Zell., identificaţi în plantaţiile de măr din Oltenia*. Comunicări ştiinţifice ICPP Bucureşti - Băneasa.
4. Balachowschy A.S., 1966. *Entomologie appliqueé a l'agriculture*. Tom II, 258-273, 321-328, 267-271 (pp. 19-21).
5. Berar V., 1994. *Cercetări asupra bioecologiei şi combaterii moliei miniere Leucoptera malifoliella O.G. Costa*. Teză de doctorat, Timişoara.
6. Blanc M., 1983. *La mineuse cerealée des feuilles en vergers de pommiers dans la vallée de la Durance*. La Déf. De végétaux, no. 224 (pp. 323-331).
7. Briolon G., 1960. *Ricerche su qautra specie di Microlepidopteri minatori delle faghie di Malo. Nepticula malella Staint. e N. pomonella Vaug (Nepticulidae); Leucoptera scitella Zell (Bucculatricidae); Lithocolletis blancadrella F. (Glacilariidae).* Bul. dell'Instituto di Entomol. di Bologna, V.XXIV (pp. 239-271).
8. Duvlea I. şi colab., 1985. *Molia minieră a frunzelor de măr Leucoptera (Cemiostoma) scitella Zell., un dăunător periculos al livezilor*. Hortic. 2, 30-31.
9. Lefter Gh., Berar V., 1990. *Contribuţii la studiul biologiei şi combaterii moliei miniere a pomilor -Leucoptera scitella Zell*. Analele ICPP, vol. XXV.
10. Man I., 1991. *Cercetări privind cunoaşterea biologiei, ecologiei şi combaterii moliei minatoare (Leucoptera scitella Zell.).* Prot. Pl. (SPPT), 1/1991 (pp. 19-31).
11. Mai I., 1992. *Contribuţii la studiul biologiei, ecologiei şi combaterii moliei miniere a frunzelor Leucoptera scitella Zell*. Lucrările Stiinţifice ale Institutului de Cercetare şi Producţie pentru Pomicultură Piteşti - Mărăcineni, vol. XV (pp. 363-373).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

EFFECT OF CORONA DISCHARGES AS A POSSIBLE NON-POLLUTANT MEAN TO CONTROL THE GRANARY WEEVIL (*SITOPHILUS GRANARIUS* L.), MAJOR PEST OF STORED CEREALS

A. DINUȚĂ*, H. BUNESCU, GABRIELA TEODORA DAN*, ILONKA BODIŞ****

*Technical University of Cluj-Napoca,
**University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca

Keywords: *corona discharges, pest, stored cereals*

Abstract

Talking into consideration that chemical control is generally pollutant, its use to protect the stored cereal seeds is accepted in the main for the stocks but at the same time strictly limited in case of stocks destined for human and animal consumption.

The paper presents some laboratory results of the tests concerning the effect of corona discharges as a possible non-pollutant mean to control the granary weevil adults (Sitophilus granarius L.). The corona discharges were generated between a superior filamentary electrode and a ground flat electrode, connected to a fully adjustable high–voltage electric source. The testing method is the direct exposure of the infested cereal seeds by granary weevil adults to the filamentary corona field. The effect of corona field was studied at different level of voltage and exposure time against the infested stock in the Laboratory of Entomology at the Faculty of Agriculture of USAMV Cluj-Napoca and at the Technical University of Cluj-Napoca, during 2002-2010.

The recorded results after the tests in different filamentary corona discharges concluded that in the future these could be an unpolluted and low energophagous technology to protect the agricultural stored products.

INTRODUCTION

Biological effect of corona discharges produced by the electric fields on different living organism (seeds and pest) is certain, although the biophysical mechanisms which can influence the biological functions are now insufficiently know. Corona discharges produced in the case of both, continuous and alternative electric currents, are effective, the efficacy being dependent on the nature of the constitutive parts of the target organisms [3].

Depending on the electric field voltage, intensity and on the time of exposure, the living material may be affected differently, from the stimulation to the inhibition of its biological functions [1].

In the present paper the authors attempt to present how the corona discharges produced in the air, by an alternative electric current, can be used directly as an efficient unpollutant agent, in the control of the pests of the agricultural stored products. Our experiments tried to establish the parameters which can be able to destroy the pests, the pathogen microorganisms, without affecting the normal biology of the treated seeds (or even inducing a stimulation as collateral bio-physical effect) [4].

The ionic bombardment produced by the filamentary corona elements is established between two metallic electrodes, one superior having the form of a filamentary electrode and one inferior, the „ground" electrode, flat. The bottom and the walls of the Petri dishes which contained the „target" sampe , act like a dielectric obstacle for the electric corona discharges. This ionic filamentary bombardment, relatively uniformly distributed in the whole corona discharge, having values between 0.01 and 4.0 mA, is able to determine the destruction of the microorganisms and harmful fauna and in the same time, to induce an electro-stimulation of the germination and the plant growing in the first days after germination [2].

MATERIAL AND METHODS

The treatments were made in intense electric fields, produced by device (Figure 1), in the case of different exposures, applied to the experimental samples.

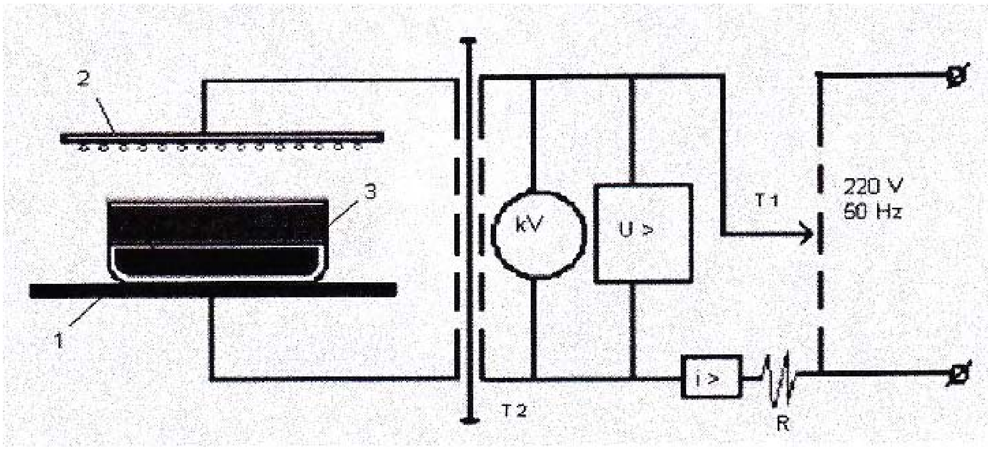


Fig. 1. Treatment stand with filamentary corona discharge for infested cereals stocks

1) ground flate electrode; 2) filamentary electrode; 3) Petri dishes; T1- autotransformator; T2- transformator; R- a limitation resistance of the electricity of short circuit; (I>, U<) an electric protection at overweight and short circuit (Dinuță, 2006)

The high-voltage adjustable source of (at 50 Hz) may assure a variable voltage between the electrodes, in the upper/higher limits of 1 kV and 25 kV. The source is composed by a transformator (T2), a limitation resistance of the electricity of short circuit (R), an electric protection at overweight and short circuit (I>, U<) and a block of measurement of high voltage (kV). The filamentary discharges is realized between the „filamentary" electrode (2) and a ground flate electrode (1), connected to the high-voltage source.

The „filamentary" electrode is made by 0,5 mm Ø wolfram wires 0,5 mm, parallel placed with 5 mm pitch. Between the two electrodes the discharge interstice was of 20 mm. In this interstice was placed the glass Petri dishes (3) contained the experimental sample. The thickness of the bottom and walls of the Petri dish were 2 mm, the diameter about 60 mm and the walls were about 20 mm high.

The experimental samples were composed by 100g of „intact" wheat or corn seeds, each sample being „freshly" infested with 100 young adults (imago) of *Sitophilus granarius* L., having the the age of 24 to 48 hours. These adults were selected from a middle infested wheat seed stock, according the colour (light brown) and the time after the appearance of the adult weevils. The „experimental culture" was obtained in a chamber with controlled atmosphere: t = 26˚C (± 2˚C) and relative air humidity of 75% (±5%).

The experimental variants (samples) were treated in 3 repetitions, in the corona discharges obtained in the fields of 5 kV, 10 kV, 15 kV and 20 kV voltage and the exposure times of 30, 45 and 60 minutes. After the exposures, the treated samples were transferred from the Petri dishes in little cylindrical boxes (methyl-meta-acrylate), their lid having the major surface represented by a dense metallic screen.

RESULTS AND DISCUSSION

The treatments applied on the wheat samples showed that the adults of *Sitophilus granarius* L., exposed in corona fields, manifested firstly a low answer to the mechanical stimuli, a low coordination of movements, followed by a progressive paralysis, lower level of the feeding and digestive functions, progressive dehydration and finally, the death.

All the reductions of the biological functions increased simultaneously with the increase of the voltage and with the exposure time. Finally, as a result of all these effects, the death occurred earlier in the treated samples, simultaneously with the increase of the voltage and the increase of the time.

In the tables 1 and 2 there are presented the mortalities of the *Sitophilus granarius* L. adults, after different time periods from the exposures of the infested seed samples in the corona discharges.

Table 1

Mortality of *Sitophilus granarius* L. adults, induced by corona filamentary discharges after the exposure of infested wheat seed stocks (Cluj-Napoca 2009)

Voltage	Exposure time (minutes)	Mortality (%) observed after:						
		24 h	48 h	72 h	96 h	120 h	144 h	168 h
5 kV	30	34.66	62.33	73.33	82.66	89.33	98.66	100.00
	45	40.00	67.66	82.33	88.66	93.66	100.00	100.00
	60	48.00	74.33	88.00	95.33	100.00	100.00	100.00
10 kV	30	53.66	85.66	94.00	100.00	100.00	100.00	100.00
	45	63.33	88.66	99.33	100.00	100.00	100.00	100.00
	60	78.66	97.00	100.00	100.00	100.00	100.00	100.00
15 kV	30	64.00	90.00	100.00	100.00	100.00	100.00	100.00
	45	92.33	100.00	100.00	100.00	100.00	100.00	100.00
	60	100.00	100.00	100.00	100.00	100.00	100.00	100.00
20 kV	30	94.66	100.00	100.00	100.00	100.00	100.00	100.00
	45	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	60	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Mean value		72.44	88.80	94.74	97.22	98.58	99.88	100.00

Table 2

Mortality of *Sitophilus granarius* L. adults, induced by corona filamentary discharges after the exposure of infested corn seed stocks (Cluj-Napoca 2010)

Voltage	Exposure time (minutes)	Mortality (%) observed after:						
		24 h	48 h	72 h	96 h	120 h	144 h	168 h
5 kV	30	30.66	51.33	63.00	71.66	84.33	95.00	100.00
	45	36.00	63.33	74.66	83.33	94.66	100.00	100.00
	60	44.00	68.33	83.33	91.33	100.00	100.00	100.00
10 kV	30	52.33	71.00	86.33	100.00	100.00	100.00	100.00
	45	62.33	84.33	95.66	100.00	100.00	100.00	100.00
	60	75.00	91.66	100.00	100.00	100.00	100.00	100.00
15 kV	30	86.33	92.33	100.00	100.00	100.00	100.00	100.00
	45	93.33	100.00	100.00	100.00	100.00	100.00	100.00
	60	100.00	100.00	100.00	100.00	100.00	100.00	100.00
20 kV	30	96.66	100.00	100.00	100.00	100.00	100.00	100.00
	45	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	60	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Mean value		73.05	85.19	91.91	95.52	98.24	99.58	100.00

The complex analysis of the two tables show insignificant differences between the results obtained on grain and corn stock. The lowest effect (mortality induced to adult weevil population) was recorded in the case of the variant treated with 5 kV voltage, in an exposure time of 30 minutes (the mortality of 100% was induced only after 168 hours after the treatment). The reduction of the feeding and digestive functions, paralysis and a low rate of coordinating movement, was proved by the low rate of damages observed on the seeds.

Mortality increases according to the higher voltage and a longer exposure time. So, in the case of 15 kV (60 minutes exposure time) and 20 kV voltage (45 and 60 minutes exposure time), mortality of 100% was induced in the first 24 hours after the exposure. In the case of these variants, the used voltage and time of exposure proved to be the most efficient in the control of the adults of *Sitophilus granarius* L.

CONCLUSIONS

From the presented data concerning the treatment of stored seeds (wheat and corn) with filamentary corona discharges, the following conclusions are notable:

1. the corona discharges in alternative electric current (50 Hz, high voltage) can control the adults of the granary weevil, *Sitophilus granarius* L.;
2. there are no significant differences between the results obtained on infested wheat and corn seed samples;
3. the lowest mortalities were obtained by the variants treated with the lower voltage (5kV) and the lower time of exposure (30 minutes), 168 hours were needed to obtain a 100% mortality;
4. the higest mortalities (100% after 24 hours) were obtained by the variants treated with highest voltage (15kV and 20kV) and longer exposures (45-60 minutes);
5. the other combinations between the different voltages and times of exposure obtained intermediate results, the mortality increases proportionally with voltage and exposure time;
6. the presented experiments, can lead to conceive a high voltage source and a device for the treatment of cereal seeds, with a wide field of applications in the control of the stored cereal pests.

REFERENCES

1. Dinuță A., I. Ghizdavu, I. Suărăşan, H. Bunescu, 2005. *The mixed effects of the intense electric fields and generated ozone on the granary weevil* (*Sitophilus granarius* L.). Bulletin of the University of Agriculture Science and Veterinary Medicine Cluj-Napoca (pp. 96-100).
2. Dinuță A., 2006. *Cercetări de combatere neconvențională a gărgărițelor din genul Sitophilus, dăunătoare cerealelor depozitate* (*Researches of unconventional control of the weevils from Sitophilus genus, pest of stored cereals*). Teză de doctorat,

Universitatea de Ştiinţe Agricole şi Medicină Veterinară Cluj-Napoca, Facultatea de Agricultură (pp. 355).

3. Suărăşan I., A. Dinuţă, I. Ghizdavu, R. Morar, S. Budu, 2005. *Ozone and intense electric fields upon some pests present in cerrealiere depots*. 5Th International Conference on Electromecanical and Power Systems (SIELMEN 2005), Chisinau, Republic of Moldova, vol. 2 (pp. 760-763).

4. Suărăşan I., I. Ghizdavu, A. Dinuţă, S. Budu, 2006. *Ozone and high intense electric fields - ecological factors in the control of the diseases of the stored corn and wheat seeds*. 5ième Conférence bi-anualle de la Société Française d`Electrostatique (SFE 2006), Grenoble, Franţa (pp. 333-336).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

RESEARCH REGARDING THE IDENTIFICATION OF *GLOBODERA* SPP. USING MORPHOLOGICAL CHARACTERS AND POLYMERASE CHAIN REACTION IN ROMANIA

MARIANA GROZA*, I. ROŞCA, CLAUDIA COSTACHE*, L. BOROŞ*****

*Central Phytosanitary Laboratory of Bucharest
**University of Agronomic Sciences and Veterinary Medicine of Bucharest
***Regional Laboratory of Nematology of Braşov

Keywords: *Globodera pallida, Globodera rostochiensis, Multiplex-PCR, potato cyst nematodes*

Abstract

The control of potato cyst nematodes Globodera rostochiensis (Wollenweber) Behrens and Globodera pallida (Stone) is regulated by Directive 2007/ 33 EC, which is transposed in Romanian legislation by 139/2010 Ministerial Order. These species are included in the list of harmful organisms of potato which are monitored annually. Both species were detected in the soil samples from Brasov, Covasna, Harghita County in 2010-2011 period. The detection of potato cyst nematodes from soil was carried out with Schuiling centrifuge. The identification of potato cyst nematodes species was based on a combination of morphological, morphometric characters and molecular technique (Multiplex-PCR). It is presented our results regarding criteria, materials and methods which were used for identification of these dangerous pest allover the world and in EU states. In order to investigate species and distribution of the Potato Cyst Nematode (PCN), Globodera spp., present in Romania, soil samples were collected from different fields. Identification of Globodera species was based on some morphological criteria and confirmed by PCR. This is the first report of molecular identification of PCN populations which was done in Romania.

INTRODUCTION

The potato cyst nematodes (PCN) *Globodera rostochiensis* (Wollenweber) Behrens and *Globodera pallida* (Stone) are quarantine nematodes on potato. The control of these nematodes is regulated by Directive 2007/33 EC, which is transposed in Romanian legislation by 139/2010 Ministerial Order. This Order establishes the measures to be taken against PCN in order to determine their distribution, to prevent their spread and to control them. Soil samples are taken from the areas where producers intend to cultivate potato and plants listed in Annex I of 139/2010 Ministerial Order, before planting, annually.

Studies on PCN in Romania have been performed by Man Simion (Rojankovschi and Deheleanu, 1986) since 1984, and Szabó demonstrated the presence of both species (Szabó, 1994). The identification of PCN species were performed using only morphological methods. The aim of the present study was to analyse the cyst nematode species *Globodera* that occur in Romania using PCR analysis.

MATERIAL AND METHODS

Positive soil sample were collected from different fields prior to the planting of potato seed. The flotation method with application of Schuiling's centrifuge was used for extracting cysts from dried soil. The extraction was carried out in Regional Laboratory for Nematology of Brasov (samples from Braşov and Harghita county) and Central Phytosanitary Laboratory of Bucharest - Nematology Division (samples from Covasna county).

Identification of the two species of *Globodera* was based on a combination of morphological, morphometric characters and Multiplex-PCR.

G. rostochiensis and *G. pallida* are morphologically and morphometrically closely related (Stone, 1973a,b). We used a combination of cysts and stage juveniles characteristics. For cysts, the most important diagnostic differences are in the perineal area: number of cuticular ridges between vulva-anus and Granek's ratio and for second stage juvenile characteristics are length and stylet knob shape (EPPO Bulletin 39, 2009).

For molecular identification, we used Multiplex-PCR (Bulman&Marshall, 1997) with some changes indicated below. The method was set up together with our colleagues from Nematology Division of the National Plant Protection Laboratory, Le Rheu, France. DNA extract was obtained from crushed juveniles incubate for 1h at 60°C, 10 min at 95°C and 5 min at 10°C. Were used one universal primer ITS 5 and also specific primers PITSp4 for *G. pallida* and PITSr3 for *G. rostochiensis*. For amplification was used Taq DNA polymerase (Qbiogene).

DNA amplification was carried out in a 25 µl final volume of reaction mixture containing 1x Taq buffer with Mg Cl_2, 0.5 mM Mg Cl_2, 0.25 mM dNTPs, 0.64 µM for each primer, 0.6U Taq DNA Polymerase, 5µl DNA extract. PCR cycling parameters were: 2 min - 94°C, 35 cycles of 30s - 94°C, 30s - 60°C, 30s - 72°C, final elongation 7 min - 72°C. A negative control with no template DNA and positive controle whith DNA of *G. rostochiensis* and *G. pallida* were used.

DNA fragments were separated by horizontal electrophoresis on 1.5% agarose gel with ethidium bromide and visualized under UV light. The size of DNA fragments were estimated using the 100bp DNA Ladder.

PCR analyses were performed in Central Phytosanitary Laboratory from Bucharest.

RESULTS AND DISCUSSION

Our studies were developed during 2010-2011. Analysis of different field areas and the previous crop showed that the majority of cysts were found in fields with grain crops, manly wheat. We identified *G. pallida* in Braşov County (Fagăraş - 3 ha) and Harghita County (Miercurea Ciuc - 12 ha, Lăzarea- 5 ha). *G. rostochiensis* was identified in Covasna county (Sânzieni - 8 ha, Târgu Secuiesc - 4.79 ha, Catalina - 15 ha) and Harghita County (Lăzarea).

The cysts of *G. pallida* were identified for the first morphologically and morphometrically (Figures 1, 2). After that we perform PCR to confirm the species.

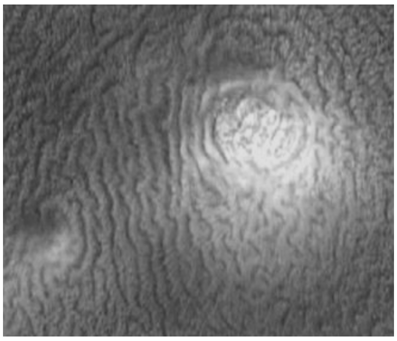


Fig. 1. ***G. pallida*** **- perineal area**

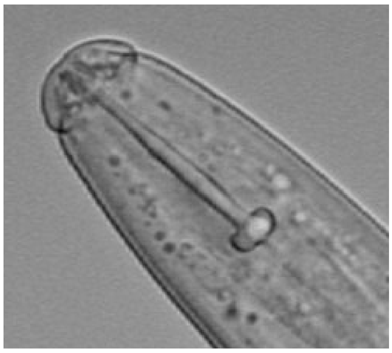


Fig. 2. ***G. pallida*** **- anterior part of juvenile**

For cysts of *G. rostochiensis* (Figures 3, 4), some of them were identified only morphologically and morphometrically when the measurements were very clear. We performed PCR when the cysts presented similar characteristics with *G. pallida*.

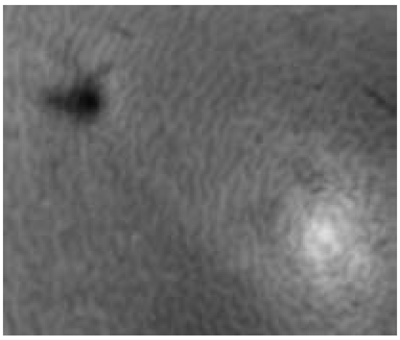


Fig. 3. ***G. rostochiensis*** **- perineal area**

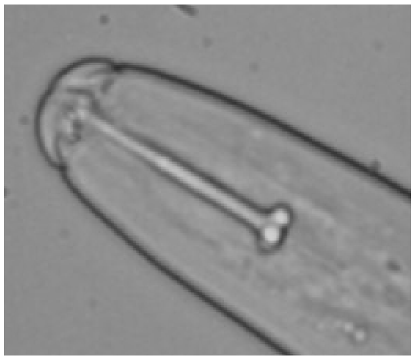
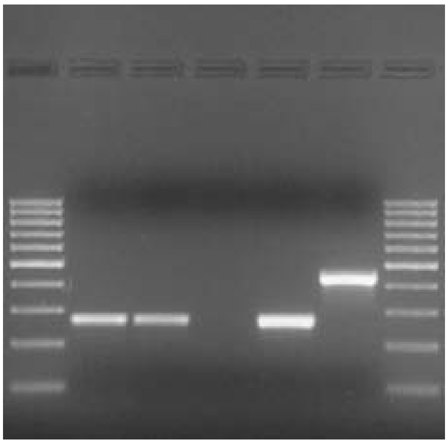


Fig. 4. ***G. rostochiensis*** **- anterior part of juvenile**

PCR analysis revealed that the lenghts of amplified DNA bands were specific to *G. pallida*, by 265 bp (Figure 5) and *G. rostochiensis*, by 434bp (Figure 6).

1 2 3 4 5 6 7



1 2 3 4 5 6

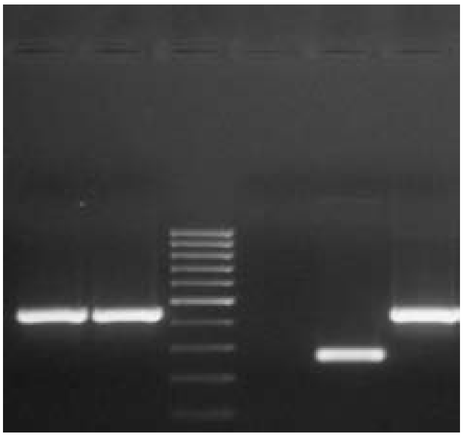


Fig. 5. PCR products of *G. pallida*

Fig. 6. PCR products of *G. rostochiensis*

Figure 5 shows PCR products of *G. pallida* of sample from Braşov County: 1, 7- ladder; 2,3- *G. pallida*; 4 - negative control; 5 - positive control *G. pallida*; 6 - positive control *G. rostochiensis*.

Figure 6 shows PCR products of *G. rostochiensis* of samples from Covasna county: 1,2 - *G. rostochiensis*; 3 - ladder; 4 - negative control; 5 - positive control *G. pallida*; 6 - positive control *G. rostochiensis*.

PCR products of *G. pallida* and G. *rostochiensis* are showed in figure 7: 1,2 - *G. pallida;* 3 - both species (*G. pallida and G*. rostochiensis); 4,5 - *G. rostochiensis*; 6 - ladder; 7 - negative control; 8 - positive control *G. rostochiensis*; 9 - positive control *G. pallida*.

CONCLUSIONS

1. *G. pallida* and *G. rostochiensis* were found in Romania in potato growing areas (Braşov, Covasna, Harghita Counties), using morphological analysis and a sensitive PCR method based on DNA analysis.
2. Based on the results obtained it can be concluded that on were detected mixed populations in Harghita County (Lăzarea) and also isolated populations of *Globodera rostochiensis* (Covasna) and *Globodera pallida* (Braşov and Harghita Counties).
3. All populations of nematodes were found in natural diapauses, the eggs following to hatch in a short time once the host culture was established.

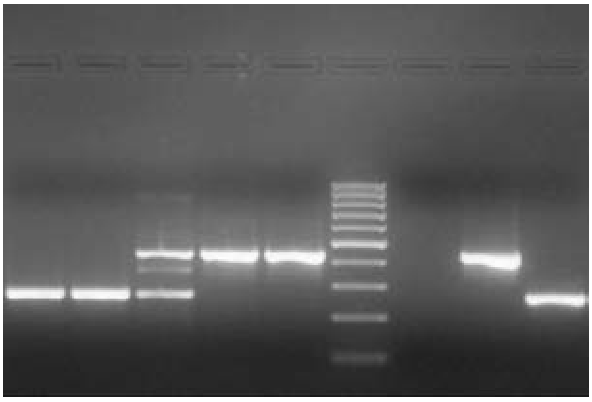


Fig. 7. PCR products of *G. pallida* and *G. rostochiensis*

ACKNOWLEDGEMENTS

The authors are grateful to the Nematology Division of the National Plant Protection Laboratory (Le Rheu - France) for entire the support.

REFERENCES

1. ***2009. *Diagnostic Globodera rostochiensis and Globodera pallida-PM 7/40*. Bulletin OEPP/ EPPO Bulletin, 2009, Bulletin 39 (pp. 354-368).
2. Bulman S.R. & J.W. Marschall, 1997. *Differentiation of Australian potato cyst nematode (PCN) population using the polymerase chain reaction (PCR).* New Zealand Journal of Crop and Horticultural Science 25 (pp. 123-129).
3. Rojancovschi Elena, A. Deheleanu, 1986. *Nematodul cu chist al cartofului, Globodera rostochiensis (Woll) Mulvey & Stone, un nou daunator detectat in tara noastra*. Buletinul de Protectia Plantelor Nr. 2/1986 (pp. 43-50).
4. Szabó I., 1994. *Cercetări privind rolul unor factori biologici, ecologici asupra evoluției nematozilor din genul Globodera*. Teză de doctorat, USA Cluj.
5. Stone A.R., 1973a. *CIH Description of Plant-Parasitic Nematodes No 16 Globodera rostochiensis*. CAB International, Wallingford (GB).
6. Stone A.R., 1973b. *CIH Description of Plant-Parasitic Nematodes No 15 Globodera rostochiensis*. CAB International, Wallingford (GB).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

AN INVESTIGATION AND COMPARISON INTO OPERATOR FIELD OF VISION FOR MODERN TRACTOR CABS

M. LUND, L. BUTTERS

Myerscough College, England

Keywords: *agriculture, tractor, safety*

Abstract

An investigation into the operator's field of vision of modern agricultural tractor cabs. Visibility patterns and areas of blind spots were compared for people of different heights and for 2 tractors from the same manufacturer (Fendt) but fitted with different operator's cabs. The testing was carried out using 2 tractors of similar physical and hp size with test subjects of below, above and of average height. The test procedures similar to those used in British Standards [1].

By comparing the cab fitted to the older tractor with the most modern cab fitted to newer, the results can be analysed and concluded.

Comparing the new cab to the older cab showed a moderate improvement in all round visibility; due to the newer cab construction having fewer and slimmer cab pillars this resulted in decreased areas of blind spots, although direct forward visibility was not improved.

The investigation provided areas of further research, testing and recommendations to see whether operator field of vision can be improved further.

INTRODUCTION

In recent years there has been an increased emphasis on health and safety. Agriculture is one of the most dangerous industries in Britain [2]. There are plenty of statistics to back up the need for an increase in health and safety.

In 2008 there were nearly 3 times as many deaths as the second most dangerous industry, construction. 24% of the accidents were related to agricultural machinery, resulting in 42 deaths, [3], in the 600- 800 road traffic accidents that occur each year involving agricultural vehicles [4].

Background to the investigation

There was no law stating agricultural tractors had to be fitted with cabs until 1970 when The Tractor Cab Regulations 1967 came into force [5].

All tractors manufactured after 1st September 1970 had to be fitted with a roll over protective structure and older vehicles to be compliant from 1st September 1977 if driven by workers. Pre 1970s tractors were retro fitted to comply with the regulations [6].

Many were fitted by aftermarket companies from the late 1940s onwards. There were several different companies manufacturing and fitting these with the most well known being, Duncan, Sekura, Sirocco and Lambourne. Even though these were not made by the tractor manufacturers they still had to conform to Organisation for Economic Co-operation and Development (OECD), Society of Automotive Engineers (SAE) and International Organisation for Standardisation (ISO) standards [1].

In 1966 the National Institute of Agricultural Engineering (NIAE) devised a test for approving safety cabs. These tests consisted of a 2 tonne pendulum weight hitting the cab. Cabs that were badly distorted or broke were redesigned until they passed the test. The outcome was some good sensible standards and well engineered operator protection, which did much to improve agriculture's safety record [7].

After the 1970 regulations came into force some of these companies were discontinued and others continued to supply manufacturers with cabs, e.g. Duncan and Lambourne (MF 200 series). Lambourne fitted MF 200 series tractors which in the UK were supplied with cabs from GKN Sankey and Duncan, Collins A. Classic Tractor [8].

MATERIAL AND METHODS

This report will analyse the operator's field of vision, the area which can be viewed from the seated operator's eye position (for 2 modern wheeled tractors of similar physical and horsepower (hp) size. The aim of the test is to compare the horizontal plane of vision and to calculate the areas of poorer visibility and total blind spots. A blind spot, or zone of invisibility, is a distortion or absence of sight in a small portion of the visual field [9]. The blind spots on a vehicle will generally be to the left and right of the vehicle which are not covered by internal or external mirrors and where the peripheral vision ends [10].

The testing will use the same methods as the British Standard methods for 'Determination of operator's field of vision for agricultural tractors.

The results produced by the test were analysed with future recommendations and conclusion being drawn up.

Height of participants

The test included 3 people of different height

- A person of average height (5' 9"/175 cm).
- A person below the average height.
- A person of above average height.

This will then give a wider range of results for the comparison of different views from the operator's seat. The results from both tractors were then analysed. The two tractors were compared to each other with the results for the three people of different heights. As agricultural machinery is predominantly operated by men the average height figures used for the report will be for UK males.

The average height for UK males is 5’ 9” (175 cm) [11, 12].

A person of average height was used for the testing along with persons 6” (15 cm) either side of average.

Testing method

The testing was based on the ISO Agricultural tractors-Operator’s field of vision method. The seat position is the centre of the circle. The clear area is area visible from the seat and the shaded areas are areas that are not visible areas from the seat.

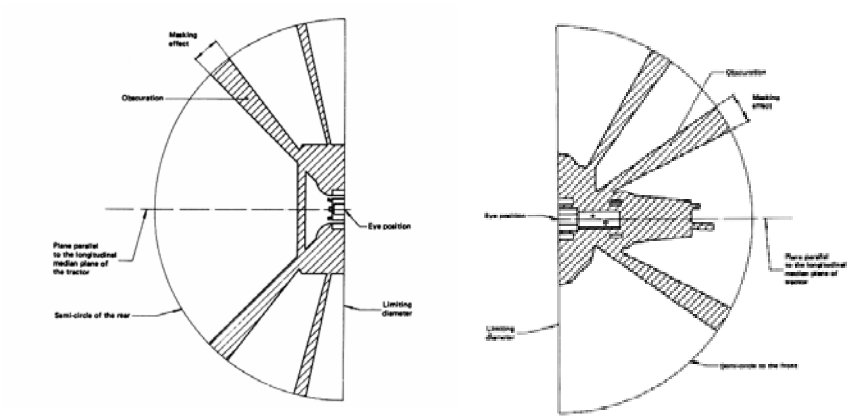


Fig. 1. Semi circle of visions showing the front and rear (showing typical obscuration) Taken from the ISO document ISO 5721:1981

Machinery used for testing

For the testing 2 tractors were used of similar physical size and hp.

Tractor 1 Fendt 926

Tractor 2 Fendt 930

Fig. 2. The cherry picker used for aerial photographs. A 2008 Genie Z60/34

Test subjects

For the methods of testing 3 people were used. Each subject was sat on the tractor in their theoretical driving position:

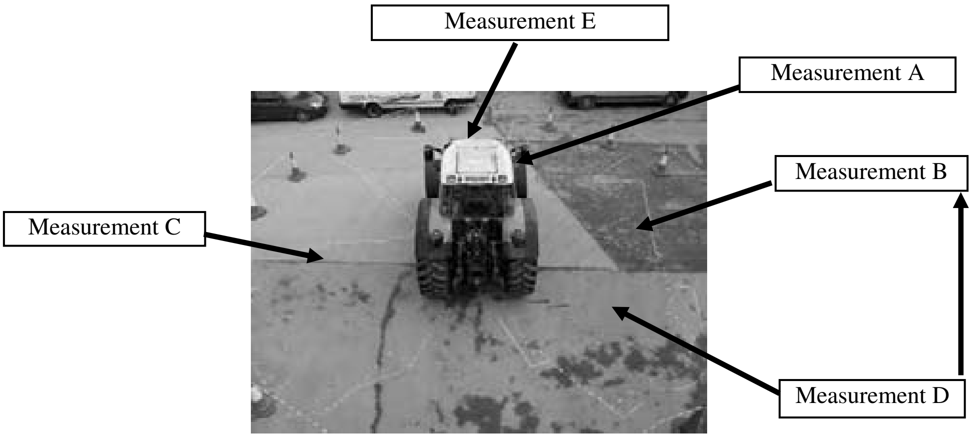
- Base of spine in the back of the seat to prevent back problems.
- Holding the wheel at ten to two or quarter to three - keeping thumbs vertical
- Arms slightly bent.
- Legs slightly bent when feet are on the pedals.
- The back of the seat should be fairly upright, giving a good view of the road ahead, and of course mirrors (rear and door) display and dials.
- Head restraints adjusted so they align with the top of head [15].

Testing

The field of vision for the three test subjects was marked on the ground surrounding the tractor. This process was then repeated for the other subjects on the same tractor.

Fig. 3. Showing testing area

The same method was then applied for the second tractor. This provided 6 different sets of results that were marked out on the same test area.



RESULTS AND DISCUSSION

	Fendt 926			Fendt 930		
	Below average height	**Average height**	**Above average height**	**Below average height**	**Average height**	**Above average height**
A	3.70 m	3.63 m	3.60 m	3.69 m	3.79 m	3.47 m
B	3.80 m	2.10 m	1.95 m	1.50 m	1.85 m	0.90 m
C	3.26 m	3.4 m	3.55 m	4.43 m	4.50 m	3.95 m
D	4.30 m	3.94 m	3.97 m	3.47 m	4.44 m	3.48 m
E	6.55 m	6.00 m	5.96 m	7.40 m	7.12 m	6.70 m

Analysis

- Forward visibility on a standard equipment tractor is poor, even for the tallest person.
- Rear vision either side the tractor is poor.
- Sideways vision is not good and the drive would not be able to see other traffic or pedestrians who come alongside.
- Generally the taller person has slightly better visibility.
- Even the shortest distance of 5.96 m would be a sufficient amount to conceal, pedestrians, cyclists or even a small car, especially in heavy traffic. This emphasises the importance of ways required to improve forward visibility to reduce the possibility of accidents caused by this blind spot.

Whilst the driver can make allowances for the poor frontal vision, and possibly the rear the visibility on either side of the tractor is close to zero, mirrors help but it is easy for a bicycle or motor cycle to be completely out of vision. On turning, the long over hang of mounted implements swing out into the complete blind spot at the rear and side. Many tractors are fitted with a front linkage and this creates a similar problem, most of the machine will be invisible in the straight ahead position and if turning it will be entering a blind spot.

CONCLUSIONS

1. The report focuses on tractor cab visibility from the point of Health and Safety and the prevention of accidents and it is apparent that the majority of the area around the modern tractor is a zone of invisibility creating a potential trap. In addition, if the same principles are applied in the field, a number of obstacles or growing crop will not be visible to the driver.
2. Further research is required to produce more accurate data, which could be linked to a camera which could be activated by position sensors and pictogram.

REFERENCES

1. British Standards, 1983. BS 6389:1983 Determination of operator's field of vision for agricultural tractors (ISO 5721:1981).
2. Health and Safety Executive; 1998. http://www.hse.gov.uk/aboutus/meetings/iacs/aiac/transport/conference0308/paper5.pdf: accessed 14/04/10.
3. Health and Safety Executive (2009) http://www.hse.gov.uk/agriculture/hsagriculture.htm:accessed 23/11/09.
4. Department for Transport; 2009: Agricultural vehicles influencing safety through accident data provision; http://www.dft.gov.uk/pgr/roads/vehicles/vssafety/safetyresearch/vsercompendiums/vehiclesafetyresearchcompend4569?page=1; accessed 21/11/2009.
5. National Farmers Union; 2009: NFU Centenary; http://www.nfu100.com/x224.xml; Accessed 19/11/09.
6. Deb. HC; 1974. Agriculture (Tractor Cabs) Regulations; http//hansard.millbanksystems.com/commons/1974/nov/20/agriculture-tractor-cabs.
7. Stewart J; 2003: Classic Tractor; Sundial Magazines, Beckenham, Kent; August 2003.
8. Formula Medical Group; 2005: http://www.formulamedical.com/Topics/Head&Neck/blind%20spots.htm; accessed 10/03/10.
9. Safe motoring; 2010: Driving blind spots; accessed 10/03/10 http://www.safermotoring.co.uk/learning-about-blind-spot-when-driving.html.
10. Guardian; 2010: average height; accessed 03/03/10 http://www.guardian.co.uk/uk/2002/aug/28/science.research.
11. University of Nottingham; 2009: what is anthropometry? accessed 23/03/10; http://www.udeworld.com/anthropometrics.html.
12. Advanced Driving; 2010 Driving Position; http://www.advanced-driving.co.uk/driving-tips/what-is-a-good-driving-position-behind-the-wheel/; accessed 31/03/10.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

CAMELINA CROP - OPPORTUNITIES FOR A SUSTAINABLE AGRICULTURE

P. DOBRE, ŞTEFANA JURCOANE

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *camelina, oil, low input systems*

Abstract

The recent research has demonstrated that Camelina sativa (camelina, false flax) has unique agronomic qualities: low demands for nutrients and for plant protection treatments. Camelina - based jet fuel reduces carbon emissions from jets. Because the camelina crop has lower production costs than oilseed rape in some climates, this plant is considered as an emerging biodiesel. Camelina oil is a better biofuel than the other vegetable oils.

