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## RESEARCH REGARDING THE INFLUENCE OF CROP ROTATION AND NUTRITION REGIME ON THE QUALITY INDICATORS OF SEEDS IN WINTER WHEAT CULTIVATED ON THE PRELUVO SOILS

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### Abstract

*The quality of production is related to a series of physical and chemical characteristics of plants which gives a positive mark to the applied agrotechnical methods for the correlation of the latter to the production obtained on the surface unit. The research performed in this field made clear the fact that quality is conditioned by the species and the cultivated hybrid, the climatic conditions of the cultivating year and also by the technology applied to the agricultural plants.*

**Key words:** crop rotation, nutrition regime, nitrogen, phosphorus, potassium, raw protein, seeds, winter wheat

### INTRODUCTION

To justify some of these aspects with consequences regarding the quality of the final production, we make some references to the specialised scientific literature, i.e. Hera and her team (1986) underline the importance of nitrogen for the increase of the protein content, wet and dry gluten and for the improvement of the quality indicators of gluten. The authors also mention the importance of the ameliorative plant (the pea) for the quality indicators of the wheat. Boldea *Eleonora and her team* (1986) also mention the importance of the new species of wheat for the quality of raw protein and gluten (Dincă, 1982, Bilteanu, 1993).

The production quality is related to a series of physical and chemical characteristics of the plants which gives a positive mark to the agrotechnical applied measures for the correlation of this with the production obtained for the surface unit (Munteanu, et al., 2011, Domuta, 2012).

Some analyses have been made to establish the quality of the final product regarding the content of N, P, K in wheat seeds and raw protein (Bandici, et al., 2003, Domuta et al., 2007, 2008).

The main component of the chemical composition of the seeds is represented by the glucides (62-75 %) of the fresh wheat grain mass, the proteins 10-16 %, lipids 1.8-2.6 %, cellulose 2-3.5 % and mineral substances 1.5-2.3 % (Hera, 1986, Soltner, 1990, Salisbury, 1995). A series

of analyses of the N, P, K and raw protein content in the wheat grains has been made in order to specify the quality of the final product (Zăhan, 1989; Bandici, 1997; 2001, Ardelean 2006, 2013).

## MATERIAL AND METHOD

The experiment was made at Agricultural Research and Development Station Oradea (ARDS), in the period 2018-2019, on the luvosol. For “Delia” winter wheat grains a series of chemical test were made regarding the content of nitrogen, phosphorus, potassium and raw protein according to the precursory and the nutrition system. The nitrogen was determined using the Kjeldahl method, the phosphorus was determined by colorimetry with ammonium molybdate and tin chloride reduction. The potassium was determined through flame photometry and the raw protein was determined through calculation ( $N_t \times 5.7 \%$ ).

## RESULTS AND DISCUSSION

Analysing the data in Table 1, regarding the influence of forerunner plant and fertilization level on the total N content in the wheat seeds, we can see that both the forerunner plant and fertilization level influenced the content of this element in seeds. Therefore, comparing the wheat monoculture with wheat cultivation that was preceded by corn = maize or pea (3 and 4 years crop rotation) the latter induces an increased production of 22.4-53.8 %.

As an ameliorative plant, pea determined the increase of nitrogen content in the crop as a consequence of its symbiotic particularities. Compared to the unfertilized type, with a value of 1.37 g/100 g.d.w. (grains of dry substance = wheat), mineral and organo-mineral fertilization determine important increase of nitrogen, i.e. 38.7 % and 62 %.

Table 1

The influence of crop rotation and nutrition regime of the final content of *nitrogen* of the seeds in wheat cultivated on preluvosols, Oradea, 2018-2019

Observed factor	Total g/100 g.d.w.	Nitrogen %	Difference +/-
a. Crop rotation			
Wheat – Monoculture ( $M_t$ )	1.43	100	-
Maize (W-M)	1.75	122.4	+0.32
Pea (P-W-M)	2.20	153.8	+0.77
Pea (P-W-M-M)	1.95	136.4	+0.52
b. Nutrition regime			
$N_0P_0$	1.37	100	-
$N_{120}P_{80}$	1.90	138.7	+0.53
$N_{120}P_{80}+10$ t/ha manure	2.27	162.0	+0.85

In point of the factors interactin: crop rotation x nutrition regime (Table 2), we note that no matter the crop rotation used, mineral or organo-

mineral fertilization increase by 12.1-86.7 %. The lowest values of total nitrogen content can be found in the wheat monoculture (1.24-1.65 g/100 g.d.w.) compared to short wheat – maize rotation (1.27-2.07 g/100 g.d.w) or to 3 and 4 year wheat – pea crop rotation – (1.70-2.78 g/100 g.d.w. and 1.28-2.39 g/100 g.d.w.).

Table 2

Influence of the factors interaction: crop rotation x nutrition regime on the final content of *nitrogen* of the seeds in wheat cultivated on preluvosols, Oradea 2018-2019

Nutrition regime	Total g/100 g.d.w.	Nitrogen %	Difference +/-
a. Wheat – Monoculture (M <sub>t</sub> )			
N <sub>0</sub> P <sub>0</sub>	1.24	100	-
N <sub>120</sub> P <sub>80</sub>	1.39	112.1	+0.15
N <sub>120</sub> P <sub>80</sub> +10 t/ha manure	1.65	133.1	
b. Maize (W-M)+0,41			
N <sub>0</sub> P <sub>0</sub>	1,27	100	-
N <sub>120</sub> P <sub>80</sub>	1.90	149.6	+0.63
N <sub>120</sub> P <sub>80</sub> +10 t/ha manure	2.07	163.0	+0.80
c. Pea (P-W-M)			
N <sub>0</sub> P <sub>0</sub>	1.70	100	-
N <sub>120</sub> P <sub>80</sub>	2.13	125.3	+0.43
N <sub>120</sub> P <sub>80</sub> +10 t/ha manure	2.78	163.5	+1.08
d. Pea (P-W-M-M)			
N <sub>0</sub> P <sub>0</sub>	1.28	100	-
N <sub>120</sub> P <sub>80</sub>	2.18	170.3	+0.90
N <sub>120</sub> P <sub>80</sub> +10 t/ha manure	2.39	186.7	+1.11

Concerning the *total raw protein* content (Nt x 5.7), in the *Table 3 and 4* we note the direct link between the nitrogen content and raw protein.

In this case, the crop rotation and the nutrition regime in the process induce important raw protein increase, which, in case of 3 year wheat-pea crop rotation may rise up to 12.58 g/100 g.d.w., compared to monoculture of 8.15 g/100 g.d.w. The highest values of raw protein increase were established in the organo-mineral fertilization process of 12.58g/100 g.d.w., compared to the witness (N<sub>0</sub>,P<sub>0</sub>) 7.92 g/100 g.d.w. In the case of raw protein, no matter what the precursory was, the organo-mineral fertilization determined the highest values of raw protein content which varied between 9.43 g/100 g.d.w., in wheat monoculture and 15.84 g/100 g.d.w., in pea (3 year crop rotation).

Table 3

The influence of crop rotation and nutrition regime on the final content of *raw protein* of the seeds in wheat cultivated on preluvosoils, Oradea 2018– 2019

Observed factor	Raw protein g/100 g.d.w.	Raw protein %	Difference +/-
a. Crop rotation			
Wheat – Monoculture (M <sub>i</sub> )	8.15	100	-
Maize (W-M)	9.96	118.5	+1.81
Pea (P-W-M)	12.58	154.3	+4.43
Pea (P-W-M-M)	11.23	137.8	+3.08
b. Nutrition regime			
N <sub>0</sub> P <sub>0</sub>	7.92	100	-
N <sub>120</sub> P <sub>80</sub>	10.84	136.9	+2.92
N <sub>120</sub> P <sub>80</sub> +10 t/ha manure	12.68	160.1	+4.76

Table 4

Influence of the factors interaction: crop rotation x nutrition regime on the final content of *raw protein* of the seeds in wheat cultivated on luvosoils, Oradea 2018-2019

Observed factor	Raw protein g/100 g.d.w.	Raw protein %	Difference +/-
a. Wheat – Monoculture (M <sub>i</sub> )			
N <sub>0</sub> P <sub>0</sub>	7.07	100	-
N <sub>120</sub> P <sub>80</sub>	7.95	112.4	+0.88
N <sub>120</sub> P <sub>80</sub> +10 t/ha manure	9.43	133.3	+2.36
b. Maize (W-M)			
N <sub>0</sub> P <sub>0</sub>	7.26	100	-
N <sub>120</sub> P <sub>80</sub>	10.83	149.2	+3.57
N <sub>120</sub> P <sub>80</sub> +10 t/ha manure	11.79	162.4	+4.53
c. Pea (P-W-M)			
N <sub>0</sub> P <sub>0</sub>	9.72	100	-
N <sub>120</sub> P <sub>80</sub>	12.17	125.2	+2.45
N <sub>120</sub> P <sub>80</sub> +10 t/ha manure	15.84	163.1	+6.12
d. Pea (P-W-M-M)			
N <sub>0</sub> P <sub>0</sub>	7.62	100	-
N <sub>120</sub> P <sub>80</sub>	12.43	163.1	+4.81
N <sub>120</sub> P <sub>80</sub> +10 t/ha manure	13.65	179.1	+6.03

Regarding the total content of *phosphorus* in the wheat seeds, in Table 5 we note that neither crop rotation, nutrition regime, nor their interaction led to significant differences, regardless of the quality of the forerunner plant or organo-mineral fertilization, except the pea (3 year crop rotation) when the mineral or organo-mineral fertilisation determined more than 10 % increase of the total content of phosphorus.

Table 5

Influence of the crop rotation and nutrition regime on the final content of *phosphorus* of the seeds in wheat cultivated on preluvosols, Oradea 2018-2019

Observed factor	Total phosphorus g/100 g.d.w.	Phosphorus %	Difference +/-
a. Crop rotation			
Wheat – Monoculture (M <sub>i</sub> )	0.36	100	-
Maize (W-M)	0.36	100	-
Pea (P-W-M)	0.40	111.0	+0.04
Pea (P-W-M-M)	0.36	100	-
b. Nutrition regime			
N <sub>0</sub> P <sub>0</sub>	0.36	100	-
N <sub>120</sub> P <sub>80</sub>	0.37	102.8	+0.01
N <sub>120</sub> P <sub>80</sub> +10 t/ha manure	0.38	105.5	+0.02

Regarding the total content of *potassium* in the wheat seeds, in Table 6 under the individual influence of both the observed factors, we could notice significant difference.

Table 6

Influence of the forerunner plant and fertilization level on the final content of *potassium* of the seeds in wheat cultivated on preluvosols, Oradea 2018-2019

Observed factor	Total g/100 g.d.w.	Potassium %	Difference +/-
a. Crop rotation			
Wheat – Monoculture (M <sub>i</sub> )	0.64	100	-
Maize (W-M)	0.67	104,7	+0.03
Maize (P-W-M)	0.64	100	-
Pea (P-W-M-M)	0.63	98,0	+0.01
b. Nutrition regime			
N <sub>0</sub> P <sub>0</sub>	0.67	100	-
N <sub>120</sub> P <sub>80</sub>	0.63	94.0	-0.04
N <sub>120</sub> P <sub>80</sub> +10 t/ha manure	0.63	94.0	-0.04

## CONCLUSIONS

A more intense accumulation of the biomass which determines an intensification of the photosynthesis positively influences the chemical composition of the final product – the grains.

The total content of nitrogen in the winter wheat grains was influenced by the crop rotation and the nutrition system.

The raw protein content follows the natural way similarly to nitrogen total content being influenced mainly by the crop rotation and the fertilization level.

There weren't observed any essential changes of the total phosphorus and potassium content under the influence of the crop rotation and the fertilization level.

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## **SOILS AND PEDOGENETIC CONDITIONS IN THE LOW PLAIN OF CRIȘURILOR**

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### **Abstract**

*The aim of the paper is to approach in a detailed interdisciplinary analysis of some aspects related to the natural framework of soil formation in the Low Plain of Crișurilor and the characterization in a unitary conception of the soil taxonomic units.*

*The paper presents a detailed interdisciplinary analysis, conceived and developed through a multitude of interdependence relations between the physico-chemical parameters of the soil, correlated with the elements of the natural environment. The analysis of the physical-geographical factors in the formation and evolution of the soils of the area, will allow a better understanding of the particularities of this area and the taking of the most efficient decisions regarding the judicious use of the land fund.*

*Surveys on soil identification and mapping were conducted between 2017 and 2020*

*Following the correlation of the field data with the laboratory analyzes and the previously existing scientific information, the soils from the Low Plain of the Crișuri were identified, on structural plain units.*

**Key words:** soil profile, soil taxonomic unit, climatic parameters, physico-chemical parameters, synthesis.

### **INTRODUCTION**

From a hydrographic point of view, the Crișuri Low Plain is a component part of the Crișuri Transboundary Basin. Geographically, it is a subunit of the Crișurilor Plain, being located in the northwestern part of Romania (fig. 1). It presents as western limit the western border of the country, and as eastern limit the Crisene Hills. To the north it continues with the High Plain of Criș, and to the south the Mureș Plain, having continuity in Hungary.



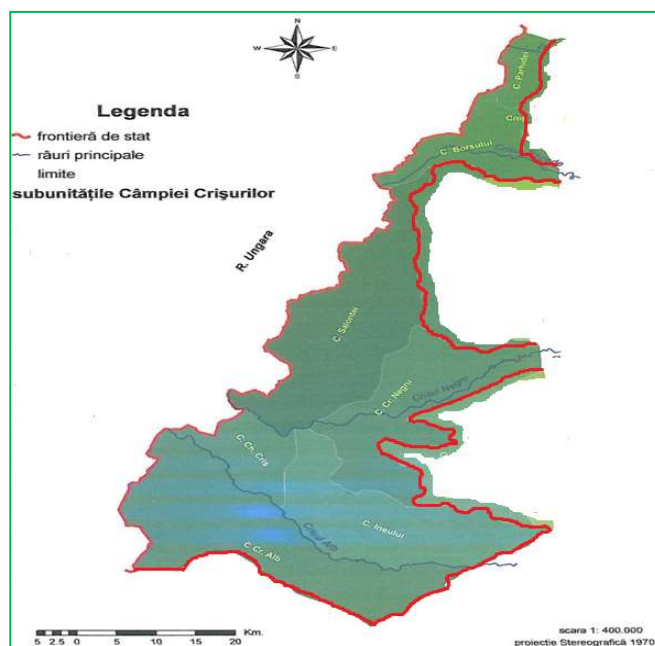


Fig. 1. The Low Plain of Crișuri

It presents as subdivisions: Parhidei Plain, Borșului Plain, Salontei Plain, Crișului Alb Plain (Măhăra - 1977), subdivides this plain into: Teuzului Plain north of Crișul Alb, Chișineu Criș Plain occupying the western part in continuation of Salontei Plain and Ineuului Plain, Crișului Negru Plain.

## MATERIAL AND METHOD

The identification of the soil surfaces was performed following the correlation of the field data with the laboratory analyzes and the scientific information provided by OSPA Bihor. Based on these correlations, the soil surfaces occupied by different soil taxonomic units were identified and established at the level of the entire plain and by subdivisions of the low Crișuri Plain.

## RESULTS AND DISCUSSION

### Geological structure and hydrogeology of the low plain of Crisurilor

The surface deposits in the Low Plain of Crișuri are of Quaternary age, the clay-sand alluvial deposits predominate (Măhăra 1977). The widest distribution is the Holocene alluvial deposits but also the alluvial-proluvial deposits that appear at the contact of the plain with the hills.

The presence at depths of 2-6 m of chalcosodium muds in some areas of the plain has guided the process of pedogenesis in the direction of the formation

of salsodisols or saline, sodium or salsodic subunits of different types of soils.

Following the drilling, in the surface lithology, an alternation of clays and powders with pseudo-psammitic banks was highlighted. In the localities of Batăr and Talpoș, the drillings highlighted the composition of the Crișului Negru deposits, made of sands, gravel sands and boulders, interspersed with clays, to the south, at Berechiu, with the presence of fine-grained deposits (Măhăra 1977).

The deposits in the south of the plain are made up of an alternation of clays, sandy clays and sands. In the Crișului Alb meadow the deposits are of alluvial nature, made up of sands, gravels and boulders.

#### **The relief and morphometric characters of the Low Plain of Crișuri**

In the Low Plain of Criș, the altitude of the relief presents oscillating values between 80 and 120 m. The arrangement of the relief forms is longitudinal, in steps from east to west. The lowest altitude is found in the southeast of the plain, on Crișul Alb, at the Romanian-Hungarian border, being 88 m. The maximum limit is about 200 - 230 m, in the south of Barcău and the Cigher basin of 140m). The average altitude of the plain is 110-120m. The rivers that make up the hydrographic network lack terraces, with many abandoned branches and a migratory character (Măhăra 1975).

The watercourses that drain the Low Plain of Crișuri have a permanent character to which are added those with a temporary character, presenting importance also the secondary valleys, with lengths of 3 -5 Km and widths of maximum 150 m and permanent flow, like Canaliș Valley, Valea Gepiu, Valea Vida, Valea Topei, Valea Holodului. There are also a series of canals, oriented in the NS direction: Collector Canal (61Km, Crișul Repede-Tărian locality → Crișul Negru-Tămașda locality), Cermei Tăut Canal, Morilor Canal (Crișul Alb, Buteni locality → border with Hungary), Canal Culișer (Crișul Negru → Collector Canal → Salonta → Hungary), Cermei-Tăut Canal or Criș Canal, Matca Canal (Mureș → Crișul Alb). In many cases, due to alluvial deposits, the flow level increased. This is the main factor in groundwater rise, stagnation and wilting. In years with above average rainfall, torrential and lasting rains, or a long rainfall, there is a high frequency of floods.

#### **Groundwater**

The depth at which the groundwater is found increases from east to west of the plain. The average depth is between 1 and 5m. In February-March the hydrostatic level is at maximum levels, minimum levels are recorded in October-November, the average amplitude of variation being between 1 and 1.5 m, even 2.5 - 3 m, depending on the rainfall regime. It has a medium or high content in soluble salts which, associated with the

depth (critical or subcritical), determines the manifestation in the soil profile of the salinization, soda and salsodization processes. The critical depth favors the manifestation of stagnogleization in profile, with the formation of gyrosols or endogleic, gleic and batigleic subtypes of different types of soils (Chisinau-Criș Plain, Crișului Alb Plain, Salonte Plain).

#### **Stagnant waters**

They are represented by water accumulations from precipitation or surface runoff above a hard permeable horizon. They have a temporary or permanent character in the soil, being in close accordance with the pluviometric regime and the existence in the soil profile of the argic B horizon. Water stagnation in the soil causes the manifestation of stagnant processes and the formation of stagnant soils or stagnant subtypes of other soil types.

As a result of the stagnation of rainwater or groundwater in the Low Plain of Crișuri, over time have resulted large areas affected by swamps (about 1200 h). Large areas between the former swamped areas, have been transformed over time and arranged as ponds so they were introduced into the economic circuit: the lake complex of Cefa (670ha), Lake Inand (200ha), Madaras (30ha), Homorog (105ha), Tămașda (206 ha), the lakes on Crișul Alb (Bocsig, Ineu, Seleuș - Crișului Alb Plain), Tăuț , Cigher lake, Socodor lake (155ha), Pilu lake (260ha).

#### **The natural vegetation of the Low Plain of Crișuri**

The role and influence of the biological factor in the pedogenesis process is inseparable from the climatic factor, depending on it the distribution, the structure and the floristic composition of the vegetation, microflora and fauna of the soil, as well as the intensity of the pedogenetic processes.

The primary steppe plant associations have over time been replaced by agricultural crops or secondary herbaceous vegetation, often degraded or ruderalized. In the remains of primary steppe meadows, the associations of *Carex praecox*, *Poa pratensis* with *Festuca vallesiaca* and *Festuca pseudovina* with *Stipa pennata*, *Poa bulbosa*, *Koeleria gracilis*, *Koeleria javorkae*, and *Botriochloa ischaemum* with *Adonis vernalis*, *Chrysopsis ech italicum*, *Nepta nuda*, *Orobancha elatior*, *Orobancha reticulata*, *Ranunculus ilyricus*, *Stipa capillata*, *Vicia narbonensis*, *Vicia serratifolia*, *Artemisia* sp., *Lathyrus silvestris*, *Peucedanum alsaticum*, *Senecio doria*, *Seseli varium*, *Trinia ramosissima*. Weed associations predominate in agricultural crops: *Artemisia austriaca*, *Cynodon dactylon*, *Poa bulbosa*, *Bromus squarrosus*, *Agropyron* sp.

The areas that have a good water supply, but face drought during the summer period have in the floristic composition the species: *Alopecurus pratensis*, *Becmannia eruciformis*, *Roripa kernerii*. Specific to the area are

also plant species: *Plantago schwartzenbergiana*, *Plantago tenuiflora*, *Pholiurus pannonicus*, *Limonium gmelini*, *Peucedanum officinale*, *Aster sedifolius*, *Filipendula vulgaris*, *Agropyron pectiforme*.

The woody vegetation is sparse, having an accidental character (clumps of scattered forests left behind by massive deforestation). *Robinia pseudocacia* and *Quercus pedunculiflora* appear predominantly, with *Quercus pubescens*, less frequently *Quercus frainetto* and *Quercus cerris*. On the soils under the oak forests appears *Dornicum hungaricum*, *Gladolus imbricatus*, *Iris graminea*, *Oenanthe fistulosa*, *Corydalis solida*. The shrub substrate is dominated by *Crataegus monogyna* and *Rhamnus cathartica*. The lands located in the low and wet meadows are mostly affected by siltation (areas with groundwater at critical or subcritical depth), presenting a natural vegetation composed of mesohydrophilic and hydrophilic associations, with *Dechampsia caespitosa*, *Agrostis canina*, *Agrostis stolonifera*, *Agrostis*, *Tripholium hibridum*, *Festuca pratensis*, *Euphorbia palustris*, *Cirsium brachicephalum*, *Stipa pennata*, *Echium maculatum*, *Dictamnus albus*, *Phragmites communis*, *Typha latifolia*, *Carex riparia*, *Carex hordeistichos*, *Carex apporopinquata*, *Carex elata* Hot, aloides, *Hypericum tetrapterum* *Menyanthes trifoliata*, *Ranunculus lingua*, *Geranium pratense*, *Berula erecta*, *Aster linosiris*, *Iris spuria* and *Juncus* sp .. Uncommon are *Menianthes trifoliata*, *Cicuta virosa*, *Salix aurita*, *Urtica kioviensis*. On the surface of the lake water gloss, we can find *Nymphaea alba*, *Nuphar lutea*, *Trapa natans*, *Sagittaria sagittifolia* *Caltha palustris*, *Berula erecta*. The presence of a groundwater close to the surface with a high content of chloride salts, in addition to changing soil properties and properties (evolution and degree of salinization), has also led to changes in vegetation. The meadows that occupy these soils are composed of: *Static gmelini*, *Bassia hirsuta*, *Puccinellia distans*, *Agropyron elongatum*, *Crypsis aculeata*, *Spergularia marginata*, *Petrosimonia triandra*, *Aster tripolium*, *Atriplex* sp., *Camphorosma annua*, *Camphorosma lonsumia*, *Planthorosma monspelia*, *santonium*, *Hordeum histrix*, *Trifolium fragiferum*, *Aster tripolium*, *Aster sedifolius*, *Peucedanum latifolium*, *Scorzonera parviflora*, *Scorzonera laciniata*, *Mentha pulegium*, *Spergularia media*, *Sueda maritima*, *Artemisia maritima* ssp. *Achillea collina*, *Scorzonera canum*, *Juncus gerarde*, *Sueda pannonica*, *Crispis aculeata*. In springs with a high rainfall regime, due to the washing of the salts from horizon A, a rich nehalophilic flora can appear, with *Orhis elegans* and *Silene multiflora*. Out of the total of over 600 species of grassy and woody plants, there are 20-40 rare or endangered species, which are protected, among which we mention: *Acer negundo*, *Ailanthus altissima*, *Amorpha fruticosa*, *Fraxinus pennsylvanica*, *Xanthium* sp.

In the composition of the woody vegetation, *Quercus pedunculiflora* and *Quercus pubescens* predominate, in pure stands or in fields, together with *Quercus cerris*, *Quercus frainetto*, *Quercus robur*, *Tilia tomentosa*, *Acer campestre*, *Fraxinus excelsior*. On soils with a shallower aquifer, the forest vegetation is characteristic, consisting of forests of *Quercus robur* with *Carpinus betulus* and *Corylus avellana*.

The forests are a mixture of woody species: *Tilia tomentosa*, *Carpinus betulus*, *Ulmus foliacea*, *Fraxinus excelsior*, *Quercus robur*, *Quercus robur* with *Carpinus betulus* and *Corylus avellana*, along with which *Quercus petraea* can appear. *Quercus frainetto*, *Acer campestre*, *Ulmus foliacea* and *Carpinus betulus* have a more limited distribution. The subshrub is dominated by *Ligustrum vulgare*, *Crataegus monogyna*, *Rosa canina*, *Cornus mas*, *Cornus sanguinea*, etc. *Brachypodium silvaticum*, *Hypericum hirsutum*, *Geum urbanum*, *Carex* sp., *Juncus* sp., *Convallaria majalis*, *Fragaria vesca*, *Festuca gigantea*, *Hieracium racemosum*, *Hieracium murorum*, etc. dominate the structure of the grassy vegetation under the forests. On soils with groundwater at depths greater than 2 meters, plant associations of *Festuca sulcata* with *Festuca pseudovina*, *Poa bulbosa*, *Alopecurus pratensis*, *Koeleria gracilis*, *Lolium perenne*, *Euphorbia cyparissias*, *Antoxantum odoratum*, *Lolium perenne*, *Plantara lanceolata* appear. The associations of *Alopecurus pratensis*, *Poa pratensis*, *Agrostis stolonifera* and *Agrostis alba*, occur in wet pastures and hayfields. *cannina*, *Trifolium hybridum*, *Festuca pratensis*, *Phragmites communis*, *Typha latifolia*, *Carex* sp., *Juncus effusus*, *Juncus inflexus*, *Scirpus palustris*, *Schoenoplectus palustris*.

#### **Taxonomic units of higher level soils in the Low Plain of Crişuri**

Following field research and subsequent correlation with laboratory results, 13 soil types belonging to 7 soil classes were identified, researched and mapped and 60 soil subtypes (Table 1 and Table 2)

*Table 1.*

Soil cover of the Low Plain of Crişuri (by territorial administrative units), by classes and types of soils (according to SRTS)

Crt. No.	Soil type (World Reference Base for Soil Resource)	Area of spread
1	Regosols	The old terraces of the rivers
	Fluvisols	Sântandrei, Oradea, Batăr, Apateu, Ciurmeşiu, Boiu, Avram Iancu, Tâmaşda, Chiorac, Craiva, Coroi.
2.	Cernozems	Vârşad, Pîlu, Grăniceri, Sîclău, , Nădaş, Olari, Cîntei, Siontea Mică, Zărand.
	Phaeozems	Berechiu, Bicaci, Homorog, Sântău Mic, Sântău Mare, Girişu de Criş, Tărian, Sântandrei, Vânători, Boiu, Roit, Sânicolau Român, Cefa, Mădăras, Salonta, Roşiori,

3.	Cambisols	Sântandrei, Salonta, Oradea, Parhida, Niuved, Arpășel, Tulca, Bătar, Tăut, Mădăras, Ineu, Chereșuș, Vaida, Homorog,
4.	Luvisols	Sepreșuș, Mișca, Zerindu Mic, Tămașda, Ghiorac, Tinca, Chișineu Criș, Seleșuș, Ineu, Nădab, Chereșuș, Șicula, Sinteia Mică, Oradea, Miersig, Bicaci, Gurbediu.
		Mioșca, Sepreșuș, Zerindu Mic, Ghiorac, Tămașda, Oradea, Ucriș, Căușad, Usag, Craiva, Crișu Negru, Avram Iancu.
	Planosols	Sunt răspândite în complex cu luvisolurile
5.	Vertisols	Zerindu Mic, Sepreșuș, Vășad, Moroda, Pîlu, Cînteia, Sinteia Mică, Zărand, Nădab, Zerind.
6.	Gleysols	Borș, Parhida, Tulca, Ghiorac, Cefa, Homorog, Salonta, Ciurmeșiu.
	Stagnic Luvisols	Girișu de Criș, Ghiorac, Tămașda, Zerindu Mic, Vânători, Sepreșuș, Oradea, Cihei, Bicaci, Vasile Goldiș, Avram Iancu, Coroi, Tălmaci, Soșag, Berechiu.
7.	Solonetz	Tărian, Cheresig, Sântion, Mihai Bravu, Tămașda, Cînteia, Sinteia Mică, Zărand, Grăniceri, Socodor, Ineu, Adea, Mișca, Zerind,
	Solonchaks	sectorul Zărand-Cînteia-Sinteia Mică, județul Arad.

*Table 2*

Soil units from Low Plain of Crișuri, by territorial administrative units, and areas  
(according to SRTS)

Subunit of the plain	Total area -ha	soil type	Surface - ha Location- ha	Location- ha
Borșului Plain	15516	Fluvisols	7229	Borș, Biharia, Cetariu, Oradea, Sântandrei, Girișu de Criș, Toboliu.
		Phaeozems	4463,9	
		Gleysols	2776,6	
		Cambisols	605,2	
		Luvisols	345,5	
		Solonetz	1,3	
		Valleys, canals, waters	223,3	
Parhidei Plain	5509,6	Phaeozems	2514,8	Roșiori, Tămașeu, Biharia, Sălărd și Cetariu.
		Gleysols	1665,0	
		Cambisols	826,8	
		Solonetz	276,6	
		Luvisols	31,9	
		Fluvisols	18,0	
		Valleys, canals, waters	176	
Salontei Plain	14269,3	Phaeozems	10495,1	Toboliu, Nojorid, Sânicolau
		Solonetz	7572,4	
		Cambisols	3848,5	

		Gleysols	2284,8	Român, Cefa,
		Vertisols	701,2	Mădăras,
		Luvisols	59,3	Salonta,
		Fluvisols	14269,3	Ciumeghiu,
				Avram Iancu.
Crişului Alb Plain	51041,4	Cernozems	12425,6	Pilu, Socodor,
		Phaeozems	10495,1	Grăniceri,
		Solonetz	7572,4	Marca, Şimian,
		Cambisols	3848,5	Chişineu Criş,
		Gleysols	2284,8	Zărand, Olari,
		Vertisols	701,2	Pâncota, Seleuş,
		Luvisols	59,3	Ineu.
Crişului Alb Plain	51041,4	Cernozems	12425,6	Pilu, Socodor,
		Solonetz	12086,7	Grăniceri,
		Cambisols	1202,8	Marca, Şimian,
		Luvisols	1353,7	Chişineu Criş,
		Arenosols	55,6	Zărand, Olari,
		Rendzic leptosols	2,1	Pâncota, Seleuş,
		Valleys, canals, waters	64,0	Ineu.
Crişului Negru Plain	34823,3	Fluvisols	18957,6	Tulca, Tinca,
		Cambisols	5766,7	Batâr,
		Gleysols	2652,5	Ciumeghiu,
		Phaeozems	2296,3	Apateu, Mişca,
		Solonetz	2128,8	Sîntea Mare,
		Luvisols	2309,1	Sepreuş
		Vertisols	521,4	
		Stagnic Luvisols	217,8	
Ineului Plain	35666,4	Fluvisols	18781,6	Mişca, Avram
		Vertisols	5417,8	Iancu, Zerind,
		Cambisols	3014,2	Socodor,
		Phaeozems	2701,5	Chişineu Criş,
		Gleysols	2358,2	Sîntea Mare,
		Solonetz	2249,9	Zărand, Şicula,
		Luvisols	1014,4	Ineu, Beliu,
		Cernozems	38,7	Cermei.
		Valleys, canals, waters	38,7	
Chisinau Cris Plain	12221,1	Vertisols	4466,8	Chişineu Criş,
		Fluvisols	4004,7	Zerind, Socodor,
		Solonetz	2488,4	Pilu
		Phaeozems	1116,3	
		Gleysols	144,9	

## CONCLUSIONS

The identification of soil taxonomic units was performed at the level of soil class, type and subtype. In the Low Plain of Crişuri, the largest

surface is occupied by the soil type Fluvisols 7.0916.0 ha, present in all plain subunits. Luvisols occupies an area of 5,259.5 ha, in the Crişului Alb Plain, Crişului Negru Plain, Ineului Plain, in a smaller property Borşului Plain, and of planosols, present in Crişului Alb Plain and Borşului Plain.