INTRODUCTION

When the purpose is to introduce a new species in the crop and its potential role is analysed, it must meet unique characteristics that set it apart from the existent cultivated species. In the case of oleaginous crops it is not enough for a new species with oleaginous properties to simply become "a new oleaginous crop". It must possess unique and convincing properties and to continue offering incentives for crop development.

If we are referring to *Camelina sativa,* researches have demonstrated that it has unique agronomic characteristics that could substantially reduce and even eliminate requirements regarding the soil preparation and annual weed control. It was demonstrated that this ancient oil plant is compatible with systems of reduced soil works (minimum tillage), or even with systems without works (no till). It is competitive with annual weeds and presents an increased resistance to drought and disease and pest attack. At the crop establishment, the seed rate is low. These unique features recommend the camelina crop for having the lowest input as compared to any other oleaginous crop. They also recommend it for its compatibility with the objectives of reducing energy consumption and pesticides use and the soil protection against erosion [2].

Camelina can be sown directly into the stubble at the surface by broadcast-sown, or it can be cultivated on marginal lands. Sowing does not require special, expensive equipment [2].

Although ameliorators did not work too much on the populations of *Camelina sativa*, they have proven to be suitable for oil production. Rapid qualitative and quantitative leap in some cruciferous species shows that plants in this family are highly workable through selection, by crossing or by biotechnology (oilseed rape, cabbage, mustard, etc.). Therefore, it can be concluded that in a short period of time, camelina varieties can be significantly improved in terms of productivity, growth of seed oil content, low temperatures, to drought, etc., in order to ensure an important role of camelina on oleaginous seeds' market.

Thorough and complete research is needed to enable the enhancement of unique agronomic qualities of camelina. In the absence of clear usage recommendations, possibilities for the use of camelina seeds (in human alimentation, animal feed, as edible or industrial oil, as a biofuel, or other applications), remain largely unexplored.

MATERIAL AND METHODS

Case study. Within the "Innovative technologies for obtaining high performance biofuels from renewable raw materials, specific to Romania" project (TINOCIP Project Nr. 22138/2008), a series of investigations were done in the pilot fields regarding the innovative technologies for oleaginous plants cultivation, in order to obtain vegetal oils and biodiesel. Besides oilseed rape, soya, sunflower and safflower, *Camelina sativa* was also taken in the study, a widely cultivated species in Romania since the Bronze Age [1]. Within the Decision of the Council of Ministers of the R.P.R. no. 1146 August 12, 1958 regarding the contracting conditions of technical plants necessary for the alimentary industry, with application for the harvest of 1959, the contract price of 2.6 lei/kg of oilseed rape and *Camelina sativa* seed is mentioned [4]. Therefore, we can conclude that, at that time in Romania, camelina was still cultivated for the oil necessary in alimentary industry. In the TINOCIP project for the camelina crop, the technology used had a low number of works, with low inputs, renouncing to chemical fertilisers and pesticides, as camelina was produced in an ecologic system. Soil tillage were represented by: stubble ploughing after wheat harvesting, followed by summer tillage at a depth of 20 – 22 cm, and in spring the seed bed preparation with disk harrows. For sowing, a seed rate of 7 kg/ha was used. In 2009, on the experimental fields of Constanta district, an average production of 1500 kg/ha was obtained and in 2010, because a severe drought in May-June, the production obtained was of 720 kg/ha [5].

RESULTS AND DISCUSSION

Following tests on cold-pressed oil extraction from camelina seeds, conducted by S.C. ZECASIN S.A. together with the Czech company „FARMET" (equipment manufacturer for oil extraction and filtration) through Axe Consulting Plus S.R.L. Company, the results presented in Table 1 were obtained.

Table 1

Results regarding oil extraction from *Camelina sativa* seeds by cold-pressing

Oil extraction method: seed cold-pressing	**Sieve apertures 6 mm**	**Sieve apertures 8 mm**
Seed moisture (%)	8	8
Seed oil content (%)	40	40
Extracted oil from seeds (%)	27.02	32.32
Unextracted oil from seeds (%)	12.98	7.68
Cakes resulted (%)	72.98	67.68
Oil remained in cakes (%)	17.79	11.35

It is noticed that the sieve apertures diameter of cakes from the press have a major importance in the process of camelina oil extraction, the 8 mm nozzle being recommended.

Through a new cakes pressing, 2-4% of oil can be recovered.

In order to determine the efficiency of camelina crop, oilseed rape crop was chosen for comparison, representing the basic culture in Romania for obtaining biofuels. Table 2 presents comparative economic calculations regarding seed production and crude oil in camelina and oilseed rape.

Table 2

Comparative economic data for camelina and oilseed rape crops

Considered surface - 1ha	**Camelina**	**Oilseed rape**
Seed production (kg/ha)	1500	3400
Production costs (lei/ha)	570	1380
Seed oil content (%)	40	43
Oil quantity resulted after pressing (kg)	484	1190
Oil density at 40^0C (g/cm^3)	0.9219	0.9186
Oil quantity resulted after pressing (l)	525	1295
Costs for cold-pressing of seeds (lei)	225	510
Cake quantity resulted after pressing (kg)	1016	2210
Cakes value (0.7 lei/kg) (lei)	711	1547
Production prices /litre of crude oil (lei/l)	0.121	0.265

It is ascertained that although the seed production per hectare is much lower in camelina than in oilseed rape, the production price of camelina crude oil is much lower than that of the oilseed rape (half in comparison with the oilseed rape price), due to low inputs. So far, for this species, little plant protection treatment is done. It presents diseases (blight and dry rot) and pests common to those of oilseed rape. If sown early, camelina plants present a better competitiveness towards the weeds because of the effect of allelopathy [2].

Also, camelina represents an exception in terms of fatty acid composition. With a low content in saturated fatty acids and a high content in unsaturated fatty acids, camelina oil can be considered high quality edible oil. It is also very rich in natural antioxidants such as tocopherols (vitamin E), which offers the oil a high stability in time, being resistant to oxidation. In table 3, camelina oil composition is presented, determined at INCDBNA - Balotesti, Chemistry and Physiology Laboratory.

Table 3

Oil composition in Camelina sativa

	Fatty acids		**Fatty acids content (%)**
Saturated	Myristic acid	C14:0	0.10
	Palmitic acid	C16:0	6.51
	Stearic acid	C 18:0	2.15
Unsaturated	Palmitoleic acid	C 16:1	0.18
	Linoleic acid	C 18:2	22.05
	Linolenic acid	C 18:3	47.17
	Oleic acid	C 18:1	16.27
	Erucic acid	C 22:1	1.60
	Arachidonic acid	C 20:4	1.11
	Docosadienoic acid	C 22:2	2.24
	Tocopherols (Vitamin E)		0.110
	Other fatty acids		0.50

Camelina oil could be use as a biofuel for the diesel engines, replacing conventional fuel. Camelina oil is also the raw material for obtaining jet fuel. In table 4 are presented the main characteristics of vegetable oils (the data are from the test results conducted by INMA Bucharest and TINOCIP Project).

Table 4

Main characteristics of diesel and vegetable oils

Fuel	**Heat output** (kj/kg)	**Density at 15^0C** (g/cm^3)	**Heat output** (kj/l)	**Kinematic viscosity at 40^0C** (mm^2/s)	**Cetane number**	**Flash point** (^{0}C)
Diesel	45385	0.832	37780	3.32	49.2	62
Rapeseed oil	38887	0.918	35698	33.10	45.3	153
Sunflower oil	38525	0.919	35404	31.81	40.3	195
Soya oil	39252	0.919	36072	30.70	40.8	205
Camelina oil	39104	0.921	36014	28.78	45.8	154

The oil characteristics that are important for the use of pure oil in diesel engine are heat output, kinematic viscosity and flash point. We noticed that among the vegetable oil presented, camelina oil has the heat output value closed to diesel, the lowest kinematic viscosity value and a quite small flash point. From this point of view, camelina oil is a better biofuel than the other vegetable oils.

CONCLUSIONS

1. Camelina plants are competitive with annual weeds, due to the allelopathic effects of camelina plants. For that reason, most of the times chemical treatments for weed control are not necessary (if in spring the sowing is not delayed).
2. It is tolerant to drought and pests and disease attack.
3. Seed oil content is quite high and may reach up to 46% [3].
4. Camelina oil could be used as biofuel in the diesel engines.
5. Camelina oil is a viable solution to produce jet fuel.
6. Taking into account all the special qualities of this oleaginous species, further research extension is compulsory on a long period of time.

ACKNOWLEDGEMENTS

Partnerships in priority areas Grant no. 22138/2008 TINOCIP financially supported this study.

REFERENCES

1. Carciumaru M. *Plante folosite de traco-geto-daci.* (Thraco-dacica VIII).
2. Putnam D.H., J.T. Buda, L.A. Field, and W.M. Breen, 1993. *Camelina: A promising low-input oilseed*. In: J. Janick and JE Simon (eds.), New crops. Wiley, New York (pp. 314-322).
3. Tabara V., Georgeta Pop, W. Ladislau, C.G. Tabara, Ioana Maria Mateas, Monica Daniela Prodan, 2007. *Plantele, surse de producție pentru biocombustibili.* Buletinul AGIR nr. 3/2007.
4. xxx, 1958. Hotărare nr. 1146 din 12 august 1958 pentru modificarea si completarea Hotararii Consiliului de Ministri nr. 212 din 8 februarie 1957.
5. xxx, 2008. *Tehnologii inovative de obținere a biocarburanților de înalta performanță din materii prime regenerabile, specifice României*. Proiect Nr. 22138/2008 TINOCIP.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

CAMELINA SATIVA - AN OILSEED CROP WITH UNIQUE AGRONOMIC CHARACTERISTICS

P. DOBRE, ŞTEFANA JURCONE

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *camelina, oil, low input systems*

Abstract

Camelina sativa (camelina, false flax, wild flax, German sesame, Siberian oilseed), is a flowering plant in the family Brassicaceae. It has been grown in Europe for a long time (in the Bronze Age it was considered a major crop), as an oilseed crop to produce high quality vegetable oil. In modern age, camelina cultivation has been diminished, but in very recent years, the surfaces have increased. This reconsideration of camelina crop is due do the interest for biofuels and low input production systems. Camelina could be an interesting solution for marginal lands and for conservation tillage systems.

INTRODUCTION

On the basis of an increase in request for high quality oils, biofuels and edible powders, the surfaces occupied by the oleaginous crops are continuously extending. For the temperate climate, basic oleaginous species are represented by soya, sunflower and oilseed rape. The percentage of the three species will continue to grow in agriculture, taking into account the wide adaptation of these crops and the continuous development of new varieties and hybrids, with improved characteristics.

However, each of these major oleaginous crops has its limits. In the last years, there was an increased interest in developing agricultural systems with minimal requirements for fertilisers, pesticides, energy and they offer a better control for soil erosion as opposed to conventional systems. This has determined the extension of researches on *Camelina sativa* species as an oleaginous plant, with minimal crop requirements, as a well adapted species for marginal lands cultivation, or as a source for soil conservation through agricultural practices.

Camelina is a plant originating from Middle Est. There is much archeological evidence showing that the plant has been cultivated in Europe for at least 3000 years. The oldest archeological sites include the Neolithic period in Switzerland (dated in 2nd millennium B.C.), the Chalcholitic period in Greece (dated in 3rd millennium B.C.) [6].

Oils could be obtained from camelina and poppy seeds, being used in alimentation, illumination and leather tanning.

According to Zohary and Hopf, until 1940, the *Camelina sativa* crop was an important oil crop in Eastern and Central Europe, and has currently continued to be cultivated in a few parts of Europe for its seed which was used, [2] for example, in oil lamps (until the modern harnessing of natural gas and propane and electricity) and as an edible oil. Sativa was spread in Central and Eastern Europe, the oil obtained from the seeds being used in oil lamps for illuminating purposes and as edible oil [6]. The plant continued to be cultivated in several parts of Europe for its seeds (Poland, Romania, Russia etc.).

MATERIAL AND METHODS

Botanical and biological particularities

Camelina sativa (L) Crantz is part of the *Brassicaceae* family, the *Camelina* type that includes many species. The plant is generally known as "c*amelina", false flax, gold of pleasure, lennica* etc. For the production of alimentary oil, two species are used: spring camelina - *Camelina sativa* (Figure 1) and fall camelina - *Camelina silvestris* [7]. For biofuels, spring camelina is considered.

Camelina sativa is a plant with a taproot, whose branched stem in the superior third has a height between 40 and 100 cm. The plant is glabrous or covered with fine hairs in the upper part.

Its leaves are simple, glabrous or covered with fine hairs, lanceolate shaped, short-petiolate at the base, and sessile in the upper part.

Its flowers are small, pale yellow, of type 4 as all the crucifers. They are racemosely disposed in inflorescence. The fruit is a long pyriform pod of 6-12 mm and contains 7-10 rust-colored or yellowish-brown seeds of approx. 0.7 mm x 1.5 mm. It is an allogamous plant.

Camelina proved to be an allelophatic plant [4].

Economic and alimentary importance

Camelina is cultivated especially for seeds with content in oil of 26-46% [5]. Camelina oil is used in a fresh condition in alimentation, having a "specific taste of onion and mustard, as well as a pleasant, moderate and pure perfume" [7]. Possessing siccative properties, the oil is also used in the paint and varnish industry. Camelina oil is also utilized in the manufacture of soap, in the metallurgic industry etc. Camelina cakes are being used with good results in animal feed, as an organic fertiliser or as a solid biofuel.

a

b.

Fig. 1. ***Camelina sativa*** **(L.) Crantz:** ***a*****. plant [5]*****; b*****. seeds (original)**

Crop technology

Camelina sativa belongs to the oleaginous plants' group, with a short period of vegetation, reaching maturity in 70-95 days. It is a long day plant and, as such, it shortens its vegetation period along with the northward advance.

Due to the short period of vegetation, it can be successfully cultivated in the North of Europe, sometimes exceeding even the line of the Arctic Circle. Concurrently, camelina can be also cultivated in highlands, at heights up to 1400 m. Camelina does not pose many requirements regarding the climate, and high temperatures from the flowering period do not influence the production considerably. It presents a low sensibility towards late spring frosts. For its development, it needs a bit of warmth, the crop containing forms of spring and fall camelina. Those planted in the fall are relatively resistant to frost, surpassing from this point of view the oilseed rape. Fall forms are cultivated more in the southern regions where there are no harsh winters; instead, spring forms are being cultivated both in the northern regions and in the southern ones. Camelina can be successfully cultivated in arid areas. Due to the short period of vegetation, summer drought is avoided.

Camelina is not pretentious towards the soil. It thrives well even on light, sandy soils, poor in nutrients. Camelina does not grow well on heavy, clay soils that form a crust and block the normal emergence of plants. Also, the peat or the swampy soils are not suitable. Camelina finds very good conditions for developing in our country. It can be recommended especially in areas with poor, eroded soils, in which other less pretentious crop plants do not offer satisfactory results.

Crop rotation. Camelina does not pose many conditions towards the place we offer in the crop rotation. It gives satisfying results after any preceding plant; the best are the widely-grown crops. Camelina can successfully replace the fall cereals compromised by frosts, due to the fact that it has a short period of vegetation, which allows a late sowing. In turn, camelina is a good predecessor for most of the crop plants, as it leaves the land early and in a good fertilisation state.

Soil tillage. The land intended to camelina crop establishment must be very well levelled and superficially hoed, as camelina has small seeds. When crop rotation comes after cereals, soil tillage begins by stubble harrowing, followed by a tillage at 20-22 cm deep. After corn and sunflower only the deep fall ploughing is done. Before sowing, the soil must be tilled with a combinator to a depth of 5-6 cm.

Seed and sowing. Camelina emerges at 1^0C, and plants resist to late spring frosts reaching minus 5^0C, therefore, the crop can be established without any danger, as early as possible in spring. Early sowing gives the possibility for seeds to find the necesary moisture for germination. Late sowing reduces the yield because of weed competion. Fall camelina is sown in November - December.

Sowing is executed with drill machines in rows, to a distance of 12.5 cm between rows and a seed rate of 6-7 kg/ha, assuring a density of 200 plants/m^2. Good results can also be obtained by sowing directly in the stubble, if the land is cleared of weeds. Drill machines in rows are used directly on the stubble (with a disc drilling) and the same seed rate. In winter, the method of superficial sowing can be used by seed brodcast on the frozen soil, case in which the seed rate reaches up to 14 kg/ha. The sowing depth is of 1-1.5 cm.

Plant protection. Due to the short period of vegetation and the fast rate of growth, camelina controls very well the weeds in case of winter or early spring sowing.

The first work of plant protection is executed after plants' emergence and consists of perpendicular harrowing of the crop in the direction of the rows, executed with a light harrow, in order to destroy the weeds. When camelina plants have reached the height of 6 - 7 cm, the first work with the comb-harrow is done and the second one before the floral buds formation.

Chemical weed control in the camelina crop is not well established. In studies conducted over several years, camelina was not affected by Trifluralin herbicide incorporated in fall or spring before sowing, but the yield has not recorded growths, as compared to the variants which the herbicides were not used [4]. Currently, herbicides are not recommended to be used in the camelina crop, as their use would include a significant increase in the production cost, with no production gains.

For fertilisation doses of chemical fertilisers are recommended: **N:** 60-75 kg/ha; **P_2O_5:** 30-40 kg/ha; **S:** 12-24 kg/ha, but it also responds well to lower doses.

In terms of water, conditions are reduced, being better adapted to arid areas than other oleaginous plants, valuing well the winter and spring rainfalls.

Pests and diseases. From the studies extended on several years, it was noticed that the damages caused by diseases and pests to camelina crops do not usually justify the chemical control measures.

The diseases that sometimes affect camelina crops are represented by:

- Blight (*Peronospora camelinae*) is sometimes observed in camelina crops. It appears as a grey or white mould which is manifested in the upper part of the stem. As a control measure, crop rotation is imposed and if necessary, chemical control with specific fungicides.
- White mould (*Sclerotinia sclerotiorum*) is manifested sometimes on stems as discolored lesions, on which a white, soft mushroom can develop. Following the lesions, stems can bend or break, causing yield losses. As in the case of oilseed rape, the crop rotation method is imposed and if necessary the application of fungicides treatments is required. The attack is not virulent as in the case of oilseed rape crop.

Camelina has proven to be resistant to black leg (*Leptosphaeria maculans, Phoma lingam*), which is a serious disease of oilseed rape. Also, camelina is resistant to alternalia blight (*Alternaria brassicae*), a disease that causes significant damages to the oilseed rape [4]. Amongst pests, the attack of crucifer flea beetle (*Phlylotreta cruciferae*) was observed in the camelina crop during the arid years, but it does not cause serious damages as in the case of the oilseed rape.

Harvesting. Camelina is characterized by a uniform maturation. The proper moment for harvesting initiation is when pods turned brown and seeds have gained the characteristic shape, size and color. The losses caused by shattering in case of harvesting delay are significant and can even reach up to 20-30%, therefore being required for the harvest to be done on time. After thashing, if necessary, the seeds are cleaned of impurities, usually remaining mixed with other pod remains, weed seeds, insects etc. For their storage, they must be dried, so that the percentage of water will not exceed 8-9%. The production of seeds for camelina can reach 800-1500 kg/ha, but yields of over 2000 kg/ha can be obtained by applying superior agrotechniques.

CONCLUSIONS

1. *Camelina sativa* has unique agronomical features that could substantially reduce and even eliminate the requirements regarding the soil preparation and annual weed control.
2. It is compatible with reduced systems of soil works (minimum tillage), or with systems without works (no till), with reduced inputs.

3. It presents high resistance to draught and disease and pests attacks.
4. It resists very well to high temperatures during flowering time.
5. It can be also used as a cover crop.
6. It does not impose conditions towards the soil. It thrives well even on light, sandy soils, poor in nutrients, where more pretentious crops do not give results.
7. It is recommended for cultivation of marginal or degraded lands.
8. The seed rate is reduced (6-14 kg/ha) and it does not require special and expensive sowing equipments.

Considering all the special qualities of this oleaginous species, further researches and an extension on a longer period of time are required.

ACKNOWLEDGEMENTS

Partnerships in priority areas Grant no. 22138/2008 TINOCIP financially supported this study.

REFERENCES

1. Britton NL. and A. Brown, 1913. *An illustrated flora of the northern United States*. Canada and British Possessions.
2. Cârciumaru M. *Plante folosite de traco-geto-daci*. (Thraco-dacica VIII).
3. Putnam D.H., J.T. Buda, L.A. Field, and W.M. Breen, 1993. *Camelina: A promising low-input oilseed.* In: J. Janick and JE Simon (eds.), New crops. Wiley, New York, 1993 (pp. 314-322).
4. Tabără V., Georgeta Pop, W. Ladislau, C.G. Tabără, Ioana Maria Mateaş, Monica Daniela Prodan, 2007. *Plantele, surse de producție pentru biocombustibili*. Buletinul AGIR nr. 3/2007.
5. xxx, Wikipedia - Enciclopedia liberă.
6. xxx, 2008. Cerere de înregistrare a unei STG - Regulamentul (CE) nr. 509/2006 al Consiliului „olej rydzowy” nr. CE: PL-STG-007-0049-28.12.2006 - Jurnalul Oficial al Uniunii Europene 25.09.2008.
7. xxx, 1958. Hotărâre nr. 1146 din 12 august 1958 pentru modificarea si completarea Hotărârii Consiliului de Miniştri nr. 212 din 8 februarie 1957, privind regimul de contractare al plantelor tehnice necesare industriei alimentare din România.
8. xxx, 2008. *Tehnologii inovative de obținere a biocarburanților de înalta performanță din materii prime regenerabile, specifice României.* Proiect Nr. 22138/2008 TINOCIP, Programul PN II - Parteneriate, Domeniul 2 ENERGIE.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

NEW TECHNIQUES IN *ASPARAGUS OFFICINALIS* L. MICROPROPAGATION

ADRIANA PETRUŞ-VANCEA

University of Oradea

Keywords: *deuterium, honey, micropropagation, Asparagus*

Abstract

In this study we aimed to identify new techniques for sparrow grass (Asparagus officinalis L.) micropropagation and to increase plant biomass, quantitatively and qualitatively. The objective was achieved by using deuterium depleted water (DDW), containing only 25 ppm deuterium, and honey, in double-layer system practice vitro-cultures. Thus, 90 days after the sparrow grass propaguls were cultivated on Murashige-Skoog medium (1962), solid, with no growth regulators, over which was applied a liquid layer consist in DDW (V_4), rhysogenesis and caulogenesis processes were significantly stimulated, as well as applying a mixture of honey 15 g/l and distilled water (V_5) over the solid layer. Both to the single and the double layer system, the honey and DDW combination (V_3, respectively V_6) caused rhysogenesis process inhibition to 100%, but in case of double layer system the caulogenesis was stimulated. Variants of culture medium in single-layer – in which distilled water was replaced with DDW (V_1) or in which sucrose was replaced with honey (30 g/l) (V_2) - are recommended to delay the growth of sparrow grass vitro-plantlets (vitro-conservation).

INTRODUCTION

Deuterium depleted water (DDW) - produced by National Research and Development Institute for Cryogenic Technologies from Râmnicu Vâlcea, Romania had many uses in cancer therapy [22]. In time, research was performed regarding their effect upon vegetal organisms, including the effect on phyto-inoculum [3, 13, 17, 19, 21]. Somlyai and his colleagues [23] found that a decreasing of the deuterium, from the content of the water used by animals, influenced the cell metabolism till to the halt of the development and even disappearance of the tumour cells. In this author's opinion, the cells are able to regulate deuterium (D)/hydrogen (H) ration and those changes in this rapport can trigger certain molecular mechanism having a key role in cell circle regulation. It is suppose that the concomitant increase of D/H ratio is the real trigger for the cells to enter in the S phase of division [24]. The decreases of D level can interfere in the signal transduction pathways thus leading to tumour regression. In the case of transplantable tumours, low-deuterium water treatment lead to a significant inhibitory effect on the volume of all tumour patterns concerned: it delayed nodule formation at transplantation site.

On the other hand, on plants, DDW was used as tracers to characterize whole-tree water transport and storage properties in individual trees belonging to the coniferous species and on five tropical tree species and a bamboo species [8]. DDW tracing method appears suitable for answering some questions, such as relative differences in water use among trees, water redistribution among neighbours and internal water transport and storage processes in plants [25]. Also, the effects of combined soil physical stresses of compaction and drought on the production of fully hydrated mucilage (mucilage) and root border cells (RBCs) in maize was studied using deuterated water method [26].

DDW and double system layer for *in vitro* cultures are the solution that Petruş-Vancea and collaborators [16] found it to *Coleus* and *Petunia* vitroplantlets, suffering by hyperhydricity. After 30 days of vitrocultures in double layer the mentioned authors observed the following results: at the *Coleus* vitroplantlets a new formation of healthy apexes, which were subcultivated on fresh medium and finally the new regenerated vitroplantlets were ready for acclimatization, especially to those lots which were treated with a 1.5% glucose solution, prepared with DDW and to the *Petunia* vitroplantlets, the acclimatization surviving rate was 90% - 95% to the lots treated with DDW and was zero to the vitroplantlets submersed in distilled water (DW - control lot).

By replacing bidistilled water in the Murashige - Skoog (MS) [9] culture media, with DDW (with 25 ppm D), even in the presence of 6-Benzylaminopurine (BA) in 2.5 mg/l 6 concentrations was achieved callusogenesis, an undesirable phenomenon in some vitrocultures [15]. The presence of the DDW in this culture medium has exercised a 100% inhibitory effect of the callusogenesis, determining regeneration of vigorous and healthy plantlets.

As belonging, the genus *Asparagus* (*Monocotyledonatae, Liliaceae* family) plantlets are susceptible *in vitro* to hyperhydricity, a phenomenon that significantly decreases the quantity and quality of final plant mass obtained by micropropagation, in the present experiments, we aimed to study a new procedure for optimization this, by the double-layer culture system. Also, distillate water was tested the replacement from culture medium composition of DW with DDW and/or replacement of sucrose with honey (acacia honey). Procedures for replacing DW with DDW in *in vitro* culture have already been patented [5], and research regarding carbon source replacement from culture medium are numerous, but the use of honey is less studied [10, 17]. The optimisation of *Asparagus officinalis* L. micropropagation is a important objective of the research in this field, because, in bioindustry, there is an high economic and commercial interest, especially for megastores [6], and in the future, in bio-economic and eco-economic context, the human need for food will be considerable higher [4, 7]. The i*n vitro* conservation is an important method of germplasm conservation, as traditional conservation of crop both plants of agricultural interest [1, 2, 20], as well as the medicinal [19].

MATERIAL AND METHODS

The plant material consisted of uniform asparagus propaguls (*Asparagus officinalis* L.), which are in laboratory phyto-vitrobase, grown on basic medium (BM) MS, solid, without growth regulators.

The culture medium used in these experiments was MS, modified by us, namely: thiamine vitamins HCl, pyridoxine HCl and nicotinic acid, instead of 0.1 mg/l or 0.5 mg/l, as provided in the original recipe, were added to each 1 mg/l and amino-acids were removed; the solidification was achieved by 7 g/l agar-agar; culture medium pH was adjusted to a value of 5.7 before its autoclaving.

The culture medium preparation was performed according to the following test: Single-layer system:

V_0 - BM-MS solid prepared with DW and sucrose 30 g/l (control);

V_1 - BM-MS prepared with DDW and sucrose 30 g/l;

V_2 - BM-MS prepared with DW and honey 30 g/l;

V_3 - BM-MS prepared with DDW and honey 30 g/l.

Double-layer system:

V_4 - BM-MS prepared with DW and 30 g/l sucrose + supernatant DDW;

V_5 - BM-MS prepared with DW and sucrose 15 g/l + supernatant honey 15 g/l, mixed with DW;

V_6 - BM-MS prepared with DW and sucrose 15 g/l + supernatant honey 15 g/l, mixed with DDW.

We were taken into account that to each experimental variant, the carbohydrate content (regardless of its nature) to a total of 30 g/l, both for single layer and double layer cultures.

Vitrocultures vessels consisted of glass jars, 7 cm height and 4 cm diameter, each one with 20 ml of solid medium (first layer). The supernatant was 5 ml.

Incubation and growth was realised in growth chamber at 22°C ± 2°C, illuminated with white fluorescent tubes, 16 h day length photoperiod of 24 h day light and 1700 l x intensity.

The biometrisation of plantlets growth indices were realised at 90 days after inoculation and the dry weight were weighed after maintenance in aluminium foil, in oven at 115°C, for 3 days. The dates obtained from measurements were interpreted statistically by analysis of variance, also the statistical significance was determined using *one sample t test* of statistical SPSS for Windows vs.16.0. Software.

RESULTS AND DISCUSSION

90 days after inoculation, the rhysogenesis of sparrow grass vitroplantlets was absent to those vitroplantlets cultured on medium with honey and DDW mixture, either to simple layer (V_3) or at the supernatant (V_6) (table 1). The same inhibitory effect, exercised by DDW, was reported [13, 14] in case of watering, with this type of water, at the base of chrysanthemum or African violets plantlets, throughout the all period of acclimatization to the septic medium. Also the rhysogenesis, at the *Tradescantia* minicuttings level, rooted in perlite as natural living conditions, was inhibited by watering them with DDW, compared with DW [11].

In *Cymbidium hybridum* and *Petunia* vitroplantlets, grown on MS medium, in single layer system, solid, with no growth regulators, the DDW took effect on timing growth of phyto-inoculum, with an important role in preserving *in vitro* cultures [12].

Growth index values, registered on type V_1, were noted with statistically insignificant, because this lot has huge losses by the lack of regeneration process at the phyto-inoculum level, the deuterium depleted water, as an replacement of DW, on solid layer, exerted a powerful inhibition effect of organogenesis. To previous experiments were noticed light inhibition of *in vitro Cymbidium* organogenesis [27], or to the chrysanthemums and African violets plantlets [17], grown on culture media in which the sucrose was replaced with acacia honey, 20 g/l, but, when the plantlets (species regardless) were transferred to septic medium, the survival of the lot grown *in vitro* on medium with honey, was superior to that from the medium whose carbon source was sucrose.

Instead, caulogenesis, expressed by the total number of propaguls, was very high on double layer cultures medium (V_4 - V_6), especially to the vitroplantlets grown on culture medium prepared with DW and 30g/l sucrose, as the first layer, over which the DDW supernatant was applied (V_4) (Table 1). Additionally, the lots cultured in the double layer system (V_4-V_6) were also reported propaguls with larger sizes, up 3.4 cm.

Directly proportional with the organogenesis, highlighted to the phyto-inoculum's level, were the fresh weights vitroplantlets values, at the experimental tested variants. Instead, the dry weight of the vitroplantlets cultured on medium prepared with DW and sucrose 15 g/l with honey supernatant 15 g/l, mixed with DW (V_5) (whose fresh weight was the highest and statistically significant) marked values similar to those registered on the other two lots cultivated on medium with supernatant (V_4 and V_6) (Table 1).

Table 1

Comparative analysis of average values of sparrow grass (*Asparagus officinalis* L.) vitroplantlets growth indices, at 90 days after inoculation, as follows: V_0 - BM-MS solid prepared with DW and sucrose 30 g/l (control); V_1 - BM-MS prepared with DDW and sucrose 30 g/l; V_2 - BM-MS prepared with DW and honey 30 g/l; V_3 - BM-MS prepared with DDW and honey 30 g/l; V_4 - BM-MS, prepared with DW and 30 g/l + supernatant DDW; V_5 - BM-MS, prepared with DW and sucrose 15 g/l + supernatant honey 15 g/l, mixed with DW; V_6 - BM-MS, prepared with DW and sucrose 15 g/l + supernatant honey 15 g/l, mixed with DDW

Biometrisation	V_0		V_1		V_2		V_3		V_4		V_5		V_6	
	Mean ± st.dev	Sig	Mean ± st.dev	Sig	Mean ± st.dev	Sig	Mean ± st.dev	Sig	Mean ± st.dev	Sig	Mean ± st.dev	Sig	Mean ± st.dev	Sig
No. rootlets	1.86± 0.38	***	1.50± 0.71	ns	1.90± 0.31	***	0.00± 0.00	-	2.00± 0.63	***	2.00± 0.50	***	0.00± 0.00	-
Length rootlets (cm)	3.86± 0.69	***	1.50± 0.71	ns	1.60± 0.52	***	0.00± 0.00	-	4.00± 0.63	***	1.30± 0.48	***	0.00± 0.00	-
No. propaguls	11,3± 0.95	***	5.00± 0,7	ns	3.30± 0.82	***	3.90± 0.99	***	15.3± 1.27	***	10.0± 1.70	***	10.0± 0.94	***
No. propaguls with 0.0-0.9 cm length	1.67± 0.58	***	4.00± 0.01	ns	1.17± 0.41	***	1.00± 0.01	***-	1.00± 0.01	***	3.00± 0.94	***	1.11± 0.33	***
No. propaguls with 1.0-1.9 cm length	3.86± 0.38	***	1.00± 0.03	ns	1.00± 0.01	***	1.11± 0.33	***	2.09± 0.70	***	2.30± 0.48	***	1.80± 0.42	***
No. propaguls with 2.0-2.9 cm length	2.57± 0.98	***	0.00± 0.00	ns	1.00± 0.01	***	1.21± 0.43	***	6.18± 0.60	***	1.80± 0.92	***	4.20± 0.42	***
No. propaguls with 3.0-3.4 cm	3.00± 0.58	***	0.00± 0.00	ns	1.13± 0.35	***	1.56± 0.73	***	6.00± 0.63	***	2,90± 0.74	***	3.00± 0.47	***
Weight fresh (g)	1.94± 0.06	***	1.25± 0.01	ns	0.52± 0.01	***	1.63± 0.06	***	2,95± 0.01	***	5.27± 0.01	***	3.19± 0.01	***
Weight dry (g)	0.17± 0.01	***	0.22± 0.02	ns	0.04± 0.01	**	0.28± 0.01	***	0.35± 0.03	***	0.33± 0.01	***	0.36± 001	***

Note: BM-MS – basal medium Murashige-Skoog (1962); DW – distilled water; DDW-deuterium depleted water; sig. – significance [ns – no significant; ** *significant*, ****very significant*]; st.dev. – standard deviation; no – number; L – length; W – weight.

CONCLUSIONS

1. Double layer system improves quality and quantity of the aerial part of *Asparagus officinalis* L. vitroplantlets.
2. The replacement of distillate water from the sparrow grass culture medium with deuterium depleted water (with 25 ppm D) led to lower rhysogenesis, but with honey mixture this system improved organogenesis.
3. Replacing sucrose with honey caused an inhibition both to the rhysogenesis and to the caulogenesis, in case of single layer system, but in double layer system, this compound of culture medium improve quantity of biomass.

ACKNOWLEDGEMENTS

This work was cofinanced from the European Social Fund through the Sectoral Operational Programme Human Resources Development 2007-2013, project number POSDRU/89/1.5/S/63258 ”Postdoctoral school for zootechnical biodiversity and food biotehnology based on the eco-economy and the bio-economy required by eco-san-genesys”, coordinated by the National Institute of Economic Research ”Costin C. Kirițescu”, Romania, in collaboration with ”Lucian Blaga” University of Sibiu, ”Vasile Goldiş” West University Arad, S.C. GNIR Holding S.A. and S.C. SIAT S.A.

REFERENCES

1. Antofie M., Mihaela Dana Constantinovici, M.R. Pop, Pompilica Iagrăru, Camelia Sand, G. Cirotea, 2010. *Theoretical methodology for assesing the status of conservation of crop landraces in Romania.* Analele Universității din Oradea - Fascicula Biologie, Tom. XVII (2) (pp. 313-317).
2. Antofie M. Mihaela, M.R. Pop, Camelia Sand, G. Ciotea, Pompilica Iagrăru, 2010. *Data sheet model for developing a red list regarding crop landraces in Romania.* Annals. Food Science and Technology, Vol. 11(1) (pp. 45-49).
3. Beleş Dana, Dorina Cachiță, 2007. *Pistia stratiotes L. exvitoplantlets acclimatization on medium prepared with deuterium depleted water.* The XVth Plant Cell and Tissue Culture National Symposium, Dorina C. Cachiță, (ed.). Cluj-Napoca, Risoprint Publish House (pp. 173-181).
4. Bogdan A.T., Iudith Ipate, V. Bara, D. Diaconescu, Cornelia Purcarea, Amalia Strateanu, 2010. *Ecoeconomic and bioeconomic impact of food safety and security in perspective increased consumption of food and feed during 2030-2100.* International Symposium “Risk Factors for Environment and Food Safety”, Faculty of Environmental Protection, November 5-6, Oradea 2010 (pp. 1044-1056).
5. Cachita Dorina, Adriana Petrus-Vancea, Dorina Radovet, 2010. *Procedures for preventing or controlling hyperhidration in phyto-inoculi by using deuterium depleted water.* Patent RO 125649-A2, Published in 30.08.2010, International Patent Classification A01N-02500; C01B005/00.