Cernozems occupy an area of 46,258.7 ha, the class is represented by calcium cernozems in the Crişului Alb Plain and the Ineului Plain, phaeozems are present in all areas, and rendzic leptosols that occupy very small areas in the Crişului Alb Plain. Gleisols and stagnic luvisols occupies an area of 22,714.1 ha, represented by the types of stagnant soil luvisols, present in the Crişului Negru Plain and gleisols, present in all areas of the Low Plain.

Solonetz occupies an area of 26,804 ha and is spread in all areas of the Low Plain. Cambisols occupy 15,264.2 ha, eutric cambisols being spread in all areas of the plain. The soils from the vertisols class occupy larger areas in the Low Plain compared to the High Plain, the total area occupied by vertisols being 12,996.9 ha, present in the Salonte Plain, the Crişului Alb Plain, the Crişului Negru Plain, the Ineului Plain and the Chişineu-Criş Plain.

In a systematic presentation, the studies and researches with pedogeographic character carried out in the Low Plain of Crisuri, constitute a real basis in solving some aspects little studied or neglected so far, regarding:

- making maps and sketches on the main pedogenetic factors: climate, relief, rock, groundwater.
- making soil maps, in a unitary conception
- obtaining and carrying out maps regarding: soil properties, soil technological indicators and maps regarding production capacity
- conservation and rational use of the entire land fund
- knowledge of soil surfaces affected by erosion and establishment of anti-erosion measures in order to capitalize on these lands
- improvement of soils affected by salting; depending on the degree of alkalization or salinization
- the improvement of acid soils followed the knowledge of the physico-chemical properties, the hydric regime, the nutritional regime and the surfaces occupied by these soils
- land leveling, by knowing the thickness of the humiferous horizon and the degree of development of the profile
- organization of the territory
- designing land improvement works
- the correct application in the units with agricultural profile of a differentiated agrotechnics
- credit rating and technological characterization of land areas



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## ECOLOGICAL EFFICIENCY IN URBANISM AND LAND PLANNING

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### Abstract

*This paper explains what the Cradle to Cradle concept would be like in the practice of urbanism and landscaping. The ecological efficiency described by this concept provides a handy tool, both in planning thinking and discussions, and for creating sustainable alternatives. Cradle to Cradle is a sustainable development concept that teaches us how to apply sustainability to new dimensions by creating quality products both biologically and technically. It provides us with in-depth knowledge and tools to work on Cradle to Cradle type projects, not only in industrial design, but in all fields such as architecture, infrastructure, energy, politics, scientific research, etc., not only with materials and products, but also with logistics, partnerships, business models, and the pooling of materials or things developed and / or re-designed in accordance with C2C requirements.*

**Key words:** concept, sustainable development, effective, design, urban planning

### INTRODUCTION

Since 2000, more and more attention has been paid to urbanism and spatial planning both around the world and in our country, more exactly to: spatial quality, sustainable development, ecological efficiency of spaces, in both urban and rural environments (Timofte, 2016). Sustainable development and environmental awareness are not just areas for activists. That is why the media puts a special emphasis on sustainable development. Even the government and the private sector feel more involved in this and play an important role into it. In our country, there is the Agency for Sustainable Development for each county, in order to facilitate cooperation between member administrative-territorial units, in order to promote and implement development projects of common interest in compliance with the principles of sustainable development.

A new way to become sustainable is the "Cradle to Cradle" concept created by M. Braungart and W. McDonough in 2002. They thought of this concept as a journey. In their book, the two authors insisted on the right of humanity and nature to co-exist, recognized interdependence, respected the relationship between spirit and matter, accepted the consequences of design, created objects safe with long-term value, eliminated the concept of waste, rely on natural energy flow, understood the limitations of designers, seek constant improvement by sharing knowledge. (Braungart, & McDonough, 1992) Then the two thought of this concept as a frame: by cultivate

diversity, connect place and context, combine city and nature, anticipate change, continue innovation, design healthy systems, empower people to transform the city.

These are the three C2C principles:

1. Waste = food; any food can be a nutrient for something else. Biological or technological nutrients should be reused as nutrients for natural and/or production processes.

2. Use solar energy: energy should come from renewable resources.

3. Celebrate diversity: biological, cultural and conceptual diversity should be strengthened, promoted and combined.

In other words, sustainable development can be achieved by using recycled materials in a closed circuit and giving up strict dependence on raw materials. This means that the products are made of pure components, which are easy to disassemble, in order to create new products, and to reintroduce them either in a biological or a technical cycle. Manufacturing processes are based on renewable energy, water conservation and embrace social responsibility. (Working and learning in a world of C2C, 2013)

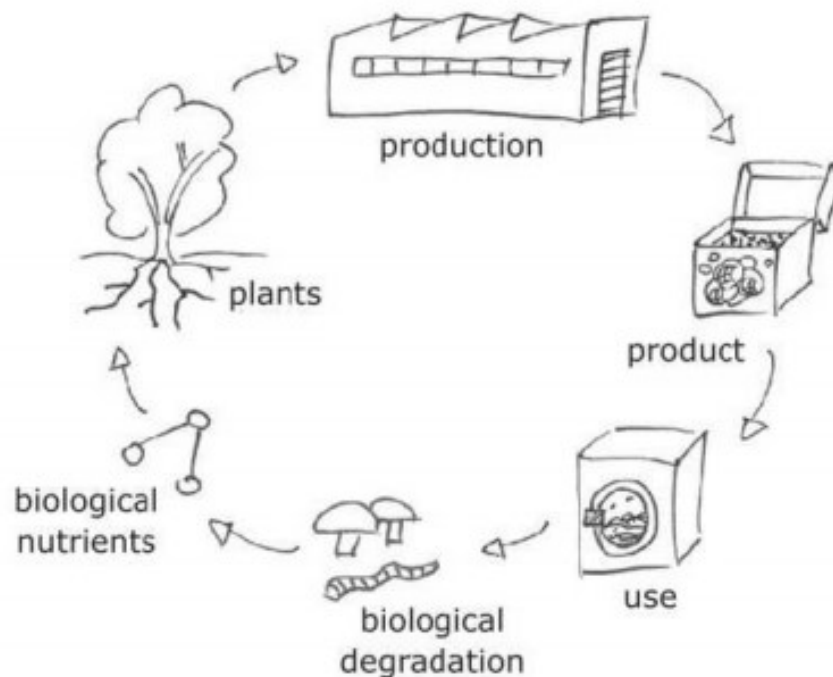


Fig. 1 Biological cycle of consumer products  
([www.EPEA-akademie.de](http://www.EPEA-akademie.de))

Despite the fact that Cradle to Cradle has been widely applied in product development, with a focus on recycling and use of materials (for example: Nike shoes, Rohner Textile AG Climatex - textiles, Herman Miller office chair, floor, roof, lighting, Desso - carpets, etc. (MBDC all with C2C certificates, 2011), the application of this concept is less known in other areas such as urbanism and landscaping. (9)

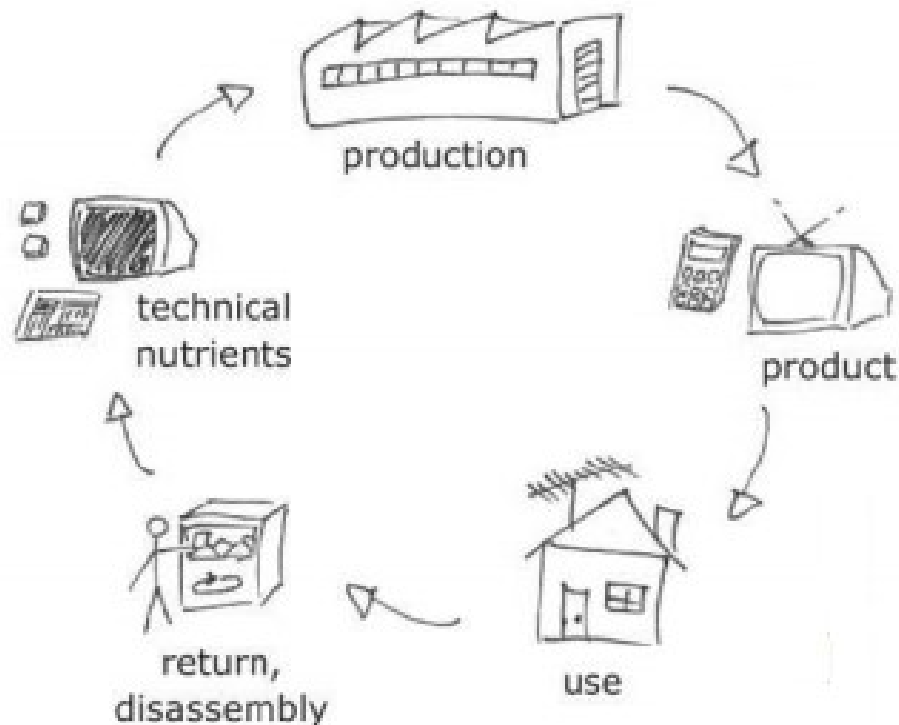


Fig. 2 Technological cycle of products that provide services  
([www.EPEA-akademie.de](http://www.EPEA-akademie.de))

However, unlike other concepts, Cradle to Cradle is not just about recycling waste and generating energy but goes deeper into the process of turning an urban or rural area into something that involves a lot of intangible products. Therefore, in applying the concept of Cradle to Cradle in the process of urbanization and landscaping of a city it is important to focus on its guiding principles and principles of transformation. (Feddes,, 2008)

As it was presented earlier, this concept is inspired by nature. Ecological efficiency aims at designing systems that simulate the healthy

abundance of nature in a city. It is a change of perspective, from the old perspective of nature, to something to be controlled.

Using natural resources efficiently, we create an ecosystem that integrates easily into nature and produces abundant resources for another ecosystem. Its main design objective is to be energy efficient. From an industrial design perspective, this means products that work in life cycles from cradle to cradle not from cradle to grave. (8)

## **MATERIAL AND METHOD**

Eco-efficiency or ecological efficiency means consuming and producing less by minimizing, avoiding and reducing waste. The goal is to create a society with: zero waste, zero emissions, zero ecological footprint. As long as human beings view the word zero as a "zero" word, a "zero society" is a good goal. (Albrechts, 2001)

Ecological efficiency, on the other hand, is certainly a well-intentioned concept, but unfortunately it is not a successful long-term strategy because it does not address the issue in depth. It works within the same system that caused the problem, slowing it down with moral reproaches and punitive demands. Based on the ecological efficiency of saving the environment, this concept will actually achieve the opposite - it will let the industry finish everything quietly, persistently and completely. (Tosics, 2003).

Landscaping is vital to the future of any country. In particular, urbanism contributes to the conservation of common resources: land, air and water, which are subject to increasing development pressure. If a city is to have sustainable economic growth and an equitable society, then ecologically efficient spatial planning is needed. The specific strength of urbanism lies in its ability to create opportunities and counter threats posed by new developments. Urbanism is situated, simultaneously, between the long-term action and the application, in emergency regime, of some immediate effective actions.

The common vision and principles adopted by urban planners across Europe guide their actions towards achieving greater coherence and greater and lasting cohesion. These objectives can be achieved by developing networks of cities and regions interconnected with each other, efficiently with the whole society.

Urbanism allows communities to formulate strategic visions to achieve their aspirations. The expression of these strategic visions can directly and significantly influence the creation of optimal living areas and the construction of a sustainable future for communities across Europe. Urbanism, associated with land use planning, intervenes at all territorial

levels, from the local to the national, cross-border and beyond European borders.

European diversity is expressed by the local specificity and by the interdisciplinary nature of the urban planning profession in Europe. These particularities guarantee that urbanism takes into account the diversity of cities, regions and other European entities, which are defined by specific geographical, environmental, landscape and cultural conditions. Therefore, this ecologically efficient concept does not advocate a unique system of spatial planning, but emphasizes the value of urbanism and spatial planning as tools of work and creation, regardless of the administrative framework in which it intervenes.

## **RESULTS AND DISCUSSION**

The landscaper or urban planner sets some ecologically efficient principles from the beginning of the project so that in the end the chances of success are maximum:

Setting the intention - choosing a new paradigm. Thus, in planning or transforming an urban area, do not choose an old model to do something efficient, but choose a new effect. This requires a clear vision that must be clearly communicated to all affected actors so that everyone can see and understand your intention, the direction of development of your urban or rural intention.

Restoration - something new does not mean the destruction of all that is old. It is important to fight for it to create a good local image. In other words, you can design a neighborhood with "restoration capacity" by using the history, local culture or elements of nature that function as "carriers" for its urban transformation. Here are some examples: the use of a portion of an "old street" to restore a new area has proven that it can be restored and may even remain habitable; or restoring the original structure of a natural feature can create more space for other natural elements, which in turn can improve the quality of our urban environment or even mitigate natural disasters. (Kusumo, 2011)

Be inventive - restoration does not mean that we stop in time and do not innovate anything. Don't just focus on basic activities, but leave room for innovation, new experiments, and adjustments to new situations. Sustainable development is often a long-term process. Due to the complicated trajectory of the permit, it takes years before a plan can be made. If the plan was completed, the community changed and a new social trend emerged. Therefore, a modern large-scale landscaping, after a few years, will be old. This makes the plan quite rigid and inflexible. On the other hand, eco-efficient small-scale planning provides more room for real-

time adjustments and innovations. In this way, you can create a neighborhood where the use of the land and its functions are flexible and multifunctional, offering opportunities for change or dividing the plots only when necessary. In this way, the neighborhood will be ready for any change in the future and will be invented with the change. This will stimulate diversity and mixed function, so that the inhabitants of the neighborhood can be preserved.

Preparing the roadmap - innovation requires openness to the signals that come from society, the environment and the world in which we live. It is not a long process but it is the result of our communication with all the parties involved. Regarding the C2C concept, McDonough & Braungart (2002) said: "be open to feedforward, not just feedback". Understanding these signals and continuing to learn from them will make it easier to recognize that change can be difficult, messy, and time-consuming. But it is important to offer a way to adapt and invent on the go. Rather than spending time and money correcting an existing plan, it would be better to design an environmentally oriented plan, a future-oriented plan, an innovative plan based on "feedforward" involving different disciplines, a new technology, the principles of nature and society in which live.

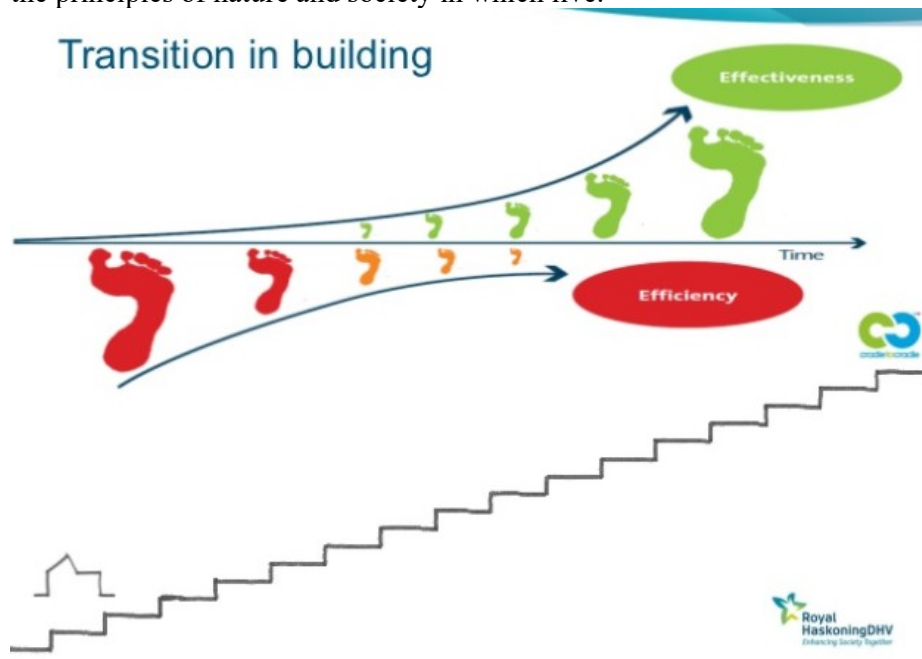


Fig. 3 Road Map  
(Michiel Visscher (Cradle to Cradle consultant Buildings, Royal Haskoning DHV))

Accountability - one of the main goals of sustainable development is to design a neighborhood where the basic needs of the next generation can be guaranteed. One way to do this is by trying to be trained in the basic needs of our modern society, such as food, water and energy. The supply of necessary food can be done by creating urban farms or by stimulating urban agriculture and urban gardening. The inhabitants of the city can use the space in front of the block or from their own balconies to generate their own food. In this way, many families can (partially) meet their nutritional needs. Obviously, another way would be to stimulate the local economy or even social cohesion in the neighborhood. Along with food, clean water should be guaranteed for the next generation, applying the principles of ecological efficiency of water recycling, making them aware of its efficient use. Energy availability is another important factor for the next generation. Designing a neighborhood that encourages walking and creates sustainable transportation systems reduces energy demand in any urban area. Projects must be submitted for the use of sustainable energy and the natural resources such as wind, solar energy and water inside the neighborhood must be renewable. And encouraging the community to use fossil fuel energy as efficiently as possible.



Fig. 4 Forrest in Rotterdam

These eco-efficiency principles are citizen-oriented and focus heavily on participation and communication between landscapers and society. In this way, the Cradle to Cradle concept can be effectively applied in urban planning and landscaping and considered a modern process.

Applying these principles to field projects will be a personalized task of innovation and design, but it will allow these projects to pursue their full potential. One of the first examples of the application of the Cradle to



Cradle principle for urban planning was made in the city of Venlo, one of the satellite cities in the Netherlands (6).

## CONCLUSIONS

At first glance, it seems that the Cradle to Cradle concept can offer only a limited solution for sustainable urban development, but if we study in depth its ecologically efficient vision, we realize that it offers a lot of possibilities: a different approach to sustainable planning of a city, a direction to create socially and economically sustainable environments.

A good long-term sustainable solution will be: stop investing in buildings as if they were static objects or short-term businesses, but start investing in performance like: dynamic, infinitely reusable building business, long term business case, keep the value of knowledge and materials. In this way, the landscaper will not be limited to solutions that focus only on the recycling of equipment or materials, but will overcome this and take into account the whole context around him.

Eco-friendly vision can function as a holistic economic and social framework, can provide an umbrella for other sustainable methods in urbanism, can provide transformation tools that focus more on participation and communication between landscapers and our society.

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## COMPARISON BETWEEN ANATOMICAL STRUCTURES AND METALS FROM *CHELIDONIUM MAJUS* L.

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### Abstract

*Chelidonium majus* L., also known as great celandine, from the Papaveraceae family, is a medicinal plant used to treat ulcer, cancer, liver and skin disorders. Different parts of the plant contain alkaloids such as chelidonine, chelerythrine, berberine, sanguinarine. Great celandine is known for its properties like antimicrobial, anti-inflammatory, spasmolytic, analgesic, diuretic and antitussive. This study discusses differences between anatomical structures and characteristic elements, from *Chelidonium majus* L., harvested in May 2017, from different areas of Bihor County: Borod, Borș, and eight places in Oradea: Oncea, Velența, Cantemir Blvd., Caișilor Street, Căpșunilor Street, Apostol Andrei Street, Matei Corvin Street. We determined with X-ray fluorescence spectrometry the metal and sulfur content from ten samples of *Chelidonium majus* L. harvested from different areas of Oradea and from Bihor county and we observed that these metals are below the toxicity limit set by current standards, so they are not dangerous for the human body.

**Key words:** *Chelidonium majus* L. , alkaloids, metals, antimicrobial, medicinal plant.

### INTRODUCTION

*Chelidonium majus* L., commonly known as greater celandine is an herbaceous plant easily recognizable by the yellow latex that comes out the moment you break it and in contact with the air turns brown as shown in Fig. 1 and Fig 2.



Fig. 1. Vegetable product of *Chelidonium majus*



Fig. 2. Section through the stem of *Chelidonium majus*

*Chelidonium majus* L. is a plant of the Papaveraceae family, which grows wild in Asia, Central and Southern Europe, the Azores and North America (Gilca M. et al., 2010, Gușiță B. R., Datcu A. D., 2019, Kadan G. et al., 1990, Pantano F. et al., 2017). This plant has been used for a long time in hepatobiliary disorders, gallbladder and digestive dysfunctions, spasms, and in phytotherapy and traditional medicine (Barnes J. et al., 2007). Also, *Chelidonium majus* have diuretic, antitussive, eye-regenerative effect, anti-osteoporotic activity, radioprotection and antispasmodic and relaxant activity (Zielinska S. et al., 2018).

Celandine is very common in shady places, around human settlements, in bushes and up to the mountain region. The plant is rich in isoquinoline alkaloids, which have anti-viral effects (Samatadze T.E. et al., 2020). Also, it is used in the cosmetic industry for treating skin scratches because has antibacterial effects like many other plants, for example *Calendula officinalis* L. (Dejeu I. et al., 2019). The main components are: chelidonine, homochelidonine, chelidonic acid, saponosides, carotenoids, resinous substances, volatile oil, flavonoids, tannins, nicotinic acid and nicotinamide (Habermehl D. et al., 2006, Warowicka A. et al., 2019, Zielinska S. et al., 2020).

Celandine is recommended in the natural therapy of liver diseases, in the healing process of constipation and rheumatism (Freire C.J. et al., 2020, Kumar Singh A. et al., 2020, Nawrot J. et al., 2020) and the yellow milky sap latex is used in skin diseases and warts for the antimicrobial properties (Salome Abarca L.F. et al., 2019, Warowicka A. et al., 2020).

## MATERIAL AND METHOD

The microscopic analysis involves the comparative study of anatomical structures and characteristic elements, from several vegetable products of *Chelidonium majus* L., harvested in May 2017, from different areas of Bihor County: Borod, Borș, and eight places in Oradea: Oncea, Velența, Cantemir Blvd., Caișilor Street, Căpșunilor Street, Apostol Andrei Street, Matei Corvin Street.

Stem and leaf cross sections were performed and the pollen grains were morphologically studied, which were subsequently analyzed under the Optika B350 Analysis Microscope.

The identification and differentiation of tissues (mechanical fibers, secretory channels, conducting bundles, etc.) were possible by different staining of cell membrane under the action of chemical dyes: the cellulose membrane was colored red and the lignified one was yellow.

The solutions used in optical microscopy were:

1. Aqueous- ammoniacal solution of Congo red: Congo red 3 g, distilled water 100 ml, ammonium hydroxide conc. 5 ml.
2. Chrysoidin alcoholic solution: 0,1 g chrysoidin, 12 ml 96° ethyl alcohol.

The prepared solutions were kept for 2 days, stirring from time to time. After dissolution, the two solutions were mixed and kept at rest for days. After filtration, the solution was conditioned in a brown bottle. The mixture is known in the literature as the *Genevez reagent*.

The sections were stained for 1-3 minutes and then the excess dye was removed by washing with distilled water.

Determination of the metal and sulfur content of the ten samples of *Chelidonium majus* was performed using GNR TX 2000 X-ray fluorescence spectrometry. That must be carefully selected, handled with care, because modern spectrometers can detect even the fingerprints of the person handling the samples. Circular samples (in the form of discs) with a radius of 5-10 mm can be measured, placed in a support that is inserted into the spectrometer (Antal et al., 2011).

## RESULTS AND DISCUSSION

In cross-section, the stems used from various populations of the species *Chelidonium majus* L., have a uniform round-oval contour on the outside.

The epidermis contains one single layer of cells, tightly joined together and with slightly bulging outer walls. Next is the subepidermal parenchyma, in which the first 2-3 layers of cells are collenchyma and contribute to increasing the resistance of these strains. The assimilating parenchyma consists of cells with thin, cellulosic walls, rich in chloroplasts. In this parenchyma are arranged the mixed conducting fascicles. The conducting bundles are made up of liberian tissue located on the outside and woody tissue located towards the central axis of the stem. Central has a medullary gap (Pallag, 2015, Szabo, Pallag, 2007, Szabo, Pallag, 2007, Szabo, 2009).

We observe in Fig. 3-6 that the stems of *Chelidonium majus* L. harvested from Borod and Velența Oradea have a much larger gap, and the

number of fascicles and secretory channels are smaller, compared to specimens harvested from Borş and Oncea in Oradea city.

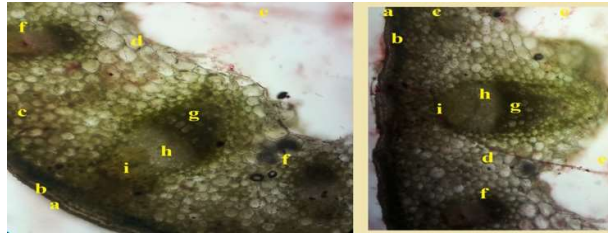


Fig 3: Cross section through the strain of *Chelidonium majus* L. – Borod, 2017 (ob. 10 x): a-epidermis, b-collenchyma, c-subepidermal assimilative parenchyma, d-fundamental parenchyma, e-gap, f-conducting bundle, g- wood, h- free.

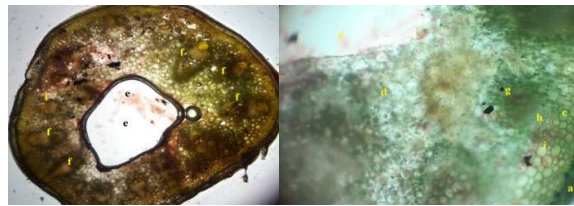


Fig 4. Cross section through the strain of *Chelidonium majus* L. – Borş, 2017 (ob. 10 x): a-epidermis, b-collenchyma, c-subepidermal assimilative parenchyma, d-fundamental parenchyma, e-gap, f-conducting bundle, g- wood, h- free.

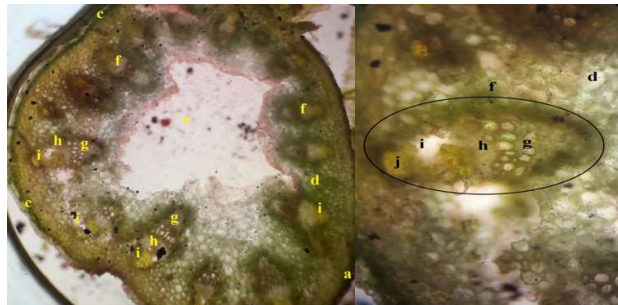


Fig 5. Cross sections through the strain of *Chelidonium majus* L.- Oncea, Oradea, 2017(ob. 10 x): a-epidermis, b-collenchyma, c-subepidermal assimilative parenchyma, d-fundamental parenchyma, e-gap, f-leading beam, g- wood, h- free, i- secretory canal, j- sclerenchyma sheath

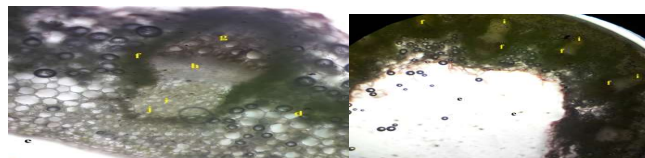


Fig 6. Cross sections through the strain of *Chelidonium majus* L.- Velența, Oradea, 2017(ob. 10 x): d-fundamental parenchyma, e-gap, f-leading beam, g- wood, h- free, i- secretory canal, j- sclerenchyma sheath

The anatomical structure of the leaves from *Chelidonium majus* L. has a bifacial structure, with two epidermises with the mesophile and conducting fascicles inside it. The superior epidermis consists of a single row of cells, closely joined together. The palisadic parenchyma contains 2-3 layers of elongated cells rich in chloroplasts. In addition to the conducting bundles included in the mesophile, we identify here the presence of secretory channels protected by a sclerenchyma sheath. These secretory channels were highlighted on all leaves, regardless of the area of origin (Fig. 7).

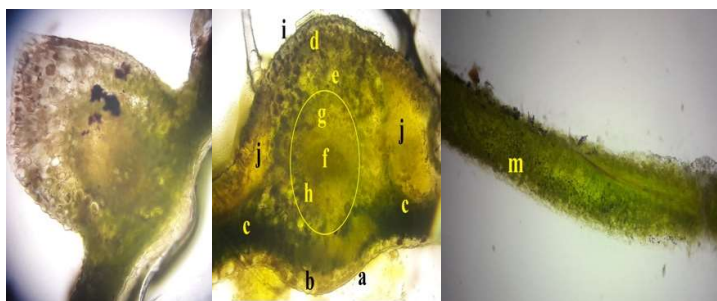


Fig. 7: Cross section through the leaf of *Chelidonium majus* L.

a - superior epidermis, b - stomata, c - palisadic assimilating parenchyma, d - collenchyma, e - conducting beam, f - wood, g - free, h - sclerenchyma sheath, i - lower epidermis, j - secretory canals, m – mesophylic

The morphology of the pollen grain in *Chelidonium majus* L. may differ even within the same genus, in terms of surface structure, shape, size and type of ornamentation.

We analyzed, by optical microscopy, the appearance, color, shape and number of pollen grains, from the stamens of celadrin flowers, *Chelidonium majus* L., harvested from various places, more or less polluted in Bihor County. From the analysis performed, we noticed that the pollen from the 10 mentioned areas is identical in shape and color. However, we also observed that the pollen grains from the Borş area are smaller in size, more abundant and have air sacs on the outside (Fig. 8-9).



Fig. 8 Pollen grains observed by light microscopy (ob. 10X) in the species *Chelidonium majus* L., origin Borod, Oncea, Velența



Fig. 9 Pollen grains observed by light microscopy (ob. 10X) in the species *Chelidonium majus* L. origin Borș

The results of the determinations of the elements that are found in very small quantities in the ten samples of *Chelidonium majus* L. harvested from different areas from Oradea and from Bihor county are represented in table 1.

Table 1

Elements determined in small quantities in *Chelidonium majus* L.