6. Hurgoiu Floare, Dorina Cachiță, 2006. *Inițierea de vitroculturi la Asparagus, Plant vitroculture conservation.* The XIVth Plant Cell and Tissue Culture National Symposium, Cachiță, C.D. and Sand, C. (eds.), Alma Mater Publish House, Sibiu (pp. 217-222).
7. Ipate Iudith, A.T. Bogdan, M. Paraschivescu, M. Sandu, Simona Ivana, N. Ipate, Amalia Strateanu, G. Toba, M. Enache, 2010. *Use rare breed for genuine foods in Romanian rural tourism and possibility of traceability the traditional products.* Bulletin UASVM Animal Science and Biotechnologies, 67(1-2) (pp. 225-230).
8. Meinzer F.C., J.R. Brooks, J.C. Domec, B.L. Gartner, J.M. Warren, D.R. Woodruff, K. Bible, D.C. Shaw, 2005. *Dynamics of water transport and storage in conifers studied with deuterium and heat tracing techniques.* Plant, Cell & Environment, Vol. 29 (1) (pp. 101-114).
9. Murashige T., F. Skoog, 1962. *A revised medium for rapid growth bioassays with tobacco tissue cultures.* Physiologia Plantarum, No. 15 (pp. 473-497).
10. Pătru Diana, Dorina Cachiță, 2001. *Research regarding Dianthus caryophyllus var. Tundra minicuttings in vitro grown on culture medium in which the sucrose was replaced total or partial with honey.* Analele Universității din Oradea - Fascicula Biologie, Tom. VIII (pp. 453-451).
11. Petruş C.M., Dorina Cachiță, 2008. *Foliar and radicular sprinkling of Tradescantia cuttings, with different types of water, and their effect to organogenesis and the epidermal formations of foliar limbs*. Analele Universității din Oradea - Fascicula Biologie, Tom. XV (pp. 73-78).
12. Petruş C.M., Adriana Petruş-Vancea, Dorina Cachiță, 2004. *Cymbidium and Petunia micropropagation on culture medium prepared with deuterium depleted water*. Plant cell physiopathology in vitroculture system - The XIIIth Plant Cell and Tissue Culture National Symposium, Cachiță, C.D. and Ardelean, A. (eds.), Daya Publish House, Satu - Mare (pp. 185-192).
13. Petruş-Vancea Adriana, Dorina Cachiță, 2008. *Regards on Chrysanthemum (Chrysanthemum morifolium Ramat var. Lamet), leafs epidermis which were sprinkle, during "ex vitro" acclimatization period, with Pi water and deuterium depleted water.* Studia Univ. Vasile Goldiş, Seria Şt. Vieții, Vol. 18 (pp. 81-86).
14. Petruş-Vancea, Adriana, Dorina Cachiță, 2009. *The effect of Pi or deuterium depleted water on foliar stomata of Saintpaulia ionantha L. exvitroplantlets sprinkled foliar or radicular.* Studia Univ. Vasile Goldiş, Seria Şt. Vieții, Vol. 19(2) (pp. 309-312).
15. Petruş-Vancea Adriana, Dorina Cachiță, 2011. *New methods for preventing the unwanted callusogenesis at sugar beet (Beta vulgaris var. Saccharifera).* Romanian Biotechnological Letter (accepted, in press).
16. Petruş-Vancea Adriana, Dorina Radoveț, Dorina Cachiță, 2008. *Hiperhydricity annihilation out of vitrocultures with deuterium depleted water and Pi water, using a double layer system.* Lucrări Ştiintifice. Serie F, Special Volume, Biotechnology (pp. 20-30).

17. Petruş-Vancea Adriana, G.E. Bandici, Dorina Radovet, C.F. Blidar, 2008. *The acclimatization capacity of the Saintpaulia and of the Chrysanthemum exvitroplantlets, derived from vitroculture medium in which the saccharose was replaced with honey.* Analele Universității din Craiova, Vol. XII (XLVIII), Secțiunea Biologie (pp. 209-214).

18. Petruş-Vancea Adriana, Dorina C. Cachiță, C.F. Blidar, I. Ştefănescu, 2003. *The effect of dedeuterised water in acclimatization of Chrysanthemum vitroplantlets to septic medium.* Papers of the 5th International Symposium Young People and Multidisciplinary Research, Sudura Press, Timişoara (pp. 335-340).

19. Pop M.R., 2010. *Characters with multiple usages – phenotypic variability analysis at Echinacea purpurea (L.) Moench species.* Analele Universității din Oradea - Fascicula Biologie, Tom. XVII (2) (pp. 329-331).

20. Pop M.R., Camelia Sand, Dana Bobiş, Mihaela M. Antofie, H. Barbu, Petronela B. Pavel, L. Muntean, M. Savatti, 2010. *Studies concerning the production of volatile oil, rhizomes and roots, to different genotypes of Valeriana officinalis L.* Analele Universității din Oradea - Fascicula Biologie, Tom. XVII (2) (pp. 332-335).

21. Radoveț Dorina, 2004. *Study of acclimatization capacity of Coleus blumei Benth. Vitroplantlets, which was obtined from vitroculture from hyperhydrice plantlets treated with deuterium depleted water.* Papers of the 5th International Symposium Young People and Multidisciplinary Research, Timişoara, Sudura Publish House (pp. 507-515).

22. Somlyai G., 2001. *Să învingem cancerul! Efectele biologice ale reducerii de deuterium.* Conphys Publish House, Râmnicu Vâlcea.

23. Somlyai G., G. Laskay, T. Berkenyi, Z. Galbacs, G. Galbacs, A.S. Kiss, G. Jakli, G. Jancso, 1998. *The biological effect of deuterium depleted water, a possible new tool in cancer therapy.* Z. Onkol./Z of Oncol., Vol. 304) (pp. 91-94).

24. Turusov V.S., I.E. Siniak, A. Grigorev, D.G. Zaridze, E.E. Antoshina, L.S., Trukhanova, T.G. Gorkova, 2005. *Low-deuterium water effect on transplantable tumors*. Vopr Onkol., Vol. 51(1) (pp. 99-102).

25. Schwendenmann L., D. Dierick, M. Köhler, D. Hölscher, 2010. *Can deuterium tracing be used for reliably estimating water use of tropical trees and bamboo?* Tree Physiology, Vol. 30(7) (pp. 886-900).

26. Somasundaram S., T.P. Rao, J. Tatsumi, M. Iijima, 2009. *Rhizodeposition of mucilage, root border cells, carbon and water under combined soil physical stresses in Zea mays L.* Plant Production Science, Vol. 12 (pp. 4443-4448).

27. Vancea Adriana, Dorina Cachiță, Diana Pătru, 2002. *Adapted capacity of Cymbidium hybridum plantlets at ex vitro conditions, which was provided from culture medium with honey as sucrose replaced.* Analele Universității din Oradea - Fascicula Biologie, Tom. IX (pp. 213-218).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

VARIABILITY OF SOME APRICOT VARIETIES AND HYBRIDS QUALITY TRAITS CREATED IN ROMANIA

VALERICA TUDOR, A. ASĂNICĂ

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *apricot, phenotype, varieties, quality, traits*

Abstract

Current requirements of the species Prunus armeniaca in terms of creating new varieties are required to conduct extensive research in the apricot breeding program in the southeastern Romania. It's been proceeded to early selection based on correlations in order to create new varieties with high productivity and organoleptic qualities. Characteristics and traits of the 36 varieties and hybrids studied, grouped according to the period of maturation, were studied starting with the IPGRI descriptors used in Genus Prunus. The characteristics were followed: fruit weight (g), fruit color, fruit shape (index), fruit firmness (kgf/cm^2), dry matter content (%), titratable acidity (malic acid g%) and ascorbic acid content (C vitamin mg/100g). The resulting correlations between quality characteristics to base the selection criteria, in an early stage as the goal being to shorten it and choosing the best varieties.

INTRODUCTION

The creation of varieties with different fruit maturation periods, with high organoleptic qualities, 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 Mediterranean countries like Italy, France, Spain, Turkey, is a strong argument for the scientists involved in the improvement of this species.

MATERIAL AND METHODS

The biological material is represented by a total of 33 phenotypes of apricot and 3 control varieties, phenotypically grouped by period of fruit ripening: extra early, early, middle and late.

Specific methods were applied regarding fruit quality: fruit weight (g) using IPGRI Descriptors, skin color using the Ctifl color code, fruit shape (index), fruit firmness (kgf/cm^2), dry matter content (%), titratable acidity (malic acid g%) and ascorbic acid content (C vitamin mg/100 g).

For a more objective interpretation, the results were statistically processed using statistical software, obtaining the coefficient of variability analysis of variance to express the variability in the character analysis.

RESULTS AND DISCUSSION

VARIABILITY QUALITY PROPERTIES OF APRICOT PHENOTYPE

►**Average weight of the fruit**

→ The highest average fruit weight are phenotypes: 85.4.104 BIII – Viorica and 77.4.73 BIII – Carmela.

→ Significant differences resulted between early phenotypes group (72.74 g) and medium (69.85 g) than that of phenotypes extraearly (58.6 g), but not to the late (64.67 g).

→The coefficient of variability (16.21%) expressing a low-medium variability average weight of the fruit.

► **Fruit shape**

→ The highest shaped index values are the phenotypes: 82.32.29 BIV and 82.6.62 BIV - Siret, the appropriate index elongated shape, while at the other to indicate a value close to the corresponding spherical-shape is flattened and even spherical phenotypes: 85.3.100 BIII, 85.5.100 BIII, 85.5.104 BIII, 85.4.104 BIII – Viorica, 83.31.10BI – Bucovina, Dacia – Mt. and 85.1.96 BIII – Nicuşor.

→ The coefficient of variability 7.07% indicates a small variability of the character in the statistical population.

►**Skin color of the fruit**

→ 77.4.73 BIII – Carmela is the most colorful phenotype, followed by 85.4.104 BIII – Viorica and Dacia Mt., then groups of phenotypes that have the same background color of the skin, thus being assured of significant differences between the phenotypes studied.

→ Significant differences resulted between the classes of maturation studied: the most intense skin color (orange) belonging to the early group (average 6.58), the late (average 5.92 - yellow orange) and extraearly (5.00 - yellow).

→ The coefficient of variability 12.96%, indicating a small - middle variability of the character in the statistics population.

► ***Ferminess of the fruit***

→The phenotypes most ferminess are: 85.8.88 BIII – Alexandru, 83.25.9 BI – Andrei, 83.25.23 BI – Atractiv and 82.15.10 BIV – Adina, all having an average indicator of the quality of the fruit of over 3 kgf/cm^2. Phenotypes most strongly are all having an average indicator of the quality of the fruit of over 3 kgf/cm^2. 16 of the 36 phenotypes studied between 1.5 and 2.0 kgf/cm^2, corresponding to a moderate firmness.

→ Significant differences are statistically assured of maturation between the classes as follows: late phenotypes have the highest fruit firmness of fruits (2.42 kgf/cm^2), followed by early grades (1.75 kgf/cm^2) and average (1.76 kgf/cm^2) with a medium firmness and soft extratimpurii strongly (1.38 kgf/cm^2).

→The coefficient of variability 35.32% indicating a high variability of the character in the statistical population.

►The dry matter content

→ The phenotype: 85.11.95 BIII, 85.4.104 BIII – Viorica, 77.4.73 BIII – Carmela, have the highest content of dry matter. 50% of the phenotypes studied have a gradually average dry matter content over 18%.

→ The coefficient of variability 12.86% indicates a low-average variability within the population statistics.

►Titratable acidity (malic acid g%)

→ The lowest malic acid content were: 85.4.108 BIII, 85.2.89 BIII, Dacia Mt. and 85.5.104BIII up to 1.2 g%. Had the highest content of 2.5 g%: 85.5.100BIII, followed a significant Favorite Mt. 2.0 g% and then Excelsior Mt. 1.9 g%.

→ The result was a significant difference between the phenotypes of late maturation class (1.65 g%) than extraearly (1.27 g%). Statistical differences uninsured to meet the early (1.54 g%) and medium (1.43 g%).

→ The coefficient of variability 18.24% indicates a medium variability in the population statistics.

►Ascorbic acid content (C vitamina mg/100 g)

→ The phenotypes with the highest content of ascorbic acid (Vitamin C mg/100 g) are: 77.4.73 BIII – Carmela, Dacia Mt., 82.15.10 BIV – Adina, 83.31.10BI – Bucovina, Excelsior and 85.4.104 BIII – Viorica.

→ The significant differences between the classes of maturation are: late phenotypes (15.49 mg/100 g.), early (15.3 mg/100 g.), extraearly (15.10 mg/100 g.) and middle (12.95 mg/100 g.).

→Variability of ascorbic acid content of fruit had a moderate amount, expressed as the coefficient of variability 17.63%.

Correlations between components of fruit quality

There are strong correlations between:

- the average fruit weight and soluble solids content (Figure 1), the correlation coefficient being 0.6258;
- the average fruit weight and ascorbic acid content (Figure 2), the correlation coefficient is 0.1139;

- the average weight of fruit and fruit skin color (Figure 3), with correlation coefficient of 0.3868.

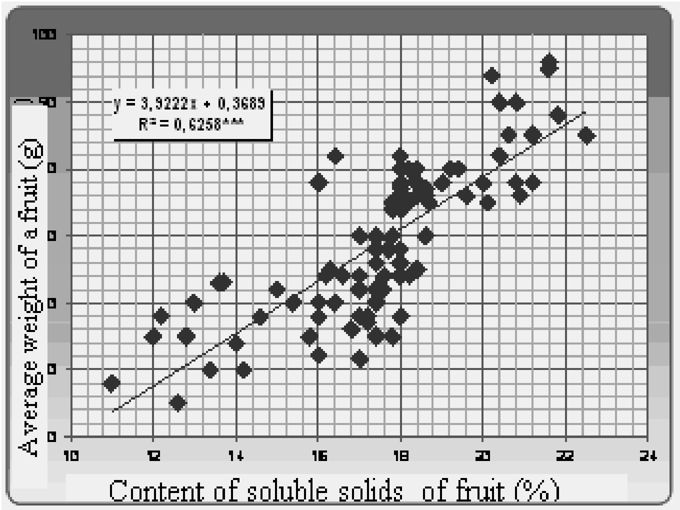


Fig. 1. Intensity correlation between the average weight of a fruit and content of soluble solids of fruits (2001, 2003, 2004)

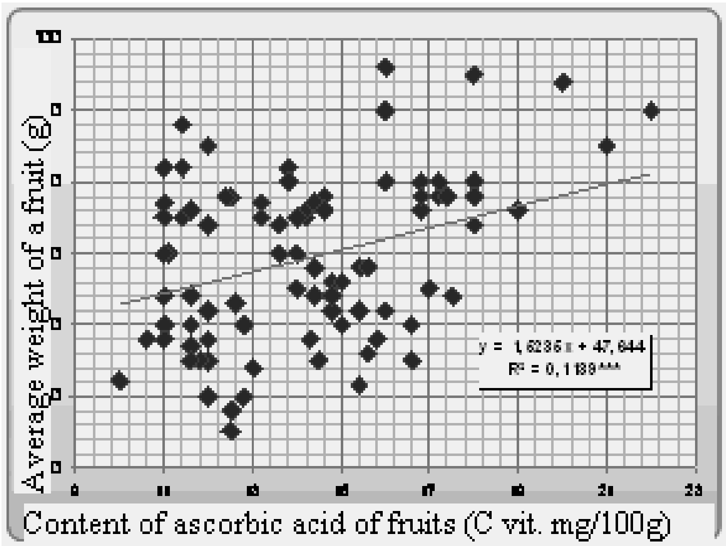


Fig. 2. Intensity correlation between the average weight of a fruit and content of ascorbic acid of fruits (2001, 2003, 2004)

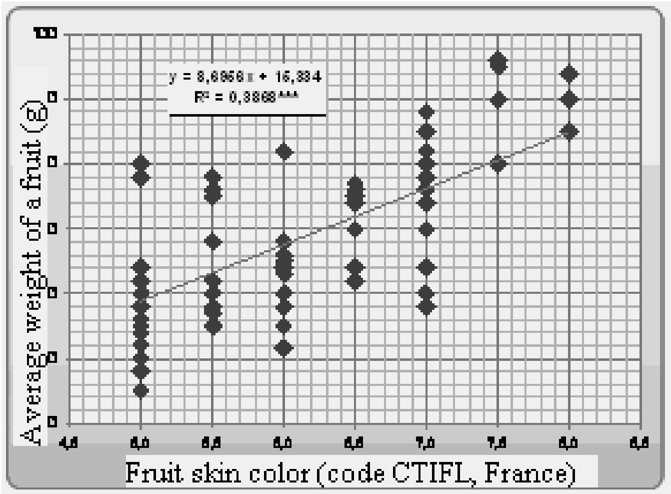


Fig. 3. Intensity correlation between the average weight of a fruit and fruit skin color (2001, 2003, 2004)

CONCLUSIONS

1. The highest average fruit weight are phenotypes: 85.4.104 BIII – Viorica and 77.4.73 BIII – Carmela.
2. The early phenotypes group (72.74 g) have the fruits with the highest weight.
3. The result was a low-medium variability (16.21%) of the average weight of the fruit in the population statistics.
4. Phenotypes with the index close to 1, according to a spherical shape are:

85.3.100 BIII, 85.5.100 BIII, 85.5.104 BIII, 85.4.104 BIII – Viorica, 83.31.10BI – Bucovina, Dacia – Mt. and 85.1.96 BIII – Nicuşor.

5. The result was a small variability (7.07%) of the fruit shape in the population statistics.
6. The most colorful phenotype are: 77.4.73 BIII – Carmela, followed by 85.4.104 BIII – Viorica and Dacia Mt.
7. The group of early maturating phenotypes have the most intense color of skin (orange=6.58).
8. The result was a small-midlle variability (12.96%) of the skin color in the statistics population.
9. The phenotypes with the most firmness of the fruit (over 3 kgf/cm^2) are: 85.8.88 BIII – Alexandru, 83.25.9 BI – Andrei, 83.25.23 BI – Atractiv and 82.15.10 BIV – Adina.

10. The phenotypes with late maturation have the highest fruit firmness of fruits (2.42 kgf/cm^2).
11. The result was a high variability (35.32%) of the firmness of the fruit in the statistical population.
12. The highest dry matter content are the phenotypes: 85.11.95 BIII, 85.4.104 BIII – Viorica and 77.4.73 BIII – Carmela.
13. The result was a small-middle variability (12.86%) of the dry matter content in the population statistics.
14. The phenotype 85.5.100BIII have the highest malic acid content (2.5 g%).
15. The phenotypes of late maturation class had the highest malic acid content (1.65 g%).
16. The result was a medium variability (18.24%) of the malic acid content in the population statistics.
17. The highest content of ascorbic acid (Vitamin C mg/100g) are: 77.4.73 BIII – Carmela, Dacia Mt., 82.15.10 BIV – Adina, 83.31.10BI – Bucovina, Excelsior and 85.4.104 BIII – Viorica.
18. The late phenotypes has the highest content of ascorbic acid (vitamin C mg/100 g) (15.49 mg/100 g).
19. The result was a medium variability (17.63%) of ascorbic acid content of fruit in the population statistics.

REFERENCES

1. Asănică A.C., 2006. *Cercetări anatomo-fiziologice şi biochimice privind compatibilitatea la altoire a unor soiuri de cireş asociate cu diferiți portaltoi*. INVEL Multimedia.
2. Bălan V., V. Tudor, C. Petrişor, 2006. *Providing the quality features variability of apricots descendents: F1, F2, backross and V2*. Acta Horticulturae 717.
3. Bălan V., V. Tudor, E. Topor, 2007. *Apricot genetics and breeding in Romania*. ISHS Acta Horticulturae 760 (pp. 483-489).
4. Bălan V., V. Tudor, E. Topor, M. Corneanu, 2007. *Apricot Genetics and biotechnology in Romania*. Invited review, The European Journal of Plant Science and Biotechnology, ©2007 Global Science Books (pp. 153-169).
5. Petrişor C., V. Bălan, V. Lazăr, V. Tudor, 2006. *Evolution of colour during maturation of different romanian apricot cultivars*. Acta Horticulturae 717 (pp. 369-372).
6. Tudor V., 2010. *Cercetari privind comportarea noilor soiuri şi hibrizi de cais obținuti la S.C.D.P. Băneasa pentru zona de sud a țării*. Teză de doctorat, USAMV Bucureşti.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

INFLUENCE OF POT TYPES ON GROWTH AND DEVELOPMENT OF PEPPER

MARIANA MUŞA, TUDORA RĂDOIASA, FLORINA ULEANU

University of Pitesti

Keywords: *seedling, pepper, pot*

Abstract

To increase the culture quality is absolutely necessary improving the methods of obtaining the seedlings. This paper refers to the behavior of pepper seedlings cultivated in different types of pot. The experiments were done in 2007 in cold glass house at the National Research & Development Institute for Biotechnology in Horticulture - Ştefaneşti - Argeş. For the development of experimental model we used seeds from two hybrids: Oscar and Topepo. Seeds were sown in mixture substrate and then either were transplanted, in plastic pots of 450 cm^3, in plastic pots of 300 cm^3 or seedling without transplanting, planted straight from the tray where they were sown where the density at sown were reduce up to 1:5. At the planting, each row represents one repetition, each hybrid it's cultivated in three repetitions. The experimental variants are represented each by 20 plants and those are disposed in this order regarding the length of the glass house (30 m): V_1- seedling transplanted in plastic pots of 450 cm^3, V_2 - seedling transplanted in plastic pots of 300 cm^3, V_3 - seedling without transplantation. All the studied characters were higher when compared to alternatives variant witness seedling without transplantation. Using transplanted lead to a harvest of peppers used two-three days earlier meaning the achievement of significant additional income and in addition, filling a niche market.

INTRODUCTION

In the latest years researches were made for finding new, modern solutions regarding the economic efficiency insurance, optimum seeds germination, the reduction of seeds lost, early crop, the elimination of some costs and the reduction of hand work.

This paper was made as a comparative study of the pepper seedlings obtaining methods (in different types of pots) concerning they recommendation in to the small, medium and big farms. The purpose of this study is the prominence of the differences of the pepper seedlings obtaining methods for the protected seedlings culture.

MATERIAL AND METHODS

For the realization of experimental model we wised seeds from *Capsicum annuum*: Oscar - sweet pepper variety and l Topepo - bell pepper variety.

OSCAR- early sweet pepper variety, conic, recommended for plastic and glass greenhouses, with good results in field culture. The indeterminate plant produce three lobs fruits, for 6 x 14 cm and 0.5 cm pulp. The average fruit weight is 180 g. The seeds wore treated with Thiram.

TOPEPO- red bell pepper variety, medium early to mature, recommended for field culture. The plant is vigorous, with fruits that can have 150-200 g weight. The seeds wore treated with Thiram.

Seeds were sown in a mixture substrate with manure, sand and top soil in 1/3 equal parts. We added peat for increase the water retaining capacity. Some seedlings were transplanted in plastic pots of 450 cm^3 and in plastic pots of 300 cm^3 and others were planted straight from the tray where they were sown where the density at the sown were reduce up to 1:5 cm. At planting, each row represents one repetition, each variety it's cultivated in three repetitions.

The experimental variants are represented each by twenty plants disposed in this order regarding the length of the glass house (30 m):

- V_1 - transplanted seedlings in plastic pots of 450 cm^3;
- V_2 - transplanted seedlings in plastic pots of 300 cm^3;
- V_3 - witness - seedlings without transplantation.

Fig. 1. Oscar sweet pepper seedlings in the two types of pots

Because we wanted the measurements to represents the correct period of stagnation and the period of grow restarting was established a marker by the mounting of some pieces of glass on the soil, beside the pepper stem base, so that each measurement to be made from the same label.

RESULTS ANS DISCUSSION

The influence of the seedlings obtaining methods on the Oscar sweet pepper growing is represented in Figure 2.

In the first part of the experiment V_1 had an accelerated growing (at 7.06.2010 V_1 had 27.9 cm and V_2 had 17 cm). Meanwhile V_2 values exceeds V_1, V_2 values being then higher than V_1 values until the end of growing period (at 26.07.2010 V_1 had 74.6 cm, and V_2 had 78.3 cm). The lowest values had V_3 (at 7.06.2010 V_3 had 15.3 cm, and la 26.07.2010 V_3 had 65.8 cm).

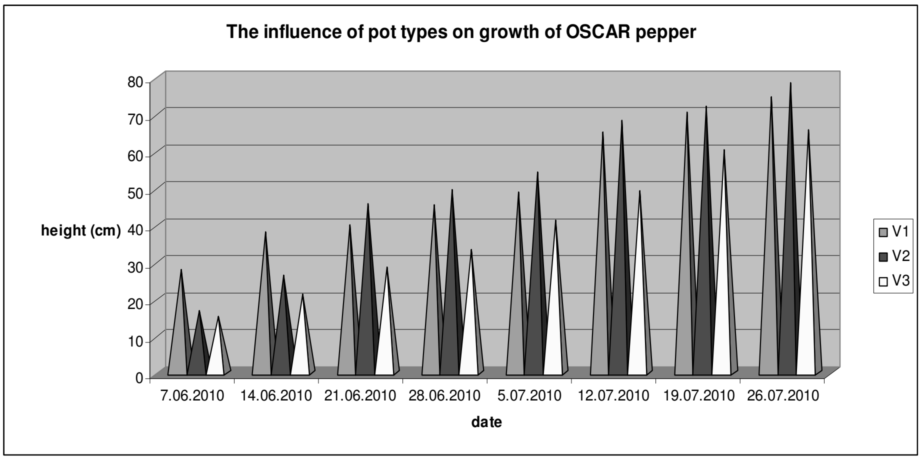


Fig. 2. The influence of pot types on growth of OSCAR pepper

The pot volume was important only at the beginning of growing period. In this period we observe that the growth was least in seedling without transplantation case.

The influence of the seedling obtaining methods on the Topepo pepper growing is represented in Figure 3.

In the first part of experiment V_1 had an accelerated growing for Topepo to (at 7.06.2010 V_1 had 28.3 cm, and V_2 had 25.6 cm). Meanwhile V_2 values exceeds V_1, V_2 values being then higher than V_1 values until the end of growing period (at 26.07.2010 V_1 had 50 cm, and V_2 had 52.1 cm). The lowest values had V_3 (la 7.06.2010 V_3 had 18.6 cm, and la 26.07.2007 V_3 had 49.3 cm).

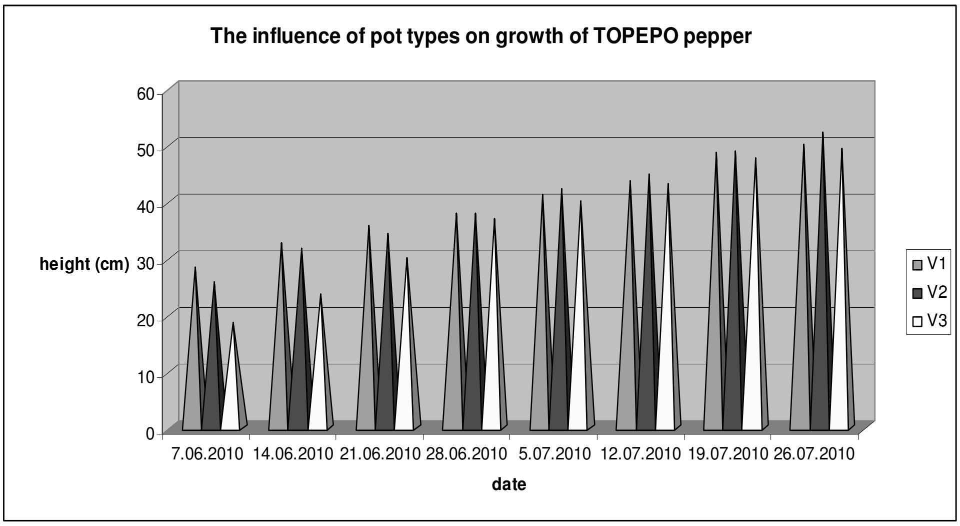


Fig. 3. The influence of pot types on growth of TOPEPO pepper

The values were close but V_3 had the lowest one.
We consider necessary to study the plants production. Figure 4 illustrate the productions/variants.

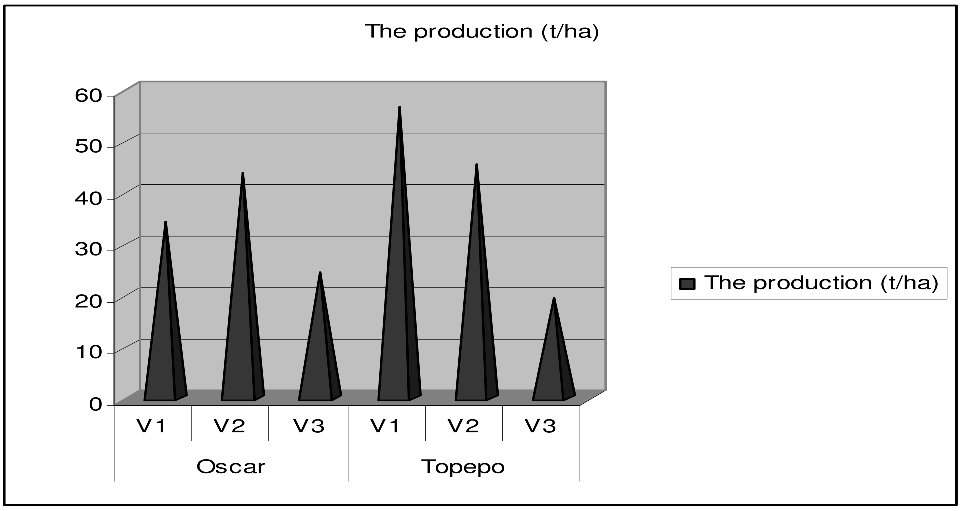


Fig. 4. The production

In Oscar case the biggest production had V_2 (43.75t/ha), in the Topepo case V_1 (56.66 t/ha). Between the experimental variants V_3 is less profitable because of the small production (Oscar 24.41 t/ha, and Topepo 19.41 t/ha).

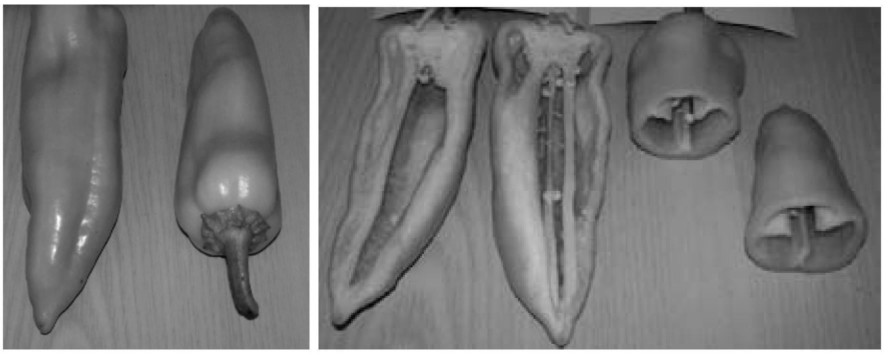


Fig. 5. Oscar fruits

Fig. 6. Topepo fruits

CONCLUSIONS

1. Soil volume is important only in the beginning of growing period, the seedling transplanted in plastic pots of 300 cm^3 exceeds after planting seedlings transplanted in plastic pots of 450 cm^3.
2. The growth speed after planting depends of the hybrid, Oscar had higher values than Topepo.
3. The transplanted variants had elder values of the studied characters than no transplanted variants.
4. The plants development and the early crop depend of the growth speed after planting and the planting stress reducing.

5. Using transplanted lead to a harvest of peppers used two-three days earlier meaning the achievement of significant additional income and in addition, filling a niche market.
6. The PVC pots volume is not very important for the research that we made.
7. The experimental variant V_3 is less profitable because of the small production.
8. The pots volume is not justifying the big production and early productions.

REFERENCES

1. Ciofu Ruxandra şi colab., 2003. *Tratat de legumicultură*. Ed. Ceres, Bucureşti.
2. Popescu V., 2003. *Legumicultură*. Vol. I, Ed. Ansid, Târgu-Mureş.
3. Popescu V., 2003. *Legumicultura generală*. Ed. Ceres, Bucureşti.
4. Popescu V., Gheorghiţa Hoza, 2000. *Legumicultură generală, îndrumător de lucrări practice.* A.M.C. - USAMV Bucureşti.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

EFFECT OF SALICILYC ACID ON ASSIMILATORY PIGMENTS AND AMINOACIDS CONTENT IN SALT STRESSED WHEAT (*TRITICUM AESTIVUM,* CV. CRISANA) SEEDLINGS

CORNELIA PURCĂREA*, MARIA BORBĖLY**

*University of Oradea
**Centre of Agricultural Science, University of Debrecen, Hungary

Keywords: *salicylic acid, wheat, salt stress, assimilatory pigments, amino acids*

Abstract

Abiotic stress causes drastic yield reductions in most crops. Salinity is one of the major abiotic stresses and researchers are trying to find the most suitable substance to enhance plant tolerance to stress factors. One of these substances is Salicylic Acid (SA). It has a significant impact on the various aspects of the plant life. In this paper we study the effect of presoaking seeds in 0.05 or 0.1 mM SA solutions in pot experience, on some biochemical parameters modification like: assimilatory pigment contents, proline and other free aminoacid content in salt stressed wheat seedlngs. Salt stress was simulated by irrigation of the wheat seedlings with 0.2M NaCl solution. The highest enhancements of the tolerance to salinity on Triticum aestivum cultivar Crisana, plantlets were recorded in the case of treatments with 0.1 mM SA solution.

INTRODUCTION

In developing countries, 80% of the necessary production increase would come from increases in yields and cropping intensity and only 20% from expansion of arable land. In recent years, growth rates of cereal yields have been falling. Bogdan et al [4] emphasized in their research, that a sustainable economy of the future has to become a bio-economy, adapted to the rural area based on Agrifood Biodiversity. There are many ways needed to be applied to save food and feed such as developing new policies in applying dynamic action plans in agriculture, according to environmental factors climate change impact and tolerance degree of crop landcraces [1].

Salinity is one of the major abiotic stresses which decreased the contents of chlorophyll, soluble proteins and enhanced content of free amino acids on *Vicia faba* [6]. Proline, is a protective, free amino acid, one of the potential biochemical indicators of salinity tolerance in plants involved in plant protection [2].

Salicylic acid (SA) is considered to be a very important signal molecule involved in the plant development processes and mainly involved in some agricultural plants responses to different abiotic stress factors, and plays a major role in the physiology of stress in plants.

Salicylic acid activated the synthesis of carotenoids, xanthophylls and the rate of de-epoxidation but decreased the level of chlorophyll pigments, both in wheat and moong plants also the ratio of chlorophyll a/b, in wheat plantlets [10]; SA also increased the chlorophyll and carotenoid content in maize plant [9]. Enhancing effect of SA on photosynthetic capacity can be attributed to its stimulatory effects on Rubisco activity and pigment contents. The application of SA (20 mg/ml) to the foliage of the plants of *Brassica napus*, improved the chlorophyll contents [7].

Proline, a protective free amino acid, contributes to membrane stability and mitigates the effect of NaCl on cell membrane disruption [2].

Amino acids, the building blocks of all cell formation are necessary components in many processes in the plant, among them the photosynthesis which produces carbohydrates necessary for plant growth. Stressful conditions reduced amino acid content with a corresponding decrease in crop quality and quantity.

The aim of this work was to study the influence of the exogenous SA solution on some biochemical parameters determined in the roots or leaves of wheat *(Triticum aestivum* cv. Crisana*)* seedlings under salt stress, in pot experience, in comparison with the same parameters of the control lots which were treated with water.

MATERIAL AND METHODS

The experiments were performed at the Agrifood Biochemistry Laboratory, University of Oradea and at the University of Debrecen in 2010. For the study we used wheat (*Triticum aestivum* cultivar Crisana), a cultivar created at the Agricultural Research and Development Station Oradea.

To study the action of SA treatments under laboratory conditions, the wheat seeds were germinated in plastic recipients, for 7 days, on a filter paper, moistened with 20 ml treatment solution:

- control lot (**C**) – 12 h soaked in water and germinated in water;
- sample 1 (**S_1**) – 12 h soaked in water and germinated in 0.2M NaCl solution;
- sample 2 (**S_2**) – 12 h soaked in 0.05 mM SA and germinated in 0.2M NaCl;
- sample 3 (**S_3**) – 12 h soaked in 0.1mM SA and germinated in 0.2M NaCl.

Each recipient contained 50 seeds. The germination was made at 20±3°C in a Sanyo MLR 351H phytotron, day/night, and relative humidity 65-85%, under natural photon flux density. Every day, the quantity of solutions from the recipients was brought to the level of 20 ml.

After 7 days of germination, we planted the plantlets in pots containing equal amounts of clay and sand, leaving them there for an additional 14 days. The seedlings were irrigated with water or 0.2 M NaCl, and sprayed their primary leaves each day with water or SA solutions. After 21 days we determined some biochemical parameters. The assimilatory pigments contents of the wheat seedling leaves were determined by using N,N-dimethylformamide (DMF) for the extraction [12] and an UV-visible mini-1240 Shimadzu spectrophotometer. The data obtained from the spectrophotometric determinations, were mathematically processed using the formulas proposed by Moran and Porath [14].

Proline was determined following Bates et al. [2]. The amino acid spectrum of different vegetative organs in treated lots in comparison with the ones not treated will be determined by HPLC - aminoacid analyzer**.**

The results represented the averages of 3 independent determinations and were statistically processed using the "t- test" - *Prisma 5 for windows*.

RESULTS AND DISCUSSION

Studying the content of chlorophyllian pigment (chl a and b) and carotenoids on the primary leaves of the wheat seedlings obtained from each experimental variant, we observed that salt stress decrease the assimilatory pigments content (with 20% for chl a, 11.8% for chl b and with 37.5% for carotenoids). Similar results were obtained by Kaydan et al. [8], they observed that under the influence of salinity the photosynthetic pigments greatly decreased.

The content of chl a increased nonsignificantly (with 3.4% from the control lot considered) after seeds presoaking in 0.05 mM SA solution. A very significant increase of chl a contents, with 35.6% from the control lot, was observed in the case of treatment with 0.1 mM SA solution. In the case of the chl b contents a nonsignificant increase could be observed, with 5.1% from control lot when using a 0.05 mM SA solution, and a very significant increase, with 47% in the case of treatment with 0.1 mM SA solution (Table 1).

Studying the carotenoid pigments content in the case of treatment with 0.05 mM SA solution, the results show that the accumulation of these pigments in the leaves of wheat seedling on the 21th day of germination, increased very significantly, with 20%, in comparison with the same parameter determined from the salt stressed lot. The treatment with 0.1 mM SA solution significantly increased this pigment contents, with 44%, from salt stressed lot. Zhao et al., [15] obtained similar results in soybean plants, so treatment with SA, increased pigments content as well as the rate of photosynthesis. Sinha et al. [13] pointed out that chlorophyll and carotenoid contents of maize leaves were increased upon treatment with SA.

Under stress conditions, free proline level increased in the leaves of wheat seedlings, after 21 day's of germination. Studying the value after spectrophotometrycal determination of proline content, we observed that under salt stress, with or without SA treatement the proline content increased very significantly, but in case of SA treated seedling leaves the increase of proline content was higher that in untreated leaves.

For the salt stressed leaves the increase was with 302.3% higher in comparison with control lot. The treatment with 0.1mM SA alleviated the effect of salt stress and had a protective effect, in this condition the increase was higher (with 205.3%) in comparison with salt stressed wheat seedlings (Table 1).

Deef [5], demonstrated that the application of exogenous SA enhanced the drought and salt stress resistance of plants. During the germination period a considerable increase was observed in proline levels (up to 185% in *T. aestivum* and about 128% in *H. vulgare*) in the seedlings subjected to saline stress and treated with SA in comparison with salt stresed seedlings. Taken together, the results of the previous authors support our findings.

Table 1

Estimative mean values for some biochemical parameters of the salt stressed wheat seedling leaves with or without treatment with different concentration SA solutions in comparison with the same parameters of the control lot

Parameters		**Treatment**			
		Control (C)	**Salt (S_1)**	**Salt+ 0.05 mM SA (S_2)**	**Salt+ 0.1 mM SA (S_3)**
Assimilatory pigments mg/g FW	**chl a**	1.15±0.02	0.92±0.04 ***	1.19±0.03 ns	1.56±0.05 ***
	chl b	0.51±0.03	0.45±0.02 *	0.53±0.04 ns	0.75±0.03 ***
	carotenoids	0.40±0.01	0.25±0.006 ***	0.30±0.01 ***	0.36±0.004 **
Proline µmoles proline/g FW	**leaves**	0.85±0.02	3.42±0.05 ***	2.11±0.03 ***	8.77±0.04 ***

$p>0.05$= non-significant; $p<0.05$=* significant; $p<0.01$=** distinctly significant

In case of determination of amino acids, salt stress reduced significantly the content in amino acids. Treatement with SA solution determined an enhancement of these values in comparison with salt stressed lot differences from the control lot getting to be insignificant. The highest value of enhancement was registered in roots of salt stressed plantlets treated with 0.1mM SA solution (Table 2).

CONCLUSIONS

1. Diluted SA solutions, with 0.05 mM and 0.1 mM concentration determined an increase in the chlorophyllian and carotenoid pigments content in the primary leaves of wheat seedlings in comparison with the salt stressed samples.
2. The treatment with 0.05 mM and 0.1 mM SA significantly increased the proline and other amino acids content. The highest value of enhancement was registered in roots of salt stressed plantlets treated with 0.1mM SA solution.

3. As a final conclusion of our studies - the results showed that exogenous SA solution, administrated to the wheat seeds significantly ameliorate the negative effect of salt stress. Positive effects were more pronounced in the case of 0.1 mM SA solution.

Table 2

Estimative mean values for amino acids content (g/100 g FW) of the salt stressed wheat seedling leaves with or without treatment with different concentration SA solutions in comparison with the same parameters of the control lot

Aminoacid	Control (C)	Salt (S_1)	Salt+ 0.05 mM SA (S_2)	Salt+ 0.1 mM SA (S_3)
ASP	0.15±0.007	0.10±0.016 ***	0.23±0.01 ***	0.22±0.003 ***
THR	0.10±0.004	0.07±0.006 *	0.09±0.018 ns	0.09±0.010 ns
SER	0.10±0.012	0.071±0.002 ns	0.086±0.006 ns	0.10±0.006 ns
GLU	0.195±0.009	0.121±0.017 *	0.164±0.019 *	0.189±0.017 ns
GLY	0.10±0.031	0.071±0.002 ns	0.086±0.013 ns	0.096±0.005 ns
ALA	0.077±0.004	0.057±0.006 ***	0.07±0.015 *	0.078±0.007 ns
VAL	0.11±0.01	0.079±0.018 ***	0.095±0.016 *	0.104±0.019 ns
Aminoacid	**Control (C)**	**Salt (S_1)**	**Salt+ 0.05 mM SA (S_2)**	**Salt+ 0.1 mM SA (S_3)**
MET	0.03±0.001	0.017±0.009 ***	0.034±0.022 *	0.034±0.01 *
ILE	0.07±0.007	0.052±0.02 ***	0.062±0.008 ns	0.069±0.008 ns
LEU	0.16±0.073	0.112±0.013 ns	0.13±0.004 ns	0.147±0.006 ns
TYR	0.05±0.003	0.031±0.011 ***	0.041±0.002 *	0.044±0.005 ns
PHE	0.08±0.003	0.052±0.002 ***	0.061±0.011 ***	0.066±0.007 **
HIS	0.14±0.016	0.083±0.007 *	0.131±0.008 ns	0.132±0.011 ns
LYS	0.17±0.006	0.113±0.009 ***	0.13±0.006 ***	0.155±0.011 *

$p>0.05$= non-significant; $p<0.05$=* significant; $p<0.01$=** distinctly significant

ACKNOWLEDGEMENTS

This work was cofinanced from the European Social Fund through Sectoral Operational Programme Human Resources Development 2007-2013, project number POSDRU/89/1.5/S/63258 ”Postdoctoral school for zootechnical biodiversity and food biotehnology based on the eco-economy and the bio-economy required by eco-sanogenesys”.

REFERENCES

1. Antofie M.M., D. Constantinovici, M.R. Pop, P. Iagaru, C. Sand, G. Cirotea, 2010. *Theorethical methodology for assessing the status of conservation of crop landcraces in Romania*. Analele Universității din Oradea, fascicula Biologie, TOM XVII, Issue2, nov. (pp. 313-317).
2. Ashraf M., P.J.C. Harris, 2004. *Potential biochemical indicators of salinity tolerance in plants*. Plant Science*,* 166 (pp. 3-16).
3. Bates, S. *Rapid determination of free proline for water stress studies*. Plant and Soil, 1973, 39 (pp. 205-207).
4. Bogdan A.T., V. Miresan, A. Mironov, S. Chelmu, V. Boboc, I. Surdu, R. Burlacu, D. Diaconecu, Strateanu 2010. *A Prospects of Agrifood Green Power in 2050 and forecasting for 2010 with Sustenable Solutions Based on Ecobioeconomics new Paradigm*. Bul. USAMV Animal Science and Biotechnologies, 67(1-2) (pp. 1-18).
5. Deef H.E., 2007. *Influence of Salicylic acid on stress tolerance during seed germination of Triticum aestivum and Hordeum vulgare*. Advances in Biological Research 1 (1-2) (pp. 40-48).
6. Gadallah M.A.A, 1999. *Effects of proline and glycinebetaine on Vicia faba responses to salt stress*. Biologia Plantarum, 42(2) (pp. 249-257).
7. Ghai N., R.C. Setia, 2002. *Effect of paclobutrazol and salicylic acid on chlorophyll content, hill activity and yield components in Brassica napus l (cv. gsl-1).* Phytomorphol. 52 (pp. 83-87).
8. Kaydan D., M. Yagmur, N. Okut, 2007. *Effects of salicylic acid on the growth and some physiological characters in salt stressed wheat (Triticum aestivum L.).*Tarim Bilimleri Dergisi, Ankara Universitesi Ziraat Fakultesi, 13(2) (pp. 114-119).
9. Khodary S.E.A., 2004. *Effect of SA on growth, photosynthesis and carbohydrate metabolism in salt stressed maize plants*. Internat. Journal Agri. Biol. 6 (pp. 5-8).
10. Moharekar S.T., S.D. Lokhande, T. Hara, R. Tanaka, A. Tanaka, and P.D.Chavan, 2003. *Effect of salicylic acid on clorophyll and carotenoid contents of wheat and moong caryopsis, Photosynthetica*. 41 (pp. 315-317).
11. Moran R., 1982. *Formulae for determination of chlorophyllous pigments extracted with N,N- dimethylformamide, Plant physiol*. 69 (6) (pp. 1376-1381).
12. Moran R., D. Porath. *Clorophyll determination in intact tissue using N,N-dimethylformamide.* Plant Physiol, 65 (pp. 478-479).
13. Sinha S.K., S.H. Srivastava, R.D. Tripath, 1993. *Influence of some growth regulators and cations on inhibition of chlorophill biosynthesis by lead in maize*. *Bul Env. Contamin Toxic*; 51 (pp. 241-246).
14. Tester M., R. Davenport, 2003. *Na^+ tolerance and Na^+ transport in higher plants.* Ann. Bot. 91 (pp. 503-507).
15. Zhao H.J., X.W. Lin, H.Z. Shi, and S.M. Chang, 1995. *The regulating effects of phenolic compounds on the physiological characteristics and yield of soybeans.* Acta Agron. Sin., 21 (pp. 351-355).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

ETHNOBOTANICAL STUDIES IN DOBROGEA

F. TUDOR, MIHAELA IOANA GEORGESCU

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *The legend of the name Niculițel, medicinal, tinctorial herbs*

Abstract

A field study was conducted in the commune of Niculițel to record the knowledge of the inhabitants of different plants and their uses. A legend link to the name of this commune is known by the village elders and it is also recorded.

INTRODUCTION

Ancient traditions and customs are the most valuable knowledge we receive from generation to generation and that we can give them further. The research of these enables "... to link the thread of today's life to the most far off ways of living, insufficient revealed by the prehistoric archaeological data " and thus "to complete the image of bygone times the evidence still held in the deed and consciousness of the contemporary human" [9].

Dobrogea, as seen in historical and geographical perspective, is a place to ”... temporary or permanent establishment of economic or religious groups, or simply due to chance of the times”, becoming”…a model of coexistence and interconnections, on the same territory, of groups of populations from a diversity rarely seen in Europe” [8]. Ethnobotanical research in such a complex area comes to emphasize the knowledge of the traditional use of plants for therapeutic purposes, in various household chores or in holidays, some of them found in other parts of the country also, others specifically to this region.

MATERIAL AND METHODS

The study was conducted in Tulcea County, in the Niculițel commune and consisted in carrying out interviews with local people: Cărbunaru Ana (CA), aged 67 years, of Russian origin (Lippovan); Ioana Tudor (TI 1), aged 82 years, of Romanian origin; Niculache Varvara (NV), aged 74 years, of Romanian origin; Tudor Ion (TI 2), aged 84 years, of Romanian origin. The data from the questionnaire were grouped according to categories of plant uses, stating in each case the person (s) from which they were obtained. The similarities or differences on plant uses in other parts of the country were highlight with referenced of the work of the Ethnobotanical Romanian Encyclopedia [1]. Scientific names are according to Illustrated Flora of Romania [3].

RESULTS AND DISCUSSION

Niculițel commune (Tulcea County) is located in the E-NE of the Niculițel plateau (Figure 1), at the foot of the hill Sarica, in the area of the river Telița spring (Figure 1). Artifacts belonging to the Dacians (IV - III BC), and to the Roman (II - VII AD), were discovered in this places. In 1971 were discovered the ruins of a Christian basilica, from Roman period, built of bricks in the late fourth century. In the altar was found a tomb that housed the relics of martyrs Zotikos, Attalos, Kanasis and Philippos persecuted in the years 369-372 by Visigoth king Atanaric; their names were written in red on the walls of the tomb. The relics were buried in 1973, in the basilica of the Coces Monastery [4].

Fig. 1. Niculițel commune - general view

Legend says that the commune name comes from a young shepherd, Niculiță, who, while he was looking after their sheep on a hill, in the highest point of this, begins to dig a hole in the ground. First, he discovers a piece of iron, and then continuing the excavation, revealed that the piece of metal was part of a cross. The inhabitants, seeing what the young shepherd boy has discovered, continued the excavations and found an intact church, which was covered with earth about 1,000 years ago, owing to migrants fear. Following this discovery, the young shepherd names was given to the village (the author collected this legend from village elders).

The data obtained from field surveys were grouped by the use of plants in the following categories:

A. Herbs:

Potatoes (sliced) (*Solanum tuberosum* L.): for sore throat (CA).

Tubers, cut slices, place in bundle on the forehead and temples against headache. From the heap baked potatoes, peeled and blended with oil, were made flat cakes which tie around the neck against quinsy [1].

Sea buckthorn (*Hippophaë rhamnoides* L.): for liver pain, immunity (CA). *In Encyclopedia of Romanian ethnobotany there are no indications on the use of this plant of medicinal purposes [1].*

Onions (cooked) (*Allium cepa* L.): to treat boils (CA).

It was one of the most popular remedies. The bulb is crushed or cooked and used against strikes and boils [1].

Wild Thyme (*Thymus* L.)[1]: for maintaining normal blood pressure (NV).

None of the species listed below are in the Encyclopedia of Romanian ethnobotany [1].

Cherry (*Cerasus avium* (L.) Moench) (stalks): to treat kidney problems (CA).

Cherry stalks are used almost everywhere for kidney disease [1].

Horse tail (*Equisetum arvense* L.): to treat heart and stomach problems (NV).

Sterile strains had a wide use almost everywhere, due to diuretic and astringent properties [1].

Yarrow (*Achillea* L.): is used to treat liver problems (NV).

Floriferous tips tea is also used in kidney disease, liver and to nerve strengthening [1].

Marigold (*Calendula officinalis* L.): to treat liver problems (CA, NV).

The plant should be boiled in wine, which is taken against icterus [1].

Quince (*Cydonia oblonga* Mill.) (Leaves): to treat stomach problems (CA).

Tea leaves mixed with lime flowers, were taken in tonsillitis and colds. Dried tea leaves were used in heart diseases, or in cases of heart failure [1].

Horse radish (*Armoracia rusticana* P. Gaertn., B. Mey. et Scherb.): is used against colds (CA).

Leaves and rhizomes of the plant were used as a cure for headaches, in various forms ... Tea leaves, sweetened with honey, were taken against cold [1].

Dog-rose (*Rosa canina* L.) (flowers): in maintaining normal blood pressure (CA).

There are no indications on the medicinally use of flowers in the Encyclopedia of Romanian ethnobotany [1].

Spearmint, peppermint (*Mentha* x *piperita* L.): used in stomach pain (CA, NV, TI1, TI2).

---

[1]According to the Illustrated Flora of Romania [3], in Dobrogea grow spontaneously specimens of *Thymus zygioides, T. comptus, T. callieri, T. glabrescens, T.sibthorpii, T. pannonicus*

It were taken many times, knead in spirit, in diseases of the stomach. Tea was given to children against colic [1].

Chamomile (*Matricaria recutita* L.): used in eyes lavement (CA), stomach pain, poisoning (NV), irritation (TI1, TI2).

Decoction was used liked lavement and cataplasm against headaches. Against ear pain was made exhalation or lavement with the decoction of flowers. It was used to care wounds, sores, bumps, and abscess. Everywhere is used in stomach diseases [1].

Dandelion (*Taraxacum officinale* Weber ex F.H.Wigg.): is used for weight loss, and to eliminate toxins (TI).

The tea leaves were taken, in some places, to blood renewed [1].

Wormwood (*Artemisia absinthium* L.): for gynecologic affections (CA).

Among, it was the most important plants used in folk medicine. Wormwood tea was used against colds and baths against rheumatism and paralysis. Decoction is used in women's diseases [1].

St. John's Wort (*Hypericum perforatum* L.): to treat liver and stomach problems (NV).

Floriferous stems teas were taken in cough, sweat, colds, and sore stomach, liver or kidney diseases [1].

Sloes (*Prunus spinosa* L.): is used to treat heart problems (TI 2).

The decoction of yellow under bark slime was used to treat heart pain [1].

Maize (*Zea mays* L.) (silk): to treat stomach problems (TI 1).

Corn silk tea was taken as a diuretic and to treat the calculus [1].

Castor bean (*Ricinus communis* L.): to treat constipation, and to increased hair and nails (CA).

As a purgative, it took three or six seed put in milk or crushed and mixed with sour milk. It gave, also crushed to the animals [1].

Smoke tree (*Cotinus coggygria* Scop.): for the treatment of open wounds (CA, NV, TI 2), to treat gynecological problems (TI 1).

Sprout decoction were used to wash the throat in perished (syphilis) diesis, and the remnants were used in cataplasm [1].

Common elder (*Sambucus nigra* L.): is used for rest, quiet (TI).

Flower tea is taken cough and respiratory diseases [1].

Linden (*Tilia tomentosa* Moench) (flowers): is used for headaches (NV), resting, and sleeping (TI 1).

Lime Tea with St. John's Wort is takes against pain heart. It may be used in neurological diseases, headaches, dizziness and indigestion [1].

Garlic (*Allium sativum* L.): is used against colds (CA).

It was one of the most important remedies used by old women. Typical, it was used as a sauce against the indigestion, abdominal pain, influenza, headache, or intestinal worms [1].

White cabbage (*Brassica oleracea* L. convar. *capitata* (L.) Alef): is used to treat rheumatism (CA).

Leaves, blanched or pickled, were put on frostbite, scalds, and burns [1].

B. Tinctorial plants (for dyeing)

Onion (*Allium cepa* L.) (peel): it is used for dyeing, the resulting color is orange (CA, NV, TI, Ti).

Beetroot (*Beta vulgaris* L. var. *conditiva* Alef.): is used for pigmentation of the various dishes, the resulting color is red-purple (CA).

Nut (*Juglans regia* L.) (shell): for hair dye, the resulting color is reddish brown (CA, NV).

Stinging nettle (*Urtica dioica* L.): it is used for dyeing Easter eggs, the resulting color is green (CA).

Quince (*Cydonia oblonga* Mill.): the resulting color is beige (NV).

Lime (*Tilia tomentosa* Moench) (flowers): the resulting color is brown (TI).

Mulberry tree (*Morus* L.) (wood): the resulting color is yellow. Pigmentation is used for alcohol, by maintaining it in barrels of mulberry wood (TI 2).

B. Plants used in holydays

Willow (*Salix alba* L.) (sprout): they are used to represent the crown of olive twigs resting on Our Saviour's head when He was entry into Jerusalem on Palm Sunday (CA, NV, TI 1, TI 2).

Walnut tree (*Juglans regia* L.) (leaves): they are used at Pentecost (CA, NV, TI 1, TI 2).

Wild Thyme (*Thymus* L.) (grass of God) is used at Pentecost (CA).

Lime (*Tilia tomentosa* Moench) (sprout): is used at Whit Sunday (NV).

Basil (*Ocimum basilicum* L.): is used in most Orthodox Christmas (CA, NV, TI 1, TI 2).

Comparing data from field interviews with those found in the literature on this subject [1, 2, 5, 6, 7] shows that the usefulness of 6 plants among the 24 species of medicinal uses is specific to Niculițel commune: sea buckthorn, wild thyme, quince, dog-rose, castor bean, common elder. Of the seven species listed for dyeing stinging nettle (leaves), quince (leaves), limes (flowers) are used in original recipes. A specific feature for Niculițel commune is to use the walnut leaves, the thyme field, or lime sprout for different religious holidays.

CONCLUSIONS

1. Niculițel village has its own legend about the origin of their name.
2. There were recorded 24 species of plants with medicinal uses, 7 species for dyeing and 5 species used for religious holidays.
3. Knowledge about six of medicinal species, three of dyeing species and three of plants use for holidays is specific to Niculițel commune.

REFERENCES

1. Butură V., 1979. *Enciclopedie de etnobotanică românească*. Ed. Ştiinţifică şi Enciclopedică, Bucureşti.
2. Chirilă C., Jeana Marin, Eufemia Calmuş, 1999. *Plantele tinctoriale şi folosirea lor pentru vopsitul lânii*. Tipografia Curtea Veche Trading S.R.L., Bucureşti.
3. Ciocârlan V., 2009. *Flora ilustrată a României. Pteridophyta et Spermatophyta*. Ed. Ceres, Bucureşti.
4. Ghinea D., 1997. *Enciclopedia geografică a României*. Vol. II, Ed. Enciclopedică, Bucureşti.
5. Ghinoiu I., 2005. *Comoara satelor. Calendar popular*. Ed. Acad. Române, Bucureşti
6. Marian, S.F., 2000. *Botanică românească*. Ed. Paidea, Bucureşti.
7. Pârvu CV., 1997. *Universul plantelor. Mică enciclopedie*. Ed. Enciclopedică, Bucureşti.
8. Popoiu Paula, 2008. *Dobrogea: memoria pământului*. Ed. Mega, Cluj-Napoca
9. Vrabie Gh., 2002. *Ritualurile agrare la români*. Ed. Paralela 45, Piteşti.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

MORPHOLOGICAL CHARACTERS VARIABILITIES OF SOME POPULATIONS OF SPECIES *POLYGALA MAJOR* JACQ.

D.C. POTOR, MIHAELA IOANA GEORGESCU

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *leaves, wings, carpophores, strophiole, Polygala major subsp. major*

Abstract

Four populations with different localities are compared in terms of morphology to determine which of two subspecies of Polygala major they appertain. All four populations are belonging to P. major subsp. major and fruit and seed characters show that.

INTRODUCTION

Polygala major is a xero-xeromesophilous, subthermophilic and oligotrophic species, frequent encountered in meadows and bushes from the steppe area to the sessile oak floor [4]. Like the other species of the genus *Polygala*, plants may contain bitter substances, saponins, tannins and polygalic acid, and are considered poisoned plants in the grassland [1], but also with medicinal properties [3].

Called by the Romanian people *iarbă lăptoasă* (The Milkwort), *apărătoare* (The Protector), *seceruici* (The Reaper) (due to inflorescence aspects), or *şopârliţă* (The Lizard) [2], *Polygala major* species consists of populations that can show a number of characters different from that the typical one. In Flora RPR are described seven different forms as wing shape, flowers size and color and length of the bracts [9]. In the Illustrated Flora of Romania and some other papers there are described two subspecies: *major*, and *anatolica* (Boiss. et. Heldr. in Boiss.) Ciocârlan respectively, that differs in carpophores length and in strophiole shape [4, 5]. In other works subsp. *anatolica* is considered like a distinct species from *P. major* [6, 8]. In Romania, till now, the spreading area of the populations of the subspecies / species *anatolica* is limited, according to the references, to the Dobrudja regions [5, 7, 8], while the spreading area of the subsp. *major* is much greater [4, 7].

To emphasize the variability of morphological characters in the *P. major* populations in our country, we proposed to make some observations on these characters in individuals belonging to different grassland areas populations.

MATERIAL AND METHODS

Plants were harvested from meadows in Botosani, Buzau (localities: Aldeni, Bisoca) and Calarasi. The photos were taken with a digital camera DCM-LZ7

Panasonic type. Details of morphology of leaves, wings, fruit and seeds were revealed using a binocular magnifier. The data obtained were compared with descriptions in literature.

RESULTS AND DISCUSSION

Fig. 1. Botosani population

Fig. 2. Buzau (Aldeni) population

Fig. 4. Calarasi population

Fig. 3. Buzau (Bisoca) population

All four selected populations consist of perennial plants with woody taproot. From the basal lignified area of the stem starts many ascending or erect shoots (Figures 1, 2, 3, 4).

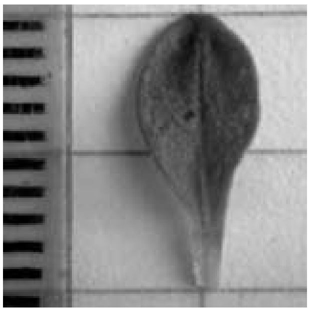


Fig. 5. Botosani population-basal leaf

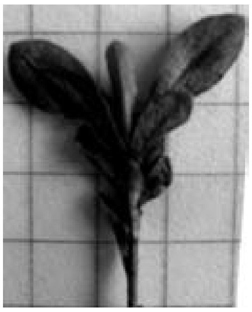


Fig. 6. Botosani population-basal leaves series

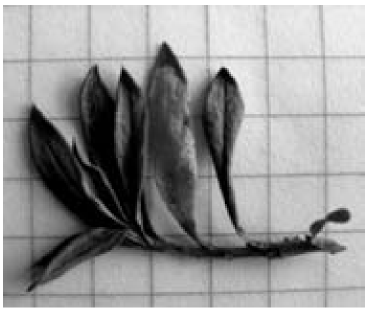


Fig. 7. Calarasi population-basal leaves series

To the Botosani, Calarasi populations, basal leaves are obovate or elliptic-lanceolate (Figures 5, 6, 7), average length of 10 and 19 mm respectively (Table 1). The stems ones are narrow, long, linear-lanceolate in shape, ranging in size from 17 to 28 mm in Botosani population and from 16 to 19 mm in Calarasi population (Figures 8, 9) (Table 1).

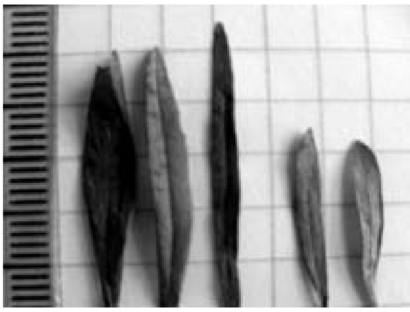


Fig. 8. Botosani population-stem leaves series

Fig. 9. Calarasi population-stem leaves series

Fig. 10. Buzau (Bisoca) population-stem leaf

Fig. 11. Buzau (Bisoca) population-wing and fruit

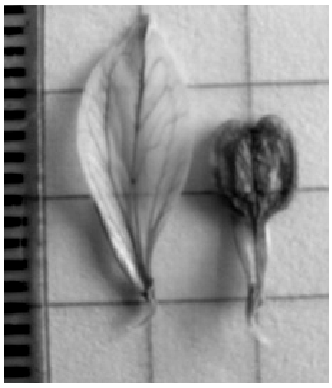


Fig. 12. Buzau (Aldeni) population-wing and fruit

Plants of the populations harvested of grassland in Bisoca and Aldeni show no leaves in basal area (Figures 2, 3), but only stem leaves, lanceolate or linear in shape (Figure 10) that are between 20-39 mm in length to the Aldeni population and between 27-32 mm to the Bisoca population, respectively (Table 1).
Wings (internal sepals) are elliptical or obovate in shape and have prominent veins: the midvein, branched towards the top, is thicker than the laterals veins; those are slightly curved and out branched. The wings are longer than the capsule to the fructification, between 12 mm in length to the Bisoca population and 16.5 mm to the Aldeni population (Table 1). The literature is referred to wing length in *P. major* subsp. *major* (*P. major* respectively) as being between 10 to 15 mm [6], or up to 17 mm [9].

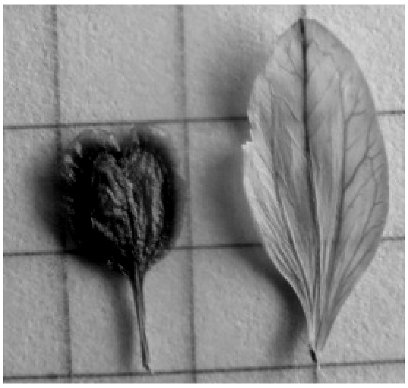


Fig. 13. Botosani population-wing and fruit

The obcordate and wide winged capsule has an average length of 8 mm to the Aldeni population (Buzau), 9 mm to the Bisoca population (Buzau) and Calarasi, and 10 mm to the Botosani population (Table 1). The carpophore average length is 4 mm in Aldeni (Buzau), Botosani Calarasi populations and 3mm in Bisoca population (Table 1) (Figures 11, 12, 13, and 14). The literature states a 3-4 mm in length for the carpophore to *P. major* subsp. *major*, longer than half the length of the fruit respectively, while to the subsp. *anatolica*, the carpophore can reach up to 3 mm in length, being shorter than half the length of the fruit [4].

Fig. 14. Calarasi population-wing and fruit

Fig. 15. The lateral lobes of the seed (Bisoca population)

Fig. 16. The central lobe of the seed (Bisoca population)

All four populations formed ovate seeds, surface covered with attached bristles, provided with an unequal trilobate strophiole, central lobe being shorter than the lateral ones (Figures 15, 16, 17, 18).

Comparing the data on the morphology and size of wings, fruits and seeds observed in all four observed populations with the literature data shows that they fall within the limits of variation for *P. major* subsp. *major.*

Fig. 18. Central lobe of the seed (Botosani population)

Fig. 17. Lateral lobes of the seed (Botosani population)

Table 1

Variation of morphological characters of *Polygala major* jacq. populations

Population	Basal leaves - average length (mm)	Stem leaves - length (mm)	Wings - average length (mm)	Fruit	
				average length (mm)	*carpophore - average length (mm)*
Buzau - Aldeni	-	20 - 39	16.5	8	4
Buzau - Bisoca	-	27-32	12	9	3
Botoşani	10	17 - 28	14	10	4
Călăraşi	19	16 - 22	13	9	4

CONCLUSIONS

1. All four populations are composed of perennial plants with lignified roots and stems.
2. The length of stem leaves, lanceolate or linear in shape, is highly variable, in a large range.
3. The wings to the fructification are greater than the capsule.
4. The average length of carpophore is equal to or less than half of the fruit ones.
5. Seeds show strophiole central lobe shorter than the lateral ones.
6. All four populations include plants from the *Polygala major* subsp. *major* (Boiss. et. Heldr. in Boiss.) Ciocârlan.

REFERENCES

1. Bărbulescu C., P. Burcea, Gh. Motcă, 1980. *Determinator pentru flora pajiştilor cu elemente de tehnologie*. Ed. Ceres, Bucureşti.
2. Borza Al., 1968. *Dicţionar etnobotanic*. Ed. Academiei RSR.
3. Buţură V., 1979. *Enciclopedie de etnobotanică românească*. Ed. Ştiinţifică şi Enciclopedică, Bucureşti.
4. Ciocârlan V., 2009. *Flora ilustrată a României. Pteridophyta et Spermatophyta*. Ed. Ceres, Bucureşti.
5. Ciocârlan V., M. Costea, 1995 - 1996. *Flora rezervaţiei botanice Dealul Alah-Bair (jud. Constanţa)*. Acta Horti Botanici Bucurestiensis (pp. 97-104).
6. Mc.Neill J., 1968. *Polygala* in *Flora Europaea* vol. II, University Press, Cambridge.
7. Oprea A., 2005. *Lista critică a plantelor vasculare din România*. Ed. Universităţii „A.I.Cuza", Iaşi.
8. Popescu A., 1984. *Lens nigricans (Bieb.) Gordon şi Polygala anatolica Boiss. et. Heldr., specii noi pentru flora României.* Stud. Şi Cerc. Biol, seria Biol. Veg., T 36, nr. 1, Bucureşti (pp. 20-23).
9. Săvulescu T. (coordonator), 1958. *Flora R.P.R.* Vol. VI, Ed. Academiei Române, Bucureşti.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

RESEARCH ON TWO PASTURES SITUATED IN THE NORTH AND EAST OF BUCHAREST

MIHAELA IOANA GEORGESCU, ELISABETA DOBRESCU, A. GHEORGHE

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *composition by species, life forms, chorological, and ecological categories*

Abstract

In two pastures situated in the North and East of Bucharest field studies were conducted and the results are presented to compare them by the specifically composition, life forms, chorological, and ecological categories.

INTRODUCTION

A current problem in modern urban areas is the need to mediate between the extension of the buildings aria and maintaining or increasing the area occupied by green space. Among the solutions proposed include the implementation of green roofs. There are several systems that may be used, one is represented by the making up of an herbaceous carpet, with a little support, were the vegetation is install and develop by itself. It is therefore necessary to know the characteristic flora of Bucharest and its possible developments. Our study adds to previous research on the flora of Bucharest and its surroundings, research which can be grouped as follows: a) research on composition by species - of the authors: Dimitrie Brandza, D. Grecescu, Zaharia C. Pantu, Lucretia Spiridon [6]; b) research on the anthrophile plant associations: I. Morariu [4, 7, 8, 9]; c) studies on adventives species of Bucharest flora: Paulina Anastasiu [1]; G. Negrean, N. Constantine [10].

MATERIAL AND METHODS

Research was conducted on two pastures, one located near Băneasa forest, to exemplify the situation in the Northern area, and the second near the lake Pantelimon I on a vacant lot used, sometimes as pasture to exemplify the situation in the Eastern area. There are made up lists of characteristic species to compare the vegetation of the two chosen locations. Observations were conducted in spring and summer time to capture the vernal and aestival aspects, as is recommended for pastures in the lowland area [6]. The working method consisted of crossing the land diagonally and writing down of all encountered species. They were listed in the tables to determine the phytocoenosis composition in terms of: species, life forms, chorological and ecological categories.

RESULTS AND DISCUSSION

A. <u>Vernal flora</u>

1. <u>The analysis of plant communities located in the North of Bucharest</u>
Specifically composition: were recorded 39 species from 15 families. Species distribution on families were: *Asteraceae* - 10 species, *Fabaceae* - 5 species, *Brassicaceae* - 4 species, *Scrophulariaceae* - 4 species, *Poaceae* - 3 species, *Boraginaceae*, *Lamiaceae*, *Rosaceae* - 2 species, *Apiaceae*, *Caprifoliaceae*, *Caryophyllaceae*, *Convolvulaceae*, *Cornaceae*, *Plantaginaceae*, *Polygonaceae* - 1 species. Of the 39 species, depending on the appearance and duration of life has been recorded: annual - 9 species (23.07%); annual hibernating - 3 species (7.69%); biennial - 3 species (7.69 %), annual-perennial - 3 species (7.67%), perennial - 19 species (48.71%), woody species - shrubs 2 species (5.12%). **Life forms**: *therophytes* - 16 species (41.02%); *hemychryptophytes* - 17 species (43.58%); *geophytes* - 3 species (7.69%); *chamaephytes* - 1 species (2.56%); *phanerophytes* - 2 species (5.12%). **Chorological elements**: most species are of Eurasian origin (25 species, 64.10%), followed by Cosmopolite (7 species, 17.94%), European (3 species, 7, 69%), Adventives (1 species, 2, 56%), Pontic - Caucasian (1 species, 2.56%).

2. <u>The analysis of plant communities located in the East of Bucharest</u>
Specifically composition: 39 species were recorded in 15 families. Distribution of species by families was as follows: *Poaceae* - 6 species, *Brassicaceae* - 5 species, *Asteraceae, Fabaceae* - 4 species, *Scrophulariaceae, Boraginaceae, Rosaceae* - 3 species, *Caryophyllaceae, Geraniaceae, Lamiaceae* - 2 species, *Apiaceae, Malvaceae, Rubiaceae, Plantaginaceae, Polygonaceae* - 1 species. Of the 39 species, depending on the appearance and duration of life have been recorded: annual - 14 species (35.89%); annual hibernating - 2 species (5.12%); biennial - 5 species (12.82%), annual-perennial - 2 species (5.12%), perennial - 16 species (41.02%), woody species - 1 shrub species (2.56%). **Life forms**: *therophytes* - 17 species (43.58%); *hemychryptophytes* - 19 species (48.71%); *geophytes* - 2 species (5.12%); *phanerophytes* -1 species (2, 56%). **Chorological elements**: Eurasian origin (28 species, 71.79%), Cosmopolite (6 species, 15.38%), European (3 species, 7.69%), Adventives (1 species, 2.56%), Pontic - Caucasian (1 species, 2.56%).

Comparing the two surveys in terms of specific composition, it is found that in both cases the total number of species (39) and families (15) is equal. However, species distribution on families differs: in the North zone are predominant plants of *Asteraceae* family - 10 species, while in the East zone those of Poaceae family - 6 species.

A total of 12 species noted in the survey of land made in the North of Bucharest were not found in the East, namely: *Lathyrus tuberosus, Lotus corniculatus, Trifolium repens, Cornus sanguinea, Armoracia rusticana, Thlaspi arvense, Artemisia absinthium, Arctium lappa, Carduus acanthoides, Cirsium arvense, Erigeron annuus, Matricaria perforata.* In the East there are a number of 15 different species from those in the North, namely: *Silene alba, Potentilla reptans, Vicia angustifolia, Vicia sativa, Erodium cicutarium, Malva sylvestris, Alyssum desertorum, Bertheroa incana, Anchusa ochroleuca, Echium vulgare, Verbascum phlomoides, Galium mollugo, Phragmites australis, Dactylis glomerata, Festuca valesiaca.*

In both areas predominantly are herbaceous perennial plants to annual ones, and that those from *Hemychryptophyta* form of life, which indicates a climate with thermal or humidity deficiency; the same thing is signalize by the abundance of *Poaceae* formations with perennial grass of the pasture type.

The predominance of the Eurasian species is according to the general rule to the cormophytes in our country where the species of this group are the best represented. The cosmopolitan species, ranked second like number in the two pastures, emphasis the ruderal characteristic of the two lands.

In terms of requirements for soil moisture, nearly half of the species identified in the North are plants with moderate requirements (xero-mesophilic), again emphasizing the character of steppe grasslands of the association. In the East this characteristic is more evident: here 22 of the 39 species are xero-mesophilic.

Most of the species are indifferent to air temperature and soil reaction.

B. Aestival flora

1. The analysis of plant communities located in the North of Bucharest

Specifically composition: were recorded 47 species of 19 families. Distribution of species by families was as follows: *Asteraceae* - 13 species, *Poaceae, Fabaceae* - 7 species, *Scrophulariaceae* - 3 species, *Brassicaceae, Rosaceae* - 2 species, *Apiaceae, Caprifoliaceae, Boraginaceae, Convolvulaceae, Cornaceae, Juglandaceae, Onagraceae, Malvaceae, Oxalidaceae, Papaveraceae, Plantaginaceae, Polygonaceae, Ulmaceae* - 1 species. Of the 47 species, depending on the appearance and duration of life, have been recorded: annual species - 10 species (21.27%); annual hibernating - 1 species (2.12%); biennial - 5 species (10.63%), perennial - 27 species (57.44%), woody species - shrubs 2 species (4.24%), tree 2 species (4.24%). **Life forms**: *therophytes* - 15 species (31.91%); *hemychryptophytes* - 21 species (44.68%); *geophytes* - 5 species (10.63%); *chamaephytes* - 2 species (4.24%); *phanerophytes* - 4 species (8.51%). **Chorological elements**: of Eurasian origin (23 species, 48.93%), Cosmopolite (9 species, 19.14%), European (7 species, 14.89 %), Adventives (4 species, 8.51%), Pontic - Caucasian - (1 species, 2.12%), Mediterranean (1 species, 2.12%).

2. <u>The analysis of plant communities located in the East of Bucharest</u>

Specifically composition: were recorded 50 species in 19 families. Distribution of species by families was as follows: *Asteraceae* - 12 species, *Poaceae* - 9 species, *Fabaceae* - 6 species, *Brassicaceae, Rosaceae* - 3 species, *Boraginaceae*, *Caryophyllaceae* - 2 species, *Apiaceae, Caprifoliaceae, Convolvulaceae, Geraniaceae, Elaeagnaceae, Lamiaceae, Malvaceae, Papaveraceae, Plantaginaceae, Rubiaceae, Scrophulariaceae, Simarubaceae, Ulmaceae* - 1 species. From the 39 species, depending on the appearance and duration of life have been recorded: annual - 10 species (20%), annual hibernating - 2 species (4%); biennales - 10 species (20%), perennial - 21 species (42%), woody species - shrubs 1 species (2%), trees 3 species (6%). **Life forms**: *therophytes* - 14 species (28%); *hemychryptophytes* - 26 species (52%); *geophytes* - 6 species (12%); *phanerophytes* - 4 species (8%). **Chorological elements**: most species are of Eurasian origin (28 species, 56%), followed by Cosmopolite (11 species, 22%), European (6 species, 12%), Asian (2 species, 4%), Adventives (1 species, 2%), Ponto-Pannonian (1 species, 2%), Atlantic 1 - (2%).

In the aestival survey in the North of Bucharest were recorded 47 species from 19 families. Most species are, as for the survey of spring, of the *Asteraceae* family - 13, followed by those of *Poaceae* - 7.