Origin of the plant product / Determined element	Pb	Se	As	Hg	Ni	Co	Mn	Cd
Caișilor Street	< 5	< 3	< 3	< 9	< 34	< 27	< 42	< 246
Matei Corvin Street	< 4	< 3	< 3	< 8	< 30	< 44	< 25	< 67
Cantemir Blv.	< 4	< 3	< 3	< 9	< 31	< 23	< 17	< 74
Săvineștilor Street	< 5	< 4	< 4	< 12	< 44	< 31	< 45	< 56
Apostol Andrei Street	< 4	< 2	< 3	< 7	< 24	< 22	< 32	< 61
Căpșunilor Street	< 4	< 2	< 3	< 6	< 22	< 22	< 31	< 44
Velența zone	< 3	< 2	< 2	< 5	< 18	< 18	< 25	< 47
Oncea zone	< 3	< 2	< 2	< 6	< 21	< 21	< 32	< 49
Borș	< 3	< 2	< 2	< 6	< 21	< 21	< 33	< 49
Borod	< 4	< 2	< 3	< 7	< 24	< 24	< 61	< 60

The analysis of the results obtained led to the conclusion that although the plant product of *Chelidonium majus* L. is not grown in standardized crops, but is harvested from places where it grows spontaneously, it also contains metals that are harmful to the body's health, but these metals are below the toxicity limit set by current standards, so they are not dangerous.

## CONCLUSIONS

The paper provides important and original information that shows the true value of the species *Chelidonium majus* L., harvested from Borod and Velența-Oradea and has a much larger gap in the stems, the number of free-wood bundles and secretory channels is lower, compared to specimens collected from Borș and Oncea-Oradea.

The pollen grains analyzed show that there are morphological differences depending on the origin of the species. Although they are identical in shape and color, it is observed that the pollen grains in the Borș area are smaller in size, more abundant and have air sacs on the outside. This is due to the fact that the Borș and Oncea-Oradea area has higher pollution, compared to the Velența-Oradea area, or Borod, probably due to the noxious substances emitted by the Electro-Thermal Power Plant, located nearby.

The analysis of the content of metals led to the conclusion that in addition to the pharmacological effect of the plant, it is also a source of minerals for the body.

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## **ASPECTS OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN AGRICULTURAL INDUSTRY**

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### **Abstract**

*The pressure to produce more food has led to the need for identification of applicable solutions, to solve, to improve the sustainability of production processes and accelerate innovation in the agriculture. These solutions based on the technical revolution can be characterized by the Farming 4.0 concept.*

*This concept is primarily based on the application of precision agriculture methods with the help of new technical achievements such as IoT (Internet of Things), AI (Artificial Intelligence), Big Data, Cloud and battery modernization. Among the important technological achievements, we list the automatic steering based on GPS, autonomous tractors and agricultural machines, the replacement of the thermal motors with electric motors, using batteries as the main source of energy, robots and drones for agriculture, direct communication between agricultural machines and centralization of all information in Cloud-based software applications.*

*This article gives a brief overview of the achievements based on artificial intelligence and machine learning for agricultural industry and tries to synthesize the main future directions.*

**Key words:** artificial intelligence, machine learning, Farming 4.0, IoT, precision agriculture, robots for agriculture.

### **INTRODUCTION**

The Department of Economic and Social Affairs, Population Division, of the United Nations, (United Nations, 2017) has predicted that the global population will reach 8.55 billion people by 2030 and almost 10 billion people by 2050. In order to feed this growing population, according to FAO, food production must increase with 70 percent by 2050 and a 60 percent increase in demand for high quality protein such as milk, meat and eggs.

Agriculture is energy intensive and the pressure to produce more food requires more energy, an increasingly costly input to the production process.

The early part of the past decade saw the rise of data-driven technologies and insights, going from basic analytics tools to the significantly more powerful business intelligence (BI) suite, which boasts the ability to aggregate an organization's data and display it, in an easily digestible format. The massive leap in analytics capacity meant that data became a valuable asset, and organizations are happy to invest millions into applications and tools if it means they can use it successfully for ROI acceleration.

Artificial Intelligence (AI) is a broad field of research at the intersection of several disciplines, among which Computer Science,

Statistics, Neuroscience, Mathematics, Cognitive Science, Information Engineering with aim to design intelligent computer systems.

Machine Learning is about programming the computer to learn from the given input automatically and improve through experience without being explicitly programmed. It has been evolving and has gained importance because of the ability to predict and have a crucial role in decision making and real time actions. Machine learning algorithms consumes large voluminous amount of data from which learning happens by considering different entities, drawing relationships and correlating them. The learning is better when there is large and diverse data integrated from various sources.

Machine learning (ML) has emerged together with big data technologies and high-performance computing to create new opportunities to unravel, quantify, and understand data intensive processes in agricultural operational environments. Among other definitions, ML is define as the scientific field that gives machines the ability to learn without being strictly programmed.

Deep Learning (DL) is a subset of Machine Learning that relies on *multi-layered neural networks* or *deep neural networks*. In particular, it is a formalism to represent the relationship between an observation and the desired behaviour. It was inspired by neuroscience, and borrows rough intuitions from how neurons in the brain are supposed to process information. (Patraucean, Pascanu, 2019).

## **MATERIAL AND METHOD**

AI and Machine Learning are emerging technology in agriculture domain. AI-based equipment and machines, has taken today's agriculture system to a different level.

This technology's has enhanced crop production and improved real-time monitoring, harvesting, processing and marketing. The latest technologies of automated systems using agricultural robots and drones have made a tremendous contribution in the agro-based sector. Various new computer based systems is design to determine various important parameters like weed detection, yield detection and crop quality and many other techniques (Liakos et al., 2018).

The most popular applications of AI in agriculture appear to fall into three major categories:

- Agricultural Robots and complex machinery's – Companies are developing and programming autonomous robots to handle essential agricultural tasks such as harvesting crops at a higher volume and faster pace than human labourers.

- Crop and Soil Monitoring – Companies are leveraging computer vision and deep-learning algorithms to process data captured by drones and / or software-based technology to monitor crop and soil health.
- Predictive Analytics – Machine Learning models are being developed to track and predict various environmental impacts on crop yield such as weather changes.
- Water management and planning – the best solutions can be determined based on information on crops, soil and weather forecast.

Blue River Technology has developed a solution for optimize use of pesticides by using advanced machine learning algorithms to enable robots to make decisions, based on visual data about whether or not a plant is a pest, and then deliver an accurate, measured blast of chemical pesticides to tackle the unwanted pests. John Deere seeing the potential of this development acquired the start-up and added it to the catalogue of high tech, data-powered services it already offers its customers (Marr, 2019).

Blue River LettuceBot2 are the perfect tools for farmers and their lettuce crops. With its imaging system, the LettuceBot2 is a popular tool in the agriculture world that attaches itself to a tractor to thin out lettuce fields as well as prevent herbicide-resistant weeds, it uses 90% less herbicide on crops. Already the firm enables automated farm vehicles to plough and sow, under the control of accurate GPS systems. On top of that, its Farmsight system is designed to enable data-driven insights to inform agricultural decision making, based on shared user data from subscribers all around the world.

Even younger companies in the field of agricultural machinery production began to produce robots. Jacto from Brazil made Arbus 4000 JAV an autonomous solution for precision spraying.

In the field of agricultural robotics, companies not related to agriculture are also involved. For instance, Google finances Abundant Robotics, which BayWa picking robot suck ripe fruit from branches with vacuums (Claver, 2019).

Perfect for those in the citrus fruit business, the Energid Citrus Picking System are fast and efficient harvesting systems. The systems can pick a fruit every 2 to 3 seconds. Even more so, the robot is cheap to build, making it significantly cheaper than human labour.

Several companies such as PEAT (with Plantix), CropDiagnosis and Trace Genomics, has developed deep learning application that reportedly identifies potential defects and nutrient deficiencies in soil. Analysis are conducted by software algorithms, which correlate particular foliage patterns with certain soil defects, plant pests and diseases. The image recognition application identifies possible defects through images captured by the user's smartphone camera.

Satellites have been used for a decade to monitor large croplands and forestry but a new level of precision and flexibility has been obtained with the use of UAVs. For example, Sen4CAP software is an advanced solution for agriculture monitoring, commissioned by the European Space Agency, gives a direct access to the complete Copernicus Sentinel satellite data repository and dynamically scalable processing opportunities (European Commission, 2018).

Drones however can monitor crops much more accurately, frequently and affordably, delivering higher quality data that are updated regularly to provide insight into crop development and highlight inefficient or ineffective practices. The ability to assess the health of a crop quickly and precisely can be invaluable for farmers. If a bacterial or fungal infection are identified, early detection allows quick action to be taken in order to remedy the issue

Predicting the crop yield in advance of its harvest would help the policy makers and farmers for acting appropriately for marketing and storage.

For increase and improve the crop yield and the quality of the crops by analysing all problems like weather, temperature and several factors, in (Champaneri et al., 2020) was uses Data mining techniques. Data mining is the process of analysing data from various viewpoint and summarizing it into important information. Random forest is the most popular and powerful supervised machine learning algorithm capable of performing both classification and regression tasks, that operate by constructing a multitude of decision trees during training time and generating output of the class that is the mode of the classes (classification) or mean prediction (regression) of the individual trees.

The most applied deep learning algorithm for crop yield prediction is Convolutional Neural Networks (CNN), and the other widely used algorithms are Long-Short Term Memory (LSTM) and Deep Neural Networks (DNN) algorithms (Klompénburga et al., 2020).

Agriculture accounts for the vast majority (70%) of water used in the world. Drones equipped with special monitoring equipment can used to identify parts of a field experiencing “hydric stress” (inadequate of water of sufficient quality). They use infrared and thermal sensors to provide snapshots of entire fields, allowing targeted diagnosis of areas receiving too much or too little water.

Vegetation indices such as normalized difference vegetation index (NDVI), normalized difference red edge (NDRE), chlorophyll-based indices (“chlorophyll map”), and other indices (SAVI, OSAVI, etc.) can be used to detect and quantify variability in the field. Digital surface models (DSMs) are digital representations of the elevation of the field and crop. They can be

used for water management and planning, water flow analysis, and crop optimization based on slope direction (Saad, 2020).

FIWARE is one of the open-source cloud platforms through which programmers can execute their applications. The cloud platform provides users with services to determine how to adjust the irrigation solution so as to keep the composition of the soil within desired parameter values. FIWARE was born in Europe from the Future Internet Public Private Partnership (FI-PPP), which aimed at accelerating the development and adoption of Future Internet technologies in Europe, advancing the European market for smart infrastructures, and increasing the effectiveness of business processes through the Internet. The European Commission has funded 2 projects to continue the FIWARE Accelerator Programme: Impact Growth and FrontierCities.

## **RESULTS AND DISCUSSION**

As an emerging technology in agriculture, Artificial Intelligence and Machine Learning must earn users' trust: it is certainly worth making them effective, but first and foremost they must be sure and safe. It is about demonstrating the seriousness of the issues surrounding safety, in order to meet the challenge of performance and sustainability

All over the world is a growing concern for the development of intelligent machines for agriculture. This concern is given on the one hand by the increasing need for food to feed the population but also due to the decrease in the workforce in agriculture and the need to protect the environment.

This concern has materialized through the emergence of precision agriculture technologies and Digital Farming or Smart Farming concepts, which has transformed into Farming 4.0, the fourth revolution in agriculture.

## **CONCLUSIONS**

We can conclude that the agricultural industry is about to be disrupted and will transform into a high-tech industry and will need a high skilled farmers.

Each of the applications and technologies presented is continuously improved both in terms of performance and environmental protection capabilities but also the reduction of prices to be available to all.

These maturing technologies are paving the way for the fifth agricultural revolution. They are supported by research in the university environment, by the achievements of the companies involved but also by government policies to support digitalization in all countries.

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## AGRICULTURAL CROPS IN THE PROXIMITY AREA OF THE FORMER URANIUM EXPLOITATION BĂIȚA, BIHOR COUNTY

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### Abstract

*The Beiuș intracoline basin is the result of the action of Crișul Negru and its numerous tributaries that had created a system of valleys with terraces and meadows.*

*Another representative category of the relief is the meadow. We notice, first of all, the Crișul Negru Meadow, intensely cultivated and humanized, as well as the meadows of the affluent rivers of: Băița, Pietros, Nimăieștilor, Roșia, etc. The meadows are inhabited and people practise the agriculture, despite the risk of floods.*

*Although there are no associative forms in the agricultural field in the Beiuș Basin, there are crops of corn, wheat, triticale, potato, etc., these crops being cultivated on relatively small plots of land, the surface of agricultural lands being strongly fragmented.*

*Agricultural lands in the Beiuș Basin, but especially in the Băița - Ștei area, during the exploitation of uranium ore, carried out for several decades, as well as after the extraction had ceased, primary processing, sorting and crushing and so far they have been exposed and they continue to be, to a greater or lesser extent, to the risk of radioactive pollution.*

*The protection for radiation represents an objective necessity determined by the fact that radioactivity and ionizing radiation have, on one hand, harmful effects on health and the environment and, on the other hand, they can be used for the benefit of people and the environment. Thus radioactivity and ionizing radiation are "hostile" phenomena ubiquitous in our natural environment.*

**Key words:** uranium exploitation, mining mouths, radioactive waste, radiations, production, agricultural lands.

### INTRODUCTION

The surface of the objective located in the South-East of Bihor county includes some elements that are specific to the mountain area (Bihor Mountains and Vlădeasa Mountains), the piedmont of these mountainous areas, as well as The Crișurilor Plain, is a component part of the Western Plain. The Bihor Mountains represent the highest and most massive unit in the Apuseni Mountains. The peaks of these mountains gently descend towards the Beiuș Basin. (Măhăra, 1977)

According to Figure 1., the studied surface of agricultural lands in the Beiuș Basin is about 38000ha.





Figure 1. Beiuș Basin (Google maps – processed, 2019)

Pedogenesis takes place in the western part of the country in a specific way in which the presence of relief, meteo-climatic and anthropogenic elements equally influences and strongly affects the solification process. In this sense, the high relief elements specific to the mountain area that are present in balance with the foothills, the basin and the high plain features, the anthropogenic component, the air movements, the rich hydrographic network act simultaneously in the soil formation process. (Brejea, 2011)

Crișurilor Plain has its easternmost branch developed on the Crișul Negru and presents notable complementary influences of mountain areas (Bihor-Vlădeasa-Codru-Moma Mountains), which have the specific presence of the anthropic element, inhabited areas, villages or hamlets with permanent character, some of them being identified even in the alpine area (Gârda, Arieșeni, Bihor Mountains, Țara Moților).

Crișurilor Plain has a narrow alluvial area less developed in the area we are referring to, the profile of the V-shaped riverbed with more or less wide arms that allow alluvium only in the floodplain area of watercourses (Crișul Negru and its tributaries). (Brejea, 2010)

The research works had been started in an organized way in the Apuseni Mountains in 1949 by the Soviets who, through aerogamma and ground prospecting, identified in the 1950s the Băita uranium deposit at 2.5 km from the Molybdenum mine, a deposit that was the object of the largest mining operation (up to date) in the country between the 1950s and the 1960s.

The extremely rich deposit in active substance from Băița, Bihor county, determined the opening and super intensive exploitation of the Bihor Mountains in the space between the sub-basin of Crișului Negru – Băița and the sub-basin Arieș - Leuca valley. (Dalea, 2004)

The negative effects on the environment are generated by previous activities, from 1952 to the present, as follows:

- soil pollution was caused by deposits of radioactive dust from undeveloped dumps and platforms and from the uncontrolled runoff;
- the pollution of waters and sediments from waters is due to the discharge into the emissary of untreated mine waters.(Dalea, 2000)

## MATERIAL AND METHOD

The research methods consisted of: measurements and observations in the field, discussions with landowners and owners, consultation of documents which had been locally archived in the area Băița - Beiuș, measurements on the level of gamma dose flow were performed in the field using the gamma radiation detector Gamma Scout Online.



Figure 1. The gamma radiation detector Gamma Scout Online

## RESULTS AND DISCUSSION

The gamma dose rate exceeds the reference threshold only in the Băița Plai area and in the other locations, where measurements on the gamma dose rate were performed on the agricultural lands in the Băița - Beiuș area, there are higher values than at national level, but they do not exceed. (Table 1)

Table 1

The gamma dose rate from the Băița - Beiuș area between 2018 and 2019

Crt. no	Year	2018		2019	
		Gamma dose rate nSv/h		Gamma dose rate nSv/h	
	Place of measurements	La sol	La 1 m	La sol	La 1 m
1	Băița Plai Barieră	246	175	238	171
2	Băița village	88	73	80	64
3	Nucet	84	70	77	62
4	Fânațe	80	67	74	63
5	Câmpani	72	60	68	57
6	Hârsești	70	62	71	62
8	Ștei next to Moara 4	87	76	88	79
9	Beiuș	60	51	62	54

In the Băița-Ștei area, due to the higher natural background of radiation, the Turda 201 hybrid corn harvest registers an increase of 3-5%, higher than in areas where the risk of irradiation is excluded, the productions were similar, quantitatively, with the production obtained in Beiuș (control area). (Table 2)

Table 2

Productions obtained in the areas studied for the Turda201 corn hybrid

Location	Year 2018 kg/ha	Year 2019 kg/ha
Băița sat	4950	4980
Nucet	4970	5010
Fânațe	4970	5020
Câmpani	4980	5040
Hârsești	4990	5035
Ștei	5050	5090
Beiuș (witness area)	5080	5125

In the Băița-Ștei area, due to the higher natural background of radiation, the Arieșan wheat harvest registers an increase of 3-5% higher than in areas where the risk of irradiation is excluded, the productions were similar, quantitatively, with the production obtained in Beiuș (control area).

Due to recent reductions in livestock in the area, manure fertilization is declining, which changes the chemical mineralogical composition or the mineral dowry of the soil. (Table 3)

Table 3

Crops obtained in the studied areas at the Arieșan wheat

Place	Year 2018 kg/ha	Year 2019 kg/ha
Băița village	4560	4585
Nucet	4580	4620
Fânațe	4590	4630
Câmpani	4590	4650
Hârsești	4600	4645
Ștei	4610	4640
Beiuș (witness area)	4685	4730

## CONCLUSIONS

The measurements performed with the Gamma Scout Online Radiation Detector from Băița - Beiuș area indicated a higher level in the area proposed by the study, but there are no values that exceed the reference level, exceeding the reference threshold is registered only in Băița Plai area.

Due to recent reductions in the livestock in the area, manure fertilization is declining, which changes the chemical mineralogical composition, or the mineral dowry of the soil.

Within the existing communes in the Băița - Ștei area, there are no associative forms regarding the agricultural areas.

In the Băița-Ștei area due to the higher natural background of radiation, the harvest registers an increase of 3-5% higher than in areas where the risk of irradiation is excluded, the productions were similar, quantitatively, with the production obtained in Beiuș (area control), both for the Turda201 corn hybrid and for the Arieșan wheat.

It is confirmed the possibility of cultivating different agricultural crops without risk, so the recovery of land areas in the places that are considered exposed to the radioactive risk factor in the vicinity of former uranium holdings.

Global and local meteorological-climatic phenomena influence the soil quality indicators and the wetter years favour the migration of radionuclides to the deeper layers of the soil.

Radiation protection is an objective necessity determined by the fact that radioactivity and ionizing radiation have, on one hand, harmful effects on

health and the environment and, on the other hand, they can be used for the benefit of people and the environment.

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## DETERMINATION OF ANTIOXIDANT CAPACITY OF ALCOHOLIC EXTRACTES FROM PEEL OF CITRUS FRUITS

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### Abstract

*Citrus fruits have a high antioxidant capacity due to the high content of volatile oils, polyphenolic compounds, flavonoids, carotenoids, bitter substances existing in the pericarp of the fruit. More and more studies show that these fruits can be used successfully to treat oxidative stress and chronic, degenerative diseases.*

*In this paper, three alcoholic extracts were made from the peel of mandarin, orange and grapefruit fruits and it was found following the Folin-Ciocalteu and colorimetric analysis that the peel of grapefruit fruits contains the highest amount of flavonoids and polyphenolic compounds with antioxidant effect demonstrated by the DPPH, FRAP and ABTS methods.*

**Keywords:** peel of citrus fruits, antioxidant, flavonoids, polyphenolic compounds

### INTRODUCTION

Although citrus fruits are originating in Asia, they can be found in all tropical and subtropical countries. World production in 2006 was over 124 million tonnes (Duthie et al., 2003, Fierascu et al., 2014).

Citrus fruits and peels are rich in natural antioxidants (flavonoids, phenolic acids) and the alcoholic extract of mandarins, oranges and grapefruits is beneficial in treating chronic diseases: diabetes, cardiovascular disease, cancer, respiratory diseases, etc. (Rafiq et al., 2016, Zou et al., 2016, Fraga et al., 2019) and in the fight against free radicals. In the shell are polymethoxylated flavonoids and glycosylated flavonoids which are found exclusively in citrus and are specific to each species where they can act as a marker of counterfeiting/denaturation in commercial juices (Gattuso et al., 2007, Mouly et al., 1994, Ooghe and Detavernier, 1997, Arias, Ramon-Laca, 2005).

There are many studies that have shown the antioxidant action of citrus by various chemical methods of analysis, but all in this paper are used the Folin-Ciocalteu method, the DPPH method (uses 2,2-diphenyl-1-picrylhydrazine reagents), the colorimetric method, the ABTS (2,2'-azino-bis-3-ethylbenzthiozoline-6-sulphonic acid) and FRAP method (ferric reducing / antioxidant power) (Zou et al., 2016, Lee et al., 2015, Rivero-Pérez et al., 2007, Benzi et al., 1999, Ou et al., 2001) because they have many advantages

and do not require the use of very expensive equipment (Zou et al., 2016, Nihal et al., 2006).

## **MATERIAL AND METHOD**

### **CHEMICALS**

UV-VIS PG Instruments T70 + spectrophotometer, reagents FRAP, ABTS, DPPH were purchased from Sigma Aldrich USA, Folin - Ciocâlteu reagent from Merck Darmstadt Germany, gallic acid and quercetin were supplied by Silver Chemicals Romania. The ultrapure water was prepared using a Millipore system (Millipore, Bedford, USA). All other analytical grade reagents were purchased by Silver Chemicals Romania.

### **PLANT MATERIALS**

For the preparation of citrus extracts, fruits purchased from the local market in Romania, Bihor Oradea were used in the winter of 2018.

The peels of *Citrus sinensis* L., *Citrus reticulata* and *Citrus aurantium* were shredded, dried and stored at room temperature until the extract was made. The orange, grapefruit and mandarin extracts were prepared using the Soxhlet device in order to determine the total content of polyphenolic compounds.

### **METHODS**

The peels of orange, mandarin and grapefruit were subjected to direct microscopic analysis using a digital microscope and an optical microscope.

Determination of content of polyphenols in citrus peels can be done by several methods: Folin-Ciocâlteu method and colorimetric method. The Folin-Ciocâlteu method determine the phenolic hydroxyl groups in citrus extracts, in a basic medium with sodium carbonate. The colorimetric method determine the concentration of flavonoids in the extracts (Istudor, 1998, Chen et al., 2015, Everette et al., 2010, Jurca et al., 2016, Dae-Ok et al., 2003, Zhishen et al., 1999).

Antioxidant capacity of citrus peel extracts was determined using DPPH, FRAP, ABTS methods. DPPH analysis was performed with 1,1-diphenyl-2-picrylhydrazyl reagent. It has an intense purple color in the solution, a color that changes to pale yellow or colorless when neutralized by flavonoids. Its color change offers the possibility to observe and visually the neutralization reaction of DPPH with compounds that have antioxidant capacity. FRAP is a simple, spectrophotometric method based on the reduction of the ferric tripyridyltriazine complex to the ferrous tripyridyltriazine complex by a reducing, the reaction taking place at acidic pH. or TEAC is based on the ability of antioxidants to reduce cation radicals

(ABTS +) a green-blue chromophore that absorbs at 734 nm, the method being done compared to a standard Trolox solution (Jurca et al., 2016).

## RESULTS AND DISCUSSION

By microscopic analysis of the external surface of both citrus species (*Citrus aurantium*, *Citrus paradisi*), as can be seen in figures 1 and 2, the secretory structures have a round or oval shape, of different sizes, arranged in a certain order.

The secretory pockets in the orange fruit have an oval shape and in the case of the grapefruit fruit the secretory pockets are in greater numbers, even in the albedo area of the fruit and have a round shape.

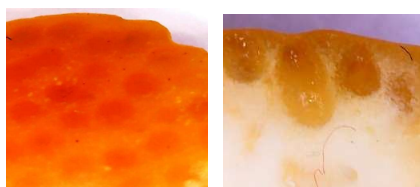


Fig. 1. Secretory pockets of the orange fruit

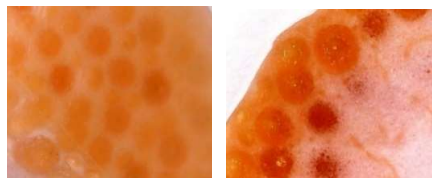


Fig. 2. Secretory pocket of the grapefruit fruit

A microscopic analysis performed using an optical microscope on successive cross sections through the epicarp of the orange and grapefruit fruit identified internal secretory pockets, larger or smaller depending on the stage of development. Microscopic preparations were studied at 10x and 40x objective. The internal space of the secretory pocket consists of flattened, parenchymal cells, closely joined together in 2-3 rows, the last row lining the secretory pocket forms the layer of secretory cells of the pocket. The secreted drops of volatile oil can only be seen in the fresh sections. The internal secretory pockets identified in the two species are differentiated by shape and number. In orange fruit, as shown in figures 3 and 4, the secretory pockets are oval, elongated, and are found only in the flavedo area of the fruit.



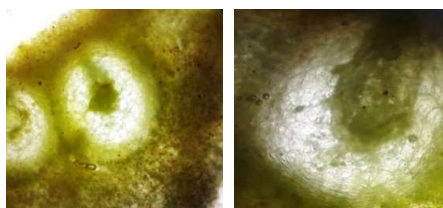


Fig.. 3. Oval internal secreting pockets, observed in the orange fruit

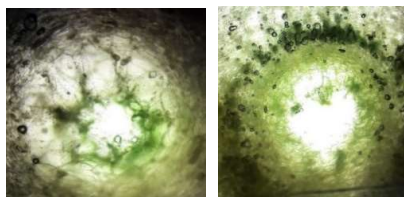


Fig. 4. Round internal secretory pockets, observed in the grapefruit fruit

The total polyphenol content determined by the Folin-Ciocalteu method is shown in table 1.

*Table 1*

Calculation of the average total polyphenol concentration of citrus peel extracts expressed in mg GAE/100 g dry product

Sample	Sample absorption read at 765 nm	Sample concentration (mg GAE/100 g dry matter)	Average sample concentration (mg GAE/100 g dry matter)
Orange	0.7065	584.9629	585.0123 ±0.4692
	0.7060	584.5926	
	0.7072	585.4815	
Grapefruit	0.7488	616.2963	615.8765±1.8024
	0.7458	614.0741	
	0.7501	617.2592	
Mandarine	0.6151	517.2592	519.6296±2.3704
	0.6211	521.7037	
	0.6187	519.9259	

From analysis of data provided in table 1 it is observed that the highest concentration of total polyphenols is found in the ethanolic grapefruit peel extract ( $615.8765 \pm 1.8024$ ), followed by the orange peel extract ( $585.0123 \pm 0.4692$ ) and then the extract from mandarine peel ( $519.6296 \pm 2.3704$ ).

Reactive oxygen species are involved in many human pathological diseases, so flavonoids are compounds that have antioxidant capacity and can fight free radicals. The amount of flavonoids determined is given in table 2.

*Table 2.*

Calculation of the average flavonoid concentration of citrus peel extracts expressed in mg EQ/100 g dry product

Sample	Sample absorption read at 510 nm	Sample concentration (mg EQ/100 g dry matter)	Average sample concentration (mg EQ/100 g dry matter)
Orange	1.5913	1930.1368	1933.2042 $\pm$ 6.3769
	1.5991	1939.5811	
	1.5911	1929.8946	
Grapefruit	1.6025	1943.6978	1947.8548 $\pm$ 4.1570
	1.6078	1950.1150	
	1.6075	1949.7518	
Mandarine	0.9940	1206.9258	1205.9168 $\pm$ 3.9553
	0.9899	1201.9615	
	0.9956	1208.8631	

Analysis of data provided by table 2 leads to conclusion that the highest concentration of flavonoids, so the highest antioxidant capacity has the alcoholic extract of grapefruit peel (1947.8548  $\pm$  4.1570), followed by the orange peel extract (1933.2042  $\pm$  6.3769) and the mandarine peel extract (1205.9168  $\pm$  3.9553).

Antioxidant capacity determined by the DPPH method on the three extracts is presented in table 3.

*Table 3.*

DPPH test results on citrus peel extracts (orange/grapefruit/mandarin)

Sample	Blanc absorbance	Sample absorbance	Percentage of inhibition, %	Average percentage of inhibition, %
Orange	0.6959	0.0381	94.5394	94.4915 $\pm$ 0.2395
		0.0372	94.6831	
		0.0400	94.2520	
Grapefruit	0.6959	0.0322	95.4016	95.5890 $\pm$ 0.2437
		0.0293	95.8327	
		0.0293	95.8327	
Mandarin	0.6959	0.0895	87.1389	87.2490 $\pm$ 0.1532
		0.0869	87.5125	
		0.0898	87.0958	

Analysis of data provided by table 3 leads to conclusion that the highest percentage of inhibition, so the best ability to neutralize free radicals has the alcoholic extract of grapefruit peel (95.5890  $\pm$  0.2437), followed by the orange peel extract (94.4915  $\pm$  0.2395) and the mandarin peel extract (87.2490  $\pm$  0.1532).

The antioxidant capacity determined by the FRAP method on the three alcoholic extracts from the citrus peels is shown in table 4.

Table 4.

Results of the FRAP method on citrus peel extracts (orange/grapefruit/mandarin)

Sample	Sample absorbance read at 595 nm	Sample concentration ( $\mu\text{mol TE}/100 \text{ g dry sample}$ )	Average sample concentration ( $\mu\text{mol TE}/100 \text{ g dry matter}$ )
Orange	1.263	69.1647	69.6835 $\pm$ 0.5188
	1.274	69.8118	
	1.278	70.0470	
Grapefruit	1.327	72.9294	72.6745 $\pm$ 0.2549
	1.319	72.4588	
	1.322	72.6353	
Mandarin	0.801	41.9882	42.4196 $\pm$ 0.4314
	0.810	42.5176	
	0.814	42.7529	

Analysis of data provided by table 4 leads to the conclusion that the highest antioxidant capacity, by the FRAP method, has the alcoholic grapefruit extract (72.6745  $\pm$  0.2549), followed by the orange peel extract (69.6835  $\pm$  0.5188) and the mandarin peel extract (42.4196  $\pm$  0.4314).

The results obtained after performing the ABTS method for determining the antioxidant capacity are shown in table 5.

Table 5.