In the East of Bucharest were also recorded 50 species of 19 families, most of them of *Asteraceae* family - 12, followed by those of *Poaceae* - 9. Compared to the vernal survey, in both cases the increasing of the number of species was observed. It was found that in summer survey were noted some common species, which in vernal survey don't appear, because, in the particular conditions of the land, they have become evident later from the date of the first observations. Also, there are some species which were completed their growing cycle and disappeared.

There are a number of species characteristic of each area that were not found in the survey conducted in the opposite location. In the case of land located in the North, they were: *Juglans regia* (occurred because of a nut tree alignment existed near the observation site), *Lathyrus tuberosus, Medicago sativa, Melilotus officinalis, Trifolium arvense, Trifolium pratense, Cornus sanguinea* (the latter is due to proximity of Baneasa forest), *Oxalis corniculata, Epilobium lanceolatum, Wool vulgaris, Verbascum blattaria, Arthemisia absinthium, Matricaria perforated, Xanthium italicum, Lolium multiflorum*.

The characteristic species in the East of the city were: *Kholrauschia prolifera*, *Silene alba, Potentilla reptans, Elaeagnus angusitfolia* (possibly planted), *Erodium cicutarium, Bertheroa incana, Ailanthus altissima, Verbascum phlomoides, Galium mollugo, Carlina vulgaris, Chondrilla juncea, Cirsium pannonicum, Cynodon dactylon, Hordeum murinum, Lolium perenne*.

In both fields, as for the vernal survey, perennial plants are dominant to the annual ones and those from *Hemychryptophyta*, which indicates a climate with a thermal and humidity deficiency.

And in this case Eurasian species are best represented, followed by the cosmopolitan, ranked second in number, again emphasizing the character of the two land ruderalizate meadows.

In terms of requirements for soil moisture, 23 of the 47 plant species identified in the North are with moderate demands to this factor (xero-mesophytic); in the East 31 of the 50 species are xerophytes or xero-mesophytes, confirming thus the findings from the vernal survey.

CONCLUSIONS

1. The specific composition of the two pastures from the North and East of Bucharest were similar in number of species and families.
2. In the vernal survey from the East of the City *Poaceae* species are dominated, while in summer most of the *Asteraceae*.
3. *Hemychryptophyta* species prevail in terms of life form, indicating a thermal or humidity deficiency climate and the abundance of *Poacee* formations.
4. The large number of xero-mesophytes species in both surveys shows the steppe character of the grassland associations, and this is more pronounced in the case of East fields.

REFERENCES

1. Anastasiu Paulina, 1994. *Plante naturalizate în Municipiul Bucureşti*. AHBBuc. (1993-1994) (pp. 135-137).
2. Ciocârlan V., 2009. *Flora ilustrată a României*. Ed. Ceres, Bucureşti.
3. Cristea V., D. Gafta, F. Perdotti, 2004. *Fitosociologie*. Ed. Presa Universitară Clujeană, Cluj-Napoca.
4. Doniță N., Mihaela Paucă-Comănescu, A. Popescu, Simona Mihăilescu, I.A. Biriş, 2005. *Habitatele din România*. Ed. Tehnică-Silvică, Bucureşti.
5. Ghinea D., 1996. *Enciclopedia geografică a României*. Vol. 1, Ed. Enciclopedică, Bucureşti.
6. Licherdopol I.P., 1889. *Bucureştii*. Tipogr. Carol Göbl, Bucureşti.
7. Morariu I., 1944. *Asociații de plante antropofile în jurul Bucureştilor cu observații asupra răspândirii lor în țară şi mai ales în Transilvania*. Bul. Grăd. Bot. Cluj 24(1-2) (pp. 13-15).
8. Morariu I., 1946. *Periodicitate şi amestecuri antropogene în flora mărginaşă Bucureştilor.* Rev. Şti. V. Adamachi 32(1) (pp. 46-48).
9. Morariu I., 1949. *Privire generală asupra florei şi vegetației regiunii Bucureştilor*. Rev. Pădur. 64(3) (pp. 107-114).
10. Negrean G., N. Constantin. 1998. *Noi plante adventive în flora Bucureştiului*. AHBBuc. (27) (pp. 143-145).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

BIOMETRICAL CONTIBUTIONS REGARDING THE REPRODUCTIVE SYSTEM OF TWO *SALIX* SPECIES FROM THE CENOSIS OF PRAHOVA RIVER MEADOW (PUCHENI)

NICULINA GHENESCU*, GH.P. NEGULESCU, TATIANA-EUGENIA ŞESAN***, AURELIA-MAGDALENA PISOSCHI**, CONSTANTIN PĂUN****

*Lazăr Edeleanu College of Ploieşti
**University of Agronomic Sciences and Veterinary Medicine of Bucharest
***University of Bucharest

Keywords: *Salix alba, Salix fragilis, catkin, ovary, still, stigma, stamens*

Abstract

The biometry of female and male flowers was followed, for two species (Salix alba and Salix fragilis), with a 76 chromosomes karyotype, for which the vegetative development is different from the 38 chromsomes karyotype, in the cenosis of Prahova River, near Pucheni.

INTRODUCTION

The study followed the development of the reproductive system for two *Salix* species, frequently encountered in the cenosis of the Prahova River meadow, having as main criterion the rapid multiplication. During the flowering phenophasis, the biometry of the floral elements was evaluated.

The importance of the study is related to the rapid multiplication of the two species, which determines the soil stabilization in case of river flow fluctuation.

MATERIAL AND METODS

The biological material belongs to the *Salix* gendre, harvested from Prahova River meadow (Pucheni, the 30th of April 2010).

The two studied species were: *Salix alba* and *Salix fragilis*. The male and female catkins were analysed and the following biometrical determinations were performed: number of catkins on the shoot, length of the peduncle (mm), length of the catkin (mm), thickness of the catkin (mm); for the female catkins, the gynoecia were analysed regarding: the length of the bracteate, the length of the pedicel (mm), the length of the ovary (mm), the thickness of the ovary (mm), the shape index of the ovary (the length/thickness ratio), the length of the still (mm), the length of the stigma (mm); for the male catkins the stamens were determined, regarding the bracteate length (mm), the length of the filament (mm) and the length of the anthers (mm).

RESULTS AND DISCUSSION

Salix alba has an average of eight catkins on the shoot, the catkin being located at the basis of 3-4 leaves. The length of the catkin varies from 25 to 52 mm, with an average of 38.5 mm. The thickness of the catkin varies form 5 to 10 mm, with an average of 7.85 mm (different form the data reported by Dămăceanu)[2]. The peduncle of the catkin has a minimum length of 9 mm and a maximum length of 14 mm, with an average of 11.35 mm. The number of gynoecia of a catkin varies from 48 to 87, with an average of 68, disposed helicoidally on the axis (Figure 1).

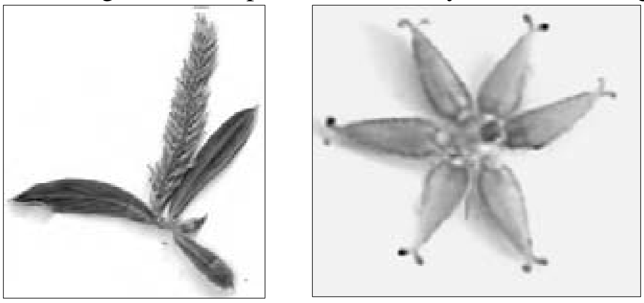


Fig. 1. Section through the catkin ♀ of *S. alba* (a. longitudinal. b. transversal)

The length of the bracteate of the gynoecium varies from 2 to 2.8 mm, with an average value of 2.22 mm. The pedicel of the the gynoecium has a length of 0.5 mm (along with the nectaria, as reported by Dihoru and colab. 2004)[3]. The length of the ovary varies between 4 and 5 mm, with an average of 4.38 mm. The thickness of the ovary varies between 1 and 1.5 mm, with an average of 1.14 mm. The shape index of the ovary varies between 2.66 and 5, with an average of 3.94. The length of the still is comprised between 0.3 and 0.5 mm, with an average of 0.45 mm. The stigma has a length of 0.3-0.5 mm, with an average of 0.46 mm.
There is an average of 11 male catkins on the shoot, which appear at the basis of 3-4 leaves (Figure 2).

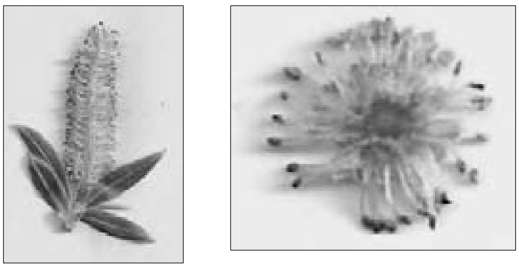


Fig. 2. Section through the catkin ♂ of *S. alba* (a. longitudinal b. transversal)

The length of the catkin varies between 30 and 53 mm, with an average of 39.6 mm (different from the data reported by Pǎrvu 2006)[5]. The thickness of the catkin varies from 6 to 9 mm, with an average of 7.95 mm. The peduncle of the catkin has a minumum length of 4 mm and a maximum length of 11 mm, with an average of 6,65 mm. The number of stamens from a catkin varies from 76 to 120 mm, with an average of 100 mm, disposed helicoidally on the axis. The length of the bracteate of the stamen varies from 1.8 to 3 mm, with an average value of 2.14 mm. The filament of the stamen has a length comprised between 3 and 4 mm, with an average of 3.47 mm. The length of the anther (free, as reported by Ocsksai Suzana and colab., 1973)[4] is comprised between 0.3 and 0.5 mm, with an average of 0.46 mm.

Salix fragilis has an average of 5 female catkins on the shoot, the catkin appearing at the basis of 3-4 leaves. The length of the catkin varies 30 and 70 mm (7 cm after Beldie-1996)[1], with an average of 64.65 mm. The thickness of the catkin varies between 5 and 10 mm, with an average of 7.45 mm. The peduncle of the catkin has a minimum length of 25 mm and a maximum one of 40 mm, with an average of 30.45 mm. The number of gynoecia from a catkin varies from 76 to 126, with an average of 101, helicoidally disposed on the axis (Figure 3).

Fig. 3. Section through the catkin ♀ of *S. fragilis* (a. longitudinal b. transversal)

The length of the bracteate (long and hairy, as reported by Beldie 1996)[1] of the gynoecium varies between 2 and 2.2 mm, with an average of 2.06 mm. The pedicel of the gynoecium (which represents 1/4 or 1/5 of the length of the ovary- Dihoru and colab., 2004)[3] has a 0.5 mm length. The length of the ovary is comprised between 2.8 and 3 mm. The thickness of the ovary is 1mm. The shape index of the ovary varies from 2.8 to 3, with an average value of 2.99. The still length is 0.5 mm - value confirmed by Dihoru et al., 2004[3]. The stigma has a length comprised between 0,5 and 0,7 mm, with an average value of 0.55 mm.

The male catkins appear before the leaves, or at the same time with the leaves on the shoot, and are in average of 5, located at the basis of 3-4 leaves. The length of the catkin varies between 25 and 49 mm, with an average of 39.35 mm (2-5 cm, as reported by Şofletea et al. 2001)[6]. The thickness of the catkin varies between 5 and 8 mm, with an average of 7.25 mm. The peduncle of the catkin has a minimum length 12 mm and a maximum length of 17 mm, with an average of 15 mm.

The number of stamens of a catkin varies between 58 and 81, with an average of 70 (the male flower is formed by two free stamens - Dihoru şi colab 2004)[3], helicoidally disposed on the axis (Figure 4).

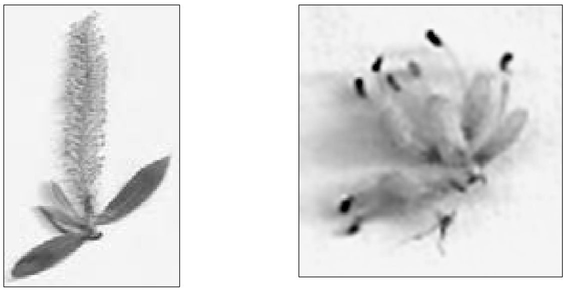


Fig. 4. Section through the catkin ♂ of *S. fragilis* (a. longitudinal b. transversal)

The length of the bracteate of the stamen is 2 mm. The length of the filament of the stamen is comprised between 2 and 3 mm, with an average value of 2.49 mm. The length of the anther is comprised between 0.5 and 1 mm, with an average of 0.685mm.

CONCLUSIONS

1. For *Salix alba*, the female catkin is around 42% smaller than the one of *Salix fragilis* and the explanation consists in the latter flowering.
2. The male catkin for both species is smaller than the female one, the explanation being related to the simpler tissular morphology.

REFERENCES

1. Beldie A., 1996. *Îndrumător pentru identificarea răchitelor din culturile forestiere*. Centrul de documentare tehnică pentru economia forestieră, Bucureşti (pp. 9-27).
2. Dămăceanu C., 1994. *Cultura şi valorificarea răchitelor.* Colectia Bibliotecarului Agricol, Ed. Ceres, Bucureşti.
3. Dihoru Gh., V. Hadîrcă 2004. *Speciile de Salix din Republica Moldova.* Vol. omagial, Analele Universității Craiova (pp. 63-74).
4. Ocskay Suzana, A. Clonaru, 1973. *Determinator pentru plopul şi salcia de interes industrial.* Redacția Revistelor agricole, Bucureşti (pp. 43-63).
5. Pârvu C. 2006. *Universul plantelor*. Ed. ASAB, Bucureşti (pp. 296-621, 698, 720-724, 1038).
6. Şofletea N., Curtu L. 2001. *Dendrologie*. Vol. II, Corologia, ecologia şi însuşirile biologice ale speciilor, Ed. „Pentru viață", Braşov (pp. 300).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

SOME BIOMETRICAL ASPECTS OF *SALIX PURPUREA* AND *SALIX TRIANDRA* FLOWERINGS ENCOUNTERED IN THE PRAHOVA RIVER MEADOW (PUCHENI)

GH.P. NEGULESCU*, NICULINA GHENESCU, TATIANA-EUGENIA ŞESAN***, AURELIA-MAGDALENA PISOSCHI*, CONSTANTIN PĂUN*, ANA-MARIA NEGULESCU******

*University of Agronomic Sciences and Veterinary Medicine of Bucharest
**Lazăr Edeleanu College of Ploieşti
***University of Bucharest
****MSc L'école Polytechnique Paris

Keywords: *catkin, stamen, bracteate, filament, anther, ovary, still, stigma*

Abstract

For the two species with a 38 chromosomes karyotype, we followed the biometry of female and male flowers, for which the vegetative development is less enhanced, when compared to the 76 chromosomes karyotype, in the cenosis of the Prahova River, near Pucheni.

INTRODUCTION

The present study followed the biometry of the flowers, for two *Salix* species, frequently encountered in the cenosis of the Prahova river meadow, having as main criterion the rapid multiplication.

The rapid multiplication of the two species determines the soil stabilization, in case of river flow variation.

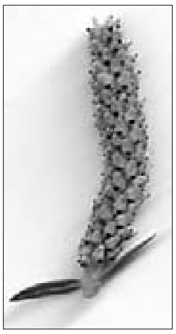
MATERIAL AND METODS

The two species belonging to the *Salix* gendre were harvested in the Prahova River meadow, Pucheni, in late April.

The two studied species were: *Salix purpurea, Salix triandra*. The male and female catkins were analysed and the following biometrical determinations were performed: number of catkins on the shoot, length of the peduncle (mm), length of the catkin (mm), thickness of the catkin (mm); for the female catkins, the gynoecia were analysed regarding: the length of the bracteate, the length of the pedicel (mm), the length of the ovary (mm), the thickness of the ovary (mm), the shape index of the ovary (the length/thickness ratio), the length of the still (mm), the length of the stigma (mm); for the male catkins the stamens were determined, regarding the bracteate length (mm), the length of the filament (mm) and the length of the anthers (mm).

RESULTS AND DISCUSSION

Salix purpurea has an average of 13 female catkins on the shoot, which are located at the basis of 2-4 leaves. The length of the catkin varies from 24 to 42 mm, with an average of 30.55 mm. The thickness of the catkin varies from 5 to 10 mm, with an average of 8.75 mm. The peduncle of the catkin has a minimum length of 5 mm and a maximum length of 10 mm, with an average of 8.75 mm. The number of gynoecia of a catkin varies from 90 to 185, with an average of 145, disposed helicoidally on the axis (Figure 1).



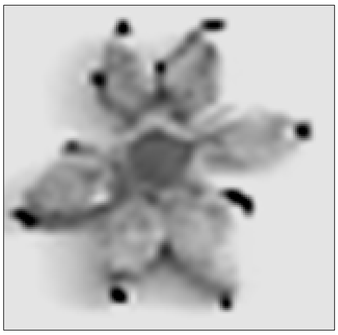


Fig. 1. Section through the catkin ♀ of S purpurea longitudinal - transversal

The length of the bracteate of the gynoecium is 1 mm. The pedicel of the gynoecium has a length of 0.5 mm. The length of the ovary is comprised between 3 and 4 mm, with an average of 3.26 mm. The thickness of the ovary varies between 1.7 and 2.5 mm, with an average value of 2.07 mm. The shape index of the ovary varies between 1.4 and 2, with an average value of 1.58. The still length is comprised between 0.1 and 0.3 mm, with an average value of 0.21 mm (0.1 mm, as reported by Săvulescu 1953)[5]. The stigma has a length comprised between 0.1 and 0.2, with an average value of 0.125 mm.

There is an average of 11 male catkins which appear before the leaves on the shoot, at the basis of 2-3 leaves.

The length of the catkin varies between 22 and 36, with an average of 30.15.

The thickness of the catkin varies between 5 and 8 mm, with an average of 6,3 mm (the catkins are long and thick, as reported by Dihoru and colab., 2004)[4]. The peduncle of the catkin has a minimum length of 5 mm and a maximum one of 10 mm, with an average of 8.3 mm.

The number of stamens of a catkin varies from 36 to 74, with an average of 56, which are united in groups of two, and helicoidally disposed on the axis.

The length of the bracteate of the stamen is 1 mm. The filament of the stamen has a length comprised between 2 and 2.5 mm, with an average of 2.21 mm (apparently one single stamen, after Beldie Alexandru 1979)[1]. The length of the anther is comprised between 0.2 and 0.5 mm, with an average value of 0.36 mm (Figure 2).

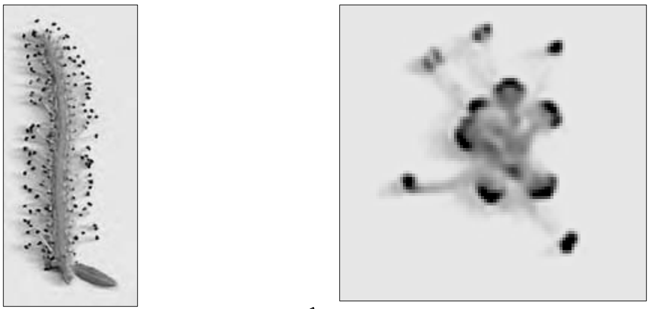


Fig. 2. Section through the catkin ♂ of S. purpurea longitudinal - transversal

Salix triandra has an average of 14 female catkins, the catkin being located at the basis of four leaves. The length of the catkin varies between 25 and 50 mm, with an average of 39.2 mm (long, as reported by Dămăceanu 1994)[3]. The thickness of the catkin varies from 5 to 9 mm, with an average of 7.55 mm. The peduncle of the catkin has a minimum length of 10 and a maximum one of 28 mm, with an average of 18.2 mm. The number of gynoecia of a catkin varies from 44 to 98, with an average of 78, disposed helicoidally on the axis (Figure 3).

Fig. 3. Section through the catkin ♀ of S. triandra longitudinal - transversal

The length of the bracteate of the gynoecia varies between 0.7 and 1 mm, with an average value of 0.95 mm. The pedicel of the gynoecium has a minimum length of 1 mm and a maximum length of 3 mm, with an average of 1.48 mm. The length of the ovary is comprised between 2.8 and 3.5 mm, with an average value of 3.14 mm. The thickness of the ovary varies between 1 and 1.2 mm, with an average of 1.07 mm. The shape index of the ovary varies between 2.5 and 3.5, with an average of 2.96. The still is absent (observation confirmed by Săvulescu 1953)[5]. The stigma has a length comprised between 0.3 and 0.5 mm, with an average value of 0.435 mm.

There is an average of 11 male catkins, which appear before the leaves on the shoot, being located at the basis of three leaves. The length of the catkin varies between 41 and 60 mm, with an average of 49.15 mm. The thickness of the catkin varies between 7 and 8 mm, with an average of 7.6 mm. The peduncle of the catkin has a minimum length of 3 mm and a maximum length of 21 mm, with an average of 7.45 mm. The number of stamens from a catkin varies from 70 to 146, with an average of 102, and are disposed helicoidally on the axis (Figure 4).

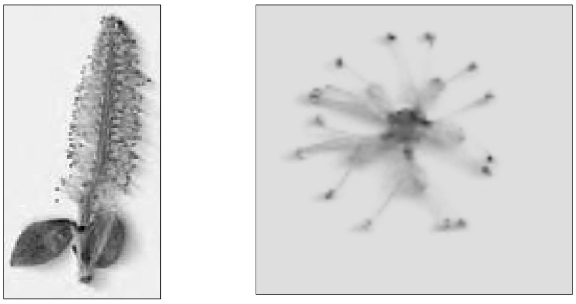


Fig. 4. Section through the catkin ♂ of S triandra longitudinal - transversal

The length of the bracteate of the stamen is comprised between 1.8 and 2.2 mm, with an average of 2 mm. The filament of the stamen (three are free, as reported by Ciocârlan 1990)[1] has a length comprised between 3 and 3.5 mm, with an average value of 3.165 mm. The length of the anther is comprised between 0.3 and 0.5 mm, with an average value of 0.47 mm.

CONCLUSIONS

1. The female catkin of *Salix purpurea* is 23% smaller than the one of *Salix triandra* and the explanation consists in the latter flowering.
2. For *Salix purpurea*, the male catkin is smaller than the one of *Salix triandra*, the reason being related to the characteristic morphology.

REFERENCES

1. Beldie A., 1979. *Îndrumător pentru identificarea răchitelor din culturile forestiere.* Centrul de documentare tehnică pentru economia forestieră, Bucureşti (pp. 9-27).
2. Ciocârlan V., 1990. *Flora ilustrată a României.* Ed. Didactică şi Pedagogică, Bucureşti (pp. 62-67).
3. Dămăceanu C. 1994. *Cultura şi valorificarea răchitelor.* Colectia Bibliotecarului Agricol, Ed. Ceres, Bucureşti.
4. Dihoru Gh., V. Hadîrcă, 2004. *Speciile de Salix din Republica Moldova.* Vol. omagial, Analele Universității Craiova (pp. 63-74).
5. Săvulescu T. 1953. *Flora României*. Vol. I, Ed. Academiei R.P.R. (pp. 277-321).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

CHARACTERIZATION OF NEW *BACILLUS* SPP. ISOLATES FOR ANTIFUNGAL PROPERTIES AND BIOSYNTHESIS OF LIPOPEPTIDES

OANA ALINA SICUIA*, VIOLETA OLTEANU, MATILDA CIUCĂ***, DOINA MARIA CÎRSTEA****, CĂLINA PETRUȚA CORNEA*****

*Research and Development Plant Protection Institute of Bucharest
**Center of Applied Biochemistry and Biotechnology Bucharest (BIOTEHNOL)
***National Agricultural Research and Development Institute Fundulea of Bucharest
****Institute of Biology of Bucharest
*****University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *Bacillus subtilis, antifungal activity, lipopeptides, oil dispersion*

Abstract

The characterization and identification of some new strains of Bacillus spp. isolated from Romanian soils and selected for their antifungal properties are the content of this paper. We investigated the antifungal properties of three Bacillus new strains and their lipopeptides involvement in these activities. The ability of these new strains to produce biosurfactants lipopeptides as antifungal agents was evaluated trough their antimicrobial potential and examined by oil spreading technique and emulsification stability test, using different types of oils: sunflower oil, olive oil, kerosene and kerosene with 20% diesel. Among the examined strains, one strain (designated as BW) was isolated from soil and the other two from onion rhizosphere (designated OS15 and OS17). These strains inhibited the growth of the majority of fungal species tested in the experiments. Differences in the ability to spread the oil in water and the emulsifying activity were detected. The best results were obtained with OS17 for all type of oils, but maximum action being recorded of kerosene. The presence of the genes involved in iturin production (a specific lipopeptide with antifungal activity) was determined. No correlation between biosurfactant production and antifungal activity was observed, suggesting that other mechanisms are responsible for antifungal action of selected bacterial strains.

INTRODUCTION

Among rhizobacteria, *Bacillus* spp. can play a vital role in the management of plant diseases to increase crop productivity via various mechanisms. Considerable progress has been made over the past three decades to elucidate the mechanisms by which bacterial strains can suppress plant diseases [21]. Lipopeptides production is a common feature by which plant-associated bacterial species, like *Bacillus* spp., can suppress plant diseases. Those molecules also present importance for functioning and survival of the producing organisms. Lipopeptides are biologically surface-active agents produced by various microorganisms, as membrane components or secondary metabolites [3, 12]. They are low molecular mass biosurfactants, including surfactin, iturin, lichenysins, mycosubtilin, arthrofactin etc., which presents amphiphilic constituents, containing hydrophobic and hydrophilic components. Having both hydrophilic and hydrophobic domains, they are able to partition at the water/air or water/oil interfaces and thus lower the interfacial of surface tension [8, 25].

In the last years, the bacteria lipopeptide compounds are getting more attention for their antifungal activity, owing their lower toxicity for plants and animals, high biodegradability, low irritancy and compatibility with human skin [2]. In the biocontrol activity, they are mentioned to interfere in microbial quorum sensing, cell motility and biofilm formation [17]. Among bacterial species, recent studies are focused on *Bacillus* genus for their ability to produced lipopeptides, a class of biosurfactants with antimicrobial effects. Lipopeptides are low molecular mass biosurfactants (including surfactin, iturin, lichenysins, mycosubtilin, arthrofactin etc.) which exhibit surface-active properties, and antimicrobial activities [11, 12]. *Bacillus subtilis* produced a broad spectrum of bioactive lipopeptides with a great potential for biotechnological and biopharmaceutical applications [9].

The aim of this work was the characterization of some new strains of *Bacillus* spp. that present antifungal properties. We also aimed to study the correlation between strains ability to disperse and emulsify different oils in water with production of lipopeptide compounds.

MATERIAL AND METHODS

Bacterial isolation

Bacterial strains OS15 and OS17 were isolated from onion rhizosphere and Bw was isolated from soil and maintained on LB agar slants.

Identification of bacterial isolates was performed using both microbiological (API 20E and BIOLOG system), and molecular methods, using *Bacillus subtilis* ATCC6633 as reference strain For molecular analysis, genomic bacterial DNA was isolated by Wizard R Genomic DNA Purification Kit. Restriction endonucleases (Hae III and Msp I) were purchased from Promega Corp. (Madison, Wis.), and DNA digestion was carried out as recommended the manufacturer. For PCR reaction universal primers f-ITS1 and r-ITS2 (Biosearch, Technologies INC.) were used [1, 19]. The amplification protocol consisted of one cycle of 94^0C for 3 min, 38 cycles of 94^0C for 1 min, 50^0C for 1 min and 72^0C for 2 min, and one cycle of 72^0C for 10 min. The presence of iturin genes in bacterial isolates was tested using two primer pairs: for *itu*D and *lpa*-14 [12]. Multiplex PCR reaction was performed according to Hsieh et al. [9]. Amplification products were analyzed by electrophoresis in 1.2% agarose and TBE buffer (0,04M Tris-borate and 0.001M EDTA) at 70V for 2 h.

Characterization of bacterial isolates: several specific tests were performed in order to characterize the new bacterial strains, including the biosynthesis of some enzymes (cellulases, amylase), the motility and biosurfactants production.

Cellulase activity was determined as the ability of bacteria to by the breakdown of the substrate carboxyl-methyl-cellulose. Bacterial strains were inoculated on plates with LB medium supplemented with 1% carboxyl-methyl-cellulose (CMC). After growth for 5 days at 28°C the plates were stained for 30 min with 0.3% Congo Red, rinsed with excess tap water, and the dye was fixed by incubation with a 10% acetic acid solution for 15 minutes. The presence of a clear halo surrounding the colony indicates the presence of cellulase activity.

Amylase activity was eamined on nutrient agar (NA) media supplemented with 0.4% soluble starch. After the incubation at 28°C for 48-72 hours, the plates were treated with iodine solution, and the presence of a clear halo around the bacterial strains was examined.

Motility. Bacterial strains were tested for their swimming and swarming motility. All strains were refreshed on LB agar plates supplemented with 1.8% agar and grown ON at 28 °C. LB agar plates (25 ml) containing 0.3% (swimming) or 0.5% (swarming) bacto-agar were prepared fresh and were dried for 30 min in the laminar flow cabinet. Each plate was toothpick inoculated and scored for swimming and swarming motility after 18 h incubation at 28°C.

Antifungal activity

The antagonistic activity of the isolates was tested *"in vitro"* against several soil borne fungi: *Alternaria tenuis, A.mali, A.tenuissima, Botrytis cinerea, Fusarium coeruleum, F.graminearum, F.oxysporum* f. sp. *cepae, F.oxysporum* f. sp. *radicis lycopersici* ZUM 2407, *F.solani, Rhizoctonia solani* and *Sclerotium bataticola.* The fungi were maintained on potato-dextrose-agar (PDA). Antifungal activity was examined by dual culture technique, on PDA medium. Mycelia growth inhibition was evaluated after 5 days of incubation at 28°C. Test was repeated 3 times. Antagonistic efficiency was biometric evaluated using a modified version of Islam *et al.* (2009) calculation, of which they determined the persentage of inhibition activity:

$$E\% = \frac{\mathrm{RC - RI}}{\mathrm{RC}} \times 100$$

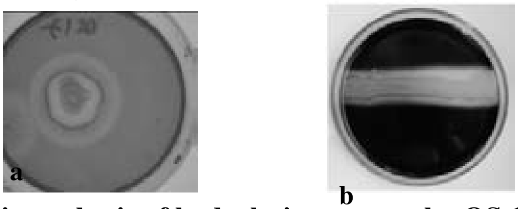
where: E (%) = antagonistic efficacy; RC = radius of the mycelia control colony (mm), RI = radius of the mycelia growth towards the interaction zone with the antagonism (mm).

Biosurfactant production was evaluated after bacterial cultivation in modified Mckeen medium [16], and the ability of bacteria to produce biosurfactants was determined by oil spread technique [13] and by examination the emulsifying activity, by measuring emulsion stability after 24 hour and calculation of emulsification index (E_{24}) [5,17].

RESULTS AND DISCUSSION

The screening experiments allowed the isolation of several bacterial strains. Among them, the strains designated as OS15 and OS17 isolated from onion rhizosphere, and the strains designated as Bw isolated from soil presented antifungal activities and were used in further tests. Biochemical tests and molecular technique (ITS-PCR-RFLP) performed identified the bacterial isolates as *Bacillus spp.*

In order to characterize the new isolates, several testes were performed: production of hydrolytic enzymes, motility, detection of antifungal action against different plant pathogenic fungi, and production of lipopeptides. Using starch and carboxymethylcellulose as substrates, it was shown that all tested strains produced amylase and cellulases (figure 1), the most efficient being the strain OS17.



a b

Fig. 1. Biosynthesis of hydrolytic enzymes by OS 17 strain: a) CMC-ase activity and b) amylolytic activity

The motility test showed that Bw, OS15 and OS17 have the ability to swim on soft media (figure 3). Bw and OS17 has also swarming mobility. These tests have a major impact in plant root colonization and are directly involved in the biological control mechanism by competing for space and nutrients with pathogens.

Antifungal activity of bacterial isolates

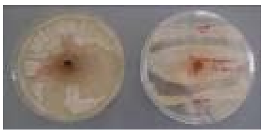
The dual culture technique revealed that the selected strains have antagonistic activity which inhibits the growth of several fungi (table 1). The microscopic examination of the interactive zone allowed the observation of mycelia modification (vacuolization and cell disintegration).

Biosurfactant production

It is well known that the antifungal action of several bacilli is due mainly to the production of different lipopeptide, like iturin, surfactin, lichenysins, mycosubtilin etc. For this reason, the ability of the new bacterial isolates to produce biosurfactants, class of compounds that includes bacterial lipopeptides was examined.

Table 1

Bacterial antagonistic activity against several fitopathogenic fungi after 5-7 days of incubation

Pathogen fungus	Bacterial isolate	Efficacy (%)	Clear inhibition space (mm)	Observations	Images
Alternaria sp.	OS15	72.4	7	The mycelia growth was inhibited	
	OS17	69	7		
Alternaria tenuissima	OS15	70.4	6	The mycelia growth was inhibited	
	OS17	63	9	The bacterial and mycelia growth inhibited each-other	
Botrytis cinerea	OS15	66.7	3.5	The mycelia growth was inhibited	
	OS17	74.1	-	The bacteria developed till the fungus growth area, colonizing more rapidly the surface media. At the meeting line the mycelia began to grow over the bacterial culture.	
	Bw	77.7	1	The mycelia growth was inhibited	
Fusarium graminearum	OS15	60	2	The mycelia growth was inhibited	
	OS17	66.7	4		
	Bw	64.2	3		
Fusarium oxysporum f. sp. *cepae*	OS15	60	4	The mycelia growth was inhibited.	
	OS17	60	6		
Fusarium oxysporum f. sp. *radicis lycopersici* ZUM 2407	OS15	55.2	-	The mycelia growth was inhibited.	
	OS17	65.5	4		
	Bw	63	2.5		
Fusarium solani	OS15	66.7	2	The mycelia growth was inhibited.	
	OS17	56.7	6		

Sclerotium bataticola	OS15	64.3	5	The mycelia growth was inhibited.	
	OS17	63.5	6		
	Bw	64	5		

Previous results with other bacilli [14] proved that the Mckeen medium stimulates biosurfactant production. The biosurfactant biosynthesis quantification, through oil spreading technique, detected significant differences, among the tested strains (table 2). The best results were obtained with OS17 strain for all oil types, with the maximum action on kerosene.

Table 2

Oil spreading technique for bacterial isolates tested

Bacterial isolates	Oil displacement area (cm^2)			
	Sunflower oil	Olive oil	Kerosene	Kerosene mixed with 20% diesel
ATCC 6633	0.28	**0.785**	5.3	4.52
BW	0.28	1.13	10.17	7.065
OS15	0.28	0.5	6.15	8.04
OS17	**0.785**	**2.54**	**50.24**	**28.26**

Similar results were communicated in literature for different strains of *B.subtilis* and *Pseudomonas aeruginosa* that were able to disperse vegetable oil, kerosene, petrol and diesel [17]. Emulsification activity of the biosurfactant from selected bacterial strains was measured with different oils and substrate and culture-free broth. The emulsification activity of OS17 was detected from the first day of incubation period on all oils, and showed the highest of emulsion formed at 60 hrs on kerosene. No changes of this activity were detected after 80hrs of incubation (Table 3). The results on the emulsification activity (EA) are comparable with those reported in literature, for the biosurfactant activity of reference *B.subtilis* strain, but EA of biosurfactants produced by OS17 was higher than the reported values [23].

In order to evaluate the involvement of biosurfactants in the antifungal activity of selected bacterial strains, crude biosurfactant extracts were obtained as indicated by Haddad et al. (2009). The lipopeptidic nature of the extracted biosurfactants was determined by TLC [15]. Similar results were observed by Priya et al. [17] and Fernandes et al. [6]. Moreover, specific primers for genes involved in iturin A production were used in a multiplex PCR reaction, and the results indicated that the expected amplicons (1203 bp for *ituD* fragment and 675 bp for *lpa* fragment) were detected in BW and OS17 (figure 2). No amplification products were obtained in OS15, suggesting that the iturin coding genes are not present or mutation in the region specific for the primers occurred. The absence of amplicons in OS15 points out that the antifungal activity of this strain could be related to the production of different lipopeptides, or to other antimicrobial compounds.

Table 3

Emulsification stability test for bacterial isolates tested

Bacterial isolates	Emulsification index (E_{24}) (%)			
	Sunflower oil	Olive oil	Kerosene	Kerosene mixed with 20% diesel
ATCC 6633	43.90%	40.24%	58.54%	51.22%
BW	47.56%	49.39%	64.03%	53.05%
OS15	43.90%	45.73%	51.22%	47.56%
OS17	54.88%	51.22%	**71.35%**	**60.37%**

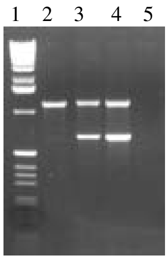


Fig. 2. Identification of *ituD* and *lpa*-14 genes by PCR. Lane1, molecular weight marker; lane 2, *B.subtilis ATCC 6633;* lane 3, BW; lane 4, OS17; lane 5, OS15

Similar results were communicated for some *B.amyloliquefaciens* and *B.circulans* strains [9] confirming that the ability to produce iturin is a common feature among bacili. Antagonistic activity of crude biosurfactant extracts was examined against three fungi: *A.tenuis, S.bataticola and F.oxysporum.* After three days of incubation at 28^0C, the compounds extracted from BW inhibited the growth of *A.tenuis* (fig.3) but not inhibition was detected against *S. bataticola*.

Moreover, no inhibition was detected with extracts from OS15 and OS17. These results suggested that, at least for the OS17 strain, the biosurfactants produced (including the lipopeptide iturin) had no inhibitory action against *F.oxysporum.* It is possible that the antifungal ability of this strain to be related to other compounds or the extraction method was not efficient for the lipopeptides concentration. However, the strain OS17 could be used for other applications (in bioremediation, for example), alone or in combination with other bacteria, including the bacilli tested in our experiments.

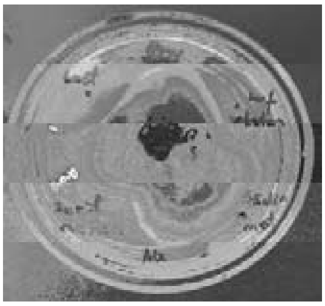


Fig. 3. Antifungal activity of biosurfactants produced by BW against *A.tenuis*

Similar results were reported in literature for lipopeptides isolated from *B.subtilis* 49 against the mycelial growth of *F.graminearum* and *Sclerotinia sclerotiorum* [19]. Cao et al. [3] had described the antibacterial and antifungal activities of a biosurfactant from *B.natto* TK-1. Moreover, the lipopeptide antibiotics producing by *B.subtilis* JA strongly inhibited phytopathogenic fungi, including *F.graminearum*, *R.solani*, *Pythium irregulare* and *Cladosporium fulvum* [4], and the surfactin produced by *B,mojavensis* RRC101, inhibited the mycelial growth of *F.verticillioides* [24].

CONCLUSIONS

1. Three new bacterial strains were isolated from natural sources and identified as *Bacillus subtilis* (according to microbiological and molecular techniques).
2. All the isolates presented antifungal activity against various fungal plant pathogens, the presence of iturin coding genes being identified in Bw and OS.17 bacterial strains. Due to these action, the producing strains could be used, separately or in combination, in the biocontrol of some fungal pathogens.
3. The strains OS17 and BW were able to produce biosurfactans (lipopeptides), as indicated the oil spreading technique and emulsification activity, with good results against kerosene and kerosen with 20% diesel.
4. The biosurfactants extracted proved antifungal action only in BW extracts, but no inhibitory action was detected in biosurfactants extracted from OS.15 and OS17. It is possible that the antifungal ability of this strain to be related to other compounds.

AKNOWLEDGEMENTS

The research was partially supported by PNCDI II Research Program, project no.204-2008 (acronym CEMAGRIM).

REFERENCES

1. Arguelles-Arias A., M. Ongena, B. Halimi, B. Joris, P. Fickers, 2009. *Bacillus amyloliquefacins GAI as a source of potent antibiotics and other secondary metabolites for biocontrol of plant pathogens.* Microbial Cell Fact., vol. 8 (pp. 1-12).
2. Cameotra S.S., R.S. Makkar, 2004. *Recent applications of biosurfactants as biological and immunological molecules.* Curr. Opin. Microbiol., nr. 7 (pp. 262-266).
3. Cao X.H., L. Zhen-Yu, W. Chun-Ling, Y. Wen-Yan, L. Mei-Fang, 2009. *Evaluation of a lipopeptide biosurfactant from Bacillus natto TK-1 as a potential source of anti-adhesive, antimicrobial and antitumor activities*. Brazilian J.Microbiol., nr. 40 (pp. 373-379).
4. Chen H., L. Wang, C.X. Su, G.H. Gong, P. Wang, Z.L. Yu, 2008. *Isolation and characterization of lipopeptide antibiotics produced by B.subtilis.* Letters Appl.Microbiol., nr. 47 (pp. 180-186).
5. Dehghan-Noudeh G., M. Housaindokht, B.S. Bazzaz, 2005. *Isolation, characterization, and hemolytic activities of a lipopeptide biosurfactant produced by Bacillus subtilis ATCC 6633.* J.Microbiol., vol.43, nr.3 (pp. 272-276).
6. Fernandes P.A.V., I.R. Arruda, A.F.A.B. Santos, A.A. Araujo, A.A.S. Maior, E.A. Ximenes, 2007. *Antimicrobial activity of surfactants produced by Bacillus subtilis R14 against multidrug-resistant bacteria*. Brazilian J.Microbiol., nr. 38, (pp. 704-709).
7. Haddad N.I.A., W. Ji, M. Bozhong, 2009. *Identification of a biosurfactant producing strain: Bacillus subtilis HOB2.* Protein & Peptide Letters, nr. 16 (pp. 7-13).
8. Haghighat S., A.A. Sepahy, M.M. Assadi, H. Pasdar, 2008. *Ability of indigenous Bacillus licheniformis and B.subtilis in microbial enhanced oil recovery.* Int.J.Environ.Sci.Technol. vol5, nr. 2 (pp. 385-390).
9. Hsieh F.C., L. Tsung-Chun, M. Menhsiao, K. Suey-Sheng, 2008. *Comparing methods for identifying Bacillus strains capable of producing the antifungal lipopeptide iturin A.* Curr. Microbiol., nr. 56 (pp. 1-5).
10. Islam R., Y.T. Jeong, Y.J. Ryu, C.H. Song, Y.S. Lee, 2009. *Isolation, Identification and Optimal Culture Conditions of Streptomyces albidoflavus C247 Producing Antifungal Agents against Rhizoctonia solani AG2-2.* Mycobiology, vol. 37, nr. 2, (pp. 114-120).
11. Kim P.I., R. Jaewon, H.K. Young, C. Youn-Tae, 2010. *Production of biosurfactant lipopeptides iturin A, fengycin, and surfactin A from Bacillus subtilis CMB32 for control of Colletotrichum gloeosporioides.* J.Microbiol.Biotechnol., vol.20, nr. 1 (pp. 138-145).
12. Lee S.C., Y. Ju-Soon, K. Sun-Hee, C. Soo-Yeol, H. Cher-Won, J. Woo-Hong, C. Yong-Lark, 2006. *Production and characterization of lipopeptide biosurfactant from Bacillus subtilis A8-8.* J. Microbiol. Biotechnol., vol.16, nr. 5 (pp. 716-723).
13. Nasr S., M.R. Soudi, M.R. Mehrnia, M.H. Sarrafzadeh, 2009. *Characterization of novel biosurfactant producing strains of Bacillus spp. isolated from petroleum contaminated soil.* Iranian J.Microbiol., vol.1, nr. 2 (pp. 54-61).

14. Olteanu V., O. Sicuia, M. Ciucă, D.M. Cârstea, C. Voaideş, G. Câmpeanu, C.P. Cornea, 2011. *Production of biosurfactants and antifungal compounds by new strains of Bacillus spp. isolated from different sources.* Romanian Biotechnol. Let., vol.16, nr.1 (pp. 84-91).

15. Patel R.M., A.J. Desai, *1997. Surface active properties of rhamnolipids from Pseudomonas aeruginosa GS3.* J. Basic Microbiol., vol.37, nr. 4 (pp. 281-286).

16. Phitnaree S., R. Vatcharin, K. Furusako, H.K. Aran, 2008. *Production and applications of biosurfactant from Bacillus subtilis MUV4.* Songklanakarin J. Sci. Technol., vol.30, nr. 1 (pp. 87-93).

17. Priya T., G. Usharani, 2009. *Comparative study for biosurfactant production by using Bacillus subtilis and Pseudomonas aeruginosa*. Botany Res.Internat., vol.2, nr. 4 (pp. 284-287).

18. Raaijmakers J.M., Irene De Bruijn, O. Nybroe, M. Ongena, 2010. *Natural functions of lipopeptides from Bacillus and Pseudomonas: more than surfactants and antibiotics. FEMS Microbiology Reviews*, vol.34, nr. 6 (pp. 1037-1062).

19. Ramarathnam R., S. Bo, Y. Chen, W.G.D. Fernando, G. Xuewen, T. Kievit, 2007. *Molecular and biochemical detection of fengcin-and bacillomycin D-producing Bacillus spp., antagonistic to fungal pathogens of canola and wheat.* Can. J. Microbiol., nr. 53 (pp. 901-9117).

20. Rodrigues L., I.M. Banat, I. Teixeira, R. Oliveira, 2006. *Biosurfactants: potential applications in medicine*. J.Antimicrob.Chemoth., vol.57, nr. 4 (pp. 609-618).

21. Satpute S.K., B.D. Bhawsar, P.K. Dhakephalkar, B.A Chopade, 2008. *Assessment of different screening methods for selecting biosurfactant producing marine bacteria*. Indian J.Marine Sci., vol.37, nr. 3 (pp. 243-250).

22. Siddiqui Z.A. (Ed.). *PGPR: Biocontrol and Biofertilization: Biosynthesis of antibiotics by PGPR and its relation in biocontrol of plant diseases, edited by* W.G. Dilantha Fernando, S. Nakkeeran, Y. Zhang, 2005. Springer (pp. 67-109).

23. Sifour M., H. Ouled-Haddar, G.M. Aziz, 2005. *Production of biosurfactants from two Bacillus species.* Egyptian J.Aquatic Res., nr. 31 (pp. 142-148).

24. Snook M.E., T. Mitchell, D.M. Hinton, C.W. Bacon, 2009. *Isolation and characterization of Leu-surfactin from the endophytic bacterium Bacillus mojavensis RRC101, a biocontrol agent for Fusarium verticillioides*. J.Agric.Food Chem., nr. 57 (pp. 4287-4292).

25. Youssef N., K. Duncan. *Comparison of methods to detect biosurfactant production by diverse microorganisms.* J. Microbiol. Method, nr. 56 (pp. 339-347).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

ANIMAL, VEGETAL AND MYTHOLOGICAL SYMBOLS IN THE COAT OF ARMS OF ROMANIAN ADMINISTRATIVE DIVISIONS - A BIOLOGICAL INVENTORY

MALA-MARIA STAVRESCU-BEDIVAN, EMILIA BRÎNDUŞA ŞCHIOPU

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *coat of arms, heraldry, administrative divisions, Romania*

Abstract

The paper presents a list of 120 symbols (animal, vegetal, mythological) drawn up in the coat of arms of some Romanian administrative divisions (36 counties, 83 municipalities, 90 cities and other towns and 351 communes). We also discuss which of those elements are more frequent related to a certain macroregion.

INTRODUCTION

According to the Constitution of Romania, Romanian territory is organized administratively into communes, towns and counties: at the county level – 41 counties (CO), and one city with special status (Bucharest, the national capital); at the town/commune level – 103 municipalities (M), 217 other towns (T) (for urban areas), and 2854 communes (C) (for rural areas) [1].

Elaboration of these administrative divisions coat of arms is made according to strict rules of science and heraldry art, taking into account the local traditions. These rules are stipulated in the methodology established by the National Committee of Heraldry, Genealogy and Sigillography subordinated to the Romanian Academy [2]. Heraldry purpose is to establish the theoretical principles, research, interpretation and development of the coat of arms of a state, city, family, corporation etc. [3].

The shield, as the main element of the coat of arms, represents the field that sits other heraldic elements, such as natural, artificial, chimerical figures. Natural figures can be taken from the stars, can be part of the human body, or may belong to the animal world, plants, etc. [3].

In the present study we intended: to outline a more complete list (for the vernacular names given in the Government Decisions we searched for a scientific correspondent) of animal, vegetables and chimerical/mythological items shown on Romanian coat of arms of the administrative divisions (counties, municipalities, towns, communes); setting the frequency with which these elements appear on the coat of arms (that reflect a certain symbolism or regional interests); distribution in a map of the most common of these symbols for each macroregion of Romania (Figure 1).

MATERIAL AND METHODS

On the web, galleries of flags and coat of arms are available for every administrative divisions of a county [4]. Besides these images, we consulted Government Decisions published in the Official Gazette of Romania, which gives descriptions and meanings for different component elements of a coat of arms [5, 6, 7]. The proposal for a coat of arms ensure the compliance of its specific elements with economic, social, cultural and historical tradition of the village, town or municipality concerned, respecting the heraldic tradition and the laws of heraldry science [5].

We actually counted how many administrative units (M, T and C) of each county (CO) shows plants, animals or mythological elements on the coat of arms, relating them to all existing coats of arms illustrated or described in the law, available on the Internet. The figures in the tables compiled on account of this coat of arms database, represents the number of citations of an element for each administrative division in part.

RESULTS AND DISCUSSION

Of the 41 counties (CO) of Romania, only 5 (12.19%) have no plants, animals and / or mythological symbols on their coat of arms. Of the total administrative divisions (AD) cited for our country [1], we identified 120 such symbols: 36 in CO, 83 in M, 90 in T and 351 in C (Table 1). The last row in the table 1 shows the fraction between the number of each administrative divisions counted in this study, and the total number of administrative divisions at the country level. The symbols were analyzed and discussed as the frequency which they appear in the AD coat of arms, both separately on three categories: animals (47), vegetal-floral (63) mythological (10) and overall (Table 2).

Among the *animals*, the most common symbols on the administrative divisions coat of arms are: fish (10.78%), lion (9.70%), sheep (8.62%), golden eagle (7.28%), horse (7.00%), bee (6,.4%), stag (6.74%), cattle (6.74%). Top five established for *plants*: wheat (23,35%), oak tree (12.84%), grape vine (11.28%), fir (8.17%), maize (6.22%). The most frecquent *mythological* elements in the coat of arms: caduceum (35%), cornucopia (15%), dacian flag (15%) and the Capitolin Wulf (7.5%).

The top 10 most popular from the total of 120 animal, vegetal and mythological elements in the Romanian coat of arms is: wheat (12.97%), oak tree (7.13%), grape vine (6.27%), fir (4.54%), fish (4,32%), lion (3.89%), corn (3.45%), sheep (3.45%), tree (3.24%), sunflower (3.13%), golden eagle (2.92%).

From the total number of fish drawn on the coat of arms, 20% seems to be the common carp (*Cyprinus carpio*), 5% trout (*Salmo trutta fario*), 2.5% European pike pearch (*Stizostedion lucioperca*) and 2.5% common eel (*Anguila anguila*).
From the total number of sheep (*Ovis aries*), 62.5% of figures showed ewes, 31.25% rams and a percent of 6.25 is represented by lambs.

Table 1

Administrative divisions of Romania related to the four macroregions (MR): counties (CO), municipalities (M), cities and other towns (T), communes (C). Each number represent the number of divisions presenting animal, vegetal and mythological symbols identified in the coat of arms

MR [1]		**CO** (abbreviation)	**M**	**T**	**C**
1	North-West	BH,BN,CJ,MM,SM,SJ	3,1,4,2,1,1	1,2,1,1,-,1	2,-,1,2,-,1
	Center	AB,BV,CV,HR,MS,SB	3,3,1,2,1,1	4,2,2,1,3,7	8,10,14,2,14,1
2	North-East	BC,BT,IS,NT,SV,VS	2,2,1,2,5,2	1,2,2,1,8,1	1,36,1,-,96,1
	South-East	BR,BZ,CT,GL,TL,VN	1,2,2,1,1,-	1,-,-,1,1,-	-,3,4,1,4,-
3	South	AG,CL,DB,GR,IL,PH,TR	3,2,1,1,3,1,4	1,-,2,1,2,9,9,-	10,4,-,-,4,40,-
	Bucharest-Ilfov	B,IF	1,1	-,3	-,8
4	South-West	DJ,GJ,MH,OT,VL	3,2,2,1,2	1,4,1,-,4	4,5,-,13,5
	West	AR,CS,HD,TM	-,2,6,2	5,3,6,4	-,47,4,5
Total		**36** / 41	**83** / 103	**90** / 217	**351** / 2854

The biological inventory drawn up for Romanian coat of arms, contains also some elements that are not appear in the table 2 or in figure 1: crawfish (*Astacus* sp.), frog (*Anura, Amphibia*), snake (*Serpents, Reptilia*), dinosaur, hen/cock (*Gallina* sp.), duck (*Anatidae, Aves*), pheasant (*Phasianus colchicus*), ostrich (*Struthio camelus*), peacock (*Pavo cristatus*), swan (*Cygnus olor*), Western capercaillie (*Tetrao urogallus*), Eurasian black grouse (*Lyrurus tetrix*), great bustard (*Otis tarda*) (extinct since 1981, but considered the Bărăgan Plane bird emblem), common crane (*Grus grus*), pelican (*Pelecanus onocrotalus*), white stork (*Ciconia ciconia*), grey heron (*Ardea cinerea*), sea eagle, falco (*Falco* sp.), Eurasian sparrow hawk (*Accipiter* sp.), craw (Corvidae, Aves), raven (*Corvus corax*), wisent (*Bison bonasus*), wild boar (*Sus scrofa*), wolf (*Canis lupus*), wildcat (*Felis sylvestris*), otter (*Lutra lutra*), European brown hare (*Lepus europaeus*), dolphin, squirrel (*Sciurus vulgaris*), griffin, dragon, manticore (legendary creature similar to the Egyptian sphinx, having the body of a red lion, a human head with three rows of sharp teeth; the tail is that of either a dragon or a scorpion [8]), unicorn, Phoenix bird, another mythological creature (with aurochs head and half-moon body), beech/beech nut (*Fagus sylvatica*), pine (*Pinus* sp.), yew (*Taxus baccata*), chestnut tree (*Aesculus hippocastanum*), poplar (*Populus* sp.), birch tree (*Betula* sp.), willow (*Salix* sp), linden (*Tilia* sp.), black locust (*Robinia pseudoacacia*), cypress (*Cupressus* sp.), olive tree (*Olea europaea*), laurel (*Laurus nobilis*), sycamore maple tree (*Acer pseudoplatanus*), elm (*Ulmus* sp.), durmast (*Quercus petraea*), hazel tree/hazelnuts (*Corylus avellana*), walnut (*Juglans regia*), European cornel/cornels (*Cornus mas*), blackthorn (*Prunus spinosa*), plum tree-plump (*Prunus domestica*), sour cherry (*Prunus cerasus*), strawberry (*Fragaria* sp.), rice (*Orzya sativa*), carrot (*Daucus carota*), pepper (*Capsicum anuum*), beet (*Beta vulgaris*), eggplant (*Solanum melongena*). tomato (*Solanum lycopersicum*), potato (*Solanum tuberossum*), cabbage (*Brassica oleracea*), garlic (*Alium sativum*), common mushrooms (*Agaricus* sp., Fungi Kingdom), poppy (*Papaver rhoeas*), flax (*Linum ussitatisimum*), tulip (*Tulip* sp.), Snake's head fritillary (*Fritillaria meleagris*), narcissus (*Narcissus* sp.), peony (*Paeonia* sp.).

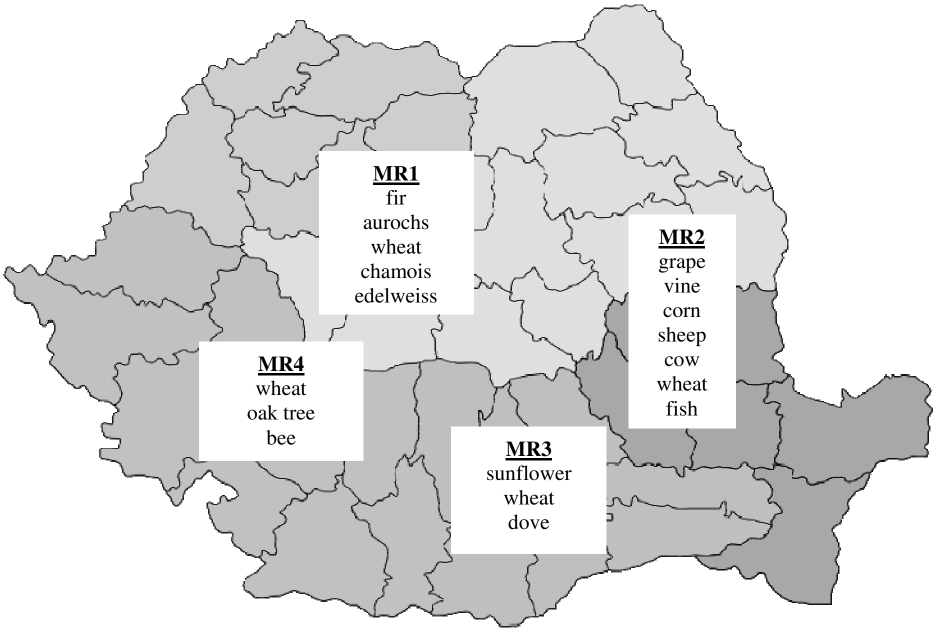


Fig. 1. The most representative vegetal and animal symbols drawn in the coat of arms of administrative divisions, related to the four macroregions of Romania (see the counties for each MR in Table 1) (map source: [9])

Table 2

List of the most frecquent animal and vegetal symbols identified on the coat of arms of the Romanian administrative divisions : counties (CO), municipalities (M), cities and other towns (T), communes (C)

Symbol	**CO**	**M**	**T**	**C**	**No. of citations (from a total of 925)**
honey bee *Apis melifera*	3	1	2	19	25
fish	3	5	3	29	40
white dove Columbiformes, Aves	-	-	1	12	13
golden eagle *Aquila* chrysaetos	3	5	4	15	27
black vulture	1	3	1	6	11
sheep *Ovis aries*	1	2	-	29	32
deer *Capreolus capreolus*	1	-	1	10	12
stag *Cervus elaphus*	1	1	7	16	25
cattle *Bos taurus*	-	-	1	24	25
aurochs *Bos taurus primigenius*	3	5	-	10	18
horse *Equus caballus*	3	10	4	9	26
brown bear *Ursus arctos*	-	2	1	7	10
lion *Panthera leo*	7	12	4	13	36
ermine (fur) *Mustela erminea*	-	3	1	6	10
tree	2	3	7	18	30
fir/Christmas tree *Abies* sp.	1	7	8	26	42
oak tree and /or acorns *Quercus* sp.	3	3	11	49	66
grape vine *Vitis vinifera*	6	3	11	39	59
apple tree and/or apples *Malus domestica*	1	-	-	19	20
maize *Zea mays*	-	-	3	29	32
wheat *Triticum* sp.	6	10	7	97	120
sunflower *Helianthus annuus*	-	2	1	26	39
edelweiss *Leontopodium alpinum*	-	2	3	8	13

Rhododendron (*Rhododendron kotschyi*), philodendron (although in the law [6] appears with this vernacular name, we consider, seeing the image of the coat of arms attached, that flowers belongs to *Rhododendron* species), rose, Piatra Craiului pink (*Dianthus callizonus*), common dogwood (*Cornus sanguinea*), bellflower (*Campanula* sp.), lily (stylized, fleur-de-lys; it was made popular by the kings of France, who used it as a royal emblem [10]), Siberian iris (*Iris sibirica*), oxeye daisy (*Leucanthemum* sp.), thistles (*Cirsium* sp./*Carduus* sp.), common reed (*Phragmites australis*), white water-lily (*Nymphaea alba*).

CONCLUSIONS

1. We identified so far in the coat of arms of some Romanian administrative divisions 120 symbols - reprezentations of animals, plants, or mythological creatures.
2. The most popular figures shown in the Romanian coat of arms (and representative for each macroregion) are: common wheat, oak tree and acorns, grape vine, fir, fish, lion, sheep, maize and sunflower.

REFERENCES

1. ***, http://en.wikipedia.org/wiki/Administrative_divisions_of_Romania.
2. ***, http://en.wikipedia.org/wiki/Romanian_heraldry.
3. ***, http://ebooks.unibuc.ro/istorie/arhivistica/13capVIII.htm.
4. ***, http://ro.wikipedia.org/wiki/Jude%C8%9Bele_Rom%C3%A2niei.
5. ***, http://www.legestart.ro/Hotararea.
6. ***, http://freelex.wolterskluwer.ro.
7. ***, http://www.dsclex.ro/legislatie/.
8. ***, http://en.wikipedia.org/wiki/Manticore.
9. ***, http://en.wikipedia.org/wiki/File:Regiuni_de_dezvoltare.svg.
10. ***, Heraldry in Canada. An educational package and activities for teacher and students, 2004. Available online: http://www.gg.ca/pdf/Heraldry-Kit-EN.pdf.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

FARM TYPOLOGY IN COPSA MICA REGION

H.V. HĂLMĂJAN, GINA VASILE

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *crop production, heavy metal pollution, Copsa Mica region*

Abstract

In Copsa Mica it was found, unfortunately, very well expressed some of the main weak points of the Romanian agriculture: the excessive fragmentation of property and land abandonment. Even if the pollution in recent years affected agricultural area, the farmers work the land properly, even if small areas. This is due to the specialists from villages, well trained and interested (some of them developed activities such as mechanical works, input distribution). A large surface of the agricultural land is uncultivated. This situation is because of losses caused by wild boars and some social issues.

INTRODUCTION

According to Luca [1], Romania has a population employed in agriculture twice in comparison with Poland, ten times higher than the share of agricultural population of Germany, Belgium etc. The average area per farm is a little higher than in Malta, but lowers than in Cyprus. For those that are agree with large and very large farms, the study reminds them that in Europe, farms have on average: 7 ha in Italy, 24 ha in Netherlands, 49 ha in Germany and France.

Heavy metal accumulation in soils and vegetal products is of concern in agricultural production due to the adverse effects on food quality (safety and marketability), crop growth (due to phytotoxicity) [2]. The uptake of metals from soil depends on different factors such as their soluble content in it, soil pH, plant species, fertilizers and soil type [3]. Phosphate fertilizer application is a significant contributor of trace element, especially for Cd accumulation in cropland soils [4]. Generally plants are characterized by translocation of larger quantities of metals to their leaves than to their fruits or seeds [5].

Cadmium is one of the most well-known environmental intoxicants to humans and is characterized by high mobility in biological systems. Its presence in nature and entrance to human's food chain, causes serious damage in kidneys, lungs, bones and also anaemia and sometime hypertension [6].

Lead as a well-known toxic heavy metal that accumulates in the human body through food chain and endangers human health. Foods such as fruit, vegetables, meats, grains, seafood, soft drinks and wine may contain significant amounts of lead. As far as it known till today, lead has no essential function for plants, animals and microorganisms. It inhibits the thiolic groups of some enzymatic systems, especially those that potentate haemoglobin synthesis [7].

During our survey, it was found that the contents of heavy metals in some places in the studied area are above the permissible limits. For example, in a farm from Axente Sever village, it was found lead levels of 1.5 ppm lead and 0.72 ppm cadmium in maize [8]. According to Commission Regulation (EC) No 1881/2006, the permissible limits for grains are 0.2 ppm for lead and 0.1 ppm for cadmium

Similar studies regarding cadmium and lead concentrations found in agricultural products were developed worldwide [9-12].

MATERIAL AND METHODS

For this study, we chose five localities in the Copa Mica region: Copa Mica city, Tarnava, Valea Viilor, Axente Sever, Micasasa and Seica Mica. In this area we unfortunately found very well expressed some of the main weak points of Romanian agriculture: the excessive fragmentation of property and land abandonment.

We have analyzed 835 farms in the five mentioned localities, using data from APIA, Departments of Agriculture and Rural Development Office and also from agricultural agents that work at corresponding city halls.

RESULTS AND DISCUSSION

In Copsa Mica there are 62 farmers. Of these, only 10 (16%) have farms larger than of 4.5 ha. Arable land in Copsa Mica is 140.42 ha.

From 10 farms considered, eight of them have the whole area as arable, the other two with 81% and 95% area in arable. It is noted that the total area of farms varies between 4.51 ha and 15.07 ha and the average area of the parcels is very small (between 0.55 and 2.04 hectares). This is due to the large number of parcels (between 3 and 16)/exploitation.

In Copsa Mica it was found the smallest surface planted with winter wheat in the region, of only 3 ha, although this year the yield was 26.7 q/ha, greater even than the natural potential of the area, which is only 21 q/ha. The explanation is a technical one: there is no harvesting combines. Therefore maize it is planted frequently (379 ha), because the yield is harvested manually. Average yield of maize was 30 q/ha. There were 70 ha of alfalfa, with a yield of 34 t/ha. Potato yield on the 20 ha was quite low (12 t/ha), potato being a crop which did not encounter good growing conditions this year (excess rains).

In Axente Sever village there are 217 farmers. Only 9 of them (4%) have surfaces in arable area of more than 8 hectares. Total arable area is 554.46 ha. From the total surface of such exploitations, arable area represents from 19% up to 100%.

It is noted that in this locality there is an excessive fragmentation of the arable area. Although the size of farms is considerably higher (between 70.91 and 10.12 ha), the number of parcels/farm (between 2 and 17), makes the average area of a field in rotation to range from 1.13 ha up to 7.07 ha.

Regarding the field crops, in Axente Sever the widest range of species are grown, though, except maize, which is cultivated on 300 ha, the areas are relatively small: 25 ha for wheat, 10 ha for barley, 5 ha for spring barley, 40 ha for potato and between 30 and 50 ha for fodder plant (annual, perennial and alfalfa).

The cereal crops have achieved the biggest yields for the localities that were studied: 50 q/ha for maize, 32 q/ha for wheat, 30 q/ha for barley. For spring barley the yield was lower, only 13 q/ha. Also a relatively low yield was obtained for potato (12 t/ha). Regarding the fodder plants, the best results were obtained in alfalfa (20 t/ha). Meadows yield were lower, between 8-12 t/ha.

It is important to mention as an example, the case of a veterinarian from this village. He has 7.5 ha and would like to expand the property. This is quite difficult because there is more land and is not worked around. Under these conditions the damages caused by the wild boars and thefts are high. For the four cows that he has, he has cultivated in 2010, 2 ha with maize (37 q/ha), 1 ha with wheat (32 q/ha), 1 ha with oats (15 q/ha), 0.5 ha with potato (20 t/ha).

He uses herbicides to control weeds in maize plots that are furthest from the village and for the remaining surfaces he uses manual hoeing. He uses hybrid seed and fertilizes with manure from the four cows. He uses plant protection products for the potato crop. Potato harvesting is made manually, but there were years when it was used harvesting machines.

In the village Micasasa there are 286 farmers. The vast majority of them (97%) have arable areas smaller than 11 hectares. In this locality it was detected the smallest area of arable land (78.76 ha).

If we analyze the 10 largest exploitation in Micasasa, it is noted that:

- arable area occupies a variable percentage between 0% and 100%;
- in most cases, the land that is not arable is abandoned; in the larger farms, non arable land is used as pasture;
- the largest areas are properties of livestock farmers (shepherds);
- in the 10 largest farms in Micasasa, the area surface varies between 11.74 and 103.86 ha;
- although there are small farms, the number of plots is high, between 1 and 28; it is important to be mentioned the case of a farmer that has merged 40 hectares in a single plot;
- in Micasasa, the average area per plot varies from 0.66 ha (18.66 ha on a farm) up to 40 ha (a “happy situation”, one plot).

Although in Micasasa it is cultivated the smallest arable surface (78.76 ha), yields were quite good this year. In winter cereals (wheat and barley), the yields were 32.5 and 30 q/ha. The spring varieties of the same species, the yields were half (15.1 q/ha for wheat and 3 q/ha for barley). The yields were 30 q/ha in maize and 30 t/ha (green weight) in alfalfa. However, potato production has been compromised on the 100 hectares, due to excess of rains. Many farmers have not recovered even the quantity that was planted. Potato yield this year was 1.5 t/ha.

An agronomist, employee of the city hall, gave a 5 ha farm: 500-1000 square meters cultivated with potato, barley on 0.5 ha, wheat on 1 ha, maize on 1 ha. He obtained pretty good yields: 65 q/ha for barley, 40 q/ha for maize, 15 t/ha for potato. Almost 90% of total number of farmers use certified seed. Maize is fertilized with 60-70 kg nitrogen/ha.

In the potato crop, plant protection products are used and in maize, herbicides are applied usually.

In Tarnava village, from 136 farmers just 10 of them (7%) have exploitations with areas larger than 5 ha.

The surface of the 10 largest farm in Tarnava varies from 5.7 ha up to 100.1 ha, while the average size of one plot varies from 1 to 4.5 ha. Number of parcels ranges from 5 to 25 (the case of exploitation of 100.1 ha).

60% of the area is desolated, being under weed growing process, a forestation and erosion. Grown on small areas (15 ha), the highest yield was obtained in winter wheat (3.5 t/ha). High yield were obtained also for spring barley (2.5 t/ha). However, green weight production of alfalfa was quite small (15 t/ha). For potato the yield was 16 t/ha.

Most farmers do not have their own equipment. For that reason, mechanical operation are hired. Maize cobs are harvested largely by a two rows harvester. For wheat and maize are used crop plant protection products.

In the Valea Viilor village, from the 177 farmers, only 10 (6%) have farms larger than 7 ha. Farm area varies from 8.1 up to 49.17 ha and the plot surface, from 0.62 ha up to 4.91 ha. Number of plots/exploitation is between 4 and 16.

Although lower than other localities, the most important surface is used to grow maize (180 ha). The yield was 30 q/ha. In the Valea Viilor, the smallest area is cultivated with winter wheat (8 ha). The yield in spring wheat is somewhat lower than for winter wheat, only of 15.1 q/ha. The same is the case of the spring barley. The potato yield was quite good (20 t/ha), because the crop is fertilized with manure and complex fertilizers. Also, the plant protection products are used.

In general the seed for sowing it is purchased, but is not always certified. In wheat and maize are used herbicides, but for the control of weeds in maize crops, also horse-drill hoe is used. The maize is harvested using combines.

In the Seica Mica village, there are 130 farmers. Among them, the largest 10 (8%), have over 15 ha each.

The 10 largest exploitations from the village are between 15.43 and 78.11 ha. The average area of a plot varies between 0.81 ha and 22.5 ha, because the number of plots/exploitation varies from two to 21 plots.

Also, in Seica Mica the largest area is planted with maize (350 ha) and production is quite good (35 q/ha) in comparison with the potential of the area. Maize it is cultivated especially for use in households to grow 1-2 pigs. Maize is a crop that is strongly affected by wild boars, situation that was met in all localities in the area. For some of the plots cultivated with maize are used herbicides, and other are manual weeding.

On the 45 ha cultivated with winter wheat the yield was 21 q/ha. In alfalfa the yield was higher than in other localities (35 t/ha), but in the case of natural grassland the yields were, as expected, smaller (12 t/ha). Potato production has been affected by rain, being only of 14 t/ha. For potato crop are used plant protection products.

In Seica Mica part of agricultural operations are carried out mechanically, and some of them with the help of animals (working with horse hoes) and also, manually. Wheat is fertilized with ammonium nitrate and manure. In this area the farmers use quality seeds that are provided by authorized distributors.

CONCLUSIONS

1. Maize is the most cultivated crop and will be probably the culture that will be the subject of an expert system for crop plants grown on contaminated land. This is because hybrid seeds are used, different methods of weed control, organic and mineral fertilizers.
2. Even if the pollution in recent years affected agricultural area, the farmers work the land properly, even if small areas. This is due to the agronomists from villages, well trained and interested (some of them developed activities such as mechanical works and input distribution of seeds for sowing and pesticides).
3. A large part of the land is uncultivated. The main obstacles for expansion of cultivated land are losses caused by wild boars and social issues.
4. The most important farm in the region has 250 ha (in Copsa Mica and Tarnava region). In 2010, the yield was 6 t/ha in maize, 3.5 t/ha for cereals, 20 t/ha for sugar beet (affected by excessive rain). There are applied 1-2 treatments with pesticides and the fertilization is performed with manure, and chemical fertilizers (about 80 kg N/ha). The farmer conducted experimental plots. Almost 60 maize hybrids were tested.

ACKNOWLEDGEMENTS

Partnerships in priority areas Grant no. 52-175/2008, METAGRO financially supported this study.

REFERENCES

1. Luca L., 2009. *O ţară şi două agriculturi. România şi reforma Politicii Agricole Comune a UE*. http://www.crpe.ro/library/files/CRPE_Policy_Memo_no.4_RO.pdf.
2. Calvert Y.R., J.J. Msak, 1990. *Adsorption behaviour of copper and zinc in soils: influence of pH on adsorption characteristics*. Soil Sci., 150(2) (pp. 513-522).
3. Aksoy A., D. Demirezen, 2006. *Heavy Metal Levels In Vegetables In Turkey Are Within Safe Limits For Cu, Zn, Ni And Exceeded For Cd And Pb*. Journal of Food Quality 29 (pp. 252-265).
4. McLaughlin M.J., R. Naidu, D.P. Stevens, K.G. Tiller, 1996. *Review: the behaviour and environmental impact of contaminants in fertilizers.* Aust. J. Soil Res. 34 (pp. 1-54).
5. Kaskova A., K. Lakticova, O. Ondrasovicova, S. Smirjakova, 2005. *The effect of cadmium and lead pollution on human and animal health*. Folia Veterinaria, 49(3) (pp. 31-32).
6. Afshar M., S. Ghazei, E. Saad, 2000. *Determination of cadmium in Amol and Thailand rice*. 4th International Iranian Congress on Poisoning, Theran, Iran, http://www.irandoc.ac.ir.
7. Grecu I., M. Neamtu, L. Enescu, 1982. *Implicatii biologice si medicale ale chimiei anorganice*. Ed. Junimea, Iasi.
8. *Evaluarea bilanţului de metale în agrosistemele din România*. http://www.metagro.cesec.ro/.
9. Ahmed M., M.A. Bhutto, G.M. Kaloi, Z. Parveen, 2006. *Determination of heavy and essential metals in different wheat varieties grown in three districts of Sindh (Pakistan).* International Journal of Agriculture and Biology, 8(4) (pp. 448-449).
10. Ahmed M.J., M.G. Kibria, K.T. Osman, 2006. *Cadmium and lead uptake by rice (Oryza sativa L.) grown in three different textured soils*. Soil&Environ. 25(2) (pp. 70-77).
11. Hejtmankova A., M. Kroutil, J. Lachman, 2010. *Effect of spring wheat (Triticum aestivum L.) treatment with brassinosteroids on the content of cadmium and lead in plant aerial biomass and grain.* Plant Soil Environ., 56(1) (pp. 43-50).
12. Bahmanyar M.A., S.M. Mousavi, H. Pirdashti, 2010. *Lead and cadmium availability and uptake by rice plant in response to different biosolids and inorganic fertilizers.* American Journal of Agricultural and Biological Sciences 5(1) (pp. 25-31).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

IALOMITA COUNTY GRAIN SECTOR DEVELOPMENT

ELENA SOARE, ELENA COFAS

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *grain sector, area, culture, production*

Abstract

The main economic activity in Ialomita County is the argriculture, because there is a number of factors that support this sector. On some significant parts from the agriculture surface is grown: wheat, rye, barley, two-row barley, oats and corn. In the analyzed period, the areas planted, yields and total yields per hectare have suffered modifications and not always in the desired direction. The development of this sector is linked with the subventions given by state.

INTRODUCTION

Production of cereals in Ialomita County agriculture is a tradition for this county. In time, the culture surfaces have increased, but grain production was an uneven trend over the period, due mainly to climatic conditions, germinating quality of the material, non-compliance culture, etc., technologies. Although there are many problems in the grain sector, the county level there is a tradition in the cultivation of cereals, just as there is demand for cereal consumption.

MATERIAL AND METHODS

Demand and consumption of cereal food consumption is based on tradition in Romania. In this study the Ialomita have used statistical data provided by National Statistical Institute for years 2005-2009. We studied the dynamics of the following indicators: land cultivated with cereals, total production, yields per hectare and inputs for cereal production.

RESULTS AND DISCUSSION

The agricultural surface of Ialomita county is 373,690 ha (83.92%) of which 348,767 hectares of arable land (93.33% from the total agricultural area) and 2.5% of the total country surface. A significant portion of the land area is cultivated with cereal grains. Evolution of grain surface is presented in Table 1.

Table 1

Area planted with major crops Ialomita county level*

No.	Main cultures	2005 (ha)	2006 (ha)	2007 (ha)	2008 (ha)	2009 (ha)	2009/2005 (%)
1	Total	344059	317213	358935	342854	347439	100.98
2	Cereal grains	202229	168789	197033	209963	215923	106.77
3	Rye	-	-	-	-	-	-
4	Wheat	104667	83454	92409	106286	109082	104.22
5	Barley and two-row barley	20766	9003	15611	22255	32714	157.54
6	Oat	761	959	658	514	550	72.27
7	Corn	74474	72941	86317	77867	68881	92.49

**Not covered area of familial gardens, greenhouses and tanning beds, intercropping and succession crops*

The area planted with cereal grains in the county increased by 6.7% in 2009 compared to 2005. Ialomita County recorded an increase of areas on the main cereal crops, as follows: for wheat by 4.2% in 2009 compared to 2005, two-row barley and barley with 57.5% in 2009 compared to 2005. For oats and maize crops, cultivated areas have dropped compared to 2005, with 27.7% to 7.6% in oats and maize.