Results of the ABTS method on citrus peel extracts (orange/grapefruit/mandarin)

Sample	Sample absorbance read at 595 nm	Sample concentration ( $\mu\text{mol TE}/100 \text{ dry matter}$ )	Average sample concentration ( $\mu\text{mol TE}/100 \text{ g dry matter}$ )
Orange	0.047	160.8471	159.7059 $\pm$ 2.2823
	0.046	157.4236	
	0.047	160.8471	
Grapefruit	0.086	239.0921	246.5077 $\pm$ 9.2695
	0.088	244.6538	
	0.092	255.7772	
Mandarin	0.072	151.0994	147.6003 $\pm$ 3.4991
	0.069	144.8011	
	0.070	146.9005	

Analysis of data provided by table 5 leads to conclusion that the highest antioxidant capacity, by the ABTS method has the alcoholic extract of grapefruit peel (246.5077  $\pm$  9.2695), followed by the orange peel extract (159.7059  $\pm$  2.2823) and the mandarin peel extract (147.6003  $\pm$  3.4991).

## CONCLUSIONS

Following microscopic determinations, it was observed that there are more secretory pockets in the peel of the grapefruit fruit than in the peel of the orange fruit, and the secretory pockets of the grapefruit peel are much more concentrated in volatile oils than of the orange peel.

Following the identification of polyphenols and flavonoids in the alcoholic extracts of citrus peels (grapefruit, mandarin, orange) we have shown that these compounds can have important antioxidant capacity. The highest concentration of total polyphenols, flavonoids and the highest antioxidant capacity, regardless of the method used, is the ethanolic grapefruit peel extract, followed by the orange peel extract and then by the mandarin peel extract.

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## DETERMINATION OF ANTIOXIDANT CAPACITY OF *HYPERICUM PERFORATUM* L. FLOWERS IN MARAMURES COUNTY BY VOLTAMETRIC METHOD WITH DIFFERENTIAL PULS

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### Abstract

*Hypericum perforatum* is a medicinal plant with a high antioxidant capacity due to its high content in flavonoids and polyphenols, as demonstrated by us in this work.

Plant was harvested from a pollution-free area in Maramures County in June when the active principles: flavonoids and polyphenols are in high concentrations in the plant. After harvesting from the plant, an extract was prepared to determine the antioxidant effect using the polarograph with differential pulse voltammetry method. The results obtained were calculated using the Trace Master 5 Software calculation algorithm and from the data analysis it was concluded that the St. John's wort flowers have a high concentration of polyphenols.

**Keywords:** plant, antioxidant, polyphenols, St. John's wort

### INTRODUCTION

*Hypericum perforatum* L. (St. John's wort, measles, etc.) is a widespread medicinal species as a geographical area and unpretentious to climatic conditions (Pallag, 2015). Although drought-resistant it prefers moist, nitrogen-rich and light soils to concentrate volatile oil (Bojor, 2018).

Many compounds have been identified in the chemical composition of the plant product: hypericin, hyperforin, flavonoids, hisperidine, isoquercetin, rutin, biflavones, tannins, polyphenolic compounds, phytosterols with many beneficial effects on the body (Pallag, 2015, Bojor, 2018).

The main effect of St. John's wort extract is the antidepressant effect, and in present there are many studies that have demonstrated this (Vollmer, Rosenson, 2004, Bojor, 2018, Sarris et al., 2012, Behnke et al., 2002, Gastpar et al., 2006). It also has other effects: antioxidant, antibacterial, antiviral (studied *in vitro* on HIV), anticarcinogen (hyperforin could offer new perspectives in the fight against cancer), oily extract St. John's wort if used externally has a healing, anti-inflammatory and skin repairing effect (Suntar et al., 2010, Barnes et al., 2001, Schempp et al., 2000, Sun et al., 2011, Henderson et al., 2002).

Different chemical methods can be used to determine the antioxidant capacity and in this paper the method of voltammetry plus differential was used. This method showed that the analyzed St. John's wort flowers has antioxidant capacity, total content of polyphenols was highlighted with ascorbic acid and gallic acid by two methods: algebraical and graphical (Ikawn et al., 2003, Ciobanu et al., 2018, Li et al., 2018, Brand-Williams et al., 1995, Sun et al., 2018).

The working electrode is used to measure and characterize chemical reactions of interest. Usually the working electrode is used in combination with auxiliary electrodes and reference electrodes, the system being tri-electrode. The working electrode can be made of gold, platinum, silver or inert carbon (glass carbon and pyrolytic carbon). Most often chemically modified working electrodes are used to research organic molecules in solutions (Jurca et al., 2016, Dae-Ok et al., 2003, Seruga et al., 2011, Romani et al., 2000).

## **MATERIAL AND METHOD**

### **MATERIALS**

Polarograph TraceLab 150 stand, working electrode made of graphene modified with graphene Metrohm, Germany, reference electrode from Ag/AgCl, KCl with double junction Metrohm, Germany, platinum wire counter electrode Metrohm, Germany, potassium chloride Silver Chemicals Romania, distilled water, rated flask, ascorbic acid Silver Chemicals Romania, gallic acid Silver Chemicals Romania, St. John's wort alcoholic extract.

### **METHOD**

After the solutions of 0.1 M KCl, 0.04 M ascorbic acid, 0.04 M gallic acid were prepared and the St. John's wort flower extract was obtained, this extract was introduced into the 15 mL electrochemical cell in which the three electrodes are found: the electrode working, reference electrode and counter electrode.

### **DRAWING VOLTAGRAMS FOR ASCORBIC ACID AND GALLIC ACID SOLUTIONS**

In the voltametric cell over 10 mL 0.1 M KCl, the ascorbic acid solution was first added in 0.1 mL steps, recording a differential pulse voltammogram after each addition and then also the 0.04 M gallic acid solution.

# DRAWING VOLTAGRAMS FOR ALCOHOLIC STRAWBERRY EXTRACT WITH THE REAGENTS: ASCORBIC ACID AND GALICIC ACID

In the voltametric cell of the device we introduced 10 mL of 0.1 M KCl solution. After the first voltammogram for KCl was recorded, I added 0.5 mL alcoholic extract of St. John's wort flowers, recorded the voltammogram and then in 0.5 mL steps to the final volume of 2.5 mL, I added the solution of ascorbic acid, using the standard addition method. The indicator electrode was used to record the voltammograms. I did exactly the same with the gallic acid solution.

## RESULTS AND DISCUSSION

In order to be able to determine the antioxidant capacity of the alcoholic extract of St. John's wort flowers, the potential values of ascorbic acid and gallic acid must first be checked. Depending on the volume of ascorbic acid and gallic acid solution that were added, the current intensities that occurred at 400 mV are shown in Table 1 and Table 2.

Table 1.

The value of the current intensity, depending on the volume of ascorbic acid solution added

Added AA solution volume (mL)	Current intensity (V)
0.1	$3.351 \cdot 10^{-7}$
0.2	$4.349 \cdot 10^{-7}$
0.3	$4.969 \cdot 10^{-7}$
0.4	$5.370 \cdot 10^{-7}$
0.5	$6.117 \cdot 10^{-7}$
0.6	$6.520 \cdot 10^{-7}$
0.7	$8.113 \cdot 10^{-7}$
0.8	$9.375 \cdot 10^{-7}$
0.9	$9.665 \cdot 10^{-7}$
1.0	$1.004 \cdot 10^{-6}$

Table 2.

The value of the current intensity, depending on the volume of gallic acid solution added

Volume of added gallic acid solution (mL)	Current intensity (V) to 400 mV	Current intensity (V) to 800 mV
0.1	$2.185 \cdot 10^{-6}$	$1.457 \cdot 10^{-7}$
0.2	$2.890 \cdot 10^{-6}$	$1.627 \cdot 10^{-7}$
0.3	$3.938 \cdot 10^{-6}$	$2.747 \cdot 10^{-7}$
0.4	$5.007 \cdot 10^{-6}$	$4.410 \cdot 10^{-7}$
0.5	$5.273 \cdot 10^{-6}$	$4.614 \cdot 10^{-7}$
0.6	$6.294 \cdot 10^{-6}$	$4.081 \cdot 10^{-7}$
0.7	$7.366 \cdot 10^{-6}$	$6.214 \cdot 10^{-7}$
0.8	$8.401 \cdot 10^{-6}$	$7.551 \cdot 10^{-7}$
0.9	$8.933 \cdot 10^{-6}$	$8.800 \cdot 10^{-7}$
1.0	$9.736 \cdot 10^{-6}$	$1.045 \cdot 10^{-6}$



Figure 1 and Figure 2 illustrate the voltammograms obtained by adding ascorbic acid and gallic acid solutions to the voltametric cell over the 0.1 M KCl solution.

Figure 3 and Figure 4 show the calibration curves of the potential values at 400 mV and 800 mV for ascorbic acid solution and gallic acid solution.

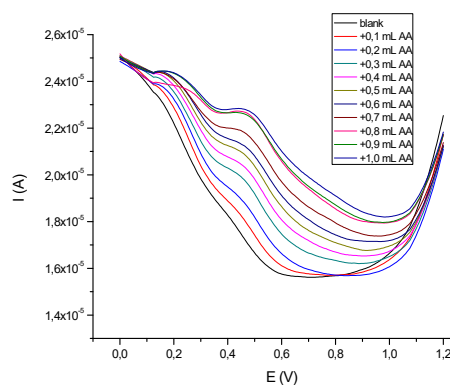


Fig. 1. Differential pulse voltammograms for ascorbic acid solution

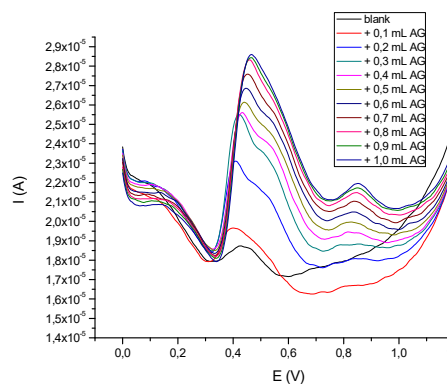


Fig. 2. Differential pulse voltammograms for gallic acid solution

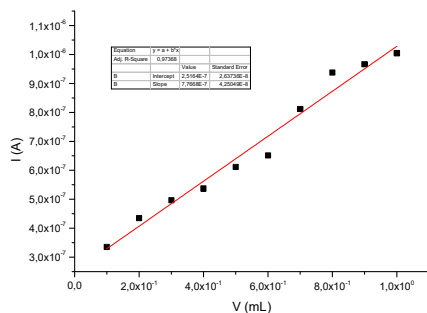


Fig. 3. Linearity of ascorbic acid solution

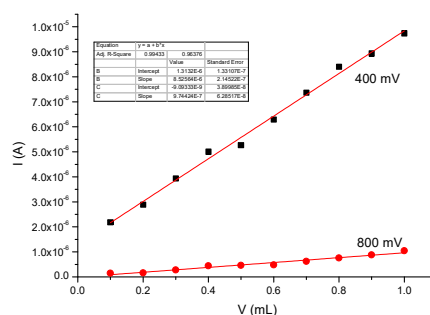


Fig. 4. Linearity of the gallic acid solution

The analysis of the calibration line demonstrates the linearity of the points for the two potentials 400 mV and 800 mV, which leads to the conclusion that this method is useful for dosing ascorbic acid and gallic acid in different products.

The values of the current intensities (baseline) corresponding to the voltammograms for the alcoholic extract of St. John's wort using ascorbic acid are presented in table 3 and the voltammogram in figure 5 and for gallic

acid the values of the voltammograms are presented in table 4 and the voltammogram in figure 6.

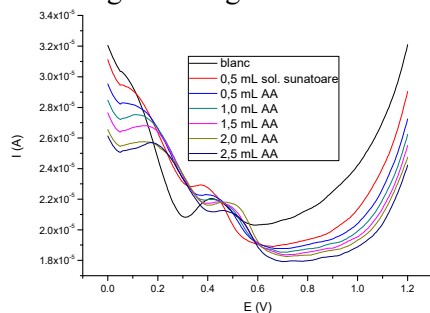


Fig. 5. Differential pulse voltammograms for alcoholic extract from flowers of sounds with ascorbic acid

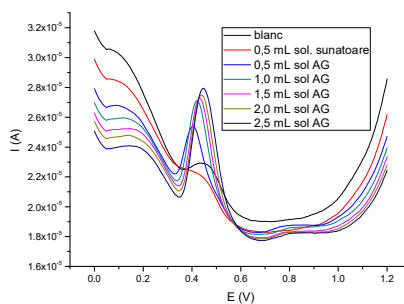


Fig. 6. Differential pulse voltammograms for alcoholic extract from flowers of gallic acid ringers

Table 3.

Intensity values as a function of concentration

Concentration (mol/L)	Intensity (A)
0	$25.76 \cdot 10^{-6}$
$1.90476 \cdot 10^{-3}$	$26.54 \cdot 10^{-6}$
$3.63636 \cdot 10^{-3}$	$27.64 \cdot 10^{-6}$
$5.21739 \cdot 10^{-3}$	$28.47 \cdot 10^{-6}$
$6.66666 \cdot 10^{-3}$	$29.53 \cdot 10^{-6}$
$8.00000 \cdot 10^{-3}$	$31.11 \cdot 10^{-6}$

Table 4.

Intensity values as a function of concentration

Concentration (mol/L)	Intensity (A)
0	$3.842 \cdot 10^{-6}$
$1.90476 \cdot 10^{-3}$	$4.262 \cdot 10^{-6}$
$3.63636 \cdot 10^{-3}$	$6.424 \cdot 10^{-6}$
$5.21739 \cdot 10^{-3}$	$6.912 \cdot 10^{-6}$
$6.66666 \cdot 10^{-3}$	$7.428 \cdot 10^{-6}$
$8.00000 \cdot 10^{-3}$	$8.479 \cdot 10^{-6}$

If it is represented graphically the intensities of the currents obtained depending on the concentration, we will obtain a line from which the concentration of the alcoholic extract solution of St. John's wort flowers can be determined in terms of antioxidant capacity relative to ascorbic acid figure 7 and for gallic acid figure 8.

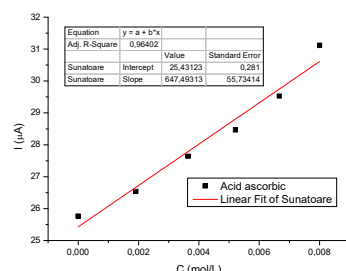


Fig. 7. Right calibration for alcoholic extract from flowers of sounds with ascorbic acid

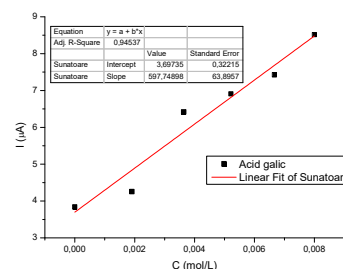


Fig. 8. Right calibration for alcoholic extract from flowers of gallic acid ringers

Calibration line for alcoholic extract of St. John's wort flowers:

- with ascorbic acid has the correlation coefficient  $R = 0.96402$  and the equation is:  $I(A) = 25.43123 + 647.49313 \cdot C(\text{mol/L})$ ,
- with gallic acid has the correlation coefficient  $R = 0.96402$  and the equation is:  $I(A) = 3.69735 + 597.74898 \cdot C(\text{mol/L})$ .

The concentration of the alcoholic extract solution of St. John's wort flowers with ascorbic acid and gallic acid can be determined by two methods:

1. Algebraical: where from the equation of the line at the value of  $I = 0$  is determined concentration as follows:

- with ascorbic acid:  $0 = 25.43123 + 647.49313 \cdot C(\text{mol/L})$ ,  $C = 3.92764 \cdot 10^{-2} \text{ mol/L}$  depending on ascorbic acid or  $C = 6.91737 \text{ g ascorbic acid/L}$ .
- with gallic acid:  $0 = 3.69735 + 597.74898 \cdot C(\text{mol/L})$ ,  $C = 6.17902 \cdot 10^{-3} \text{ moles gallic acid/L}$  or  $C = 1.05043 \text{ g gallic acid/L}$ .

2. Graphical: where the concentration is obtained following the intersection of the extension line with the Ox axis, the concentration being taken in absolute value.

Following the analysis of the two graphs, figure 9 and 10 shows that the concentration value of the alcoholic extract of St. John's wort flowers determined with:

- ascorbic acid is:  $C = 6.5 \cdot 10^{-4} \text{ moles ascorbic acid/L}$  or  $C = 11.4478 \cdot 10^{-2} \text{ g ascorbic acid/L}$
- gallic acid is:  $C = 1.15574 \cdot 10^{-3} \text{ moles of gallic acid/L}$  or  $C = 19.64758 \cdot 10^{-2} \text{ g gallic acid/L}$ .

The antioxidant capacity of the alcoholic extract of St. John's wort flowers as a function of ascorbic acid and gallic acid can be calculated using the data (coefficients of the right equation) in Table 5.

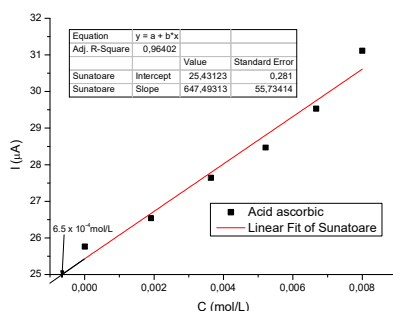


Fig. 9. Determination of the concentration for alcoholic extract from flowers of sound rings with ascorbic acid

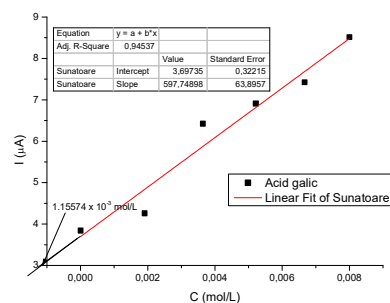


Fig. 10. Determination of the concentration for alcoholic extract from flowers of gallic acid ringers

Table 5.

Antioxidant capacity of alcoholic extract of St. John's wort flowers depending on ascorbic acid or gallic acid

Reactive	Intercept	Pant	R	Antioxidant capacity expressed in ascorbic or gallic acid equivalent/L	
				Calculated	Graphic
Ascorbic acid	25.43123	647.49313	0.96402	$3.92764 \cdot 10^{-2}$	$0.65 \cdot 10^{-3}$
Gallic acid	3.69735	597.74898	0.94537	$6.17902 \cdot 10^{-3}$	$1.15574 \cdot 10^{-3}$

From data analysis obtained for the extract of *Hypericum perforatum* we can observe that it has a concentration of  $3.92764 \cdot 10^{-2}$  moles ascorbic acid/L and  $6.17902 \cdot 10^{-3}$  mol gallic acid/L.

## CONCLUSIONS

The differential pulse voltammetry method used showed that the analyzed St. John's wort flowers have antioxidant capacity, total content of polyphenols being highlighted using the reagents used (ascorbic acid and gallic acid) by the two methods: algebraic and graphical. The method used showed that ringing flowers have antioxidant capacity, therefore this plant can be used in the fight against free radicals to preserve the health of the population.

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## MANIFESTATIONS OF THE PEST *CEUTORHYNCHUS NAPI* (LARGE RAPESEED BEETLE) IN THE AGROCLIMATE OF NORTH-WESTERN ROMANIA

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### Abstract

The expansion year by year of the areas occupied with autumn rape (*Brassica napus oleifera*) has favored, together with global warming, the increase of the attack produced by *Ceutorhynchus napi* (Rapeseed stem weevil) from a level below the economic damage threshold, at a level synonymous in some conditions with the loss of crop profitability.

The prevention and control of this pest is carried out with maximum efficiency by chemical methods aimed only at adults at the time of appearance and manifestation in the rapeseed crops, subsequent treatments after laying eggs are ineffective on eggs and larvae found in the rape stalks.

Scheduling the migration and spawning period, in some temperature conditions, associated with the similar manifestation of another pest (but higher at the lower threshold of the biological zone) *Ceutorhynchus pollidactylus* determines the number of treatments required.

**Key words:** rapeseed crop, pest, damage mode, control.

### INTRODUCTION

The increase of the cultivated areas with autumn rapeseed (*Brassica napus oleifera*) determined the proliferation of pests and consequently, the integration in the crop technology of new methods of plant protection.

If a few years before, almost entirely, the protection procedures were aimed to control pests of inflorescence and siliceous (Glossy beetle - *Meligethes aeneus*; Seed beetle - *Ceutorhynchus assimilis*; Hairy beetle - *Epicometis hirta*, Mosquitoes in bristles, *Dasineura brassicae*) in present days also are required protection measures against pests of the stem (Stem Beetle - *Ceutorhynchus napi*) and leaves (Rapeseed wasp - *Athalia rosae*; Gray cruciferous lice - *Brevicoryne brassicae*).

Favoring factors for food and climate have ensured an increasing dynamic of the pest *Ceutorhynchus napi*, registering in 2020, an attack frequency of 30-40%, manifesting in hearths.

In the first years of introduction of rapeseed into the crop, the pest *Ceutorhynchus napi* was little known, the attack being below the economical threshold, now the lack of treatment against this pest can be synonymous under certain conditions with the loss of crop profitability.

## **MATERIAL AND METHOD**

### **Pest description**

*Ceutorhynchus napi* is the most important pest from the genus *Ceutorhynchus* that causes damage in the rapeseed crop. The adults are gray with a body length between 3 and 4 mm, the legs are black and the face is 1-3 mm long. The larvae are white-yellow, without legs with a brown chitinized head (Figure 1).



Fig. 1. Aspects from S.C.D.A. Livada field

## **RESULTS AND DISCUSSION**

### **Insect biology**

This pest winters as an adult in the layer surface of the soil, around the plant where it was in nymph stage. Thus, the high level of infestation is registered in the lands cultivated in previous years with rapeseed.

The climatic factors necessary for the development of the biological processes of the insect are corresponding to the vegetation factors of rapeseed. Thus, at a soil temperature (3-4 cm) of 2 °C, which corresponds to a temperature of 7-9°C in the atmosphere, the first adults of *Ceutorhynchus* begin to appear. During this period, the rapeseed resumes its vegetation, at 2 °C, but the beginning of spring is considered when the daily temperatures average are above 5-6 °C, when the elongation of the stem begins. This moment occurs early enough in the first decade of March (Figure 2).

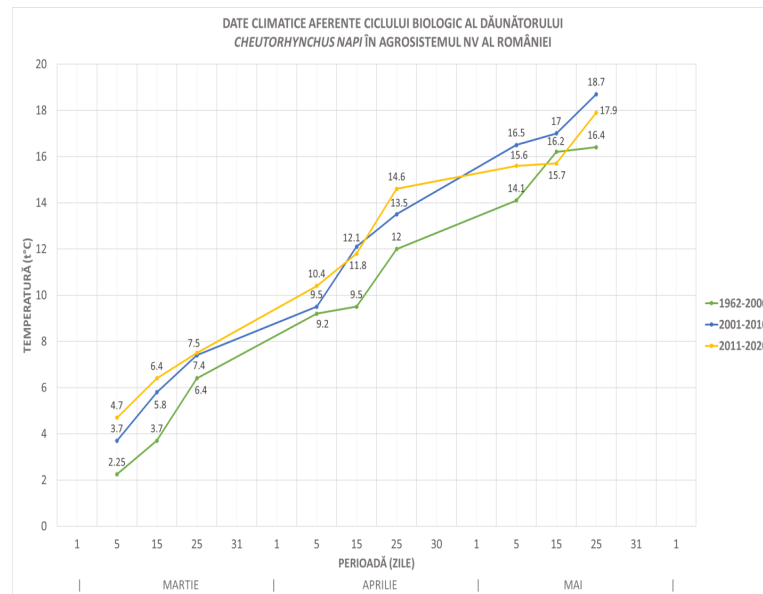


Fig.2. Climatic data related to the biological cycle

Under the conditions from Livada, the daily temperature average of 8°C, considered the temperatures threshold of biologically active appearance of adults, reached during the years 1962-2000, on April 1 and in the decades 2000-2010; 2010-2020, the moment was advanced by three days being reached on March 27-28.

Intense flight and migration in rapeseed crops occurs when air temperatures exceed 10-11 °C. In our conditions, this aspect takes place earlier starting with April 3 for the decade 2010-2020, April 7 for the decade 2000-2010, respectively April 15 for the period 1962-2000.

First, the adults feed by causing small bites on the leaves, petiole and even on the flowering stem, but without causing significant damage. Usually cultivators do not even notice the attack. The period of migration, feeding, and fertilization, until the laying of eggs lasts about 10-20 days.



Pre-fertilized females will lay eggs in the holes produced by the rostrum inside the stem. The incubation of the eggs lasts about 8-18 days, and the larval stage 21-35 days. The two stages of egg and larva are closely related with temperature. The sum of the useful thermal degrees (higher than 10°C) required for the egg-larval stages is approximately 160 ° C (Table 1).

*Table 1.*

Development of egg-larval stages in the conditions of Livada, Satu Mare

Period (years)	The period of biological stages		
	Migration + feeding + spawning	Useful thermal degrees at 160°C	Number of days
1962-2000	25.IV.-5.V.	5.V.-10.VI.	36
2001-2010	13.IV.-23. IV.	23.IV.-20.V.	28
2011-2020	14.IV.-23. IV.	23.IV.-23.V.	30

### Mode of attack

Adults, even if they feed on rapeseed leaves or cause bites on the stem, do not cause damage that could endanger the rapeseed culture. Significant damage of this pest is made by larvae. They migrate inside the stems consuming the marrow.

The symptom of larval attack is quite easy to notice. The attack manifests more strongly in hot and rainy springs. The rapeseed plant responds to the attack of larvae by tissue changes (histological). The parts above the spawning site turn in a spiral and after a period of rain or low temperatures, due to the disproportionate growth of the tissues, the stalk cracks (Figure 3).



Fig.3. Aspects from the S.C.D.A. Livada field

Sometimes the attack is not obvious by cracking and bending the stem, but the branches above the sting begin to bend, seem withered. The flowers on the branches begin to fall and the remaining siliceous is empty or contains a small number of seeds. The obstruction of the development of the plant tissues above the attack determines the start of the dormant buds under the sting, the creation of new shoots with branches, siliceous and grains of different ages. The damage caused by the weakening of the plant, due to the destruction of the tissues, is amplified by the establishment of some pathogens due to the cracks of the stem and also a higher vulnerability to breaking after storms.

### **Pest control**

The economic threshold is 2 adults per plant. In chemical treatment, the premise is that only adults of *Ceutorhynchus* are combated. There is no approved insecticide to control eggs and larvae inside the stem. Thus, all attention should be paid to the period of migration, feeding and spawning. Spraying is done at noon when the temperature is above 10 ° C and adults come out to the ground. As the occurrence and migration performed in stages depending on climate factors, one or two treatments are applied at an interval of 12-14 days.

### **CONCLUSIONS**

In the agrosystem from Northwestern part of Romania, the rapeseed crop proved to be profitable, obtaining high and constant yields in the conditions of respecting the technological elements and crop protection.

The biological zone and the thermal constant of the pest *Ceutorhynchus napi* is in correlation with the climatic preferences in the development of the phenophases of the crop plant.

The attack of the pest occurs in the phenophase of stem raising that corresponds to a climatic environment with successive temperatures over 8-10 °C.

The maximum efficiency in the pest control is achieved by insecticide treatments during the manifestation of the adult stage.

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## CURRENT STAGE OF THE RESEARCH ON THE SOIL POLLUTION WITH PETROLEUM PRODUCTS AS A CONSEQUENCE OF OIL EXTRACTION AT NATIONAL AND LOCAL LEVEL

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### Abstract

*According to the Constitution, the Romanian State recognizes the right to a healthy and ecologically balanced environment of every person, thus guaranteeing the right of association in environmental protection organisations, the access to information regarding the environment, the right to indemnification in case of damage, the right to bring before the court environmental issues, the right to be consulted in the decision-making process. In the process of harmonising the national policies with those of the European Union and of transposing and implementing the provisions of the EU regulations, the soil pollution problem represents one of the fundamental aspects of the environmental protection and the guarantee of a sustainable ecosystem development. The remediation of contaminated sites is one of the main components of a sustainable development of the communities at every administrative level. It is the basis for improving the environmental conditions, the social cohesion and the economic growth.*

**Key words** (contaminated site, bioremediation, soil pollution, EU regulations, ecosystem, sustainable development, environmental damage, environmental protection, legislation).

### INTRODUCTION

The National Agency for Environmental Protection is trying to implement a National Strategy and a National Action Plan for the Management of the Contaminated Sites of Romania, which aim at reducing the impact on the environment, generated by soil contamination. As a result of the industrial revolution, Romania inherited numerous historically contaminated sites. The history of the contamination and the aspects related to property differ from one site to another. During the development of the anthropic activities, each owner of the potentially contaminated or contaminated site had a contribution in what concerns the pollution. The strategy and action plan consists of promoting legal norms that can establish the responsibility percentage of each land owner, proportionally with the

rate of contribution to the soil contamination (National Agency for Environmental Protection 2019) .

The agriculture has an essential impact on the carbon dioxide (CO<sub>2</sub>) and nitric oxide (N<sub>2</sub>O) emissions from soil. The EU soils contain more than 70 billion tons of organic carbon, which means almost 50 times more than our annual greenhouse gas emissions. The loss of organic matter from soils and, consequently, the increased CO<sub>2</sub> emissions represent an extremely serious issue as they contribute to the climate changes.

The importance of the soil as a non-renewable resource, essential for a sustainable environment, should be recognised through broad policies and measures for its protection.

The Romanian oil and gas industry has a history of over 150 years and it has an important role for the Romanian economy. The Romanian natural gas production covers 80% of the internal consumption and the crude oil production covers approximately 40% of the necessary oil.

The first record of oil production began in 1857. The first Romanian refinery was established in the area of Ploiesti, about 60 km north of Bucharest. The production increased constantly from approximately 1.9 million tons per year in 1914 to approximately 8.7 million tons per year in 1936.



Fig. 1. Petroleum field in Moreni, 1920  
Image source: APM Bucharest site

This paper refers to the current problems of the impact that the petroleum and oil exploitation activities have on all the environmental factors, but especially on the soil and subsoil from the north-west area of



Bihor county, in Suplacu de Barcău. The purpose of this paper is to identify the sites historically polluted with petroleum products and the methods for remediating and integrating the lands in the agricultural circuit based on the land classification (Brejea,2009,2011).

The following were used for composing this paper: specialised bibliography, personal observations, documentary research, the creation of an overview of the qualitative and quantitative state of the lands.

The commune of Suplacu de Barcău is composed of six localities: Borumlaca, Dolea, Foglaș, Suplacu de Barcău, Valea Cerului and Vâlcelele. The commune centre is Suplacu de Barcău. The commune is on the eastern part of Bihor, approximately 75 km north of Oradea. It has an area of 4448 ha, out of which 775.53 within the built-up area, and a population of 4522 inhabitants.

The limits of the locality are established by the borders with the other territorial and administrative divisions that compose it:

- N- Balc locality, Bihor county commune
- S- Popești locality, Bihor county commune
- E- Marca, Sumal, Port localities from Salaj county
- V- Abram locality, Bihor county commune

On a distance of 57 km towards west, it skirts the locality of Leta Mare on the Romanian border with Hungary.