In 2005-2009, total grain production was a decreasing trend for wheat, oats, corn and recorded a positive train for two-row barley and barley. Cereal grain production in Ialomita county decreased by 18.1% in 2009 compared to 2005. Dynamics of grain production is presented in Table 2.

Table 2

Total cereal production in Ialomita county

No.	Main cultures	2005 (t)	2006 (t)	2007 (t)	2008 (t)	2009 (t)	2009/2005 (%)
1	Cereal grains	660096	506680	171977	729384	540738	81.92
2	Rye	-	-	-	-	-	-
3	Wheat	302625	206785	111323	395985	229969	75.99
4	Barley and two-row barley	31176	23694	15341	86779	71462	229.22
5	Oat	1285	1240	75	1270	921	71.67
6	Corn	319376	265128	36826	232917	217170	68.00

Source: Statistics Ialomita County in 2010, National Statistical Institute, Bucharest

Total production decreased even that the area planted with cereal grains has increased during the period under review. This can be explained due to lower yields on the one hand, and on the other hand, adverse climatic conditions. This negative trend is maintained for the cultivation of wheat (-24.1%), oats (-28.4%), maize (-32%). Production of barley and two-row barley has increased by 129.2% during 2005-2009, the increase being due to the growing attraction of a large area and increase yield per hectare. Yields per hectare in Ialomita county experienced significant declines in the 2005-2009 for crops of wheat, oats, maize. Cultures that have made an exception is barley and two-row barley, this have recorded a cumulative grow of 45.5% (Table 3).

Table 3

Average yields per hectare, the main crops, Ialomita County

No.	Main crops	2005 (kg/ha)	2006 (kg/ha)	2007 (kg/ha)	2008 (kg/ha)	2009 (kg/ha)	2009/2005 (%)
1	Cereals grains	3264	3002	873	3474	2504	76.72
2	Rye	-	-	-	-	-	-
3	Wheat	2891	2478	1205	3726	2108	72.92
4	Barley and two-row barley	1501	2632	983	3899	2184	145.50
5	Oat	1689	1293	114	2471	1675	99.17
6	Corn	4288	3635	427	2991	3153	73.52

Source: Statistics Ialomita county in 2010, National Statistical Institute, Bucharest

An important aspect which must take into account agricultural producers - in order to increase productivity - regards directly the quantity of natural and chemical fertilizers allocated to cereals. This should not be overlooked, because studies have shown that the efficiency of manure is significant if taken together with mineral fertilizers, especially those with phosphate.

Thus, the chemical fertilizers used, it occupies the largest percentage of areas that have been applied fertilizer nitrogen (79.53% of total land with chemical fertilizer applications in 2005, 71.26% in 2006, 67, 18% in 2007, 63.05% in 2008 and 70.75% in 2009), followed by areas that have been applied phosphatic fertilizer (24.95% of the area in 2005, 26.45% In 2006, 30.27% in 2007, 34.23% in 2008 and 27.41% in 2009) and areas that have been applied potassic fertilizers (3.60% of the area in 2005 2.24% in 2006, 2.53% in 2007, 2.70% in 2008 and 3.89% in 2009) (Table 4).

In Ialomita county, the total surface with chemical and naturally fertilizers applied has declined at a rate of 16% in 2006 compared to 2005 to record a significant increase of 80% in 2007 compared to 2006, and increase of 31% in 2008 compared to 2007 to record a decrease of 16% in 2009 compared to 2008.
In the period 2005-2009, cereal production has been supported by state subsidies especially on land area. This support was not uniform over the reporting period, ascertained the differences from one year to another.

Table 4

The area on which chemical and natural fertilizers applied in Ialomita county

Type of fertilizer used	**2005**	**2006**	**2007**	**2008**	**2009**
Chemistry, of which:	123569	104852	190021	249865	209785
Nitrogenous	88737	68219	116506	141699	130976
Phosphate	26286	30371	60105	90775	68876
Potassium	8546	6262	13410	17391	9933
Phosphate	878	834	400	360	823
Total area	124446	105686	190421	250225	210608

In 2005, the total production supported for wheat and rye crops was 725,000 tonnes. Direct support of the MAFRD budget was 400 billion. In 2006, the support for farmers in the vegetable sector has been directed towards supporting and achieving competitive agricultural products traded with EU quotas. It was also intended to adapt the forms of support to the European system of payments. For cereal crops, farmers have sought loans for production and have received support from public funds between 5 and 15%. Grant for two-row barleyde worth 200 lei granted in a single step, by awarding coupons. The values were used to purchase seeds, seedlings, fertilizers, pesticides, diesel, polyethylene film, water for irrigation etc.

In 2007 the plant farmers have benefited from grants ranging between 400 and 500 lei (eg for a hectare of wheat has been awarded a grant of 500 million) for the purchase of diesel fuel, seed and fertilizer required for the creation wheat, rapeseed and other produced in autumn this year. The total amount allocated to subsidize oil and/or biodiesel, certified seeds, fertilizers and pesticides needed autumn crops amounted to 1.32 billion. Financial support was granted until September 30, 2007, by awarding nominal free coupons, and aimed to reduce the effects of excessive and prolonged drought that affected large areas of crop established in autumn 2006 and spring 2007. Grants were awarded only for insured crops and worked with modern technology. Another requirement was that the farmer put seeds in the ground to be certified by a quality paper. About 2.8 million hectares of wheat, rye, triticale, barley, two-row barley (winter and spring) and rapeseed, about 1.7 million hectares were affected by natural disasters, affected by drought, according to data centralized on 20 June 2007. Drought effects were visible in the harvest of wheat. The crop was around 2.6 million tonnes, twice less than in 2006. In 2008, for wheat, barley, oats, maize (conventional cultivation), other cereal grains, other arable crops, have been applied to single area payment scheme and schedule of additional payments decoupled from production of 47 euro/ha (according to GD 1574/2007). For crops of maize at the single area payment scheme for 50 euro/ha has added complementary national payments scheme for 47 euro/ha for crops payment scheme 45 euro/ha (according HG 1574/2007).

Activities for which the farmers was financial supported in 2008 were: subsidizing diesel and/or biodiesel, for work in agriculture and other resource materials (seeds and/or pesticides and/or fertilizer) needed for crops; grant of a leu/liter for mechanical work to establish crops in 2008, ie 39 liters per hectare for all crops in the spring and 39 liters per hectare for winter crops (according to the Order 174/2008).

In 2009 were granted 1389 lei/ha from EU of funds: the single payment area - 227.28 euro/ha; from the state budget: complementary national direct payment of 174.76 euro/ha; diesel reduced rate - 31.4 lei ha; minimis aid scheme - 200 lei/ha; agricultural credit for production - 717 lei/ha (30%). For crops of maize were awarded - 1328 lei per hectare (ha) - community Funds: single payment area - 227.28 Euro/ha; crops payment - 168.30 euro/ha and from state budget: 174.76 lei complementary national direct payments per hectare, subsidized diesel 39 lei/ha, agricultural credit for production - 718 lei/ha (30%).

Table 5

Evolution of subsidies on products Ialomita county level (U.S. $ million)

Specify	Year 2005	Year 2006	Year 2007	Year 2008
Cereals (including seeds)	86.88	10.74	-	211.8
Wheat	86.22	-	-	181.76
Barley and two-row barley	-	-	-	18.32

Source: MARD, 2009

At the county level total cereal subsidy was 211.8 million RON in 2008 (an increase of 143% compared with year 2005).

CONCLUSIONS

1. Agricultural activity in Ialomita County is a priority area in the county's economy, due to location in a area with high agricultural potential, high soil and favorable climate, high skilled human resources, available and affordable labor and the existing tradition in the area for this type of activity.
2. At county level, the grain sector is presented, on the one hand, as a sector representative, helping to meet the consumption needs of the population, and on the other hand it creates favorable conditions for livestock sector development.
3. Grain acreage has increased in 2005-2009. This increase in area planted was not reflected in direct and significant impact on production results obtained.

For wheat crops (-24.1%), oats (-28.4%) and maize (-32%) has recorded a negative trend. Barley crop has seen a significant increase of 129.2% in analyzed time period.

4. Negative trend for some cereal crops was mainly due to declining yields per hectare, although they have been applied to natural and chemical fertilizers. In the period studied cereal production has been supported by state subsidies especially on land area. This support was not uniform over the reporting period, which was directly reflected in the outcomes production. After implementing the analysis of grain production in the Ialomita county found that output is below the productive potential of the area, which contributes to the achievement of low income farmers.

REFERENCES

1. Anuarul Statistic al României, 2009. Institutul Național de Statistică, Bucureşti.
2. Statistica teritorială Județul Ialomitam, 2010. Institutul Național de Statistică, Bucureşti.
3. www.ialomita.insse.ro.
4. http://edd-krafteducom.ise.ro/ialomita.html.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

RESEARCH ON CORELATION OF OCHRATOXIN A WITH STARCH AND PROTEIN LEVELS IN MAIZE

A.S. MUHAMMAD*, CRISTINA ANGELESCU**

*Bahauddin Zakariya University, Pakistan
**University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *maize, ochratoxin A, starch, protein, corelation*

Abstract

This study comprises the incidence of Ochratoxin A in Maize grains from the 2010 harvest. The samples were gathered before storage of harvest and the co-relation between mycotoxin contamination and the relative quantity of various important bio chemicals present in the maize composition was identified. Among 30 samples of early and semi-early hybrids, 24 were positive, while two were found containing OTA quantity above approved levels of 5 ng/g (19.92 and 11.72 ng/g). A decrease in the quantity of the starch is directly related with the presence of OTA in samples. The presence of OTA in the tested samples showed no effect on the quantity of proteins.

INTRODUCTION

Mycotoxins are secondary metabolites, important for the survival of producing fungus and may appear at different stages of food chain starting from the field harvest till their storage whenever optimum conditions are available for their growth. Humans are exposed to the effects of mycotoxins in various ways: through the ingestion of contaminated food products (predominant way), contact and inhalation. Mycotoxicosis has two forms: acute and chronic; usually with symptoms being relatively serious. Mycotoxicosis may interfere with immune system such as to increase the susceptibly to infectious diseases. Ochratoxin A is well known for its effects/nephrotoxicity.

A variety of foods are susceptible to mycotoxin contamination. However, cereals and millets which form the staple food for many population groups are most prominent. Mycotoxins that have been investigated so far include aflatoxins, ochratoxins, various fusarium toxins and ergot alkaloids. Considerably high levels of these mycotoxins have been detected in cereals that have been harvested and left in the field during heavy rains or floods or improperly stored without adequate drying. The levels encountered under normal circumstances are otherwise relatively low. Among the mycotoxins, much attention has been focused on aflatoxins produced by *Aspergillus flavus* and *A. parasitic* in stored grains. Aflatoxin B 1, the most toxic and abundantly found among the series of aflatoxins, continues to be a major problem in risk commodities like groundnut, maize and chillies.

Ochratoxins are a group of mycotoxins produced as secondary metabolites by several fungi of the *Aspergillus* or *Penicillium* families and are weak organic acids consisting of a derivative of an isocoumarin [2]. The family of ochratoxins consists of three members, A, B, and C which differ slightly. Crops are infected in the field during growth, at harvest, in storage and in shipment under favourable environmental conditions especially when they are not properly dried. Ochratoxin A may be present in a foodstuff even when the visible mould is not seen.

Ochratoxin A (OTA) is found mainly in cereal and cereal products. This group of commodities has been reported to be the main contributors of ochratoxin A exposure in assessments carried out by the European Commission (5,10) accounting for 50% of total dietary exposure of ochratoxin A in European countries [3].

MATERIAL AND METHODS

In this investigation, 30 early and semi-early and 13 late hybrids of maize were analyzed. All samples were collected from the harvest of 2010 in October. Early and semi-early hybrids were collected from the county Braila, whereas late hybrids were collected from the county of Alba. It must be mentioned that in Braila conditions of cultivation were not identical. The year 2010 was extraordinarily hot and dry. Samples were later submitted in the stores of the firm KWS Seeds SA. The determinations and scientific calculations were carried out at the laboratories of Biochemistry, Faculty of Biotechnology, University of Agronomic Sciences and Veterinary Medicine, Bucharest, Romania.

For the washing of samples, columns of immunoaffinity Ochraprep (RBiopharm) were used which gave good separation of the material to be analysed. After grinding the maize samples, 25 grams of each sample were weighed, extracting solvent (acetonenitril+distilled water 60:40) was added and was homogenized at a rapid speed in a blender for two minutes and later filtered though filter paper Whatman 4.For Ochratoxin A analysis, 4 ml of the filtrate was taken. Samples were diluted with 44 ml tampon phosphate 20mM pH 7.0 and were put in Ochraprep columns. After the attachment of analyte, segregation of the balast substances was carried out using 20 ml tampon phosphate 20mM, pH 7.0. The elute of Ochratoxin A was obtained with 1,5 ml solution of methanol + acetic acid (98:2) at one drop per second followed by dilution with 1.5 ml ultra pure water. 3 ml of the resulting elute was injected in 100 µl chromatograph. Quantification was carried out through liquid chromatography with fluorescence detection. For separation, columns of chromatography composed of octadecilsilani, C_{18} – Symmetry 4.6 x 250 mm, with particle 5 µm, were used. Analyte separation took place at 40°C and elution took place with a ternary mixture of acetonitril + water

+acetic acid in the ratio of 51:47:2 v/v/v, at the rate of 1 ml/minute. Detection of Ochratoxin A took place with excitation at 333 nm and emission at 43 nm. The data was obtained and worked upon using the soft ware EMPOWERS. Wave standardization used for the processing of results was set by using ochratoxin A (RBiopharm) with the concentration of 1000 ng/ml. After dilution of the standard at 16.67 ng/ml, 5 values of concentrates were obtained by injecting another volume different than the standard. Practicing two injections for each of five levels of concentrates, a standard curve was obtained with linear co-efficient (r^2) 0.999983 and co-efficient of co-relation(r) 0.999992. Using the standard curve the results for the determined were calculated.

Determination of starch quantity by polarimetric method comprised of two stages namely: extraction of starch from plant leaves and polarimetric determination of starch concentration Solubility and extraction of the starch was done in acidic medium (HCL) at the boiling point in the presence of a substance to defecate. Defecating substances have a role for separation by precipitation from the extract for dosing substances which may influence negative dosing. Amino acids and proteins (which are optically active) were precipitated by using phospho-wolframate of sodium. Dosing was done through measuring the angle α, which is the angle of deviation from the plane of polarized light while passing through the solution containing starch with the help of Lippich polarimetre. Results were calculated using the following expression:

Starch %=$\alpha \cdot Vt \cdot 100/[\alpha]^{20}Dxlxp$ where α =measured angle, Vt=sample volume, [α] = standard angle (183.7 for maize),L = tube length (20 cm),P = sample mass (g)

Protein quantity was determined by calculating the transformed amount of plant nitrogen (Nt) into the structure of proteins (Kjeldahl method).

RESULTS AND DISCUSSION

All the 43 samples were tested for the quantity of Ochratoxin A present by methods described earlier. The values obtained for early and semi-early hybrids are given in table 1.

From the data obtained, it is observed that the samples were positive in a significantly big proportion i.e. 24 from 30 of samples (around 80%). It must also be mentioned that only two of the positive samples had the values for Ochratoxin A higher than the admissible value of law EC 1881/2006 of 5 ng/g, levels determined at 19.92 and 11.72 ng/g. Rest of the positive samples were below than 2 ng/g, maximum being under 0.5 ng/g. Negative samples were considered either as zero or the lower limit of quantity (LOQ) of 0.01 ng/g. Determination of the Ochratoxin A for late hybrids gave the results presented in table 2.

The present values indicate a very low incidence of Ochratoxin A in case of late hybrids. Out of 13 only 3 showed positive values and even these were extremely small quantities approaching almost the standard limit. Co-relation of registered values for the amount of Ochratoxin A and starch for late and semi-late hybrids is shown in figure 1.

Table 1

Analysis for Ochratoxin A Quantity in early and semi-early hybrids

No.	Hybrid name	OTA (ng/g)	No.	Hybrid name	OTA (ng/g)	No.	Hybrid name	OTA (ng/g)
1	Sutesti HIB EXP 2	19.92	11	SUTESTI KWS 3381	0	21	SUTESTI KIXA 4388 STANZA	0.24
2	Sutesti HIB EXP 3	1.75	12	SUTESTI KWS 6474	0.008	22	SUTESTI KORAL 4375	0.0165
3	Sutesti HIB EXP 4	0.46	13	SUTESTI KWS 5383	0.56	23	SUTESTI KABOS	0.052
4	Sutesti HIB EXP 5	0.25	14	SUTESTI KXA 6485	0.016	24	SUTESTI AMANDA	0
5	Sutesti HIB EXP 6	0.082	15	SUTESTI KXA 5392	11.72	25	SUTESTI KITTY	0
6	Sutesti HIB EXP 7	0.028	16	SUTESTI KXA 5387	0.235	26	SUTESTI CUPIDON	0.011
7	Sutesti HIB EXP 8	0.11	17	SUTESTI KXA 6493	0.023	27	SUTESTI MIKADO	0
8	Sutesti HIB EXP 13	0.02	18	SUTESTI KXA 6542	0.021	28	SUTESTI GARBURE	1.28
9	SUTESTI KWS 1393	0.26	19	SUTESTI KXA 3376(sinatra)	1.89	29	SUTESTI LAUREAT	0.155
10	SUTESTI KWS 1394	0.005	20	SUTESTI Kalifo 3545	0.095	30	SUTESTI KAPSUS	0

Table 2

Analysis for Ochratoxin A Quantity in late hybrids

No.	Hybrid name	OTA (ng/g)	No.	Hybrid name	OTA (ng/g)
1	FRATIA 92 EXP 1	0	8	AMADEO	0
2	FRATIA 92 EXP 2	0	9	FRATIA RONALDINHO	0
3	FRATIA LOSC	0	10	FRATIA LAUREAT	0
4	FRATIA 92 EXP 9	0	11	FRATIA GAVOTT	0.025
5	FRATIA 92 EXP 11	0	12	FRATIA SEVERO	0
6	FRATIA 92 KXA 5373	0.015	13	FRATIA CARERRA	0.034
7	FRATIA KXA 5375	0			

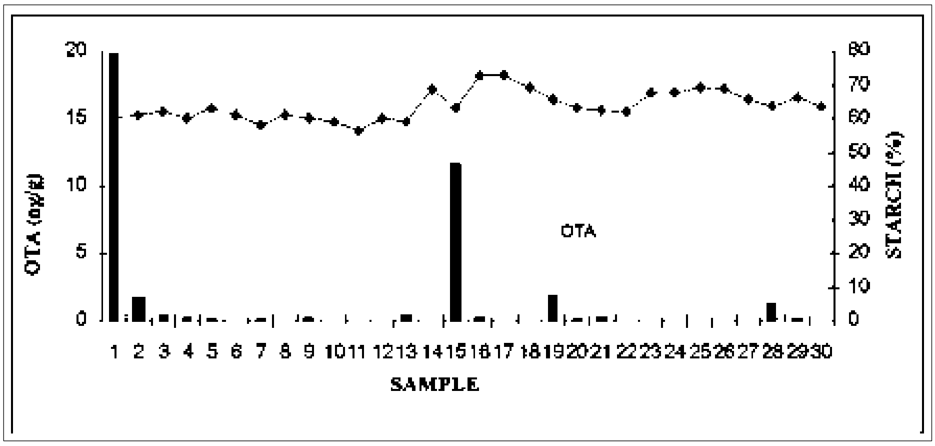


Fig. 1. Influence of contamination with Ochratoxin A upon Starch Quantity in early and semi early hybrids

The above graph presents a corelation between the quantities of Ochratoxin A and starch. It is observed that the samples contaminated with high quantities of Ochratoxin A contain reduced amounts of starch. This thing can be explained by the fact that the fungi need the resources of carbon, for their growth, glucose being the easiest source to be used. In case of studies on late hybrids, the co relation between two parameters observed is presented in figure 2.

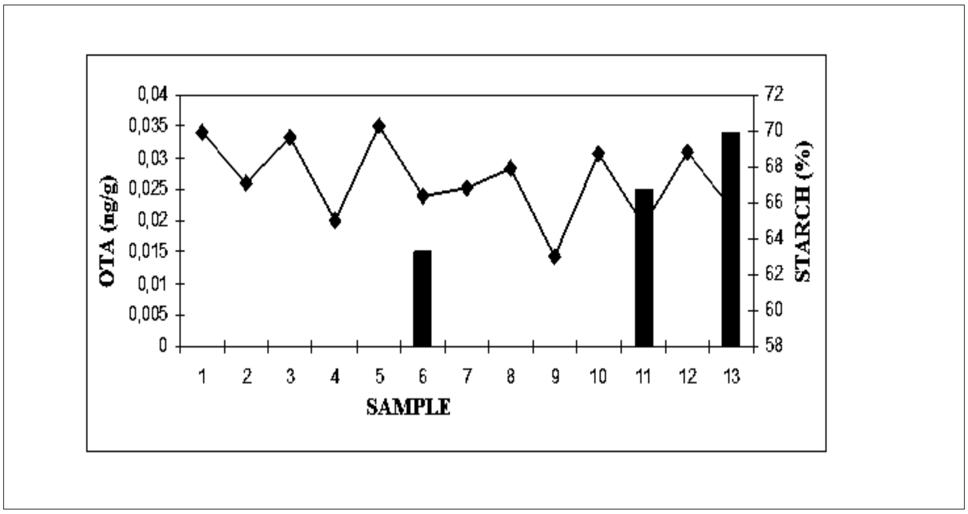


Fig. 2. Influence of contamination with Ochratoxin A upon Starch Quantity late hybrids

The corelation between the quantities of Ochratoxin A and starch for the samples of late and semi late hybrids is given in figure 3.

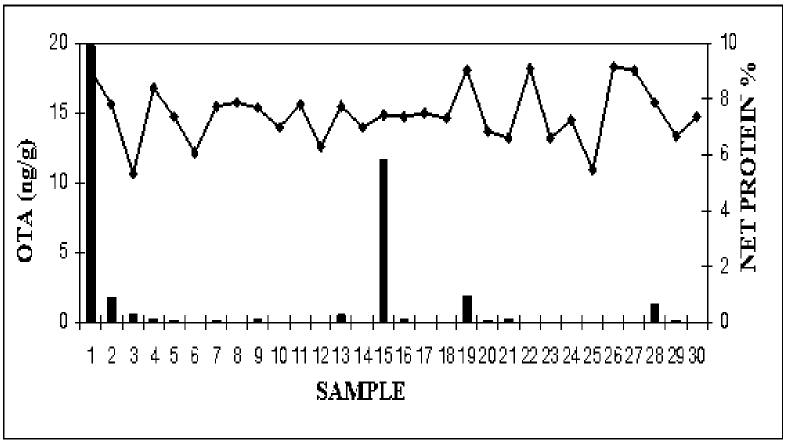


Fig. 3. Influence of contamination with ochratoxin A upon Net Protein quantity in early and semi early hybrids

Neither in late hybrids a co relation among the samples contaminated with ochratoxin was A and the quantity of gross protein was observed (Figure 4).

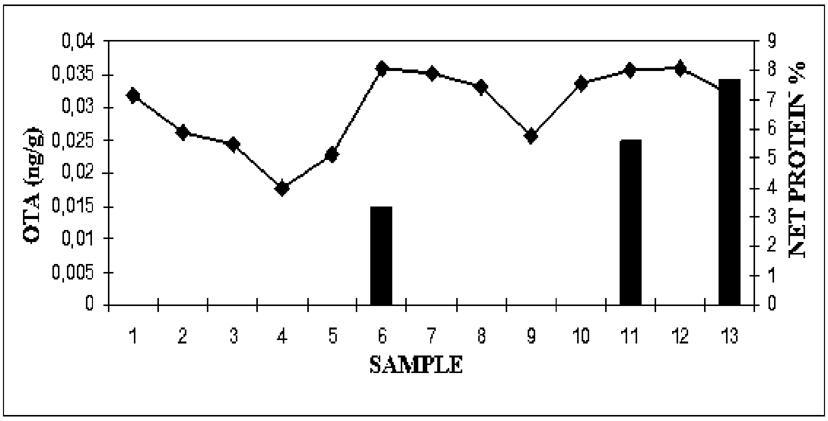


Fig. 4. Influence of contamination with ochratoxin A upon Gross Protein quantity in late hybrids

CONCLUSIONS

1. The presence of OTA has a direct effect on the quantity of starch in cells. A higher amount of OTA corresponds to decreased starch quantity. Similarly from the data, it is confirmed that amount of Ochratoxin A does not have any effect on quantity of net proteins.

REFERENCES

1. European Commission. Commission Regulation (EC) No 1881/2006. Official Journal of the European Communities No. L75 (pp. 22-28).
2. Israel-Roming Florentina, Daniela Balan, T. Radu, Evelina Gherghina, Gabriela Luta (2008). *Incidence of ochratoxin A in corn cultivated in six Romanian regions.* in Book of Abstracts– International Symposium "Trends in cereal science and technology industrial applications", Thessaloniki, Greece.
3. SCOOP - Task 3.2.7 Assessment of dietary intake of Ochratoxin A by the population of EU Member States, 2002.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

PROSPECTS OF AGRICULTURAL BIOTECHNOLOGY IN PAKISTAN

CRISTINA ANGELESCU, A.S. MUHAMMAD**

*University of Agronomic Sciences and Veterinary Medicine of Bucharest
**Bahauddin Zakariya University, Pakistan

Keywords: *GM crops, regulations, infrastructure, extension*

Abstract

Agriculture is the livelihood of rural areas and plays a vital role for the economy of Pakistan. This paper reviews the mechanism governing the research and release of transgenic crops through various research institutions and regulatory authorities. There exists a large scope for genetic manipulations of crops and an effective extension of developed GM varieties from laboratory to farm is needed. The wide spread cultivation of Bt cotton since 2002 requires implementation of biosafety regulations and capacity building in management of GM crops.

INTRODUCTION

The economy of Pakistan is dependent upon agriculture. About 67% of the population is linked with agriculture and provides 24% of GDP as well as 48.5% of national exports [3]. Due to various factors, agricultural progress is not sufficient to account for national food security. During 2004-2010, average growth rate remained 3.75% per annum (Figure 1). The depletion of national resources necessitates a 5-6% increase in agricultural output to meet national food needs substantially.

The principle aim of this paper is to provide an overview of GM crops research in the country and various related policy and legislative issues which are essential to realize for agricultural sector of Pakistan. The direct effects of new agricultural technology on poverty reduction are the productivity benefits enjoyed by the farmers who actually adopt the technology. These benefits usually manifest themselves in the form of higher farm incomes.

MATERIAL AND METHODS

The current situation of development and adoption of transgenic crops is assessed by reviewing the already work done in Pakistan. A comprehensive literature on research infrastructure, regulations and approval mechanisms was analysed and discussed.

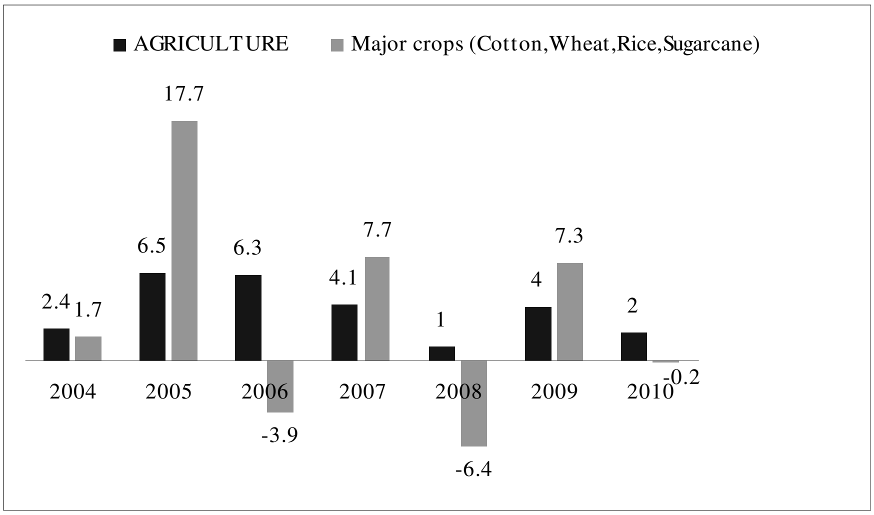


Fig. 1. Growth rates of agriculture and major crops

NEED OF AGRICULTURAL BIOTECHNOLOGY

Wheat, rice, cotton, sugarcane and maize are the major crops and they account for more than three-quarters of total crop output. Despite recent increase in agricultural output, the crop productivity is still very low as compared with the potential yield output (Figure 2). It is mainly due to biotic and abiotic stresses e.g. high price of agriculture inputs like seeds, fertilisers, pesticides, higher intensity of insects and pests attack, shortage of good quality and varieties of seeds, insufficient availability of water for irrigation.

Biotechnology can help revolutionize farm efficiency through genetic modifications of local cultivars for various characteristics such as insect resistance, herbicide, salinity and drought tolerance and development of varieties capable of growing in waterlogged soils. Similarly soil desertification must be minimised by adoption of transgenic crops with low tillage characteristics to promote soil structure.

An adoption of GM crops increased crop yields significantly in other South Asian countries. Biotechnology has played an important role in the social welfare and uplift of economies there. GM cotton was introduced in India in 2002 and today the cotton yield has increased more than double i.e. 17 millions in 2001 to about 38 million bales in 2009[2].

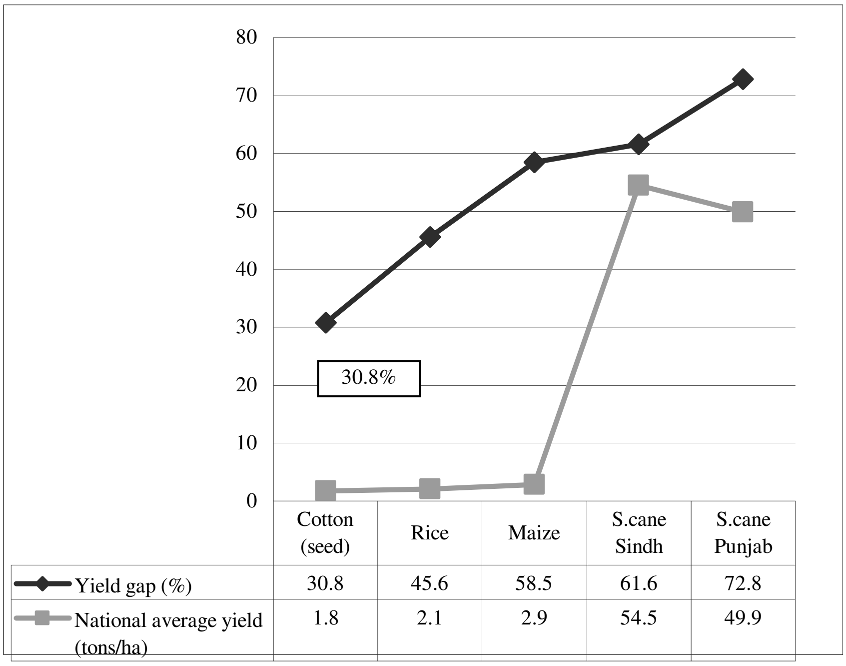


Fig. 2. Yield gap of major crops

In Pakistan, due to a lack of effective collaboration among institutes and government departments, the adoption of technologies has been very slow. Identification of priority areas of research, facilitations to plant breeders and field extension services need management.

RESEARCH INFRASTRUCTURE

Pakistan has a pro-biotech govt. and public where research and introduction of transgenic crops are emphasized. Biotechnology is recognized as priority area of research. In total there are 29 centres conducting biotech research at various levels. There are a number of new transgenic technologies being worked on relevant to major crops, in addition to insect and herbicide tolerant technologies. Most are output traits but there are also some new input traits for disease control and RNA mutations.

Several ministries and departments are responsible for biotechnology research, policy and regulation. These include the Ministry of Food, Agriculture & Livestock, the Ministry of Science & Technology Research, Higher Education Commission, and National Commission on Biotechnology, Pakistan Council of Science and Technology, and the Pakistan Atomic Energy. Biosafety aspects are the responsibility of the Ministry of Environment, Local Bodies and Rural Affairs.

Although the infrastructure is not well organized a general layout can be drawn as follows:

The Pakistan Council for science and technology (PCST) is the country's central body responsible for formulating policies and projects in support of national development. It works in close consultation with the federal ministries and provincial departments, major R&D organizations, universities and private sector. Its plans are reviewed by the Executive Committee of the National Commission on Science and Technology (ECNCST) before approval from National Commission on Science and Technology (NCST).

Pakistan Agricultural Research Council (PARC), part of the ministry of food and agriculture was established in 1981 to conduct, support, and coordinate and promote agricultural research. Under its management, a number of Biotech Institutions conduct agricultural research in various agro-ecological zones. The largest of these is National Agricultural Research Centre (NARC). NARC tests and disseminates germplasm for various food grains, vegetables and fruit crops. The research activities are organized into 11 institutes which conduct research on more than130 crops with a focus on national problems.

The Ministry of Food and Agriculture (MINFA) deals with the production and release of GM crops. It has developed several Standard Operating Procedures (SOPs) for handling of cases of improvement, approval and release of GM products. The secretary of the Ministry of Environment heads the NBC (National Biosafety Committee) and is responsible for oversight of all laboratory work and field trials as well as authorizing the commercial release of GM products. National Biosafety Committee (NBC), Technical Advisory Committee (TAC) and Institutional Biosafety Committee (IBC) administer the enforcement of National Biosafety Guidelines, awarding exemptions for laboratory and field work related with bioengineered products.

National Commission on Biotechnology composed of renowned scientists in the field of biotechnology was set up in 2001. This commission advises Govt. on specific measures for the development of biotechnology and it works for collaboration between the Govt. and the private sector in the development of high yielding disease resistant varieties.

The Pakistan Biotechnology Information Centre has been established at Latif Ebrahim Jamal National Science Information Centre, University of Karachi under the patronage of International Service for Acquisition of Agri-Biotech Applications (ISAAA) and National Commission on Biotechnology which serves as a hub to disseminate information, to support the collaborative efforts and to develop a network of institutions and individuals working in this field.

REGULATION AND RELEASE OF TRANSGENIC VARIETIES

Pakistan is very vigilant about introduction of transgenic varieties into the environment and risk assessment needs extensive information on a wide range of potential adverse effects. All GM crops are considered to be new organisms and risks of releasing GMOs into the environment are assessed during the same criteria as the risks of releasing any new species of plant, animal or microbe. The release cannot be granted if new variety might displace native species or damage natural habitats.

At present various ministries are handling issues of WTO (ministry of commerce), geographical indications (ministry of commerce), TRIPS (Pakistan Patent Office), copyrights (Ministry of Education), Biosafety guidelines, Cartagena Protocols (Ministry of Environment) and Plant Breeding Rights (Ministry of Food, Agriculture and Livestock). Many NGOs (Action Aid, Oxfam STIP, SUNGI etc.) are also actively involved inraising several issues related to biotechnology,GM crops and globalization. Safety protocols are required during development of GM crops and all such protocols are regulated under Standard Operating Procedures (SOPs). The Ministry Of Food and Agriculture (MINFA) deals with issues of development and approval of transgenic products. All field work with GM plants must proceed according to basic standards appropriate to the particular plant. Effects on the ecology in the open environment are studied for potential of cross hybridization and gene flow. But all conventionally-bred varieties are considered harmless and approved as such without further environmental assessment studies [1].

Pakistan has ratified the Cartagena Protocol on Biosafety (CPB) and WTO. Plant variety protection is regulated by the Plant Breeders Rights Ordinance (2000) which still needs enactment. Amendments to the Patent and Designs Act (1911) and Patent Ordinance (2000) to cover biotechnological innovations are also pending enactment. The Intellectual Property (IPR) Law does not cover live material and the Environment Protection Act does not cover GMOs.

Although Bt cotton has been in cultivation since 2002 in Sindh and Punjab, formal approval was granted in 2010 when 8 Bt cotton varieties, produced by Nuclear Institute of Biotechnology and Genetic Engineering (NIBGE) were released for general cultivation. In January 2011, 3 more Bt cotton varieties, developed by Centre of Excellence in Molecular Biology (CEMB) were approved for next growing season. Research work on other crops is mainly in experimental and field evaluation stages (Table 1).

Biofertilizers have been developed by NIBGE for almost all major crops and are being marketed under the commercial name "BioPower". Research work is being conducted to further improve the product and develop specific biofertilizer for each crop variety. Biofertilizers are based on living microbes (plant growth promoting rhizobacteria) with beneficial traits like nitrogen-fixation, phosphate solubilization, phytohormone production and bio-control activity.

Table 1

Development of GM Crops in Pakistan

GM Crop	Genetically Engineered Traits	Stage
Cotton	Diamond back moth resistance with Bt genes, virus (ClCuV) resistance with Tr AC gene, virus (ClCuV) resistance with RNA interference RNAi, salinity tolerance, fibre modification, drought, herbicide tolerance	8 varieties approved for commercial release in 2010 and 3 varieties in 2011, Field Trials
Rice	Bacterial blight resistance with Xa21 gene, salt tolerance with yeast and Arabidopsis Na+/H+ antiporter genes, Insect resistance with Cry1Ac & Cry2A genes	Field trials, ready for release
Maize	Drought, herbicide and insect resistance	Experimental
Potato	Virus and insect resistance, salt tolerance	Experimental
Sugarcane	Insect resistance with Cry gene	Experimental
Chickpea	Insect (Bt gene) and virus resistance, Drought and salt tolerance with yeast, Arabidopsis Na+/H+ antiporter genes	Experimental
Sunflower	Drought and herbicide resistance	Experimental
Chillies	Virus resistance	Experimental
Tomato	Virus (TLCV) resistance through RNAi, Male sterility through RNAi male sterility, salinity tolerance	Experimental
Cucurbits	Virus resistance	Experimental
Tobacco	Insect (Helicoverpa armigera and Heliothis vericens) resistance with a novel synthetic spider venom gene, Salt tolerance with Yeast and Arabidopsis Na+/H+ antiporter genes, Salt tolerance with ArDH, chloroplast transformation	Experimental
Groundnut	Fungal resistance, herbicide tolerance	Experimental
Brassica	Male sterility through RNAi	Experimental

Reasons for delay in adopting transgenic crops include a long delay to develop and approve Biosafety Rules and Guidelines by the Ministry of Environment.Plant Variety Protection Act has still not been enacted and amendment Seed Act 1976 is still pending for approval.The delay in seed and plant breeder legislation, and poor implementation of Intellectual Property Laws are perceived as a major impediment to investment in Pakistan by multinational seed companies. Reluctance in finalizing this legislation is due, in part; to the desire of Pakistan's research communities to remain autonomous.

CONCLUSION

1. Biological innovations, or bio-innovations can only be realized when policy and governance mechanisms are in place so that the benefits of the new technologies outweigh the risks. Illegal import and multiplication of Bt cotton seed in Sindh and Punjab created havoc at farmers' field. Absence of biosafety guidelines and awareness at the farm level complicated the issue. To mitigate the issue in future, following recommendations may be considered.
2. Identification of sources for import of elite germplasm.
3. Reliable information must be extended to regulators, farmers and producers to help them make decisions based on up-to-date information and knowledge.
4. Proper legislation on variety patenting is needed. Overall, Pakistan needs to strengthen its legal, institutional, scientific and technical capacity. These can be achieved through training, study or exchange visits, workshops, public awareness and education and public-private partnerships.

REFERENCES

1. ***Government of Pakistan, National Medium-Term Priority Framework (NMTPF) 2007-2010, 2006.
2. ***International Food Policy Research Institute And Pakistan Agricultural Research Council, Agricultural Research and Development in Pakistan: Policy, Investments, and Institutional Profile, 2007.
3. ***MINFA, Agriculture Statistics of Pakistan, 2009-10.

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

MATHEMATICAL MODELS, TABLES AND NOMOGRAMS TO SETTLE THE TECHNICALLY OPTIMAL RATES (TOR) OF N, P_2O_5 AND K_2O IN CORN

GH. C. BUDOI

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *nutrient rates, maximum expected yield, sustainable agriculture*

Abstract

This is the second paper from the series concerning the field crops. The presented mathematical models and agrochemical tables and nomograms serve to settle the Technically Optimal Rates (TOR) of N, P_2O_5 and K_2O in corn as function of maximum expected yield, Y_m, and the specific soil agrochemical indexes (nitrogen index: IN; mobile phosphorous: P_{ALc}; mobile potassium: K_{AL}). The TOR of a nutrient is independent of the unitary price of the fertilizer (UPF) and unitary price of the yield (UPY), while the Economically Optimal Rates (EOR) is strongly dependent of UPF and UPY, EOR decreasing with the decrease of UPY/UPF ratio. The advantage of TOR versus EOR is that TOR always allows to obtain the maximum yield in a given condition of soil nutrient supply, while EOR allows this only in the particular rare case when UPY/UPF = 1. TOR system uses the same equations for nutrients action coefficients and soil nutrient supply as the EOR system. The Fertexpert software has been used for TOR calculations. The agrochemical tables and nomograms in corn will be accessible online on a specific website.

INTRODUCTION

To establish the TOR, which allow obtain the maximum yield in given soil nutrient supply conditions, is essential for crop technologies.

TOR can be assured form manure, chemical fertilizers and other sources, excepting the soil.

Unfortunately, many authors [6, 7, 8, 9, 10] published erroneous mathematical models which give absurd results, for example more than 25000 kg P_2O_5/ha in winter wheat, which means 29 trucks of 5 t with simple superphosphate/ha, some models give negative nutrient rates, for example around – 21000 kg P_2O_5/ha, as demonstrated in another paper [5] published in this Proceedings.

Other erroneous model [9] give nutrient rates one hundred times smaller than normal, that means 1 kg instead of 100 kg.

This paper brings, for the first time, reasonable solutions in settling TOR of N, P_2O_5 and K_2O in corn depending on the yield level and relevant soil agrochemical indexes.

MATERIAL AND METHODS

The TOR system for N, P_2O_5 and K_2O [3] is partially based on the EOR system [1]: the equations for nutrient action coefficients, c_a, and soil nutrient supply, S_n, have the same coefficients; the TOR mathematical model [3] is different from the EOR model [1]. A new version, number 3, of FERTEXPERT software [2] have been developed by author in order to incorporate the TOR model and to use the specific coefficients of the c_a and S_n equations for corn. FERTEXPERT has then been used for TOR calculations.

Based on calculated TOR, specific useful agrochemical tables and nomograms have been built.

RESULTS AND DISCUSSION

1. Specific results and discussion concerning the TOR in corn. The TOR mathematical model is [3, 5]:

$$\mathbf{TOR,\ kg\ N,\ P_2O_5,\ K_2O/ha = [\log(2.3 \cdot c_a \cdot Y_m)]/c_a - S_n}$$

(condition: if $[\log(2.3 \cdot c_a \cdot Y_m)]/c_a - S_n < 0$, then TOR = 0)

where:

Y_m = maximum expected yield, kg/ha, established on the basis of the site evaluation studies; the level of Y_m depend on the variety and on the levels of all vegetation factors;

c_a = action coefficient of N, P, K, unique for the considered nutrient from fertilizer and soil (potentially available form);

S_n = soil nutrient supply, potentially available form, kg N, P_2O_5 or K_2O/ha, calculated based on the specific agrochemical analyses (IN, P_{ALc}, K_{AL}) and Y_m.

The TOR system use the same computing equations for c_a and S_n as the EOR system [1]:

For nitrogen: $c_a = 0.003 + 25.2/Y_m$; $S_n = 115(1\text{-}10^{-0.13IN}) + 0.003Y_m$

For phosphorous: $c_a = 0.005 + 15/Y_m$; $S_n = 28 + 105(1\text{-}10^{-0.0136P_{ALc}}) + 0.004Y_m$

For potassium: $c_a = 0.0035 + 20/Y_m$; $S_n = 1.02K_{AL} - 0.000957(K_{AL})^2 + 0.004Y_m$

In these equations: IN = soil nitrogen index; P_{ALc} = soil mobile P content, ppm P, corrected with a reaction factor, FR [1]; K_{AL} = soil mobile K content, ppm K.

The results concerning the variation of TOR values depending on the soil agrochemical indexes (IN, P_{ALc}, K_{AL}) and maximum expected yield, Y_m, are presented in two-sided tables (tables 1, 2, 3) and in 3 nomograms (figure 1).

These practical agrochemical tables and the nomograms allow the farmers to operative estimate the TOR. The TOR mathematical model has to be used when the exact values of TOR are desired and and Y_m, IN, P_{ALc} and K_{AL} are not exactly those from the tables or nomograms.

Table 1

Technically optimal rates (TOR) of N (kg/ha) in corn as function of the maximum expected yield (Y_m) and soil nitrogen index (IN)

Y_m (kg/ha)	IN								
	0.5	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**
2000	97	83	71	61	52	44	38	32	27
3000	141	127	115	105	96	89	82	77	72
4000	179	166	154	144	135	127	121	115	110
5000	213	199	187	177	169	161	154	149	144
6000	243	229	217	207	198	191	184	179	174
7000	270	256	244	234	225	217	211	205	201
8000	294	280	268	258	249	241	235	229	224

Table 2

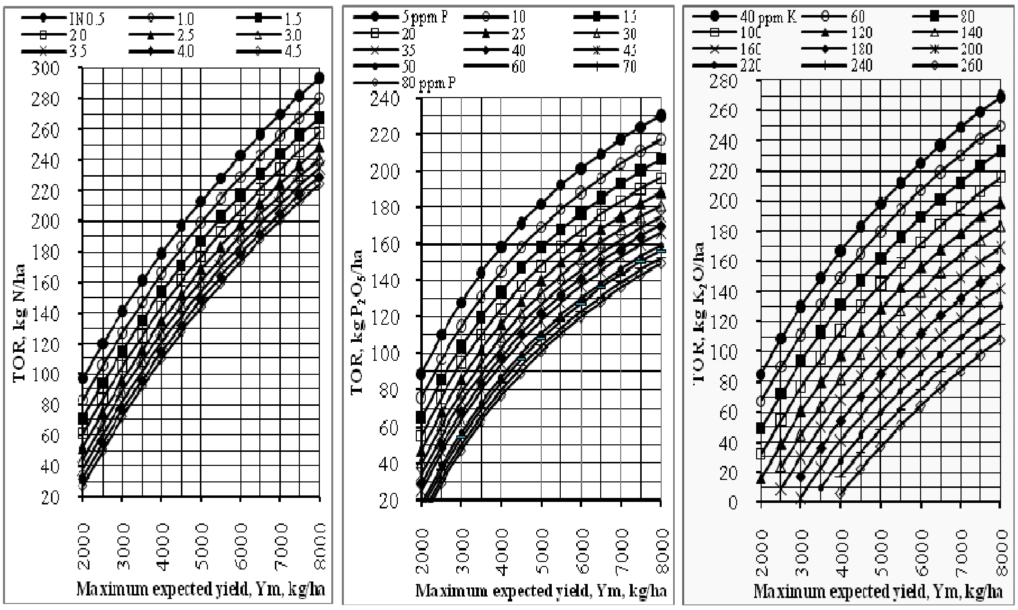
Technically optimal rates of P_2O_5 (kg/ha) in corn as function of the maximum expected yield (Y_m) and soil mobile P content (P_{ALc})

Y_m (kg/ha)	ppm P												
	5	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**60**	**70**	**80**
2000	89	76	65	55	47	40	34	29	25	18	15	11	8
3000	128	115	104	95	86	79	74	68	64	57	54	50	47
4000	158	145	134	124	116	109	103	98	94	87	84	80	77
5000	182	169	158	148	140	133	127	122	118	111	108	104	101
6000	201	188	177	167	159	152	146	141	137	130	127	123	120
7000	217	204	193	183	175	168	162	157	153	146	143	139	136
8000	230	217	206	196	188	181	175	170	166	159	156	152	149

Table 3

Technically optimal rates of K_2O (kg/ha) in corn as function of the maximum expected yield (Y_m) and soil mobile K content (K_{AL})

Y_m (kg/ha)	ppm K											
	40	**60**	**80**	**100**	**120**	**140**	**160**	**180**	**200**	**220**	**240**	**260**
2000	85	67	49	32	16	0	0	0	0	0	0	0
3000	130	111	94	77	61	45	30	17	3	0	0	0
4000	167	149	131	114	98	82	68	54	41	28	17	6
5000	198	180	162	145	129	114	99	85	72	60	48	37
6000	225	207	189	172	156	140	126	112	99	86	75	64
7000	249	230	212	195	179	164	149	135	122	110	98	87
8000	269	250	233	216	199	184	169	155	142	130	118	108



a) b) c)

Fig. 1. Nomograms for TOR of N (a), P_2O_5 (b) and K_2O (c) in corn as function of maximum yield (Y_m) and soil nitrogen index (IN), mobile P content (P_{ALc}) and mobile K content (K_{AL}) respectively

The elaborated tables and the nomograms in corn, published for the first time in this paper, will be accessible on a specific website through an online Decision Support System (DSS) which will be built.

2. A short comparison between TOR and EOR and mistakes in the use of EOR model, tables and nomograms, avoided in the TOR system.

The advantage of the TOR tables and nomograms, as compared with those for EOR [1], is that those of TOR are stable, because TOR are independent of the changing unitary price of the yield (UPY, lei/kg) and unitary price of the fertilizer (UPF, lei/kg active substance) on the market, while EOR strongly depend on the UPY/UPF ratio.

This is the reason why each of the EOR published tables and nomograms [1], as „service solutions", is valid only for the ratio UPY/UPF given by the UPY and UPF values mentioned by authors, which were practically constant in the state controlled economy before 1989 in Romania, but is only a particular case on the free market economy after 1989.

In corn, for example, the published nomogram for EOR of N [1, pp. 44] is valid only for the ratio UPY/UPF = 0.8/2.942 = 0.272; for any other ratio, the nomogram is not valid. Unfortunately, today many use the EOR tables and nomograms no matter the UPY and UPF are on the market, which is a gross mistake. In the use of TOR tables and nomograms, it is not possible such a mistake, because TOR do not depend on UPY/UPF ratio.

Not knowing the essential aspects of the EOR system, some authors [8] recently published EOR in 7 field crops, corn included, without any explanation on EOR system, on EOR model, on the fact that EOR are valid only for the particular UPY/UPF ratio they have been established in 1982 [1]; from their book, the reader (farmer, student etc.) understand, as the authors did, that the EOR rate are valid no mater the UPY and UPF values in the market, which is false, because the EOR rates can decrease even more than 50 % depending on UPY/UPF ratio. The scientific confusion of these authors [8] is so great that they put in the EOR table the values in apple and in grapevine that are in fact Experimental Optimal Rates (ExpOR), so they realized a very wrong "mixtum compositum". There are great difference between ExpOR [1] and EOR model [1], and of course, between their values. Other authors [7] confound the EOR with TOR: in a chapter with the syntagma "Economically Optimal Rates" in title they present a mathematical model that in fact calculates TOR.

The more the UPY/UPF ratio decreases, the more the EOR decreases in constant soil agrochemical index and expected yield level and becomes smaller than TOR [4], that means smaller than the optimal physiological nutrient needs. TOR are always higher than EOR, except the particular case UPY/UPF = 1, when EOR = TOR. Many use today the EOR model for calculations when UPY/UPF > 1, which is a gross mistake, as it was proved by a recent research [4]; in the use of TOR model, it is not possible such a mistake.

CONCLUSIONS

1. For the first time, useful agrochemical tables and nomograms have been elaborated, based on the TOR mathematical model, which can be used to settle the TOR of N, P_2O_5 and K_2O in corn depending on the maximum expected yield, Y_m, and on the specific soil agrochemical indexes: IN, P_{ALc}, K_{AL}.
2. The TOR mathematical model has to be used when exact values are desired; the agrochemical tables and nomograms can be used when operative settle of TOR are needed.
3. When maximum expected yields have to be obtained, the crops have to be fertilized in TOR. When maximum net revenue has to be obtained, the crops have to be fertilized in EOR; in this case, the maximum expected yield can be obtained only in the particular rare case when UPY/UPF = 1. It is wrong to calculate EOR when UPY/UPF > 1; in this case, only TOR has to be calculated.

4. Proving great scientific confusions and errors on the optimization of the nutrient rates, some authors [7], [8], [9], [10] published erroneous mathematical models and/or confound TOR with EOR, EOR with ExpOR etc. Some authors [7] confound TOR with EOR and presented TOR as being EOR. Other authors [8] presented the ExpOR as EOR or presented EOR in a wrong way. Such models and such books, that give absurd nutrient rates and induce great confusions, must not to be used in practice and in universities.

ACKNOWLEDGEMENTS

This paper is a tribute brought to Z. Borlan, the greatest and most original Romanian agrochemist ever, the best of the best, the mentor of the author.

REFERENCES

1. Borlan Z., C. Hera, Aurelia Ghidia, I. Pasc, Gh. Condei, L. Stoian, Eugenia Jidav, 1982. *Tabele şi nomograme agrochimice.* Edit. Ceres, Bucureşti (pp. 24-25).
2. Budoi Gh., 1997. *Teză de doctorat.* ASAS, Bucureşti.
3. Budoi Gh., 2007. *Technically Optimal Rates (TOR) of fertilizers: computing model, tables and nomograms in grapevine.* Proceedings of the XXXVII-th ESNA Conference, Dubna, Russia, 10-14 Sept. 2007 (in publishing).
4. Budoi Gh. 2007. *EOR versus TOR in grapevine.* Proceedings of the XXXVII-th ESNA Conference, Dubna, Russia, 10-14 Sept. 2007 (in publishing).
5. Budoi Gh., 2011. *Mathematical models, tables and nomograms to settle the technically optimal rates (TOR) of N, P_2O_5 and K_2O in winter wheat. Comparisons with some wrong models published by D. and V. Davidescu, R. Madjar, G. Neață.* Proceedings, UASVM Bucharest, Series A, Vol. LIV, 2011 (in publishing).
6. Davidescu D., Velicica Davidescu, 1981. *Agrochimia modernă*. Edit. Academiei R.S.R., Bucureşti (pp. 464, 478).
7. Davidescu D., Velicica Davidescu, 1992. *Agrochimia horticolă*. Edit. Academiei Române, Bucureşti (pp. 371, 391).
8. Madjar Roxana, Velicica Davidescu, 2009. *Agrochimie.* UŞAMV Bucureşti, Facultatea de Horticultură, Învățământ la Distanță (pp. 181-182, 190).
9. Neață Gabriela, 2000. *Agrochimie.* În Neață Gabriela, D.I. Marin, Ionela Dobrin, 2000. *Materiale de fertilizare şi de protecție fitosanitară.* UŞAMV Bucureşti, Centrul de Studii pentru Învățământ Deschis la Distanță (pp. 46, 47).
10. Neață Gabriela, 2002. *Agrochimia şi biologia solului.* Edit. Printech, Bucureşti (pp. 210-225).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

MATHEMATICAL MODELS, TABLES AND NOMOGRAMS TO SETTLE THE TECHNICALLY OPTIMAL RATES (TOR) OF N, P_2O_5 AND K_2O IN WINTER WHEAT. COMPARISONS WITH SOME WRONG MODELS PUBLISHED BY D. AND V. DAVIDESCU, R. MADJAR, G. NEAȚĂ

GH. C. BUDOI

University of Agronomic Sciences and Veterinary Medicine of Bucharest

Keywords: *nutrient rates, maximum yield, sustainable agriculture*

Abstract

This is the first paper from the series concerning the field crops. The mathematical models and agrochemical tables and nomograms in winter wheat are presented and these serve to settle the Technically Optimal Rates (TOR) of N, P_2O_5 and K_2O as function of maximum expected yield, Y_m, and the specific soil agrochemical indexes, AI (nitrogen index: IN; mobile phosphorous: P_{ALc}; mobile potassium: K_{AL}). The TOR of a nutrient, N for example, is that rate which allows to obtain the maximum yield in given conditions concerning the soil supply with the regarded nutrient, and allow a sustainable agriculture. The TOR system uses the same equations for nutrients action coefficients and soil nutrient supply as the Economically Optimal Rate (EOR) system. Fertexpert software version 3 has been used for TOR calculations. When the exact values of TOR are desired, the mathematical model have to be used; when operative settle of TOR are desired, the practical agrochemical tables or nomograms can be used by the farmers. The paper presents comparison between the nutrient rates calculated with TOR model and the absurd rates calculated with some published erroneous models.

INTRODUCTION

The TOR of N, P_2O_5 or K_2O are those rates that allow to obtain the maximum yield in given conditions concerning the soil supply with the considered nutrient, while the Economically Optimal Rates, EOR, allow to obtain the maximum net revenue/ha. The advantages and disadvantages of TOR system [3] versus EOR system [1] have been recently presented in another paper [4]. To can establish TOR is of crucial importance for the crop technologies. Unfortunately, many published mathematical models are wrong and give absurd nutrient rates [6, 7, 8, 9, 10]. This paper brings, for the first time, reasonable solutions in settling TOR in winter wheat depending on the yield level and relevant soil agrochemical indexes.

MATERIAL AND METHODS

A new version of FERTEXPERT software [2], the 3-rd, have been developed by author in order to incorporate the mathematical TOR model [3] and to use the specific parameters for winter wheat. The mathematical models used by software for TOR, nutrient action coefficients, c_a, and soil nutrient supply, S_n, are presented below; the equations for c_a and S_n have the same coefficients as those used for the EOR of N, P_2O_5 and K_2O [1]. FERTEXPERT has then been used for TOR calculations. The specific practical agrochemical tables and nomograms (graphs) have been built based on the calculated TOR.

RESULTS AND DISCUSSION

1. Specific results and discussion concerning the TOR in winter wheat. The mathematical model, logically derived from the modified Mitscherlich response function [3], which can be used in order to calculate the TOR, is:

$$\mathbf{TOR,\ kg\ N,\ P_2O_5,\ K_2O/ha = [\log(2.3 \cdot c_a \cdot Y_m)]/c_a - S_n}$$

(condition: if $[\log(2.3 \cdot c_a \cdot Y_m)]/c_a - S_n < 0$, then TOR = 0)

where: Y_m = maximum expected yield, kg/ha, established on the basis of the site evaluation studies; the level of Y_m depend on the variety and on the levels of all vegetation factors (temperature, water etc.); c_a = action coefficient of N, P, K, unique for the nutrient from fertilizer and for the nutrient from soil (potentially available form), calculated with specific models; S_n = soil nutrient supply, potentially available form, kg N, P_2O_5 or K_2O/ha, calculated based on the specific agrochemical analyses (IN, P_{ALc}, K_{AL}) and Y_m. The logical deduction of the TOR mathematical model has been demonstrated by author in another paper [3].

The same equations and coefficients as those of EOR system [1] are used in order to compute c_a and S_n in TOR system; these equations are [1]:

For nitrogen: $c_a = 0.006 + 12/Y_m$; $S_n = 24.5IN - 2.41(IN)^2 + 0.0015Y_m$

For phosphorous: $c_a = 0.004 + 14/Y_m$; $S_n = 137(1-10^{-0.018P_{ALc}}) + 0.0045Y_m$

For potassium: $c_a = 0.0047 + 17.5/Y_m$; $S_n = 180(1-10^{-0.00362K_{AL}}) + 0.003Y_m$

In these models: IN = soil nitrogen index; P_{ALc} = soil mobile P content, ppm P, corrected with a reaction factor, FR [1]; K_{AL} = soil mobile K content, ppm K.

The calculated results concerning the TOR values depending on the relevant soil agrochemical indexes, AI (IN, P_{ALc}, K_{AL}) and on the maximum expected yield, Y_m, are presented in two-sided tables (tables 1, 2, 3) and in 3 nomograms (figure 1). These agrochemical tables and nomograms show that the TOR increase with the decrease of AI and with the increase of Y_m. When the exact values of TOR are desired, the TOR mathematical model has to be used. When operative settle of TOR are desired, the practical agrochemical tables or nomograms can be used by the farmers; in such cases, visual interpolations have to be done, if necessary, in the TOR estimations; when interpolations have to be done, the results are approximates. The interpolations using a nomogram are more precise than those using a table. The agrochemical tables and nomograms in winter wheat, published for the first time in this paper, will be accessible on a specific website through an online Decision Support System (DSS).

Table 1

Technically optimal rates (TOR) of N (kg/ha) in winter wheat as function of the maximum expected yield (Y_m) and soil nitrogen index (IN)

Y_m	IN								
(kg/ha)	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
2000	130	120	110	102	96	90	85	82	80
3000	167	157	148	140	133	127	123	120	117
4000	195	185	175	167	160	155	150	147	145
5000	217	206	197	189	182	177	172	169	167
6000	234	224	215	207	200	194	190	187	184
7000	249	238	229	221	214	209	204	201	199

Table 2

Technically optimal rates of P_2O_5 (kg/ha) in winter wheat as function of the maximum expected yield (Y_m) and soil mobile P content (P_{ALc})

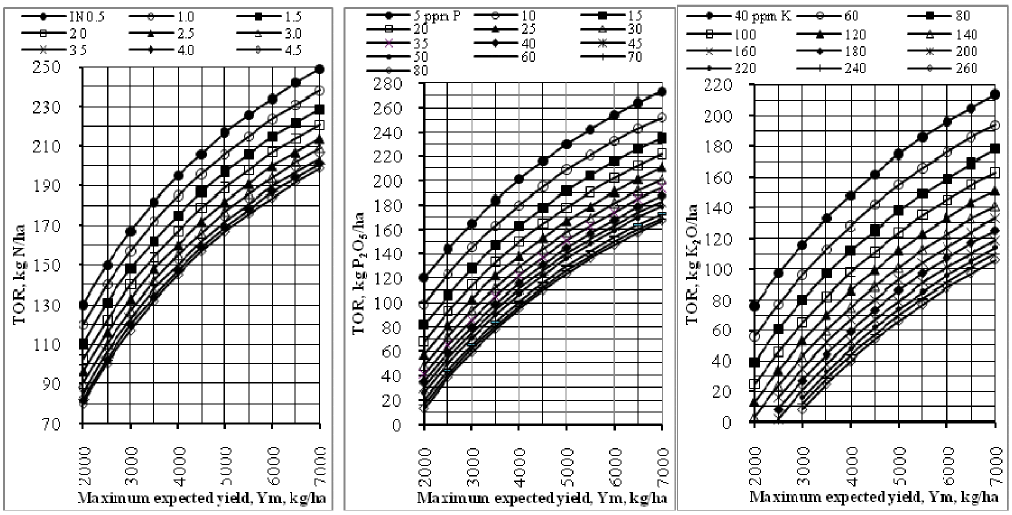
Y_m	ppm P												
(kg/ha)	5	10	15	20	25	30	35	40	45	50	60	70	80
2000	120	99	82	68	57	48	41	35	30	26	20	16	13
3000	165	145	128	114	103	94	86	80	75	71	65	62	59
4000	201	180	163	150	138	129	122	116	111	107	101	97	95
5000	230	209	192	178	167	158	151	145	140	136	130	126	123
6000	254	233	216	202	191	182	174	168	163	159	154	150	147
7000	273	252	235	222	211	201	194	188	183	179	173	169	167

Table 3

Technically optimal rates of K_2O (kg/ha) in winter wheat as function of the maximum expected yield (Y_m) and soil mobile K content (K_{AL})

Y_m	ppm K											
(kg/ha)	40	60	80	100	120	140	160	180	200	220	240	260
2000	76	56	39	25	13	3	0	0	0	0	0	0
3000	116	96	80	65	53	43	35	27	21	16	12	8
4000	148	128	112	98	86	75	67	59	53	48	44	40
5000	175	155	138	124	112	101	93	86	79	74	70	66
6000	196	176	159	145	133	123	114	107	101	96	91	88
7000	214	194	178	163	151	141	133	125	119	114	110	106

2. Comparison between TOR and EOR and mistakes in the use of EOR model, tables and nomograms, avoided by TOR system. These aspects are presented in the complementary paper published by author in these Proceedings [5].



a) b) c)

Fig. 1. Nomograms for TOR of N (a), P_2O_5 (b) and K_2O (c) in winter wheat as function of maximum expected yield (Y_m) and soil nitrogen index (IN), mobile P content (P_{ALc}) and mobile K content (K_{AL}) respectively

3. Comparison between the macronutrient rates in winter wheat calculated with the above TOR mathematical and those calculated with the erroneous models elaborated and published by some authors [6], [7], published by other authors [8], [9], [10] with the same or new errors. In literature, the mathematical models wear in texts the names of the authors which elaborated and published them. This was not allowed me by the Scientific Committee of this Proceedings.

3.1. Reasonable nutrient rates given by the above TOR mathematical model. For example, on a soil with 35 ppm P, we have to apply 41 kg P_2O_5/ha for a 2000 kg/ha yield level and 122 kg P_2O_5/ha for a 4000 kg/ha yield level (table 2).

3.2. Absurd, huge nutrient rates given by the erroneous model

$$\text{"D, kg/ha} = (C_o - R_t) \cdot G_{sa} \cdot (1/C_u) \cdot k\text{"}$$

elaborated and published by some authors [6], [7], published also by others [9], [10], where: D = the rate to be applied (nitrogen, phosphorous, potassium), kg/ha, to reach the optimum content in soil; C_o = the optimum soil content which has to be attained in soil (nitrogen, phosphorous or potassium), ppm N, P, K (it is logic that C_o assure maximum yield/ha); R_t = total soil reserve of nitrogen, phosphorous or potassium (potentially available forms), in ppm; G_{sa} = weight of soil arable layer, t/ha; C_u = utilization coefficient of fertilizer, % (12-40 %); k = correction coefficient depending on soil organic matter content for N and K rates and on soil pH, texture and degree of gleization.

Some authors [9] published the above model even in a more absurd form, with Rt in t/ha, which means that we have to substract t/ha from ppm.

Example of calculation: for Co = 80 ppm P; Rt = 35 ppm P; Gsa = 3000 t/ha, Cu = 12 %, k = 1, kg P_2O_5 = kg P · 2.29, the rate is

D = (80-35)·3000·(1/12)·1 = 11250 kg P/ha = **25762 kg P_2O_5/ha** (absurd) ≡ **143125 kg** simple superphosphate**/ha** (with 18 % P_2O_5) ≡ **29 trucks** of 5 t**/ha** (absurd).

3.3. Huge, absurd, nonsense negative rates of P_2O_5 given by the wrong model

$$"D_{P\,(kg/ha)} = (P_{ex} - P_t \cdot 100) / C_u",$$

elaborated and published by some authors [6], published also by other authors [8], and published by another author [10] as

$$"D_{P\,(kg/ha)} = (P_{ex} - P_t)\, 100 / C_u",$$

where P_{ex} = phosphorous extracted with the yield (Y), in kg/ha: $P_{ex} = Y \cdot C_{sp}$; C_{sp} = speciffic phosphorous consumption per tone of main yield: 15-18 kg P_2O_5/t [6]; C_u = utilization coefficient of fertilizer, %; Pt = total soil reserve of potentially available phosphorous, kg/ha, which, when we do not apply manure, is calculated with the equation "$P_t = G_{sa} \cdot P \cdot k_P \cdot CA_{pH} \cdot C_{Ag} \cdot 1/1000000$"; G_{sa} = weight of soil arable layer, kg/ha; P = mobile soil content, ppm P; k_P = coefficient of P assimilation from fertilizer (that means C_u); CA_{pH} = coefficient of assimilation depending on soil pH (in fact this is a correction factor of mobil soil P content with a reaction factor, FR [1], speciffic only for the AL method (extraction with ammonium acetate lactate), so the authors falsely consider this factor coefficient of P assimilation); C_{Ag} = coefficient of assimilation (0.6-1) depending on soil gleization degree.

Among other errors, the P_t equations do not contain the multiplication coefficient 2.29 in order to transform P in P_2O_5, which leads to wrong results; the D_P model use twice the coefficiant of P utilization form fertilizer, once as C_u and once as k_P, which also leads to wrong results.

Example of calculation:

If Y = 4 t/ha, C_{sp} = 18 kg P_2O_5/t, $P_{ex} = Y \cdot C_{sp} = 4 \cdot 18$= 72 kg P_2O_5/ha; G_{sa} = 3000000 kg/ha; P = 35 ppm P; k_P = 12 %, CA_{pH} = 0.9, C_{Ag} = 1, then

P_t = 3000000·35·12·0.9·1·(1/1000000) = 1134 kg P/ha= 2597 kg P_2O_5/ha (absurd)

D_P = (72 – 2597 · 100) / 12 = – 21636 kg P_2O_5/ha (absurd, nonsense)

With the other model [8], D_P = (72 – 2597)·100/12 = – 21042 kg P_2O_5/ha (absurd).

Other erroneous model [9] gives nutrient rates one hundred times smaller than normal, that means 1 kg instead of 100 kg.

The above erroneous models give absurd rates in all nutrients and all crops, not only in the exemplified P_2O_5 rate in winter wheat. Many other models published by these authors are incredible wrong.

CONCLUSIONS

1. Based on the TOR mathematical model, useful agrochemical tables and nomograms have been elaborated and published for the first time in order to operative settle the TOR of N, P_2O_5 and K_2O in winter wheat.
2. The agrochemical tables and nomograms can be used when operative settle of TOR are needed; the mathematical model has to be used when exact values of TOR are desired.
3. The erroneous models elaborated and published by some authors [6], [7], published also by other authors [8], [9], [10] with the same or new errors, give absurd rates in all nutrients and all crops. Such models and such books must not to be used in practice by farmers and in universities.

ACKNOWLEDGEMENTS

This paper is a tribute brought to Z. Borlan, the greatest and most original Romanian agrochemist ever, the best of the best, the mentor of the author.

REFERENCES

1. Borlan Z., C. Hera, Aurelia Ghidia, I. Pasc, Gh. Condei, L. Stoian, Eugenia Jidav, 1982. *Tabele şi nomograme agrochimice.* Edit. Ceres, Bucureşti.
2. Budoi Gh., 1997. *Teză de doctorat.* ASAS, Bucureşti.
3. Budoi Gh., 2007. *Technically Optimal Rates (TOR) of fertilizers: computing model, tables and nomograms in grapevine.* Proceedings of the XXXVII-th ESNA Conference, Dubna, Russia, 10-14 Sept. 2007 (in publishing).
4. Budoi Gh. 2007. *EOR versus TOR in grapevine.* Proceedings of the XXXVII-th ESNA Conference, Dubna, Russia, 10-14 Sept. 2007 (in publishing).
5. Budoi Gh., 2011. *Mathematical models, tables and nomograms to settle the technically optimal rates (TOR) of N, P_2O_5 and K_2O in corn.* Proceedings, UASVM Bucharest, Series A, Vol. LIV, 2011 (in publishing).
6. Davidescu D., Velicica Davidescu, 1981. *Agrochimia modernă*. Edit. Academiei R.S.R., Bucureşti (pp. 464, 474, 478).
7. Davidescu D., Velicica Davidescu, 1992. *Agrochimia horticolă*. Edit. Academiei Române, Bucureşti (pp. 391).
8. Madjar Roxana, Velicica Davidescu, 2009. *Agrochimie.* UŞAMV Bucureşti, Facultatea de Horticultură, Învățământ la Distanță (pp. 181-182).
9. Neață Gabriela, 2000. *Agrochimie.* In Neață Gabriela, D.I. Marin, Ionela Dobrin, 2000. *Materiale de fertilizare şi de protecție fitosanitară.* UŞAMV Bucureşti, Centrul de Studii pentru Învățământ Deschis la Distanță (pp. 46, 47).
10. Neață Gabriela, 2002. *Agrochimia şi biologia solului.* Edit. Printech, Bucureşti (pp. 210-225).

Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339

Publication Guidelines of the Scientific Papers

For consistent editing of your contributions, please follow the indications below.

- Editing: Microsoft Word
- Paper size: A4 paper format; margins: top/bottom 5.4 cm and left/right 4 cm
- Font: Times New Roman
- Line Spacing: Single
- Do not use colors and get sure the Black/White print version is legible.
- Papers should have 4 or 6 pages, including tables and figures.
- Papers should start with: Scientific Papers, UASVM Bucharest, Series A, Vol. LIV, 2011, ISSN 1222-5339 – *9 font size, alignment left, 18pt space after.*
- Title: capital letters; no full stop; 11 font size; centered; bold; 6pt space after.
- Authors' name: first name initial followed by full stop (for men) and full first name (for women), followed by last name; authors' name separated by comma; no academic titles; 10 font size; capital letters; alignment right; 6pt space after.
- Institutions name: 10 font size; alignment right; in the case of more than one institution, then each institution name on one row; 6pt space after.
- Manuscripts should be organised in the following order:
  - Keywords
  - Abstract
  - INTRODUCTION
  - MATERIAL AND METHODS
  - RESULTS AND DISCUSSION
  - CONCLUSIONS
  - ACKNOWLEDGEMENTS (if necessary)
  - REFERENCES
- Headings: 11 font size; normal; capital letters (except Keywords and Abstract); 12pt space before; 6pt space after.
- Keywords: minimum 3 and maximum 5 words; 11 font size; italic; separated by comma; no full stop.
- Ensure that page breaks do not come between any heading and the next level of sub-heading (if the case) or first line of body text after the heading (use paragraph formating of „Keep with next" for Line and Page Breaks on heading lines)
- Text body for abstract: justified; 10 font size; italic; no indent first; no space before and 3pt space after the paragraph.
- Abstract should concisely summarize the content of the paper and should crearly tell the reader what information he can expect to find in the paper.
- It should provide a brief introduction to the problem, a statement regarding the methodology and a brief summary of results.
- Gemerally, the abstract should end with a comment on the significance of the rezults or a brief conclusion.
- Abstract should contain no more than 200 words.
- Text body for all other headings: standard paragraph is justified; 11 font size; normal; no indent first; no space before and 3pt space after the paragraph.
- Introduction should deal with the background of the work and describes the field of research. It should describe the focus of the paper (the objectives of the paper) and the importance of the subject and the paper itself.

- Conclusions should be concise and clear, no hypothesis and probability, numbered (1., 2., 3., etc,); indentation: left 0.5 cm, hanging 0.5 cm; no space before and 3pt space after the paragraph.
- Acknowledgements (if necessary): here you can thank those that have supported you and your work.
- References: autonumbered; 10 font size; indentation: left 0.5 cm, hanging 0.5 cm; alphabetic order, arabic numbers; no space before and 3pt space after the paragraph.
    - References in the text should be written only by the number corresponding to the bibliographic list, marked by square brackets [ ], NOT by quoting the author's name in the text. The authors quoted in other papers should not be included in the bibliography, but directly in the text, followed by the reference number of the quoting author.
- Bullets (if necessary):
    - This is the first bullet level; indentation: left 0.5 cm, hanging 0.5 cm.
        - This is a sub-bullet level; indentation: left 1 cm, hanging 0.5 cm.
- Tables (if necessary):
    - Tables are sequentially numbers in numeric fashion with the table number and the title above the table.
    - Table number should be alignment rightm 11 font size, bold, italic, as following: *Table 1*
    - Table title should be centered in the page, 11 font size, bold.
    - Tables should be centered in the page, with 8 minimum and 11 maximum font size, with 2pt space before and 2 pt space after the paragraph.
    - Table culumn headings should still use the same style but be bold.
    - Tables are reffered to in the text by the table number, as following: (table 1)
    - If the table is going on the second page, then make sure there are inserted the table column headings.
- Figures (if necessary):
    - Figures (photos, charts, diagrams etc.) are sequentially numbers in numeric fashion with the figure number and the title below the figures.
    - Figures title should be centered in the page, 11 font size, bold, as following: Fig. 1. ..
    - Figures are reffered to in the text by the figure number, as following: (figure 1).
    -

***

By submitting a scientific paper, each author explicitly confirms that the papers meets the highest ethical standards. Authors are fully responsible for the content of their papers, including references, figures, tables, etc.

Papers are accepted with the understanding that they have not been published in other journals or publications and they are not concurrently under review elsewhere.

All papers that are submitted are subject to the peer-review process. Therefore, it is essential that all papers follow the above mentioned rules for paper preparation. Failure to comply with the formal and scientific criteria should result in eventual resubmission or rejection of the manuscript.


Agrofam
Grup
activități agricole integrate, moderne și eficiente
producție vegetală
comerț cu produse agricole
zootehnie
industrie alimentară
viticultură
www.agrofam.ro


EURALIS
ROMÂNIA
EURALIS
SEMINȚE
www.euralis.ro


EC FERTILIZER
FoliMAX®
FoliMAX Saruri Solubile:
FoliMAX orange 15-45-10+TE aminopower
FoliMAX blue 20-20-20+TE aminopower
FoliMAX green 28-14-14+TE aminopower
FoliMAX rose 08-17-41+TE aminopower
FoliMAX yellow 15-05-30+26 S+TE aminopower
FoliMAX lichide:
FoliMAX Gold aminopower
FoliMAX 10-04-07+TE aminopower
FoliMAX 05-08-10+TE aminopower
FoliMAX Calcium Plus aminopower
FoliMAX Calcium aminopower
FoliMAX Bor 150 aminopower
Fitoserv SRL. Intr. Parfumului 6, Sector 3,
Bucuresti tel/fax 0213214363; fitoserv@xnet.ro
mobil 0723298293; 0745230777
AMINO POWER