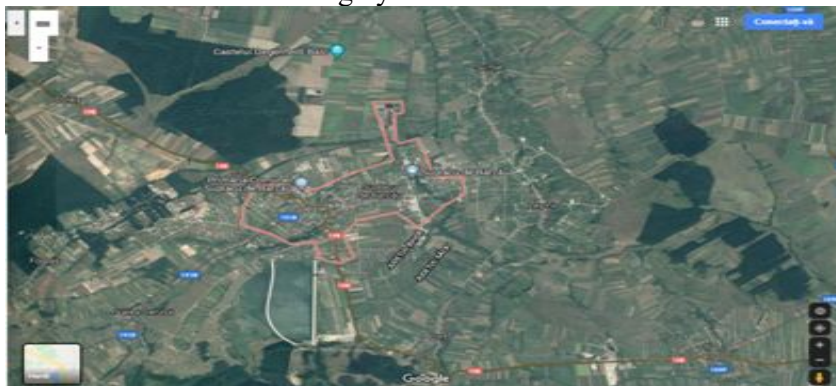


Fig. 2 Map - geographic location of Suplacu de Barcu (Google Maps source)

The studied areas are located in the built-up area and outside the built-up area of Suplacu de Barcău, being bordered by unproductive or productive lands, and nearby there are extraction activities, pipeline transport, oil processing and oil containment/storage.

Mainly because of the natural exhaustion of oil and gas resources, and the decrease in volume of the exploitation and investment works, the annual natural gas and oil production decreased in 2013 to 4.19 million tons

of oil and 11.03 billion m<sup>3</sup> of natural gas. However, in 2018, Romania remains the largest gas and oil producer of Central and East Europe.

### Oil and natural gas value chain

The value chain of the oil and gas industry is divided into three main sectors:

- Upstream,
- Midstream,
- Downstream

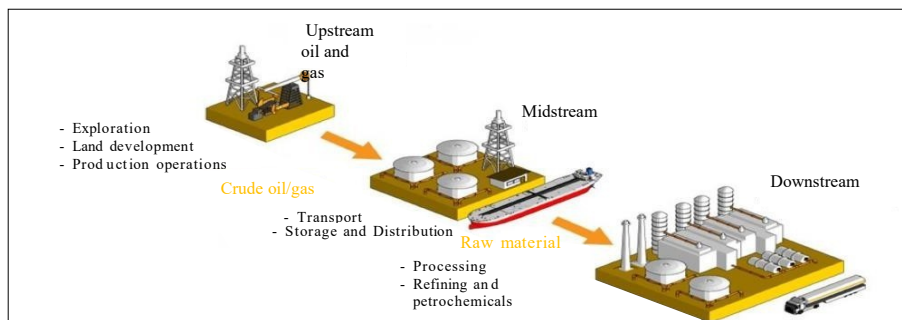


Fig. 3: The value chain of oil and natural gases - upstream, midstream and downstream sectors (source: Arcadis Design and Consultancy for natural and built assets)

**The upstream sector** includes the exploration (search and detection) of onshore and offshore natural gas and oil deposits, the drilling of exploration wells and, afterwards, the drilling and exploitation of the production wells for obtaining oil or natural gases (The HC BREF is not a part of the information exchange under the IED/IPPC Directive, 2014).

### Upstream sector

According to the information provided by the Romanian Petroleum Exploration and Production Companies Association (ROPEPCA), in 2018 in Romania there were 450 oil and gas deposits and over 13.000 active wells.

The ongoing exploitation activities in Romania include:

- 255 commercial oil and natural gas deposits with approximately 9.450 oil wells and 830 natural gas wells, where petroleum agreements are owned by a single company, an oil and natural gas producer;
- 153 commercial deposits with approximately 3.200 natural gas wells, for which the petroleum agreements are owned by a single company that carries out activities in the natural gas sector;
- other 39 deposits for which petroleum development-exploitation and petroleum exploitation agreements have been concluded, with various

companies as holders. Most deposits are mature, with an exploitation duration of over 25-30 years.

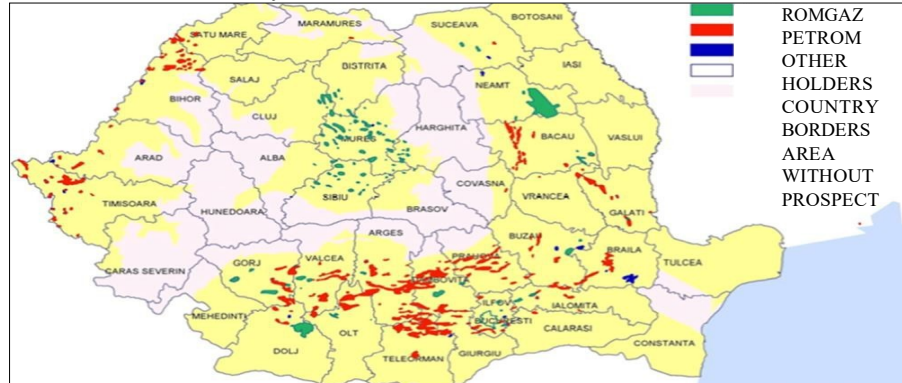


Fig 4. Onshore gas and oil concessions in Romania  
Source: Romanian National Agency for Mineral Resources

A recent update of the 2017 register establishes that the number of contaminated sites from the oil and gas industry of Romania reaches 516. Other 60 sites have been classified as decontaminated .

The numbers displayed in the table include the total number of contaminated sites from the oil and gas industry of Romania for each county. The exploration and production wells have not been considered individually due to their large number. However, groups of wells have been classified as a contaminated site if contamination of the subsoil was registered in that location.

## INVESTIGATION METHODS

The risk assessment is a systematic assessment process of the potential risks related to the contamination of soil, ground water or soil vapor. Risk assessments can be used for various purposes, such as:

- tool for assessing the need for remediation,
- tool for assessing the urgency of remediation,
- to assess if precaution measures are necessary or not,
- to establish remediation objectives based on risks.

The risk represents a combination between danger and exposure of a receptor. If one of these three components (source/danger, pathway, receptor) is missing, then there is no risk.





Fig. 5. Source-Pathway-Receptor model source: Arcadis Design and Consultancy for natural and built assets)

A **source** is a substance or an area that has the potential to cause damage or to affect in a negative way the human health or the ecological integrity. Among others, potential danger sources on an industrial location are: leakage from storage tanks and pipelines, vapor emissions, inappropriate waste management. Such sources can lead to the contamination of soil, soil vapor, groundwater and/or air. In this sense, the source is slightly differently defined compared to the classic definition used in the brownfield management, where “source” means the area where the contamination is produced and which presents high concentrations of soil-associated contaminants.

The **pathway** is the link between the “source” and the “receptor”. There are three main exposure pathways:

- Skin contact (for instance, touching the contaminated soil or washing with contaminated water that comes from a contaminated river or aquifer).
- Inhalation exposure (inhalation of contaminated dust, usually caused by aeolian erosion of contaminated soil or vapour inhalation).
- The contaminants from the soil vapours could evaporate and gather inside buildings, where they can be inhaled. Generally, their evaporation into the atmosphere will not lead to critical concentrations in the atmospheric air due to immediate dilution).
- Ingestion (for instance, the consumption of contaminated soil, the food cultivated in contaminated soil).

Also, the migration of the contaminants dissolved in the groundwater can represent an exposure pathway towards the receptors outside the location. In this case, the risk assessment will consider the delay, dilution and

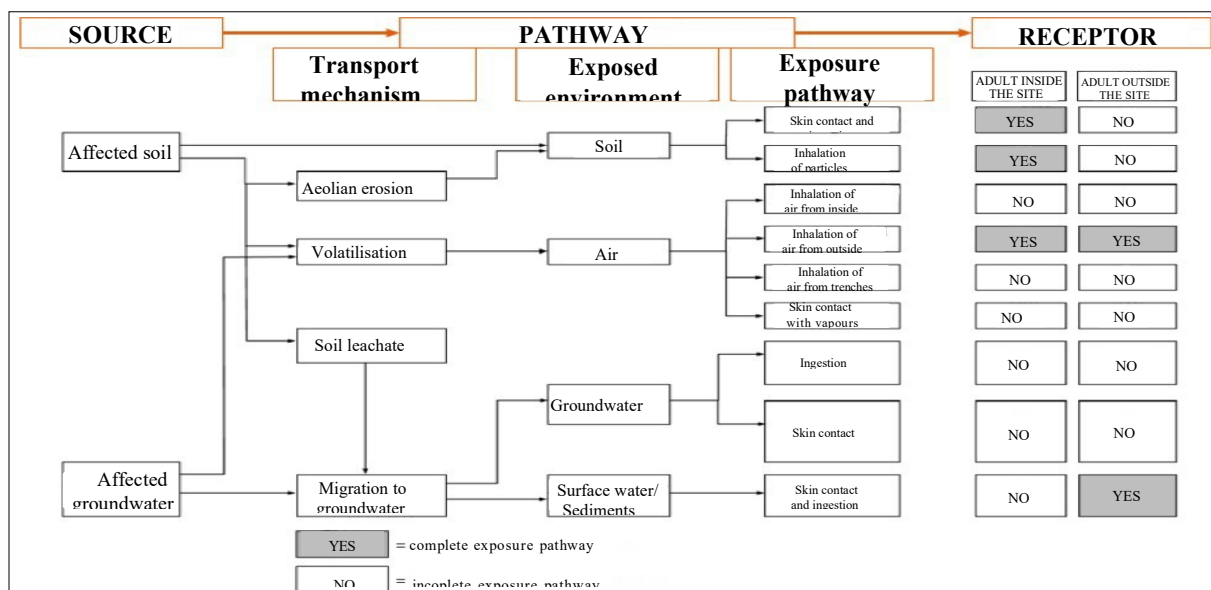


Fig. 6: The MCS example of human health (highlighting site-specific relevant pathways) source: Arcadis Design and Consultancy for natural and built assets)

## CONCLUSIONS

The rehabilitation of new lands in agricultural and forestry production, the increase of the land fund and its preservation are necessary for the agri-food production increase. The land is extremely important for agriculture, constituting the main means of production, because, through its soil layer, it is the source of nourishment for plants, which, with the help of solar energy, transform the mineral substances from soil into organic matter. The millenary existence of humanity is closely linked to this process, as it represents the basis for acquiring food and raw materials for the manufacturing industry.

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## CONTRIBUTIONS TO RESTORATION OF WASTE DUMPS OF SULFUR FROM THE CĂLIMANI MOUNTAINS

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### Abstract

*The problem of ecological reconstruction of mining dumps, industrial, domestic or other sources is particularly difficult, due to the substrate with extreme properties for the installation of vegetation. Among these dumps with great difficulties of restoration are the waste dumps from sulfur quarry in the Călimani Mountains, mainly due to the high acidity of the substrate, the very high content of mobile aluminum and the lack of fertilizers for plant installation and growth. In the years 2009-2010, several experimental plots were placed at 1500 m altitude with improvement variants for correcting the acidity of the substrate and providing fertilizers for the sown grass species. After 10 years, the best variant with 90% land cover (30% *Betula pendula*, 27% *Salix caprea*, 3% *Picea abies*, 24% sown grasses and 6% grasses from spontaneous flora) was the variant amended with 10t / ha CaO, chemically fertilized in 4 stages, every 2 years, with 100 kg / ha nitrogen, phosphorus and potassium. Through these methods of substrate improving, begin the processes of solification and final installation of the spontaneous vegetation around these sulfur dumps, extremely polluting.*

**Key words:** sulfur mining dumps, substrate improvement, ecological reconstruction

### INTRODUCTION

The problem of restoration of dumps of different origins (mine tailings, ore flotation, district heating of solid fuels, household waste and others) - product of economic activities and human existence, is a complex process through grassy and / or woody vegetation is installed on a surface with low natural fertility, more or less conducive to the growth and development of plants for fixation, solification, environmental protection, economic capitalization and landscape completeness (Marușca et al. 2000; Brejea 2008).

The dump is a distinct anthropogenic ecosystem in a first phase, with different degrees of subsequent integration in the zonal ecosystems and the types of surrounding landscape. (Harris et al. 1996; Oros 2002).

The installation of vegetation can take place on its own in a long period of time or through the immediate intervention of those who made the dump.

Certainly, it is the obligation of the economic factors that have produced these serious imbalances in the environment to act firmly to limit and eliminate the pollution. Among the methods of ecological reconstruction, most of the time, forestation is used, which is also the final goal in the areas where the forest can be installed (Căpitanu et al. 1999; Dumitru et al. 1999; Mocanu et al. 2007).

Until forestation, there are some situations and not a few when dumps with powdery materials require a fast grassing stage, to stop wind deflation and rain erosion. Therefore, it is necessary to pay special attention and often more to the grass that is applicable on dumps in all situations and only after a number of years of pedogenesis should intervene with forestation if it's necessary.

Thus on the dumps grassing can be a universal "panacea" and more economical than forestation, which is done only in some situations and these at very high costs.

Dumps from different sources are real sources of pollution for water, air, soil and landscape.

To remedy the situation, before forestation as a final method of consolidation, it is considered that rapid grassing is in a first phase, the best method to prevent particularly active erosion on the slopes and the flat top (cover) of the dump (Marușca, Dincă 2001; Marușca et al. 2009).

A very special problem is the renaturation of the dumps inside some areas protected by law, as is the case of those resulting from the exploitation of sulfur in the Călimani Mountains. (Cenușă-Leberciuc 2018).

In protected areas, the introduction of plant species from outside or even new varieties of existing species in these areas is strictly prohibited. Gathering seeds from the spontaneous flora as a solution for weeding is a utopia, as it would not be enough for 1-2% of the bare vegetation area in Călimani, in addition to very high labor costs.

Also, in these areas it is forbidden to use synthetic or chemical fertilizers such as those containing nitrogen, phosphorus and potassium, the main fertilizers necessary for the installation, growth and development of grassy or woody plants.

Without fertilizing elements derived from organic or chemical fertilizers, the vegetation cannot be installed on an inert substrate, almost completely devoid of natural fertility, such as the waste dumps from Călimani.

The provision of organic fertilizers in households, in this case is illusory. First of all, they cannot be bought and secondly, the distance to

where they must be transported (40 - 50 km) and the quantities used per hectare, which are very large (30 - 50 tons / hectare).

The question is what do we do in this extreme situation, wait decades to recover on its own or intervene forcefully to reduce and stop, as much as possible by grassing, the catastrophic erosion of these dumps with pollution of water downstream for tens of kilometers with the disappearance of aquatic life, due to its acidity and very high content of elements and chemicals harmful to life.

These open wounds of the land that currently are devoid of protective vegetation are much more polluting and unbalanced for the environment and biodiversity in general than the use for grassing varieties of perennial grasses and legumes from species that are widespread in the area and using of calcareous amendments and chemical fertilizers with a time-limited effect, which would make it possible to install vegetation with an anti-erosion and pedogenesis role as a viable support for the species in the spontaneous flora that will eventually settle on their own over time.

Furthermore, more "noble" or pretentious sown species supported by short-lived chemical fertilizers will be gradually replaced by spontaneous species from surroundings better adapted to these extreme conditions, so for medium and long term, biodiversity will not suffer too much.

## **MATERIAL AND METHOD**

The dumps from Călimani National Park, from the point of view of renaturation are quite similar to those from Bozânta and Meda Ponds near Baia Mare, in terms of physical and chemical characteristics of the substrate, especially the very acid reaction, the lower content of fertilizers and toxic effect of excess content in mobile aluminum (Oros 2002).

In 2009, in August, samples were taken from the dumps from Călimani, which were then analyzed from an agrochemical point of view at OSPA Braşov.

Agrochemical analyzes were performed according to the following methods:

- pH in water: potentiometric in water suspension in soil-solution ratio 1:2.5;
- hydrolytic acidity (Ah): extraction in sodium acetate solution at pH 8.3;
- sum of exchange bases (SB): extraction with HCl solution 0.05 N. Kappen
- Schofield - Chiriță method;
- organic carbon (Humus): wet oxidation and titrimetrically dosing, Walkley - Black method with the Gogoasa modification;
- mobile phosphorus (P<sub>AL</sub>) and mobile potassium ((K<sub>AL</sub>): extraction in acetate - ammonium lactate, Egner - Riehm Domingo method;

- exchangeable aluminum ( $Al^{3+}$ ): extract in solutions of unstamped neutral salts (KCl) Sokolov method.

The materials disturbed inside the Puturosu dump had a very pronounced acidity of 2,7 – 2,9 pH in  $H_2O$  and a very low content of humus, P, K and other elements which makes it impossible to install the vegetation on its own, without calcium amendment and fertilization.

Materials settled after 15 - 20 years of deep leaching of acid fractions, the pH index increases about 1 unit, reaching from 2,7 – 2,9 to 3,8 – 3,9, thus favoring the installation of several pioneers species in the form of isolated bushes, the most widespread is *Deschampsia flexuosa* followed by *Deschampsia caespitosa* and in some spruce seedlings (*Picea abies*) and after a few years of installation disappear one by one as the roots penetrate deep into the substrate, which in time it is enriched in mobile aluminum that reaches 11-20 me / 100 g of soil, very toxic for plants (Marușca, Haș 2015).

Considering the urgent needs to take measures of ecological reconstruction by grassing with the support and agreement of the builder, a German company, ICD Pajiști Brașov initiated a simple experiment of calcium amendment and grassing in 7 different locations: 5 on Puturosu dump (3 near the former headquarters and 2 at the station) and 2 on the Pinu dump after the company's requests.

The variants were:

**A.** Untreated variant- Control

**B.** Chemical fertilization 625 kg / ha NPK complex (16-16-16) without amendment;

**C.** Applied 5 t / ha lime powder (CaO) + chemical fertilization NPK idem B;

**D.** Applied 10 t / ha lime powder + chemical fertilization NPK idem B and C;

The size of a plot is 50 sqm (10x5 m) and a plot of 6,25 sqm (2.5x2.5 m). Calcium amendment and chemical fertilization were carried out in autumn 2009. Sowing was done in two phases: at the end of September 2009 and at the beginning of May 2010, immediately after the snow melted and the weather warmed up.

The complex mixture that was applied consisted of 50% grasses. (*Festuca rubra*, *Phleum pratense*, *Dactylis glomerata*, *Festuca pratensis* and *Poa pratensis*) 25% perennial legumes (*Lotus corniculatus*, *Trifolium pratense* and *Trifolium repens*) and 25% straw cereals (rye and oats).

Because of very low trophicity of the substrate, the fertilization with NPK complex chemical fertilizers was repeated in the spring of 2011, 2013 and 2015 in the same dose of 625 kg / ha at variants B, C and D, thus ensuring 100 kg / ha of the main fertilizer elements.

After the last NPK chemical fertilization (16x16x16) in 2015 on variants B, C and D, no other improvement measures were applied.

In August 2020, 10 years after the calcium amendment, four-stage NPK fertilization and sowing, soil and vegetation studies were continued on two experimental plots on the Puturosu dump under the demolished former sulfur station.

## RESULTS AND DISCUSSION

In the autumn of 2011, 2 years after the application of the calcium and chemical fertilization amendments, soil samples were taken again with the agrochemical probe on two depths 0-10 and 10-20 cm (Table 1).

On average on the 5 plots in variant A (control) and B (without amendment) the pH is very low by 3,9 at a depth of 0-10 cm and 2,9 – 3,0 at a depth of 10-20 cm. After applying the amendments, the pH improves, having an index of 4,5 – 5,6 on the depth of 0-10 cm and 4,3 – 4,9 at 10-20 cm.

*Table 1*

The average agrochemical composition of the mining dump substrate  
from Călimani, 2011

Variant	Adc. (cm)	pH	V <sub>Ah</sub> (%)	Humus (%)	IN	P <sub>AL</sub> (ppm)	K <sub>AL</sub> (ppm)
<b>A – Control</b>	0-10	3,9	12,4	1,19	0,13	11,5	98
	10-20	2,9	10,4	0,56	0,05	6,0	54
<b>B-100kg/ha NPK</b>	0-10	3,9	12,2	1,40	0,17	23,8	120
	10-20	3,0	9,5	0,35	0,03	15,5	46
<b>C-5t/ha CaO+NPK</b>	0-10	4,5	52,6	1,05	0,48	21,0	105
	10-20	4,3	46,4	0,63	0,33	15,0	46
<b>D-10t/ha CaO+NPK</b>	0-10	5,6	80,7	0,98	0,68	22,0	132
	10-20	4,9	69,5	0,28	0,47	15,0	58
Relativ content (%) <b>B - A</b>	0-10	100	98	118	131	207	134
	10-20	103	91	63	60	258	85
<b>C - B</b>	0-10	115	431	75	282	88	88
	10-20	143	488	180	110	98	100
<b>D - C</b>	0-10	124	153	93	142	105	126
	10-20	114	150	44	142	100	126

Through the chemical fertilization of NPK in the 2 rounds (2009 and 2011), the trophic regime was greatly improved, and together with the improvement of acidity and the increase of the bases saturation after the calcium amendment succeeded in installing the sown grasses (Table 2).

Thus, on the A variant without intervention, no blade of grass was installed, as well as around the plots.

In variant B only with NPK fertilization, the cover with grassy vegetation was on average 21% and in general, lower in autumn and better in spring.



In the amended variants C and D the situation is much better, the vegetation covering the land in average 40% at autumn sowing and 52% for spring sowing in 2010.

*Table 2*

Successfully sowing perennial herbs on the mining dumps from Călimani  
depending on application season (% coverage 2011)

Variant	Season	Repetition					Average
		1	2	3	4	5	
<b>A - control</b>	Autumn	-	-	-	-	-	-
	Spring	-	-	-	-	-	-
	Dif.	-	-	-	-	-	-
<b>B - NPK</b>	Autumn	-	-	5	10	25	8
	Spring	2	5	20	30	50	21
	Dif.	+2	+5	+15	+20	+25	+13
<b>C-5t/ha CaO+NPK</b>	Autumn	20	25	40	60	40	37
	Spring	40	60	65	70	50	57
	Dif.	+20	+35	+25	+10	+10	+20
<b>D-10t/ha CaO+NPK</b>	Autumn	25	40	50	70	50	47
	Spring	35	70	70	80	70	65
	Dif.	+10	+30	+20	+10	+20	+18
<b>AVERAGE B, C, D</b>	Autumn	15	22	32	47	38	31
	Spring	26	45	52	60	56	48
	Dif.	+11	+23	+20	+13	+18	+17

The influence of trophic factors (fertilization and amendment) on the success of sowing is maximum in variant D, where was applied 10 t / ha CaO + 2x100 N + 100 P<sub>2</sub>O<sub>5</sub>+ 100 K<sub>2</sub>O kg / ha and absent in variant A (control) (Table 3).

*Table 3*

The influence of treatment of the mining tailings substrate on the success of the sowing of  
perennial herbs in the second year of vegetation, 2011

Specification	Variant			
	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
Vegetation covering(%)	0	15	47	56
Influence NPK + CaO	100	150	470	560
Influence 5t CaO + NPK		100	313	373
Influence 10t CaO + NPK			100	119

Between 5 t / ha (variant C) and 10 t / ha CaO, the difference of plus 19% of coverage is not too big at first sight, but it was assumed that the effect will be longer until the fallow thickening and consolidation.

Another finding is related by the success of legumes, which are completely absent in variants A and B (Table 4).

Table 4

The average structure of the grass carpet formed  
from sown perennial grasses and legumes (% coverage 2011)

Variant	Graminee * (%)	Legumes ** (%)
A. -control	0	0
B. 100 kg/ha NPK	15	0
C. 5 t/ha CaO + NPK	27	20
D. 10 t/ha CaO + NPK	35	21
Relative difference (%)		
C - B	+ 12	+ 20
D - B	+ 20	+ 21
D - C	+ 8	+ 1

\*) Grasses in the order of dominance: *Festuca rubra*, *Phleum pratense*, *Dactylis glomerata*, *Festuca pratensis* and *Poa pratensis*

\*\*) Legumes: *Lotus corniculatus*, *Trifolium pratense* and *Trifolium repens*

Perennial legumes (guinea fowl, red and white clover) fixing atmospheric nitrogen are present in a proportion of 20 - 21% coverage in variants C and D, which joins the grasses covering 27 - 35% of the land in the 2nd year of vegetation. After 10 years from setup of the experimental plots, the agrochemical characteristics of the soil suffered major changes (Table 5).

Table 5

Physical and chemical values of the substrate from the mining dump from Călimani, after  
10 years from the calcium amendment and 4 stages of chemical fertilization  
(depth 0-10 cm)

	UM	Variant				Relative values to A		
		A	B	C	D	B	C	D
Skeleton 2-25 mm	%	55,6	55,7	58,6	60,3	100	105	108
Roots	%	0	0	0,2	1,7	x	x	x
Soil < 2 mm	%	44,4	44,3	41,2	38,0	100	93	86
pH in H <sub>2</sub> O	ind.	3,5	3,55	3,95	5,25	101	113	150
Humus	%	0,92	1,04	1,21	2,20	119	132	239
Nitrogen index (IN)	%	0,19	0,21	0,30	1,78	111	158	937
Mobile phosphorum (P <sub>AL</sub> )	ppm	4,0	6,5	4,8	7,8	163	120	195
Mobile potasium (K <sub>AL</sub> )	ppm	50	53	110	105	106	220	210
Sum of changeable bases (SB)	me/100g sol	2,3	2,7	3,5	16,3	117	152	709
Hydrolitic acidity (Ah)	me/100g	11,2	10,2	8,5	3,8	91	76	34
Cation exchange capacity (T)	me/100g	12,0	12,9	13,5	20,1	108	113	168
Degree of base saturation (V)	%	17,0	20,9	29,2	81,1	123	172	477
Exchangeable aluminium (Al <sup>3+</sup> )	me/100g	4,598	3,895	2,703	0,089	85	59	2

First of all, the reaction of the soil (pH) at a depth of 0-10 cm in August 2020 compared to 2011 is generally lower by 0,4 units (3,9-3,5) in the control variant A with 0,3 ( 3,9-3,6) in variant B with 0,5 (4,5-4,0) in variant C and 0,3 units (5,6-5,3) in variant D, the best.

Another limiting agrochemical factor for plant growth, mobile aluminum has decreased significantly from 11-12 me / 100 g soil in 2009 to more than half (4,6 me) in 2020 in the control variant A without improvement treatment of substrate. Following the calcium amendment and fertilization, the highly toxic aluminum for plants decreases by 15% in variant B, 41% in variant C and 98% in variant D where 10 t / ha of lime powder (CaO) were applied.

Progressively from variants B, C and D depending on the intensity of the improvement factors, the agrochemical characteristics of the soil are more favorable for plant growth although the skeleton content (2-25 mm) is 56-60% of the weight of the soil samples.

The weight of the roots of the existing plants in the soil at a depth of 0-10 cm after 10 years from sowing, was missing in variants A, B, with 0,2% of the total soil sample in variant C and 1,7% in variant D, which means that the fallow process is very slow.

From the species sown in autumn 2009 and spring 2010, in 2020, only *Festuca rubra* (9%), *Lotus corniculatus* (4%), *Poa pratensis* (3%), *Trifolium repens* (3%), *Dactylis glomerata* (2%) survived on average on the amended variants C and D (Table 6).

In the rest appeared grassy species from the spontaneous flora, especially *Deschampsia flexuosa* and *Polytrichum juniperinum*, but in a large content appeared woody species.

In variants A and B are presented *Betula pendula*, *Picea abies* and *Vaccinium myrtillus* in early stages.

In variant C and D where it was amended, *Salix caprea* is additionally installed with a coverage of 15-27% together with *Betula pendula* (18-30%) and *Picea abies* (2-3%) much better developed than in the variants A and B. Regarding the number of seedlings of birch (120-260) and spruce (40-65) trees spontaneously installed in variants C and D per 100 sqm, it can be noticed that they are sufficient for a future self-forestation of the land.

The height of the birch reaches 1-1,5 m and of the spruce 20-50 cm, lower in variant A and B and higher in variants C and D.

Table 6

Degree of installation of sown grasses and spontaneous vegetation after 10 years from improvement of the substrate in Călimani Mountains, 1500 m altitude  
(% participation)

Specification	Variant			
	A Control	B NPK	C 5t/haCaO+NPK	D 10t/haCaO+NPK
<b>Coverage</b>	<b>2</b>	<b>10</b>	<b>65</b>	<b>90</b>
<b>Sown species</b>	(-)	(-)	(16)	(24)
<i>Dactylis glomerata</i>	-	-	+	3
<i>Festuca rubra</i>	-	-	7	10
<i>Poa pratensis</i>	-	-	2	4
<i>Trifolium repens</i>	-	-	2	4
<i>Lotus corniculatus</i>	-	-	5	3
<b>Spontaneous grassy species</b>	(1)	(9)	(12)	(6)
<i>Deschampsia flexuosa</i>	1	9	5	2
<i>Chamerion angustifolium</i>	-	-	-	+
Moss ( <i>Polytrichum</i> )	-	-	7	4
<b>Spontaneous woody species</b>	(1)	(1)	(37)	(60)
<i>Betula pendula</i>	+	+	18	30
<i>Picea abies</i>	+	1	2	3
<i>Salix caprea</i>	-	+	15	27
<i>Vaccinium myrtillus</i>	1	+	2	-
<b>No. tree saplings to 100 sqm</b>				
<i>Betula pendula</i>	10	10	120	260
<i>Picea abies</i>	10	15	40	65

In the coming years, as these trees species grow, we will draw the necessary conclusions about their survival in this hostile stationary environment.

The coverage of grassy and woody vegetation of 65% in variant C and 90% in variant D show the special importance of correcting the acidity of the substrate through calcium amendment.

## CONCLUSIONS

1. The substrate of the tailings dumps from the sulfur quarry in the Călimani Mountains is extremely acid, with a toxic content of mobile aluminum and very poor in fertilizer elements where for three decades of spontaneous flora no anti-erosion protective vegetation has been installed;

2. Applying 5-10 t / ha of calcium oxide (CaO), NPK chemical fertilizers (16x16x16) in doses of 625 kg / ha every 2 years and sowing perennial grasses, a protective grassy carpet is made that favors the installation of grassy and woody vegetation from the surroundings;

3. After 5-6 years from weeding on amended and fertilized land *Salix caprea*, *Betula pendula* and *Picea abies* begin to occupy more and more land, being a guarantee of the renaturation of these dumps compared to areas without intervention and vegetation, where rain and wind erosion processes with the pollution they produce are very active.

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## **PRELIMINARY ANALYSIS ON THE SOIL POLLUTION. CASE STUDY ON THE HISTORICALLY IN DEJ-NORD**

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### **Abstract**

*The soil pollution as a result of the industrialization in the communist and current period leads to the deterioration of quality of the soil from the old industrial platforms, seldom fallen into disrepair and in precarious stage of decontamination. The purpose of the current study is to analyse degree of pollution of the soils with heavy metal in the area of Nord Dej industrial platform, in the location of the former Cellulose and Paper Enterprise and Artificial Fibers Enterprise. In order to reach this goal, we conducted field analysis and series of soil profiles, using Hydra Joy 3 equipment, which allowed us to extract soil caps from a significant depth. We used ISO 10530:1992 in order to make an analysis of the chemical properties of the soil, based on the soil profiles extracted, and (ICP-MS) EPA 6020B: 2014 to determine the existence of Cadmium, Lead, Chromium, Copper and Zinc. The highest concentration was found for Nickel, but there are other elements such as Cadmium or Zinc with high values in the studied area.*

**Key words:** *soil pollution, heavy metals, soil profiles, chemical analysis*

### **INTRODUCTION**

Human industrial activities, as well as the continuous extension of urban areas leads to an increase in soil pollution, endangering human health. It is acknowledged that substances such as Cadmium, Lead or Mercury have no biological functions and are therefore toxic for human health. (Senila et al., 2008, Constantinescu, 2008, Levei et al., 2009, Nedelescu et al., 2017).

Several sources of heavy metals which are polluting the soils are represented by human activities such as: mining (Cd, Cu, Ni, Pb, Zn), foundries (Cd, Pb), lamination (Ni, Cd, Pb), plastics industry (Cd, Zn, Pb, used as polymeric stabilizers), chemical industry (using Pb, Ni as electrode catalyst), wood industry (Cr and Cu). In the vicinity of the factories, these before-mentioned elements have been seldom identified as water and soil pollutants. (EPA, 1996, Flora and Ioanoș, 2000, Suciuc et al., 2008, Moldoveanu, 2014).

Currently in Romania there is a number of 1393 contaminated and potentially contaminated sites inventoried at the moment. In the administrative territorial unit of Dej, the historic site of Dej-Nord stands out as a representative example from the point of view of soils polluted due to industrial activities, more specifically the location of the former S. C. Cesarom S.A. Dej, in the industrial area from the north-eastern side of the city of Dej, on the lower terrace of Someș river. (Fig. 1).



Fig. 1. The geographical position of the studied area

The industrialization of the city of Dej, initiated in the 50s and maintained until the 90s, turned the northern part of the city into an industrial area, with emblematic enterprises such as: The Enterprise of Cellulose and Paper (CCH) and The Artificial Fibers Enterprise (IFA) (Cimpoieșu et al., 1995, Pop, 2012). Between 1994-1998, the enterprise became SC Someș, but, due to the more modern requirements of the market and poor management, was closed down in 1998.

Previous studies labelled the location as a contaminated site due to historical pollution with heavy metals, mud and solid waste from the technological process of obtaining cellulose and paper, on a surface of approximately 10,000 mp. The total surface of SC CESAROM SA extended to 182,863 m<sup>2</sup>, out of which 75,536 m<sup>2</sup> were occupied by built surface, 1,865 m<sup>2</sup> occupied by technological networks, 60,250 m<sup>2</sup> by transport routes and the rest of 45,212 m<sup>2</sup> remained unoccupied. Chlorinated Solvents were identified in previous studies in the river and in the soil (Sidonia et al., 2009), and the toxic effects were registered in the environment (in plants, animals and humans) (Stanescu et al., 2016).

#### MATERIAL AND METHOD

In order to achieve the main objective of the present study, the first stage of the

analysis we analysed the historical data we found regarding the location of the polluted areas.

To identify the stratigraphic successions, field operations were conducted and we collected soil samples, as well as samples from the water bed, dependent on financial support, on their dispersed placement in all compass directions taking into account the possibility of multiple sources of pollution. A Hydra Joy 3 equipment with a diesel engine of 100CP and a downforce and extraction of 3500 kg was used to conduct the drilling.

In order to collect the groundwater samples, we used PVC tubing ( $\varnothing = 70$  mm), PVC covers, and the water was collected with a bailer with a diameter of  $D_n = 40$  mm, volume  $V = 1$  l, which allows the loading of a column of 0,97 m of water, including the layer covering the same surface on the water surface. The samples of underground water were collected after pumping the water from the drilling column here times. These works were executed to the depth of interception of the layer considered to be the basis, cca. 7 m deep from the platform's elevation (Matei and collab. 2020).

After sampling the soil evidence, specific chemical analyses were conducted, on these samples as well as on the ground and underground water. We determined the content of sulphides applying ISO 10530:1992, and (ICP-MS) EPA 6020B: 2014 to determine the elements: Cadmium, Lead, Chromium, Copper and Zinc.

## RESULTS AND DISCUSSION

After analysing the data in the company's archive, we identified the main sources of pollutants for water and soil: Carbon disulphide ( $CS_2$ ) which appears in the area of chemical preparation (xanthogenate method, dissolution, maturation), the spinning area (spinning, treatment), waste water treatment station, the area of recovering the carbon disulphide ( $CS_2$ ) and storage of the carbon disulphide ( $CS_2$ ); Hydrogen sulphide ( $H_2S$ ) which is a result in the chemical preparation are (xanthogenate method) and the spinning area; Sodium hydroxide ( $NaOH$ ) resulting in the chemical preparation area (alcalicellulose, xanthogenate method) and the spinning area; Sodium hypochlorite ( $NaOCl$ ) was used in the spinning station; Sulphuric acid ( $H_2SO_4$ ) appears in the spinning baths and in the dedicated storage; Ammonium ( $NH_3$ ) used in the freezing station; Hydrochloric acid ( $HCl$ ) used in the treatment of pure water as well as waste water treatment.

During the period the enterprise operated, frequent overruns of the waste water treatment station effluents were recorded for: sulphates ( $SO_4$ ); Hydrogen sulphide ( $H_2S$ ), sulphides, Sodium ( $Na$ ), fix residue, Zinc ( $Zn$ ).

In the field trips it was determined that all installations, machineries, equipment, industrial pumps and engines were disused, dismembered and capitalized. Also, all the buildings related to the production facility, the



dispersion chimney from recovering the Carbon disulphide, the buildings from CET with smoke chimney, the warehouses and raw material and finished products storages were demolished without a systematic procedure.

The tanks from the treatment stations were demolished, but the components of the waste water treatment are still in the field, containing water and chemical substances.

The big storage of Carbon disulphide (C106 – an underground building with 8 concrete tanks where 2 metal containers with CS<sub>2</sub> were immersed) were demolished.

On the field only remained concrete tanks with rainwater. The oxidation tank, unused since 1986, is demolished and full of rubble; on the whole location, with the exception of access roads, treatment and waste water treatment station, there is waste originated from construction materials and equipment such as: brick, rubble, mineral wool, electric cables and other waste. Around the former platform for washing rich gases, the facility for recovering Carbon disulphide and the platform of draining there are Rasching rings made of plastic and ceramics.



Fig. 2. The area of the spinning section and chemical preparation



Fig. 3. The area of chemical preparation (fire pumps, water tanks, electric station)



Fig. 3. The treatment area



Fig. 4. The storage of sulphur

To analyse the degree of pollution of the soils, we used thresholds of alert and intervention of the pollutants: Cd, Cr, Cu, Ni, Pb, Zn (Table 1).

Table 1

Statistical data on soil pollution on Dej site

Element			Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)
Alert threshold	Normal values		1	30	20	20	20	100
	Types of usage	Sensitive	3	100	100	75	50	300
		Less sensitive	5	300	250	200	250	700
Intervention threshold/ Types of usage		Sensitive	5	300	200	150	100	600
		Less sensitive	10	600	500	500	1	1500
Sample 1			0.01	0.25	0.43	1.06	0.17	14.4
Sample 2			<0.005	0.47	0.51	1.01	0.08	6.9
Sample 3			0.06	0.26	0.6	2.49	0.11	7.35
Sample 4			0.08	0.85	3.6	8.35	0.24	11.1
Sample 5			0.01	0.35	0.36	17.1	0.16	9.6

(according to Order 756/1997)

Overruns of the normal levels can be observed for Nickel, as well as in the case of samples 4 and 5.

It is notable that these substances move from the surface to the underground through dissolution and absorption, causing imbalances, migrating to the root system of the plants, reaching the fruit (cereals, especially corn, fodder and leguminous plants incorporate the highest part of heavy) and thus the animal and human system. The effect can be diverse, affecting the photosynthesis in case of plants, and the circulatory, cardiac and digestive system in case of humans. (Coman et al., 2010).

## CONCLUSIONS

The negative effects observed on the environment as a consequence of using such chemical substances and lacking measures of adequate storage and decontamination of toxic substances are felt and acknowledged locally and this led to the decision of conducting detailed analysis regarding the concentration of toxic substances in the soil and groundwater.

The results of sampling the soil and water of the 6 profiles highlights the degree of pollution of the soil from the old industrial platforms of Dej-Nord, thus requiring more attention in order to invest in decontaminating the sites and reintegrate the terrains in the agricultural circuit, according to the recommendations given after the bonitation study of the farming land in the Someş area from the Cluj-Napoca – Dej sector (Matei et al., 2020) a study which took into consideration the degree of soil pollution from this sector.

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## **IDENTIFICATION OF RENEWABLE ENERGY RESOURCES FOR SUSTAINABLE DEVELOPMENT OF AGRICULTURE**

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### ***Abstract***

The research carried out by the authors of this paper is focused on identifying those areas of Romania with the potential to obtain energy from unconventional sources, sources that do not affect the surrounding environment and that are consistent with sustainable development. This issue is all the more important because the leaders of the European Union set a target in 2009 that, by 2020, 20% of the total energy consumption of EU countries will come from renewable energy, and, in 2018, it was agreed that this type of consumption will increase by 32% by 2030.

In this context, the authors have tried to identify in Romania the location of renewable energy sources (RES) from which our country can produce energy. In order to reach this goal, the main objectives have been: identification of areas with solar energy sources, identification of areas with wind energy sources, identification of areas with hydroelectricity sources, identification of areas with geothermal energy sources, and identification of the energy potential of biomass in Romania. The study is based on research, data collection from official documents, literature, and official websites, followed by data processing and interpretation.

**Key words:** energy, renewable energy sources, potential, sustainable

### **INTRODUCTION**

Agriculture as an ecological system integrates all biological, geochemical, and geomorphological processes into a unitary whole, which supports the vital activity of a community of organisms. The agricultural system is open because it changes matter with the environment in the form of energy and substance (Chiriță et al., 1967).

Compliance with environmental criteria in agriculture is part of the general issue of environmental protection and pollution control. In this respect, as Berca (2000) reported, agro-ecodevelopment is part of the “biosphere management, a key issue of the 21<sup>st</sup> century”, which requires strategies and actions to preserve and improve the agricultural landscape.

Răuță (1997) showed that the implementation of the concept of sustainable agriculture must be carried out according to the specific conditions of our country. In Romania, the implementation of sustainable

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agriculture on family farms based on private ownership requires extensive research, restructuring and, last but not least, massive investments in line with specific policies for the integration of the agricultural sector related to the other sectors of the Romanian economy (Mateoc, Mănescu, 2012). Here are some of these extremely important principles: the legal regulation of the resource base of agriculture, especially high-quality land; promotion of the integration of plant production with animal production and other related activities; protection and restoration of the natural resource base through landscape reconstruction actions and the development of agriculture in harmony with nature. (Florea et al., 2014).

Our existence, the existence of life in general on Earth depends on the health of the planet and it is already severely affected. One cannot know to what extent this process of continuous, severe degradation of the environment as a whole can be stopped, let alone if the phenomenon is reversible, but it is certain that, without urgent global measures, the scenario is apocalyptic and imminent. (Oțiman et al., 2006).

For the first time, environmental health was called into question worldwide in 1972 at the Stockholm Conference, when the “Final Declaration on the Environment” was signed, which noted the interdependence between economic and social development and the environment. This first step was followed, in 1992, by the “Millennium Declaration” in Rio de Janeiro. The 1992 United Nations Framework Convention on Climate Change aimed at limiting the rise in global temperature but, since 1995, it has been found that this was not the right strategy. As a result, the nations of the world have initiated further negotiations aimed at strengthening the unified global response to climate change. The Kyoto Protocol, which provides for the legal obligation of all developed countries, was, thus, adopted in 1997 to reduce emissions (from their 1990 level) by a minimum of 18% by 2020. The Protocol was amended in 2012 in Doha, and a second commitment period was introduced – from 2013 to 2020. Globally, the effort has continued and, on 12 December 2015, a new global agreement was signed in Paris that provided for climate change, for an action plan starting in 2020 and that aimed at limiting global warming as much as possible (below 2°C to a limit of 1.5°C). The Paris Agreement entered into force on 4 November 2016, with the ratification conditions of around 55 countries which, globally, account for at least 55% of total greenhouse gas (GHG) emissions.

At national level, the “Romanian Parliament’s Declaration No.1/2016 for the implementation of the 2030 Agenda for 15 years” was adopted containing the “Sustainable Development Goals”, with the National Strategy for Sustainable Development – Horizons 2013-2020-2030 to be modified in this respect.

## **MATERIAL AND METHOD**

The methods of research and analysis used in this study are analytical and synthetic methods, mathematical calculation, data collection, interpretation and processing, and interpretation of graphs. Research has been the basis for finding the most important sources of renewable energy to develop the relaunch of agriculture, a particularly important branch in the development of Romanian rural economy.

## **RESULTS AND DISCUSSION**

There is no longer any doubt that, in order to adequately protect and conserve renewable natural resources (namely air, soil, water and biodiversity), and also for the natural resources in agriculture to be given sustainable use, it is imperative to implement wise policies that consistently aim to mitigate climate change as far as possible. (Mănescu et al., 2014).

The sustainability of an agricultural system depends, to a large extent, on social justice and not on ensuring an immediate and momentary income; sustainability must enable constant and lasting financial support to avoid land degradation and producer poverty; ultimately, it leads to the development and consolidation of rural areas (Mănescu et al., 2014). To these can be added other criteria such as the possibility of regenerating renewable natural resources, reducing pollution as much as possible, observing biodiversity conservation and avoiding the irreversibility of economic and biological processes where they occur.

Agriculture in its evolution, especially in the last 20-30 years, has marked increases in production, in some very spectacular countries, but also increases in energy consumption (Mateoc et. al., 2012). For example, the shift from hypo traction to tractor has led to a 2.4-fold increase in the amount of fuel used for the various works of the agricultural technological flow. Moreover, as specialists suggested, the nature of the energy consumed has changed: from horse oats to diesel tractors and other machinery, imported on hard currency (Hornacek, 1979). Of course, compared to the national economy in general or with industry, energy consumption in agriculture is low. Thus, in France, agriculture consumes only 2-3% of the country's total energy. And there is another aspect: agricultural production receives so much free unconventional energy, in various forms, from the sun and from the soil, that it can continuously reduce conventional energy consumption in certain agroecosystems.

Intensive agriculture involves direct energy consumption (fuels, electricity) and indirect energy consumption (fertilizers and machinery), which is a matter of utmost importance. Reducing energy consumption requires an optimal ratio between direct and indirect energy, as well as reducing energy consumption. In France, the share of the two energy components represents 44% and 56% of total consumption, respectively. In Sweden, fuels account for 43% and fertilisers for 37% of total consumption. The industrialisation of agriculture has led to an increase in the inputs of some material resources. The estimates made by the F.A.O. admit that 2 kg of fossil fuel is required for the manufacture, distribution and soil application of 1 kg of nitrogen, 0.2 kg for 1 kg of phosphorus, and 0.18 kg for 1 kg of potassium. For the manufacture and use of 1 kg of pesticides, a consumption of 2.2 kg of conventional fuel has been evaluated. A consumption of 100-200 l/ha of fuel of irrigated land and 3-4 t of fuel per year per tractor has also been calculated.

Super intensive ecosystems are 3-6 times more productive compared to traditional ones, but their energy consumption is 10-20 times higher. (Sabău, 2008). Some of them (animal husbandry) are strongly entropic, the amount of intensive cultural energy is 2-20 times greater than the energy found in the form of food. In intensive agricultural ecosystems, the ratio between energy used and pollution produced is geometric: pollution increases by the square of energy spent. This is a catastrophic situation on which people should reflect responsibly. Another example of consumption in intensive agricultural ecosystems is enlightening. Thus, in autumn potato, an important place in the energy consumption structure is that of fertilization (50.74%), biological material for planting (24.45%) and mechanical work (22.85%). As the level of mechanisation is very high, the living workforce represents only 0.12%, and disease and pest control (1.84%). The energy balance results in the following values: energy spent – 26.665 kwh/ha, energy produced – 24.366 kwh/ha, net energy – 7.700 kwh/ha, ultimately resulting in an energy ratio of 1.45 (Tucuman, 1982).

Nowadays, humanity is turning to new sources of energy. The most used alternative energy sources are:

*Solar energy* that is captured from the sun by solar panels. However, it is known that 80-90% is lost when converting solar energy into electricity or heat. Another drawback of the capture of sunlight is that it can only be achieved during the day, which is why the energy must be stored for use at night.

*Water energy.* This type of energy has been used since ancient times. The capture is done by the construction of hydropower plants that convert the force of water into large amounts of energy.

*Wind or air current energy.* It has been estimated that the wind produces an energy that exceeds 200 times the world's needs. However, very large and quite expensive aeolian generators are needed to capture wind.

*Nuclear energy* is used on a fairly large scale worldwide because of its productivity. It is produced in two ways: through fission and fusion. However, atomic power plants, against all advanced security technologies, have a high degree of risk because of the devastating environmental consequences that any accident can cause in such an energy generation unit. There have been nuclear accidents around the world with disastrous effects on those areas.

*Geothermal energy* is also known and used in many areas of the planet.

In the field of agriculture, unconventional energy comprises the sources of solar, wind, geothermal, and recoverable energy from industrial processes, the treatment of organic, vegetable or animal residues in animal husbandry. This energy is clean and, therefore, environmentally-friendly, with a direct impact on agricultural production and on the health of consumers.

Renewable energy, together with improved energy efficiency, are key elements in the development of eco-energy, both in industry and in agriculture.

It is essential to look at unconventional energy sources in the context of a country's climate resources, bioconversion processes, and photosynthesis, which have huge, sometimes unimaginable possibilities to make different accessible forms of energy available to agriculture. Research and applications carried out, some on a large scale, have demonstrated the high efficiency of unconventional energy, even in temperate climates. Based on all this, one can speak of the ability of agriculture to also produce energy, not only food.

Solar energy is the cheapest form of energy. The farmer holds an instrument of action on the crop with an impressive force, solar energy, which he must capture by finding the right solutions. Solar energy is at the origin of all forms of energy and power. Solar energy that falls on Earth is estimated at about 120 billion MW, which equates to 100 million large nuclear power plants. For photosynthesis, a process by which green plants synthesize organic substances from carbon dioxide and water in the presence of light, which ultimately leads, in the case of agricultural plants, to crops, a small part of energy is used. This is the energy introduced into the free, biologically-founded ecosystem that actually conditions life on earth, namely human nutrition. (Șerban, Dragotă 2013).



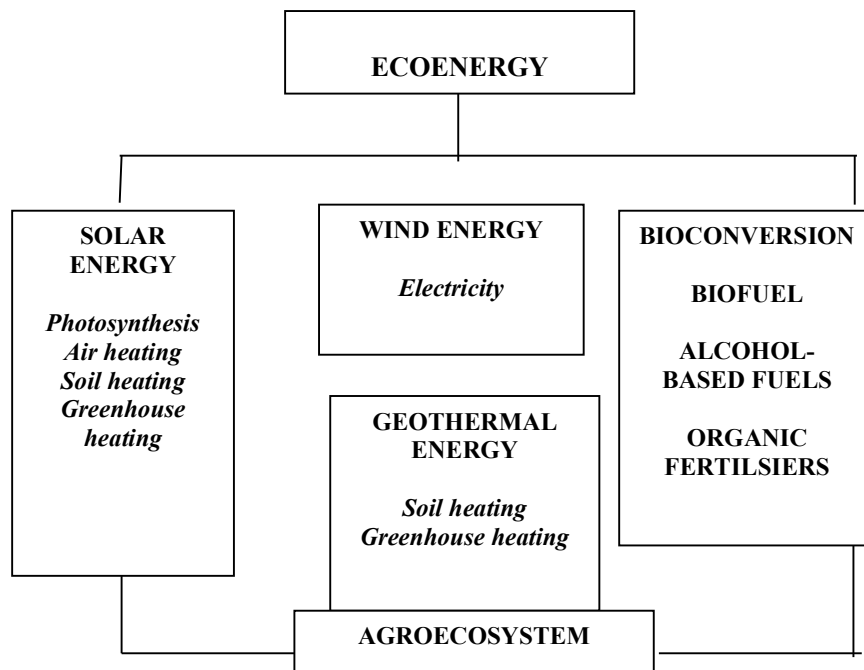


Fig. 1. Unconventional energy sources

Solar-powered heating also plays a role in agriculture. It is widespread in the householding sector, heating homes and water preparation in countries with an excessive solar regime, with high year-round sunstroke, such as Israel, Greece, Japan, and Australia. It is economic in areas with long clear days, which makes installations accessible and cost-effective to the population, both for domestic use and for different sectors of agriculture – greenhouses, nurseries, workshops, and small industries.

In greenhouses, heat accumulates as a result of the penetration of solar radiation through the transparent glass or plastic roof. On clear days, with strong heat, in winter or summer, large amounts of heat can accumulate. Solar radiation entering the greenhouse reduces heat loss, which can be seen from the overall balance sheet. Large inflows of solar radiation in greenhouses, in the spring- summer period (March-June) and autumn (September-October) allow the growing of a wide range of early vegetables without conventional energy consumption, with high yields and a superior recovery of the land and the leaf system. For southern areas, these amounts of solar energy entering the greenhouse are double and even triple, which is to the farmer's advantage. Moreover, nowadays, all vegetable cultivation in plastic greenhouses is based on the accumulation of solar energy. The greatest possibilities are, of course, for growers in areas with a large number of hours of sunlight in all seasons of the year. But, even in temperate areas,

solar energy can take over some of the energy effort, thus becoming a conventional fuel replacement resource.

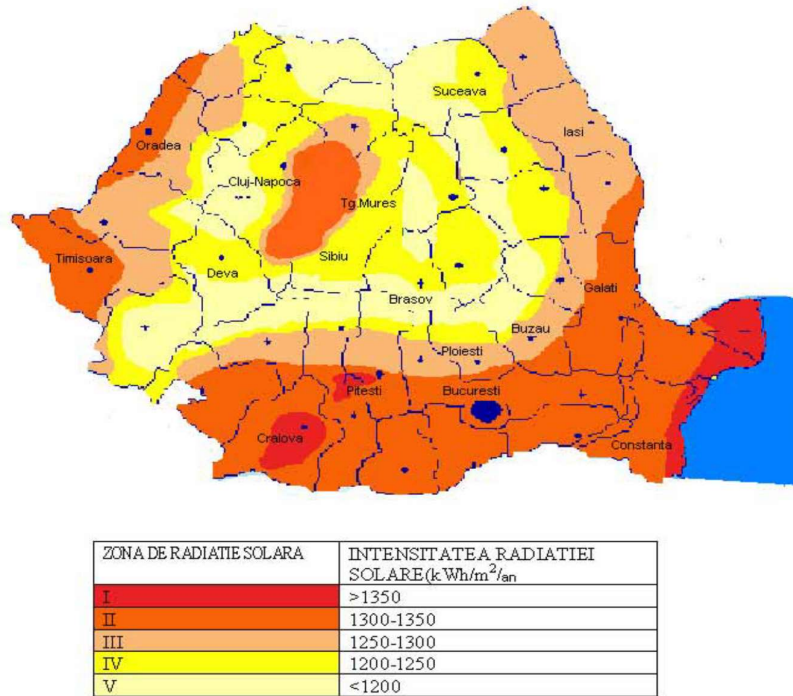


Fig. 2 Solar map of Romania

The most important areas of interest for electro-energy applications of solar energy in our country are: *The first area*, including the areas with the highest potential and covering Dobrogea and much of the Romanian Plain. *The second area*, with good potential, includes the north of the Romanian Plain, the Getic Plateau, the Oltenia and Muntenia Sub-Carpathians, a good part of the Danube Meadow, the southern and central of the Moldovan Plateau and the Western Hills and the western Transylvanian Plateau; and *the third area*, with moderate potential, with less than 1,300 MJ/m<sup>2</sup> covering most of the Transylvanian Plateau, the northern Moldovan Plateau, and the sub-Carpathian area.

Wind energy, produced by the movement of air masses, also generated by differences in temperature and pressure between different areas of a territory or on a planetary scale, is a formidable source, valued at

$38,372 \cdot 10^{14}$  kWh. Wind power could meet 20% of the world's energy needs. It was calculated that an average wind speed of 5.5 m/s corresponds to an energy flow of  $200 \text{ W/m}^2$ . Wind energy is considered complementary to electricity-generating installations and energy storage systems, which, during certain periods, contribute to the reduction of fuel consumption. Thus, the savings achieved daily by the operation of a Savonius wind power plant amount to 100 l Diesel, compared to motor pumps or 230 l compared to electro-pumps (Gănescu, 1982; Risoud, 1999).

The distribution in Romania of the average wind speed highlights as the *main area with wind energy potential* mountain peaks where the wind speed can exceed 8 m/s. The *second area* with cost-effective wind potential covers the Black Sea Coast, the Danube Delta, and northern Dobrogea where the average annual wind speed is around 6 m/s. The *third area* with considerable potential is the Bârlad Plateau, where the average wind speed is about 4-5 m/s. Favourable wind speeds are also reported in other smaller areas in the west of the country, in Banat and on the western slopes of the Western Hills. To note that the two basic technical indicators, which must be identified before assessing economically a possible investment in a wind energy production unit, are the *frequency and intensity of the wind* relative to time unit for each location, monitoring them for a period of at least one year.

Geothermal energy is the type of renewable, clean energy obtained from the capture of geothermal waters inside the Earth. Hot water and steam resulting from volcanic and tectonic activity are, thus, used for heating buildings, for electricity generation, in industry, in agriculture, or in tourism. Geothermal systems can operate permanently, without taking into account climate or meteorological conditions (Lazăr, 2009; Pătrașcu, 2015).

In the world, countries whose geothermal resources have been appreciated since ancient times are Iceland, France, Italy, Belgium, Greece, U.S.A., New Zealand, Japan, Indonesia, Hungary, etc.

Along with other European countries with a tradition of geothermal waters, Romania also has such important resources. In Romania, geothermal waters, extremely valuable resources, have not been exploited enough, and this sector has always been poorly developed. The heating of buildings, premises or greenhouses for the production of plants with geothermal water does not require transport costs, since energy capture is carried out in the same place where the consumer is located. At the same time, specialists in the field believe that geothermal waters have a major potential for electricity production, with an estimated geothermal energy technology by 2050 to produce around 10-20% of electricity demand in Europe. In this respect, the production of geothermal energy requires a number of actions to conserve and evaluate resources, substantial investments in drilling and pipeline

networks, heat pumps, water treatment and wastewater disposal technologies, etc. (David, 2017; Lazăr, 2009; Pătraşcu, 2015).

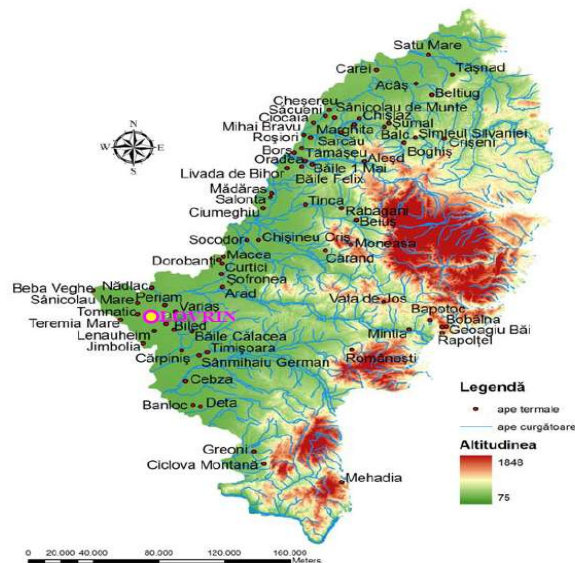


Fig. 3. Locations with geothermal waters in western Romania

Sursa: Prelucrare după datele <http://blog.zonaeconomica.ro>

The western part of Romania is an area rich in geothermal waters, with very favourable conditions for the production of geothermal energy, as well as for the development of various forms of tourism that exploit these thermal waters. Geothermal aquifers on the Romanian side of the Pannonia Depression are the best known in the country. Thus, counties such as Bihor, Satu Mare, Arad or Timiș sit on real natural treasures that must be exploited. The average temperatures at a depth of about 2,000 m are around 120°C and, at a depth of about 3,000 m, they can reach up to 150°C, representing the highest temperatures of geothermal waters in Romania.

Another area of our country rich in geothermal water resources is that of the Romanian Plain, located between the Dâmbovița Valley and the Olt Valley, where temperatures of geothermal waters can reach between 100-120°C, at a depth of 3,000 m. Also, geothermal resources can be found in the central area of Dobrogea, south of the Hârșova – Medgidia – Constanța alignment, where geothermal waters can reach temperatures very similar to those of the Romanian Plain.

Biomass energy. Biomass is a promising renewable energy source for Romania. Bioconversion is an undeniable technology of the present and the future, of great perspectives. It is an area where the huge potential of bacteria, microbial action like fermentations transform organic matter into different finished products. Bioconversion has been shown (through

anaerobic fermentation of vegetable residues and manure from animal husbandry, household garbage and even some plants) to provide an energy resource for agriculture: gas fuel (biogas). In this respect, there are many advantages: the ease, simplicity and economy of processing, the extraction of biogas in considerable amounts, the production of an organic fertilizer rich in nutrients, the efficient destruction of pathogens from garbage and, at the same time, a clean technology. By bioconversion nothing is lost, everything is transformed, everything is recovered.

Bioconversion could, in time, lead to a new type of agriculture, in which the principle of agro-energy finds a wide range of applications. It seems to be one of the basic technologies of energy production for the needs of agriculture in certain sectors. The results achieved so far at home and abroad are encouraging, some even very optimistic. It depends very much on the equipment in which bioconversion is carried out with high efficiency and costs as low as possible. It is also important to have a system for collecting, with great economic efficiency, organic materials that lend themselves to bioconversion.

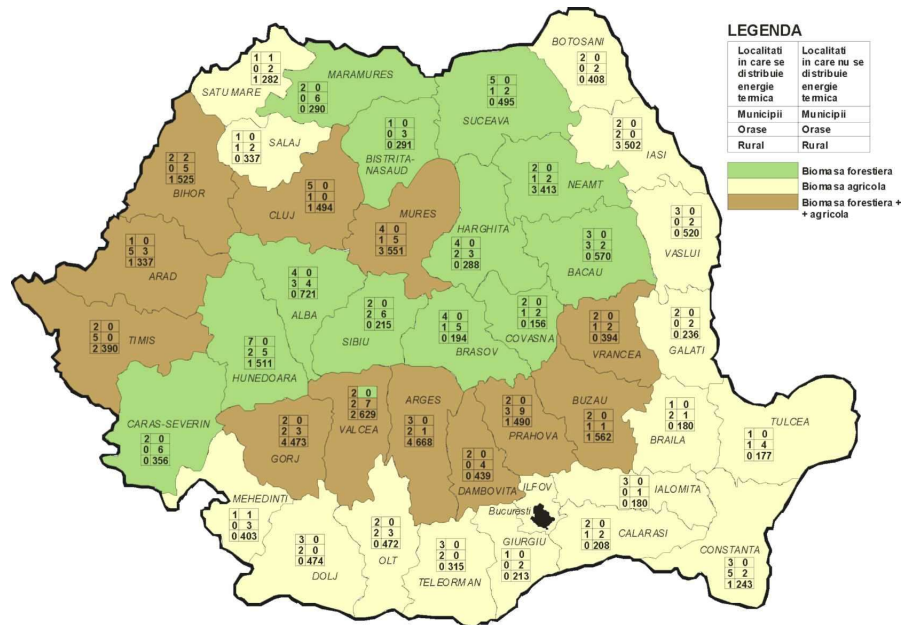


Fig.4. Romanian localities with central heating

*Biogas from manure* is the fuel made from the manure of animal husbandry farms, especially pig farms, since pollution control is the only way out of this situation, using the method of aerobic and anaerobic

biological cleansing, controlling odour by disinfectants, masking or biological deodorizers. This last process is being experienced in France and it consists in continuous anaerobic fermentation of liquid manure in a specially constructed plant. From 1 kg of treated dry matter, at 35°C in containers, an amount of 0.35 m<sup>3</sup> biogas containing 40% methane is produced by fermentation within ten days. The fertilizing substances resulting from the fermentation process are kept intact, even without any loss of nitrogen. It is partly mineralized into ammonia. Larger amounts of ammonia are lost during storage and the reaction of the residue is slightly basic. The plant becomes cost-effective at more than 1,000 pig heads in order to compete with oil.

*Biogas obtained from plants* can be obtained from the various biomass sources of agriculture and turns into biological heat. It is claimed that plants with high productivity energy potential are an important source of energy (biofuel). Biomass can only be studied and used if recovery is not too costly, if it ensures as positive and favourable an energy balance as possible and as much efficiency as possible of the conversion process. In order to ensure the efficiency of “energy crops”, production techniques, plant species and varieties should be carefully chosen, in order to obtain a maximum efficiency of the dry matter and an energy balance as favourable as possible. Important sources of plant biomass, to which specialists turn their attention, are aquatic plants. Algae such as *Hydrodictyon reticulatum* and *Cladophora glomerata* provide yields of 10 t/ha of dry matter. *Eichornia crassipes* has an extraordinary growth rate, multiplying every 8-20 days in warm and nutrient-rich waters.

In the experiments made by the Institute of Biological Research in Bucharest in the 1980s and at the Water Treatment Plant in Pitesti, *Pystia stratyotes*, another water plant, produced 90 t/ha, being used for the production of biogas with very good results.

Biofuel, another source of biological heat from the manure of cattle and horses, has a high energy value, being used in nurseries for the production of vegetable seedlings between January and March. At a temperature of +50...+70°C, it is, for vegetable farms, almost the only energy resource for heating, but also cheaper, compared to oil products. (Zagoni et al., 2012). After use, with the end of fermentation, this organic material decomposes and, in the following spring, it becomes a very valuable fertilizer for vegetable and flower crops. An example of triple conversion: manure → heat → fertilizer of great energy value.

Agriculture as a system has great possibilities to renew some of the energy needed for its normal functioning (Table 1).

Table 1

## Energy consumption in major agricultural crops

Crop	Yield (kg/ha)	Energy obtained (Gcal/ha)	Energy consumed (Gcal/ha)	Energy balance (Gcal/ha)	Energy yield
Irrigated wheat	5.500	20.76	6.24	14.52	3.32
Non-irrigated wheat	4.000	15.10	4.57	10.53	3.30
Irrigated maize	9.000	35.29	6.75	28.54	5.23
Non-irrigated maize	4.500	17.65	4.89	12.76	3.60
Irrigated sunflower	3.000	16.98	3.68	13.30	4.61
Non-irrigated sunflower	2.500	14.15	2.20	11.95	6.45
Irrigated sugar beat	40.000	39.22	12.51	26.71	3.13
Non-irrigated sugar beat	27.160	26.63	5.79	20.84	4.59
Irrigated potato	30.000	22.19	10.82	11.37	2.05
Irrigated soy	3.190	15.86	3.04	12.82	5.21
Non-irrigated soy	1.800	8.95	2.16	6.79	4.13

*Sursa: I. Teșu și V. Baghinschi, 1984*

It is interesting to note that agricultural production in Romania consumes 7% of total energy production and 5% of fuels, heat and electricity. in relation to industry, Romanian agriculture consumes 14-15 times less energy, a trend that will continue in the coming years. For the main agricultural crops, the energy consumption is shown in table no. 1

## CONCLUSIONS

Humanity is at a crossroads: the main resources, which make man's life on earth possible, are about to run out quickly. oxygen in the air, drinking water, fuels and food are already insufficient for the population of the blue planet. The path humans have chosen to follow will be the one that will not allow survival.

Undoubtedly, agriculture will exist as long as humanity exists. humanity needs a clean and healthy environment, drinking water, food and energy: all this is necessary, the rest is useful but not imperiously necessary.

Exploitation of renewable energy resources is also becoming mandatory in Romania, where the E.U. has established that by 2030 energy produced from renewable sources will reach 32% of total energy consumption.

In order to establish a coherent energy policy in a given region, it is necessary to inventory renewable energy sources according to their type. For each resource it is useful to indicate:

- theoretical potential;
- technical development potential (depending on existing technologies);
- economic potential (benefit producer taking into account investment, production costs, financing schemes and state support, as well as the state of land, infrastructure, utility networks and electricity transmission networks by regimes and voltage levels).

It is absolutely necessary that, when an entrepreneur decides to make an investment in the field of renewable energy production, he carries out pre-feasibility and feasibility studies for which he takes the financing assumptions into account in order to choose the optimal source of financing.

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## **THE EFFICACY OF DIFFERENT HERBICIDES IN CONTROL OF WEEDS FROM WHEAT CROP IN THE CONDITIONS FROM SCDA LIVADA**

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### **Abstract**

*To deal with the weeds specific to the area, we placed at SCDA Livada a technological experience in the autumn wheat crop.*

*The research conducted in the agricultural year 2019-2020 on wheat crops aimed to establish the efficacy of herbicides applied in post-emergence on the floristic composition and the influence of herbicide treatments on yield in the conditions of the agricultural year 2019-2020.*

**Key words:** wheat, floristically composition, efficacy, yield.

### **INTRODUCTION**

Wheat, in the structure of field crops, has its share in Romania. The diversity of weed species as well as the differentiation in terms of their capacity led to the further study of new and more efficient herbicides.

Decreasing of weeds in crops efficiently, cost-effectively and in accordance with ecological rules is ensured through integrated control. The most important component of this is the application of herbicides.

The synthesis and launch on the market of new herbicides for weed control in the straw cereal crops, is a permanent concern of research worldwide and in our country.

### **MATERIAL AND METHOD**

The researches were effectuated at SCDA Livada on a stagnoleized preluvosoil with a pH of 5.1, a clay content of 20.9% and a humus content of 2.8.

The experiment was placed in a randomized block, 18 variants in three repetitions, the plot area being 21 sqm, making the statistical calculation according to the variance analysis method.

The assessment of the herbicide efficacy was made before the wheat harvest by counting the weeds by species per 1sqm in each variant, calculating the efficacy according to the formula:

$$\text{Efficacy} = \frac{\text{Degree of untreated weeds} - \text{Degree of treated weeds}}{\text{Degree of untreated weeds}} \times 100$$

The biological material used in the experimental field was the *Glosa* wheat variety obtained at INCDA Fundulea.

The rates of used herbicides were specificate in Table 1.

For administering the herbicides, the equipment used was Plot Sprayer PSGF 4.3, tee jet nozzle type, 0.2 nozzle size and travel speed was 6 km / h.

The norm of the solution used was 500 l / ha, the administration being made for all variants at the same working pressure by 2 bar.

The herbicide application period was post-early autumn and post-emergence spring.

Table 1

The herbicides applied at wheat crop in 2020

Var	Herbicide	Rate l,kg/ha	Active substance
1	Sekator Progres OD	0.15	Iodosulfuron metil 25g/l+amidosulfuron100g/l+safener
2	Pelican Delta	0.100	Metsulfuron6g/kg +diflufenican 600g/kg
3	Trimax 50 SG	0.030	Tribenuron-metil 500g/l
4	Pallas 75 WG+Adjuvant	0.110+0.5	Piroxsulam 7,5% + safener
5	Pallas 75 WG+ Adjuvant	0.250+0.5	Piroxsulam 7,5% + safener
6	Floramix+Adjuvant	0.120+0.6	Piroxsulam70,8g/kg+florasulam14,2g/kg+safener
7	Floramix+Adjuvant	0.260+0.6	Piroxsulam70,8g/kg+florasulam14,2g/kg+safener
8	Attribut	0.060	Propoxycarbazon-sodiu 700g/kg
9	Axial One	1.0	Pinoxaden 45g/l+florasulam5g/l+safener
10	Axial One	2.0	Pinoxaden 45g/l+florasulam5g/l+safener
11	Lancelot Super	0.033	Aminopirid30% + florasulam 15%
12	Helmstar 75 WG	0.020	Tribenuron-metil 75%
13	Galmet 20 SG	0.030	Metsulfuron-metil 200g/l
14	Rival Super Star	0.020	Tribenuron-metil 37,5% + clorsulfuron 37,5%
15	Joystick	0.200	Florasulam 20g/kg+iodosulfuron-metil-sodiu 50g/kg+diflufenican 400g/kg+cloquintocet-mexil 100g/kg
16	Joystick	0.200	Florasulam 20g/kg+iodosulfuron-metil-sodiu 50g/kg+diflufenican 400g/kg+cloquintocet-mexil 100g/kg
17	Dicopur Top 464 SL	1.0	Acid2,4 D din sare de DMA344g/l+dicamba 120g/l
18	Untreated	-	-

The climatic data registered at the weather station of SCDA Livada in the period 2019-2020 are presented in figure 1 and figure 2.

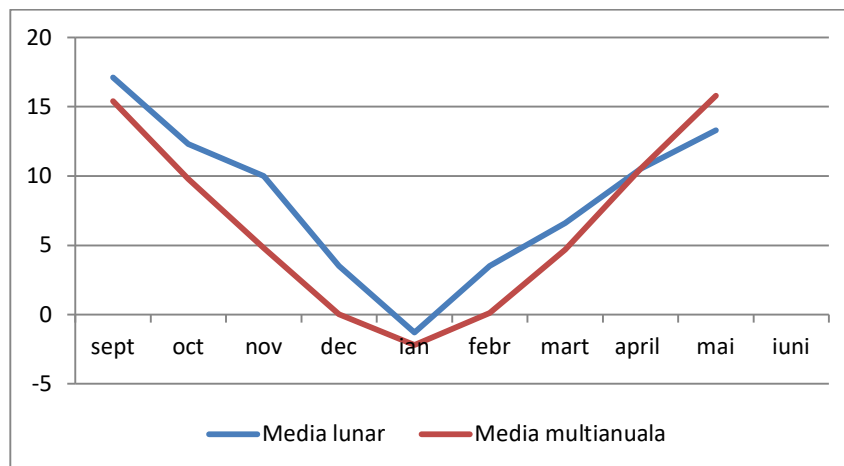


Fig. 1. Monthly temperature average (°C)

The multiannual temperature average registered at the Livada weather station in the last 56 years is 9.8°C. Compared to this value, we observe an increase of the average monthly temperature of 2019-2020, except for May 2020, when the monthly temperature average is below the value of the multiannual temperature average.

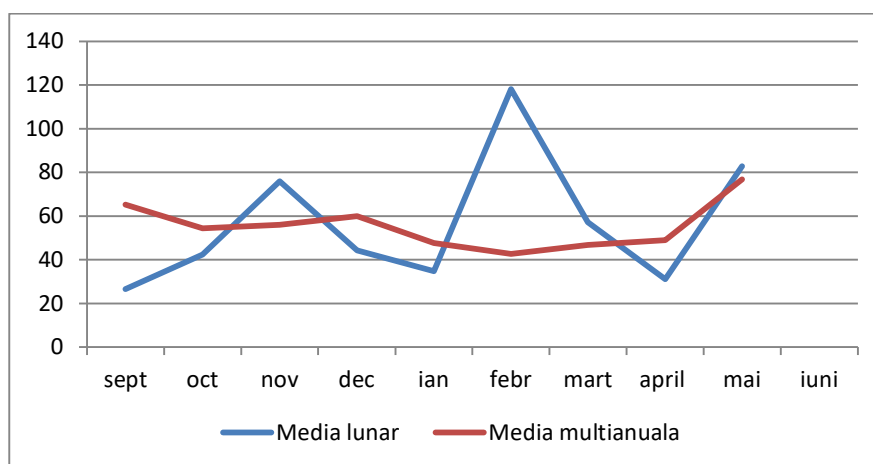


Fig. 2. Monthly rainfall (mm)

Analyzing the precipitation we see that: November and February of 2019-2020 were excessively rainy, exceeding the multiannual average which is over 740 mm.

## RESULTS AND DISCUSSION

The degree of weeding was determined by counting the weeds by species per 1sqm in each variant (Table 2).

*Table 2*  
Dominant weed species existing in untreated variant in wheat crop, 2020

Scientific name	Popular name	Density pl/mp	% Participation
<i>Apera spica-venti</i>	Iarba vântului	14	37
<i>Elymus repens</i>	Pir târător	2	5
<i>Cirsium arvense</i>	Pălămidă	3	8
<i>Raphanus raphanistrum</i>	Ridiche sălbatică	10	26
<i>Convolvulus arvensis</i>	Volbură	1	3
<i>Viola arvensis</i>	Trei frați pătați	3	8
<i>Matricaria inodora</i>	Mușețel prost	5	13
<b>Total</b>		<b>38</b>	<b>100</b>

These species of weed must be controlled before they can make strong phytocenoses that compete strongly with the wheat crop.

The control of these weeds was made with the herbicides specified in Table 1, herbicides which had a good efficacy.

Analyzing the efficiency of the products subject to research, in 2020 it is noted that: Floramix 260g / ha + Adjuvant 0.6 l / ha, Attribute 60g / ha, Pallas 75WG 250g / ha + Adjuvant 0.5l / ha, Pelican Delta 100g / ha are selective for wheat plants and assure a control of 85-98%.

*Table 3*

Selectivity and efficacy of treatment with herbicides in wheat crop, 2020

Var	Herbicide	Rate l,kg/ha	Application period	Selectivity Note EWRS	Efficacy %
1	Sekator Progres OD	0.15	post	1	72
2	Pelican Delta	0.100	post	1	85
3	Trimax 50 SG	0.030	post	1	53
4	Pallas 75 WG+Adjuvant	0.110+0.5	post	1	57
5	Pallas 75 WG+ Adjuvant	0.250+0.5	post	1	89
6	Floramix+Adju vant	0.120+0.6	post	1	80
7	Floramix+Adju vant	0.260+0.6	post	1	98
8	Attribut	0.060	post	1	94
9	Axial One	1.0	post	1	79
10	Axial One	2.0	post	1	77
11	Lancelot Super	0.033	post	1	57
12	Helmstar 75 WG	0.020	post	1	24
13	Galmet 20 SG	0.030	post	1	80
14	Rival Super Star	0,020	post	1	70
15	Joystick	0,200	post timpuriu	1	83
16	Joystick	0,200	post	1	83
17	Dicopur Top 464 SL	1,0	post	1	50
18	Netratat	-	-	-	0

At herbicide Pallas 75 WG it is noticed that at a low rate the efficacy is also much lower, but at herbicide Axial One the rate difference did not influence the efficacy.

In variants 15 and 16, variants in which were applied the herbicide Joystick the same rates, but the time of application was different, the efficiency in both cases is the same.

By applying the herbicides Helmstar 20g / ha, Dicopur Top 464 SL 1l / ha, Trimax 30g / ha, Lancelot Super 33g / ha was registered an efficiency of only 24-57% determined by the weeding degree with the species *Apera spica-venti*, herbicides having efficacy on dicotyledonous weeds.

The yield results highlight the opportunity to use herbicides to control weeds from the wheat crop. Thus, in the variant treated with the herbicide Floramix 260g / ha + Adjuvant 0.6l / ha the yield spores is significantly different from the untreated variant, and in the variants treated with the herbicides like Galmet 30g / ha, Rival Super Star 20g / ha and Joystick 200g /ha we registered an significant yield spore (Table 4).

*Table 4*

The influence of treatments with herbicides on yield in wheat crop, 2020

Var	Herbicide	Rate l,kg/ha	Time of application	Yield q/ha	Diff. +/-	Semnifi- cation
1	Sekator Progres OD	0,15	post	87,5	14,2	-
2	Pelican Delta	0,100	post	87,0	13,7	-
3	Trimax 50 SG	0,030	post	79,9	6,6	-
4	Pallas 75 WG+Adjuvant	0,110+0,5	post	81,6	8,3	-
5	Pallas 75 WG+ Adjuvant	0,250+0,5	post	81,8	8,5	-
6	Floramix+Adjuvant	0,120+0,6	post	86,8	13,5	-
7	Floramix+Adjuvant	0,260+0,6	post	93,5	20,2	xx
8	Attribut	0,060	post	81,6	8,3	-
9	Axial One	1,0	post	84,3	11,0	-
10	Axial One	2,0	post	82,6	9,3	-
11	Lancelot Super	0,033	post	72,5	-0,8	-
12	Helmstar 75 WG	0,020	post	81,6	8,3	-
13	Galmet 20 SG	0,030	post	90,6	17,3	x
14	Rival Super Star	0,020	post	89,1	15,8	x
15	Joystick	0,200	early post	88,9	15,6	x
16	Joystick	0,200	post	78,2	4,9	-
17	Dicopur Top 464 SL	1,0	post	79,5	6,2	-
18	Netratat	-	-	73,3	-	-

LSD 5% = 14,81 q/ha    1% = 19,85 q/ha    0,1% = 26,20 q/ha

## CONCLUSIONS

The researches were carried out in the agricultural year 2019-2020 on the winter wheat crop.

The experience was installed in Satu-Mare county at Agricultural Research Development Station Livada on a stagnogleized preluvosoil with a pH of 5.19, clay content of 20.9% and humus content of 2.8.

The experiments was set up using the latin rectangle method with 8 variants in three replications.

Dominated weeds species in wheat crop were: *Apera spica-venti*, *Elymus repens*, *Cirsium arvense*, *Raphanus raphanistrum*, *Convolvulus arvensis*, *Viola arvensis*, *Matricaria inodora*.

All applied herbicides had a very good selectivity.

From the point of view of efficiency, the best variants were the variants treated with: Floramix 260g / ha + Adjuvant 0.6 l / ha, Attribute 60g / ha, Pallas 75WG 250g / ha + Adjuvant 0.5l / ha, Pelican Delta 100g / ha, variants with an efficacy between 85-89%.

Yield spore statistically assured were obtained at variants treated with Floramix 260g/ha + Adjuvant 0,6l/h, Galmet 30g/ha, Rival Super Star 20g/ha and Joystik 200g/ha.

Farmers and not only have the opportunity based on these results to establish the most efficacy and efficient methods of weed control in the winter wheat crop.

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## RESEARCH REGARDING THE INFLUENCE OF NITROGEN FERTILIZERS ON SIMPLE MIXTURE OF FESTUCA ARUNDINACEA WITH MEDICA SATIVA

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### Abstract

*Festuca arundinacea* is a valuable fodder plant for meadows and lawns, given its agricultural and landscape qualities: high perennial, winter, drought, disease and ironing resistance and high production capacity. The simple mixtures with *F. arundinacea* with *M. sativa* contribute to obtaining a high quality forage, characterized by a high CP content. Analyzing the production results of dry matter obtained in the second years, average is 2,91 t/ha, fertilization level with N100 has a great influence on production of dry matter. Highest yields of forage are obtained at N<sub>100</sub>, by 3,43 t/ha DM at *Festuca arundinacea* + *Medicago sativa* mixture.

**Key words:** tall fescue, grassland, dry matter, ironing resistance

### INTRODUCTION

Simple grassland mixture between a grass and a leguminous used for improving forage quality have a long practice. So, there are mixtures recommended for different areas as well for our country. Culture of perennial grass and legumes mixtures have several advantages: high productivity due to usage of ecological niches in that biotope, high yields of protein due to presence of legumes, and increasing the protein content of grasses in the presence of legumes, economy of nitrogen based fertilizer, due to fixing nitrogen in the atmosphere by the bacterial genus of *Rhizobium* sp.

Razec, 1995 emphasizes that, depending on the floristic composition, the maximum production that is achieved in the case of pure fabaceae cultivation (13.08 t / ha SU), is followed by complex mixtures in which at least one of the perennials fabaceae species is present, (12.07-12.43 t / ha SU) and simple mixtures, in which the percentage of participation of fabaceae is 30-40%, achieve very high yields even in non-fertilized variants (11.52 t / ha). ).

*Festuca arundinacea* is a valuable fodder plant for meadows and lawns, given its agricultural and landscape qualities: high perennial, winter, drought, disease and ironing resistance and high production capacity. (Olar et al., 2018). This species is established, as participation in mixtures with legumes. For this reason, in the study we chose simple mixture of *Festuca arundinacea*+*Medicago sativa* have been studied in different levels of fertilization.

## MATERIAL AND METHOD

The experience was established in 2016 and carried out over a period of three years. (2016 - 2018). The experimental field was placed according to the method of plots subdivided into 4 repetitions with 3 variants. Statistical processing was done according to the method of analysis of variance. The annual average temperature was 10,17°C and the annual average rainfall of 566,3 mm.

The two factors studied are:

Factor A - Level of fertilization -  $a_1$  -  $N_0P_0K_0$  ;  $a_2$  -  $N_{100}P_{50} K_{100}$  ;  $a_3$  -  $N_{200}P_{50}K_{100}$

Factor B: simple mixture: *Festuca arundinacea* 50% + *Medicago sativa* 50% (Mădălina)

The biological material used is *Festuca arundinacea* (Adela) 30kg/ha and *Medicago sativa* (Mădălina) 18 kg/ha. The exploitation mode was as hayfield, and were harvested two annual cuts. Determinations were made regarding dry matter production and chemical composition of forage. The processing and interpreting data, in terms of statistical synthesis, was performed annually in the period of experimentation 2016 – 2018. Floristic studies were performed using the gravimetric method, or the method of weighing.

SOIL - Chernozem, cambic subtype, on clays, sandy-clayey clay on medium clay (SRTS), Haplic Chernozems (WBR-SR-1998), Typic Haplustosols (USDA-ST-1999)

Succession of horizons: *Am* – *Bv* – *C*

Analytical data

Horizons	Am <sub>1</sub>	Am <sub>2</sub>	Bv	C
Coarse sand % (2-0,2mm)	0-25	25-48	48-78	78-100
Fine sand % (0,2-0,02mm)	0,50	0,50	0,40	0,20
Dust % (0,02-0,002mm)	61,7	51,70	60,10	56,10
Physical clay % (sub 0,01 mm)	13,1	18,00	12,10	19,40
Texture	LN	LL	LN	LL
Carbonates	-	-	-	-

Ph in water	7,1	7,25	6,75	7,85
Humus	2,13	1,40	-	-
Total nitrogen %	0,105	0,070	-	-
Mobile phosphorus (ppm)	12	3	-	-
Mobile Potassium (ppm)	120	130	-	-
Amount of exchange bases (me./100 g. sol)	18,3	-	-	-
Exchangeable hydrogen	3,0	-	-	-
Degree of saturation in bases	96	-	-	-

Interpretation of analytical data - the texture is medium; the soil reaction is neutral at a depth of 0-48 cm and slightly alkaline at a depth of 78-100 cm; the nitrogen content is small at a depth of 0-25 cm and very low at a depth of 25-48 cm; the potassium content is low; sum of exchange bases: is small, degree of saturation in bases: indicates a eubasic soil.

## RESULTS AND DISCUSSION

Fertilization with doses of N200 P<sub>2</sub>O<sub>5</sub> 60-100, K<sub>2</sub>O 50-60 at *Festuca arundinacea* yields DM yields between 9-11 t / ha and around 1130 kg / ha PB (Bărbulescu et al., 1984; Breazu et al., 1993).

In the case of the simple mixture of *Medicago sativa* with *Festuca arundinacea* we have small crop differences, in the case of nitrogen fertilizers only the maximum dose gives a significant assurance due to a crop difference of 2.29 t / ha (Table 1). The difference in yield obtained as a result of the application of chemical fertilizers with nitrogen in this mixture is 2.91 t / ha significantly different from the control, and in the case of application of moderate doses a yield increase of 3.43 t / ha is obtained. statistically assured as very significant positive (table 3).

Table 1

Influence of fertilization with N on crop dry matter (2017)

Fertilization graduation	Variant	Production of DM t/ha	Difference	Percentage	Semnification
a1 - N 0	<i>F.arundinacea</i> + <i>M. sativa</i>	12.83	0.00	100.00	-
a2 - N 100		12.49	-0.34	97.40	-
a3 - N 200		15.12	2.29	117.90	*

LSD (p5% = 0,63) LSD (p 1%) = 1,95 LSD (P 0,1% = 1,96)

Table 2

The yield differences among variants and their significance (2017)

Variants in ascending order of harvest	DM production t/ha	Variants in ascending order of harvest	
		2	3
		SU t/ha	
		12.49	15.12
1	12.83	-0.34	2.29
2	12.49		2.63
3	15.12		

DS values 5% for different limits of comparison between variants

The mixture of *Medicago sativa* and *Festuca arundinaceae*, although developed properly, gave a smaller harvest than the previous one. For the variants fertilized with N100, the dry matter harvest is between 12.49 - 15.12 t / ha S.U. (table 1) and 12.74 - 13.26 t / ha S.U., for the variants fertilized with N<sub>200</sub> (table 3). Crop yields are higher in variants fertilized with chemical fertilizers with nitrogen with a maximum dose of 2.91 t / ha U.S. and 3.43 t / ha U.S. in variants fertilized with N100, due to the fact that moderate doses of nitrogen stimulate legumes.

Table 3

Influence of fertilization with N on crop dry matter 2018

Fertilization graduation	Variant	Production of DM t/ha	Difference	Percentage	Semnification
a1 - N 0	<i>F.arundinacea</i> + <i>M. sativa</i>	9,83	0.00	100.00	-
a2 - N 100		13.26	3.43	134.90	***
a3 - N 200		12.74	2.91	129.60	**

LSD (p5%) = 0.76 LSD (p1%) = 1.26 LSD (p 0.1% = 2.35)

Table 4

The yield differences among variants and their significance (2018)

Variants in ascending order of harvest	DM production t/ha	Variants in ascending order of harvest	
		2	3
		SU t/ha	
		13.26	12.74
1	9.83	3.43	2.91
2	13.26		-0.52
3	12.74		

DS values 5% for different limits of comparison between variants

In the culture mixture with *Festuca arundinacea* and *Medicago sativa*, we have the weakest installation in 2016, 45% *Medicago sativa* and 20% *Festuca arundinacea*, 35% weeds.

*Festuca arundinacea* is a species that settles extremely slowly, being demanding to agronomic and agrotechnical factors. In the second year (2017) it manages to eliminate weeds and reach 44% at N<sub>100</sub> and 36% at fertilization with N<sub>200</sub>, so that in 2018 the participation will reach the value of 58% at fertilization with N<sub>100</sub> and 55% at fertilization with N<sub>200</sub>. We would like to emphasize that *Medicago sativa* remains at a value close to that of the establishment of the culture 57% in 2017, compared to 59% in 2016, and *Festuca arundinacea* 42%. If we compare the coverage values of *Medicago sativa* + *Festuca arundinacea* species with those of the control variant, we observe the stressful effect of nitrogen fertilization on alfalfa.

The forage quality

For temporary pastures, forage quality is greatly influenced by floral structure of mixtures of species, including legumes who play an important role in achieving a nutritionally balanced in fodder. Crude protein content is between 14,13 – 28,64 %, lignicellulose (ADF) increased at mixture and depending on the dose of fertilizer, it had a higher value at dose N<sub>100</sub>.

Table 5

The value of quality indices

N level	Mixture	CP%	CP Kg/ha	Cellulose %	Ash %	NDF %	ADF %	ADL %	DMO %
N <sub>0</sub>	<i>F.arundinacea</i>	14.13	1583	34.05	10.04	53.19	37.55	7.50	56.76
N <sub>100</sub>	+ <i>M.sativa</i>	15.71	1983	34.96	10.20	56.44	42.30	7.81	52.41
N <sub>200</sub>		28.64	2329	34.16	11.10	52.25	38.49	7.58	55.79

## CONCLUSIONS

The highest crude protein production is recorded in the alfalfa-based mixture of 2327 kg / ha in the mixture of *Medicago sativa* + *Festuca arundinacea* in the N200 variant, but this decreases in the same mixture until 1583 in the non-fertilized variant. (Table 5).

The mixture of *Medicago sativa* and *Festuca arundinacea* reacts to fertilization similar to alfalfa and gourd. Thus, in 2017, when alfalfa has a share between 58% and 55%, there are slight increases in dry matter harvest of 2.29 t / ha in the USA at fertilization with N200 and a light of -0.34 t / ha S.U. at fertilization with N100, so that in 2018 as the share of tall fescue increases to values of 55-58%, the dry matter harvest will increase from

9.83 t / ha S.U. (unfertilized variant), at 13.26 t / ha S.U. (N100) and 12.74 t / ha U.S. (N200).

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## STUDY REGARDING THE INFLUENCE OF THE SOIL ON THE SPONTANEOUS FLORA IN THE PĂDUREA CRAIULUI MOUNTAINS

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### Abstract

*The present work is based on field studies conducted in the Pădurea Craiului Mountains which considered the collection of soil samples from the established perimeters (Bradea, Drumul Aștilenilor and Podul Pancului), the collection and processing of samples were performed according to existing methodologies. The soil analyzes were processed within OSPA Bihor. The soil samples were collected at a depth of 0-25 cm.*

*Laboratory analyzes were performed to establish environmental factors, which should show the conditions conducive to the growth and development of the following medicinal plants: elderberry-sambucus nigra, wild garlic-allium ursinum, hawthorn-crataegus monogyna, yarrow-Achillea millefolium and St John's wort-hypericum perforatum*

**Key words:** massive, spontaneous flora, climate, forest, soil

### INTRODUCTION

With very varied climate and soil conditions, our country has a diverse and very rich spontaneous flora. Optimization of plant growth and development conditions is done according to biological requirements for temperature, water, light and soil. To go through a vegetation cycle, a species needs a certain amount of heat expressed in thermal constant (the sum of average daily temperatures higher than 5 ° C), with values between 9° C and 22° C for the vast majority of medicinal and aromatic plants (Brejea, 2010). Soil requirements are particularly related to structure and texture, given that most plants have small and very small seeds and require, in the early stages of development, a favorable ratio of air, water and nutrients. The chemical properties of the soil must correspond to the needs of micro and macroelements. The reaction of the soil, expressed by a neutral pH, ensures the best conditions for growth and development for most species of medicinal plants (Brejea, 2017). Depending on the pedogenetic factors, the pedogenetic processes and the current stage of genetic evolution, the soils are enriched in ions and different ion generating substances (acids, bases, salts), which give the soil a more acidic or alkaline character. Knowing the value of soil agrochemical parameters that characterize the state of fertility has a special importance in the growth and development of



plants in spontaneous flora, as well as on bioactive components.(Domuța, 2005).

Due to the development conditions, the plants are also differentiated according to the ecological conditions, namely:

1. Hill medicinal plants - species adapted to the conditions that characterize the sub-Carpathian areas as well as forested areas (*Atropa belladonna*-nightshade, *Vinca minor*-sachiu, *Crataegus monogyna*-hawthorn, *Geum urbanum*-cernetel - species of spontaneous hill flora; *Papaver somniferum*-mac, *carum carvi*-cumin, *Valeriana officinalis*-valerian - cultivated species).

2. Mountain medicinal plants - species adapted to the conditions characterized by altitude, winds, lower temperatures throughout the year (*Gentian sp*-ghințură., *Arnica-arnica* .., *Angelica archangelica*-angelica etc.), vegetation cycle and going through the phenophases.

3. Medicinal water plants and swampy places - water-loving species (*Iris-iris*, *Colchicum autumnale*-brândușă, *Acorus calamus*-obligeană, *Valeriana officinalis*-valerian, etc.).

## MATERIAL AND METHOD

Samples were harvested from the three points located in the middle and lower part of the Craiului Forest Mountains. The collection points were located in different areas and altitudes:

- point 1.- Bradea, is located at an altitude of 639 m, Latitude 46° 54'44 "N, Longitude 22°26'18" E, located in Tomnatic locality, Vadu Crișului commune

- point 2.- Drumul Aștilenilor, at an altitude of 608 m, Latitude 46°54'41" N, Longitude 22°26'46" E, located in Tomnatic locality, Vadu Crișului commune

-point 3.- Podul Pancului, located at an altitude of 445m, Latitude 46°58'6"N and Longitude 22°24'23" E, located in Călățe locality, Aștileu commune.

The soil samples were collected with a drill probe at a depth between 0-25 cm. The aim was to determine the soil reaction, the content of humus, total nitrogen and trace elements. Depending on these values, the influence of soil quality on the growth and development of spontaneous flora will be estimated. The analysis was summarized in a series of medicinal plants, the most important of which are: elderberry (*Sambucus nigra*), wild garlic (*Allium ursinum*), hawthorn (*Crataegus monogyna*), yarrow (*Achillea millefolium*) and St. John's wort (*Hypericum perforatum*).



Fig..1. Administrative map of Bihor county with the three collection points  
[https://wiki/File:Harta\\_jud\\_bihor\\_localitati.png](https://wiki/File:Harta_jud_bihor_localitati.png)

The images below show the places where the soil samples were taken when they were harvested. It was tried that the temperature and humidity conditions are optimal at the time of harvest.



Fig. 2. Overview of the collection point (P. 1)- Brad-Tomnatic 2020



Fig. 3. Overview of the collection point (P. 2) Drumul Aștilenilor-Tomnatic 2020



Fig. 4. Overview of the collection point (P. 3) Podul Pancului-Călățea 2020

## RESULTS AND DISCUSSION

In the modern sense, soil fertility is given by a complex of agro-ecopedological factors, in which the soil chemistry is centrally positioned, with a decisive role in its definition. The state of providing the soil with nutrients in assimilable forms, as well as a complex of factors and processes that influence the soil such as pH, redox potential, buffering capacity, absorption capacity, fixation and retention capacity, represent indisputable agrochemical landmarks of fertility status. Knowing the value of the agrochemical parameters of the soil that characterizes its fertility status has a special importance and allows a long-term management of them, to prevent negative manifestations in plant growth and development.

The results of the laboratory tests are presented in the table down where we see the state of the soil's supply of nutrients.

Table 1

The state of the soil supply with nutrients in the three harvesting points in the Mountains  
Pădurea Craiului- 2020

Harvest point	NAME ANALYSIS / UM							NITRATED	
	Name	pH	H %	Azot total	P <sub>Al</sub>	K <sub>Al</sub>	Rezid. fix	N - NO <sub>3</sub>	N -NH <sub>4</sub>
P1	Bradea	5,25	9,57	0,479	29	200	0,017	50,8	5,0
P2	Drumul Aștilenilor	8,15	2,49	0,125	6	130	0,044	14,6	8,5
P3	Podul Pancului	7,90	6,88	0,344	9	360	20,03	14,1	14,1

## CONCLUSIONS

Following the soil analyzes performed in the three points (Bradea, Drumul Astilenilor, Podul Pancului), we can say that the Pădurea Craiului Mountains represent a perimeter conducive to the development of spontaneous flora due to the favorable soil conditions. Its quality contributes to the development of some species of medicinal plants, as follows: at point 1 Bradea-Tomnatic we meet a soil with medium texture - medium clay (LL) with a pH whose value is 5.25, conducive to the development of hawthorn and elderberry ; at point 2 Drumul Aștilenilor the soil has a fine clay-dusty (AL) texture, with a Ph whose value is 8.15, especially favorable for the growth of leurde, and at point number 3- Podul Pancului we have a fine texture -clay clay (AL), with a pH of 7.90, which helps to develop especially for St. John's wort and yarrow.

Given that the area of analysis is unpolluted, the products resulting from the harvesting of medicinal plants are recommended for use in both natural treatments and allopathic medicine, bringing a clear benefit in the treatment of various heart conditions (hawthorn), gynecological (yarrow), depurative (leurda), hepatobiliary (St. John's wort), laxatives and diuretics (elderberry).

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## THE EFFECT OF AUTUMN FERTILIZATION WITH NITROGEN COMPARED TO COMPLEX FERTILIZERS, ON WINTER WHEAT PRODUCTION

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### Abstract

*Fertilization is an important work in winter wheat cultivation technology that has a major impact on the level of production of winter wheat and its quality.*

*To retain plant nutrient requirements throughout the growing season, the application of nitrogen and phosphorus-based chemical fertilizers is a necessary and mandatory measure.*

*Autumn fertilization of wheat with complex chemical fertilizers results in a higher yield compared to simple nitrogen.*

*In order to highlight the role of nitrogen fertilization and complex chemical fertilizers used in the technology of cultivation of winter wheat varieties Glosa and Exotic, the level of production and its quality was analyzed through the differentiated use of nitrogen fertilizer and complex fertilizer doses of:  $N_{150}P_0K_0$ ,  $N_{150}P_{60}K_0$ ,  $N_{150}P_{60}+K_{60}$ , and unfertilized control.*

**Key words:** perishable fruits, refrigeration, fruit quality, controlled atmosphere, period of storage

### INTRODUCTION

Winter wheat is one of the agricultural plants that reacts positively to the use of fertilizers in all soil and climatic conditions in our country. Wheat consumes relatively large amounts of nutrients in the autumn-winter period. During the autumn period, the high consumption of nutrients is determined by the development of the root system, the twinning of the plants and the depositing of supplies necessary throughout the winter period (Bîlteanu, 2003).

Wheat can be difficult to fertilize due to certain features: first of all, the wheat's root is poorly developed, it uses up a small volume of soil and has a low solubilization and absorption strength of nutrients from the soil deposits. In addition, the maximum nutrient consumption of wheat plants takes place in a short period of time, from straw elongation to ripening, during which about 80% of nitrogen, over 80% of phosphorus and over 85% of potassium are absorbed; during this interval, the wheat must have at its disposal the necessary quantities of nutrients from easily accessible sources (Borza and Stanciu, 2010).

Nitrogen is an essential element for plant growth and development. It is the constituent of amino acids, structural and reserve proteins from the vegetative part and seeds, respectively. In the first period of growth, the

plants use relatively low amounts of nitrogen. The largest quantities are used during the period of maximum growth and in the development of vegetative organs, stems and leaves.

Cereal straw contains about 0.15%  $P_2O_5$ , and grains contain about five times as much. The presence of phosphorus in plants is about ten times lower than that of nitrogen, being about 0.2%, with variations depending on the species. Phosphorus increases the resistance of cereals to drought, frost and fall (Ciobanu, 2007).

The purpose of using basic fertilizers is to remove phosphorus deficiency from plant nutrition throughout the growing season. When using them, the following factors are taken into account: the time when used, the depth of incorporation, the form of the fertilizer, the dose and the interaction with other nutrients (Ciobanu, 2003).

Nitrogen fertilization is usually carried out in several stages (in installments, in fractions, in order to ensure an efficiency and a maximum coefficient of use of the active substance. NP).

Phosphorus fertilization is basically applied in autumn or spring, before or at the same time as sowing. Phosphorus is provided with nitrogen as a priority to activate the synergistic effect of N-P. Potassium fertilization is done only on soils poor in this element or on other soils previously and multiannually fertilized with N and P, in order to balance the agrochemical environment, to prevent K insufficiency and deficiency and in large potassium-consuming plants. Potassium is applied with fertilizers used as basic fertilizers (Rusu et al., 2005).

Wheat makes better use of phosphorus fertilizers compared to other crops. Doses of phosphorus are between 60 and 100 kg  $P_2O_5$ /ha, taking into account the expected production, the type of soil and its state of phosphorus supply. Potassium fertilization is recommended primarily on soils with an exchangeable potassium less than 150 ppmK, administering doses of 40-80  $K_2O$ /ha, before plowing or preparing the germination bed, in the form of potassium salt or complex fertilizers.

Nitrogen fertilizers are mainly applied in two phases: 40-80 kg N/ha in winter or early spring, depending on the state of the crop; the rest of the dose in spring, during the appearance of the first node of the stem.(Gh. Sin).

The combination of nitrogen and phosphorus creates interactions in the soil, favoring the growth and development of plants from the beginning of vegetation. That is why in some cases their application is made not only on the entire surface of the cultivated land, but also locally, near the seed in small quantities to determine a vigorous growth of plants, even from the beginning of vegetation. (Mocanu, Dodocioiu, 2007).

When fertilizing vegetation, it is very important that the condition of the crops is taken into account when determining the doses in order to

prevent the fall and attack of foliar diseases. When wheat is scarce in the spring, the aim is for the number of fertile siblings to become as high as possible, in which case we must fertilize as soon as possible, on frozen soil. When the density is high, we follow only the fertility of the ears, it is delayed with nitrogen fertilization until the ear is 5 cm above the twinning area.(Borcean et al., 2006).

The nutrients and the relationships between them influence both the development of the root system and the aerial organs. In wheat, sibling production is linked to root development and is stimulated by phosphorus fertilization (Caramete et al., 1980).

The best results for the use of chemical fertilizers are obtained when all methods of application are used, before sowing, at sowing, during vegetation, by a judicious combination of the different forms and doses to be applied, in relation to the variable needs of the plants, so that they are provided with necessary substances throughout the vegetation (Oancea, 2005).

## **MATERIAL AND METHODS**

Research on the influence of complex chemical fertilizers and simple nitrogen on wheat production and its quality was conducted on wheat varieties Glosa and Exotic, at the agricultural farm Leș Bihor, in 2018.

Three different methods of work and a control element were employed. Those methods consisted of various fertilization degrees (also known as variants) with a total of 180kg N, of which 30kg N/ha applied to the basic fertilization in autumn, 60kgN/ha applied in the spring to the first fertilization, and to the second fertilization they also applied 60 kg N/ha. To each fertilized variant a main element was added to the autumn N fertilization; NP; NPK.

The analyzed factors were:

Factor A – variety:

- Glosa
- Exotic

Factor B- nitrogen fertilization and complex fertilizers:

- V<sub>1</sub> - N<sub>0</sub>P<sub>0</sub> K<sub>0</sub>
- V<sub>2</sub> – N<sub>150</sub>P<sub>0</sub>K<sub>0</sub>
- V<sub>3</sub> – N<sub>150</sub>P<sub>60</sub>K<sub>0</sub>
- V<sub>4</sub> – N<sub>150</sub>P<sub>60</sub>K<sub>60</sub>

The analysis of the production level and its quality for the Glosa and Exotic wheat varieties was performed under the conditions of fertilization with nitrogen and complex chemical fertilizers with nitrogen and



phosphorus NP 20:20 and with nitrogen, phosphorus and potassium NPK 15/15/15. The variant chosen as a control was V<sub>1</sub> - unfertilized.

## RESULTS AND DISCUSSION

### 1. Efficiency of nitrogen and phosphorus fertilizers on the level of production of winter wheat.

The research on establishing the efficiency of complex chemical fertilizers and simple nitrogen on the production level of the Glosa and Exotic winter wheat varieties carried out in 4 working variants, depending on the doses administered, is presented in table 1.

Table 1

The influence of autumn fertilization with nitrogen and complex fertilizers on the production of Glosa and Exotic winter wheat varieties, Leş-Bihor, 2018

Type of wheat	Variant of fertilization	Production		Difference	
		Kg/ha	%	Kg/ha	%
Glosa	V <sub>1</sub> - N <sub>0</sub> P <sub>0</sub> K <sub>0</sub>	4340	100	0.00	0.00
	V <sub>2</sub> - N <sub>150</sub> P <sub>0</sub> K <sub>0</sub>	5170	119	+830	19
	V <sub>3</sub> - N <sub>150</sub> P <sub>60</sub> K <sub>0</sub>	5850	135	+1510	35
	V <sub>4</sub> - N <sub>150</sub> P <sub>60</sub> K <sub>60</sub>	6080	140	+1740	40
Exotic	V <sub>1</sub> - N <sub>0</sub> P <sub>0</sub> K <sub>0</sub>	4250	100	0.00	0,00
	V <sub>2</sub> - N <sub>150</sub> P <sub>0</sub> K <sub>0</sub>	5320	125	+1070	25
	V <sub>3</sub> - N <sub>150</sub> P <sub>60</sub> K <sub>0</sub>	5960	140	+1710	40
	V <sub>4</sub> - N <sub>150</sub> P <sub>60</sub> K <sub>60</sub>	6230	147	+1980	47

The level of production for the Glosa wheat variety in 2018 shows significant differences depending on the type of fertilizer applied. Thus, by applying to the autumn and spring fertilization only nitrogen, a dose of N<sub>150</sub>P<sub>0</sub>K<sub>0</sub>, the production obtained was 5170 kg/ ha, obtaining a production increase of 119%, compared to the non-fertilized variant; by applying to the autumn fertilization of complex fertilizers with phosphorus, in doses of N<sub>150</sub>P<sub>60</sub>K<sub>0</sub>, the production obtained was 5850 kg / ha, and an increase of production of 135%, and by fertilizing with complex fertilizers with phosphorus and potassium, in doses of N<sub>150</sub>P<sub>60</sub>K<sub>60</sub>, the obtained production reaches a production increase of 140%, with a value of 6080 kg/ha.

For the Exotic wheat variety, the production obtained also varies depending on the type and dose of fertilizers applied. When applying nitrogen fertilizers in a dose of N<sub>150</sub>P<sub>0</sub>K<sub>0</sub>, the end production is of 5320 kg/ha, with a production increase of 125%, compared to the non-fertilized variant N<sub>0</sub>P<sub>0</sub>K<sub>0</sub>. By applying complex fertilizers based on nitrogen and phosphorus, with doses of N<sub>150</sub>P<sub>60</sub>K<sub>0</sub>, the production level reaches 5960 kg / ha, obtaining an increase of 140%, and by fertilizing with complex

fertilizers based on NPK, the production obtained is 6230 kg/ha, with an increase in production of 147%.

For the Glosa wheat variety, the production increases are between 119-140%, depending on the fertilization doses, and in the case of the Exotic variety, the production increases have values between 125-147%, at the same fertilization doses.

## 2. The influence of nitrogen and phosphorus fertilizers on the amount of wet gluten in winter wheat

In terms of the quality of wheat production, at the level of 2018 studied, by administering complex chemical fertilizers and nitrogen, the gluten content of the analyzed varieties shows significant differences.

By applying nitrogen in winter wheat cultivation technology, it causes significant increases in gluten content for wheat grains (Table 2).

Table 2

The influence of autumn fertilization with nitrogen and complex fertilizers on the gluten content of winter wheat varieties Glosa and Exotic, Leș-Bihor, 2018

Type of wheat	Variants of fertilization	Wet gluten	
		Content	%
Glosa	V <sub>1</sub> - N <sub>0</sub> P <sub>0</sub> K <sub>0</sub>	23.0	100
	V <sub>2</sub> - N <sub>150</sub> P <sub>0</sub> K <sub>0</sub>	24.8	107.8
	V <sub>3</sub> - N <sub>150</sub> P <sub>60</sub> K <sub>0</sub>	25.2	109.5
	V <sub>4</sub> - N <sub>150</sub> P <sub>60</sub> K <sub>60</sub>	25.4	110.4
Exotic	V <sub>1</sub> - N <sub>0</sub> P <sub>0</sub> K <sub>0</sub>	24.2	100
	V <sub>2</sub> - N <sub>150</sub> P <sub>0</sub> K <sub>0</sub>	27.3	112.8
	V <sub>3</sub> - N <sub>150</sub> P <sub>60</sub> K <sub>0</sub>	28.5	117.7
	V <sub>4</sub> - N <sub>150</sub> P <sub>60</sub> K <sub>60</sub>	28.6	118.1

The wet gluten content of winter wheat is of particular importance on its baking quality.

In the case of the autumn fertilization of the Glosa wheat variety with nitrogen, the wet gluten content has the value of 24.8, achieving an increase of 107.8% compared to the unfertilized control variant. By applying complex fertilizers with phosphorus and the same dose of nitrogen, the value of wet gluten is 25.2, an increase of 109.5% compared to the non-fertilized variant, and by administering complex fertilizers of NPK type, the gluten level is 25.4, respectively an increase of 110.4% compared to the non-fertilized version.

The gluten content of the Exotic wheat variety shows significant increases. By applying nitrogen fertilizers, there is an increase in gluten content of 112.8% compared to the non-fertilized version; by the additional addition of NP-type complex fertilizers, the gluten content increases by 117.7%, having the value of 28.5, and by the administration of NPK-type complex fertilizers, the gluten content is 28.6.

By comparing the two varieties of winter wheat, the Glosa winter wheat variety has a gluten level of 23.0 in the non-fertilized version, and in the fertilized variants it is between 24.8-25.2, depending on the doses. of applied fertilizers.

In the Exotic winter wheat variety, the gluten in the non-fertilized version is 24.2, and in the fertilized version the level is between 27.3-28.6.

## CONCLUSIONS

By applying nitrogen fertilizers and complex chemical fertilizers to winter wheat, an increase in production was achieved between 119-140%, in the case of Glosa variety and 125-147%, in the case of Exotic variety, depending on the dose of N, NP and NPK applied.

The production increases obtained vary depending on the fertilization variant applied: by applying a dose of  $N_{150}P_0K_0$ , the production difference obtained compared to the non-fertilized variant is 830 kg/ha for the Glosa variety and 1070 kg/ha for the Exotic variety; by applying complex fertilizers, in a dose of  $N_{150}P_{60}K_0$ , the production difference is 1510 kg/ha for the Glosa variety and 1710 kg/ha for the Exotic variety, and by administering fertilizers in doses of  $N_{150}P_{60}K_{60}$ , the production difference is 1740 kg/ha to the Glosa variety and of 1980 kg/ha to the Exotic variety.

The use of nitrogen fertilizers and complex fertilizers, in addition to quantitative increases in production, also determines qualitative increases. By applying nitrogen fertilizers  $N_{150}P_0K_0$ , the gluten content for the Glosa variety is 24.8, and for the Exotic variety 27.3; by administering complex fertilizers  $N_{150}P_{60}K_0$ , the gluten content reaches 25.2 for the Glosa variety and 28.5 for the Exotic variety, and by using the  $N_{150}P_{60}K_{60}$  fertilizer, the gluten is 25.4 for the Glosa variety and 28.6 for the Exotic variety.

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## RESEARCH ON THE INFLUENCE OF CULTIVAR ON THE PRODUCTION OF EGGPLANTS GROWN IN SOLARIUMS

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### Abstract

*Eggplants have had many names throughout history. The largest quantity of eggplants is produced in Asia. In addition to culinary qualities, eggplant is also highlighted by a number of medicinal properties. The research aims at the production potential of 10 eggplant cultivars, grown in a conventional and ecological system. The results showed a better flowering and fruiting in conventional culture. Some varieties had yields above the experience average, while others were below this average. Production is higher in the conventional system compared to the ecological one.*

### INTRODUCTION

Eggplants have had several names throughout history, worldwide. The name eggplant (in English) dates back to the British occupation of India, when the egg-shaped white fruits of the species were very popular in some areas of the British kingdom, although some british people now use the name in the French version of eggplant: aubergine (Daunay Marie -Cristine and Janik, 2007).

In the tropical and subtropical regions, eggplant ranks, as a share in vegetable production, in sixth place after tomatoes, melons, onions, cucumbers and cabbage. Eggplants are also among the 35 most cultivated plants, considered to be very important for global food security, being included in Annex 1 of the International Treaty on Plant Genetic Resources for Food and Agriculture (Fowler et al., 2003, cited by Plazas et al., 2019).

The countries where large quantities of eggplant are produced are: China, India, Egypt, Indonesia, the Philippines, Japan, Spain and Italy (Ciofu et al., 2004).

Fruits that have reached ripe consumption are used in the preparation of various recipes with high potential and as a raw material for canneries and dehydrated products (Chen and Li, 1996).

Eggplant peel is edible although the vast majority of people remove it. In it is found the main natural source of nasunin, this is the substance that provides the dark pigment in the eggplant fruit and has the role of protecting it from damage caused by solar radiation or other sources of radiant energy. Nasunin belongs to the category of anthocyanins and has a high antioxidant activity (Saurabh et al., 2015). Eggplant consumption is highly recommended

for people with diabetes or rheumatic, kidney, liver diseases, eggplants having hematopoietic, diuretic, anti-inflammatory properties.

Since ancient times, Ayurvedic medicine, originally from India, recommends eggplant for diabetic and asthmatic patients (Khan, 1979, quoted by Daunay, 2007). It seems that the medicinal and aphrodisiac properties of eggplant are attributed to the bitter substances contained in the fruit (Daunay, 2007). Their preparation by boiling or baking, gives the fruit some medicinal features such as neutralizing iron or healing ear infections (Daunay, 2007, quoted by Bărbuță, 2014).

## **MATERIAL AND METHOD**

The present research was carried out in 2017, in an ecological micro-farm and an adjacent vegetable garden, in a conventional system, in Husasău de Tinca, a village located in the NW of the country. The study aims to analyze the production capacity of 10 eggplant cultivars, grown in a conventional and ecological system. In two solariums, in ecological and conventional system, two experiments with 10 variants were placed, each variant having 10 plants, the witness was the average of the experience.

The placement of the variants was done according to the method of subdivided blocks. The biological material was represented by 10 varieties, respectively: Zaraza, Violeta di Firenze, Black Beauty, Japanesse Pickling, Dourga, Monstruese de New York, Listada da Gandia, JiloTingua Verde, Carina, Orange de Turquie.

## **RESULTS AND DISCUSSION**

From the data presented in table 1, it is found that the flowering and fruiting of the plants was better for the crop cultivated in the conventional system, where a higher number of buds, flowers and fruits / plant was registered, compared to the organic cultivation system. Compared to the average experience, flowering and fruiting was better for the varieties Zaraza, Violeta di Firenze, Black Beauty, Dourga and Monstruese of New York.

Table 1

Flowering and fruiting of some varieties of eggplant grown in the solarium

Variant		Buds/plant		Flowers/plant		Fruits/plant	
Cultivar	System of crop	Pieces	% compared to the average	Pieces	% compared to the average	Pieces	% compared to the average
Zaraza	Ecologic	1.75	127.27	14.00	155.56	4.00	238.81
	Conventional	2.00	106.67	14.75	151.67	4.50	206.90
Violeta di Firenze	Ecologic	1.50	109.09	10.75	119.44	2.25	134.33
	Conventional	2,25	120,00	11,25	115,68	2,50	114,94
Carina	Ecologic	1,50	109,09	5,50	61,11	1,50	89,55
	Conventional	2,00	106,67	6,00	61,70	1,75	80,46
Black Beauty	Ecologic	1,00	72,73	6,25	69,44	2,00	119,40
	Conventional	1,75	93,33	7,00	71,98	2,25	103,45
Japanese Pickling	Ecologic	1,75	127,27	10,25	113,89	1,25	74,63
	Conventional	2,25	120,00	10,75	110,54	1,75	80,46
Dourga	Ecologic	1,25	90,91	10,50	116,67	2,00	119,40
	Conventional	1,75	93,33	11,00	113,11	2,50	114,94
Orange de Turquie	Ecologic	1.50	109.09	7.75	86.11	0.25	14.93
	Conventional	2.00	106.67	8.25	84.83	1.00	45.98
Monstruese de New York	Ecologic	1.25	90.91	13.75	152.78	1.75	104.48
	Conventional	1.75	93.33	14.50	149.10	2.25	103.45
Listada da Gandia	Ecologic	1.50	109.09	6.25	69.44	1.25	74.63
	Conventional	2.00	106.67	6.75	69.41	2.00	91.95
JiloTingua Verde	Ecologic	0.75	54.55	5.00	55.56	0.50	29.85
	Conventional	1.00	53.33	7.00	71.98	1.25	57.47
Average	Ecologic	1.38	100.00	9.00	100.00	1.68	100.00
	Conventional	1.88	100.00	9.73	100.00	2.18	100.00

Analyzing the unilateral influence of the cultivar on the eggplant production made in the solarium, it is found that on average, the production was 49.50 t / ha, with limits between 24.15 t / ha and 71.15 t / ha (table 2). The yields exceeded the average experience for Black Beauty varieties by 43.73%, Violeta di Firenze by 41.92%, Monstruese de New York by 24.04%, Dourga by 16.26%, the differences in production being very significant, respectively distinctly significant. The lowest yields were recorded for the JiloTingua Verde, Orange de Turquie and Carina varieties, where the differences from the control were very significant negative. (Table 2).

Table 2

The influence of the cultivar on the production of eggplant cultivation in the solarium

Cultivar	Production		$\pm d$ t/ha	The signification of the difference
	t/ha	%		
Zaraza	46.35	93.63	-3.15	o
Violeta di Firenze	70.25	141.92	20.75	***
Carina	28.10	56.76	-21.40	ooo
Black Beauty	71,15	143,73	21,65	***
Japanese Pickling	48,85	98,68	-0,65	-
Dourga	57,55	116,26	8,05	**
Orange de Turquie	24,15	48,78	-25,35	ooo
Monstruese de New York	61,40	124,04	11,40	***
Listada da Gandia	50,00	101,01	0,50	-
JiloTingua Verde	37,25	75,25	-12,25	ooo
Average	49.50	100.00	-	-

LSD (P 5%) 3.07

LSD (P 1%) 6.12

LSD (P 0.1%) 8.75

The cultivation system applied to the eggplants from the solariums influenced the registered productions so that for the ecological culture, the production was of 47.14 t / ha, compared to 51.85 t / ha obtained for the conventional culture, the difference between the two cultivation systems being significant (Table 3).

Table 3

The influence of the cultivation system on the production of eggplant cultivation in the solarium

System of crop	Production		$\pm d$ t/ha	The significance of the difference
	t/ha	%		
Ecologic	47.14	90.92	-4.71	o
Conventional	51.85	100.00	-	-

LSD (P 5%) 3.52

LSD (P 1%) 7.26

LSD (P 0,1%) 9.45

The eggplant production obtained from cultivars used for solarium crops averaged 49.50 t / ha (Table 4). It was found that in all cultivars the production was higher in the conventional cropping system, compared to the organic one. In the conventional cultivation system there were increases of 44.84% for the Violeta di Firenze variety, 47.67% for the Black Beauty variety, 21.62% for the Dourga variety, 27.47% for the Monstruese de New

York variety and 6, 06%, in which the production differences compared to the control variant were very significant, respectively significant. The varieties Carina, Orange de Turquie and JiloTingua Verde registered very significant negative production differences in both cropping systems. In the organic culture system, the production was higher for the varieties Violeta di Firenze, with 38.90%, Black Beauty with 39.79%, Dourga with 10.90% and Monstruese de New York with 20.60%, the differences of production being very significant, respectively significant.

Table 4

The combined influence of the cultivar and the cultivation system on the production of eggplants grown in the solarium

Variant		Production		± d t/ha	The significance of the difference
Variety	System of crop	t/ha	%		
Zaraza	Ecologic	42,30	85,45	-7,20	oo
	Conventional	50,40	101,82	0,90	-
Violeta di Firenze	Ecologic	68,80	138,90	19,30	***
	Conventional	71,70	144,84	22,20	***
Carina	Ecologic	26,90	54,34	-22,60	ooo
	Conventional	29,10	58,78	-20,40	ooo
Black Beauty	Ecologic	69,20	139,79	19,70	***
	Conventional	73,10	147,67	23,60	***
Japanese Pickling	Ecologic	45,80	92,52	-3,70	o
	Conventional	51,90	104,84	2,40	-
Dourga	Ecologic	54,90	110,90	5,40	*
	Conventional	60,20	121,62	10,70	***
Orange de Turquie	Ecologic	21,50	43,43	-28,00	ooo
	Conventional	26,80	54,14	-22,70	ooo
Monstruese de New York	Ecologic	59,70	120,60	10,20	***
	Conventional	63,10	127,47	13,60	***
Listada da Gandia	Ecologic	47,50	95,96	-2,00	-
	Conventional	52,50	106,06	3,00	-
JiloTingua Verde	Ecologic	34,80	70,30	-14,70	ooo
	Conventional	39,20	80,20	-9,80	ooo
Average		49,50	100,00	-	-

LSD (P 5%)                      3,25  
LSD (P1%)                        6,82  
LSD (P 0,1%)                    9,37



## CONCLUSIONS

The researches regarding the influence of the cultivar on the eggplant production from the solarium, allowed the elaboration of some conclusions, namely:

1. Compared to the average experience, flowering and fruiting was better for the varieties Zaraza, Violeta di Firenze, Black Beauty, Dourga and Monstruese of New York
2. The unilateral influence of the cultivar on the eggplant production made in the solarium, shows that on average, the production was 49.50 t / ha, with limits between 24.15 t / ha and 71.15 t / ha.
3. The products exceeded the average experience for Black Beauty varieties by 43.73%, Violeta di Firenze by 41.92%, Monstruese de New York by 24.04%, Dourga by 16.26%.
4. In organic farming, the production was 47.14 t / ha, compared to 51.85 t / ha obtained in conventional cultivation, the difference between the two cropping systems being significant.
5. All cultivators in the conventional system recorded higher yields than in the organic system.

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## RESEARCH ON THE INFLUENCE OF CULTIVAR ON FRUIT PRODUCTION AND QUALITY IN THE CULTIVATION OF EDIBLE PUMPKIN

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### Abstract

*The edible pumpkin has been known since antiquity, but it was introduced to Europe only at the end of the ninth century. Used as a vegetable, it helps to improve diversity, especially in the cold season. Pumpkin can be added to herbs due to its many health benefits. Pumpkin seeds are becoming increasingly important. The research took place in two different places located in NW of Romania. The objective of the research was the production obtained from several pumpkin crops, grown in a conventional and ecological system. There were cultivars with both big and small productions.*

**Key words:** pumpkin, cultivar, production

### INTRODUCTION

As a versatile vegetable, *Cucurbita maxima* makes a valuable contribution to food resources around the world. In addition to the development of improved fruit crops, attention must be paid to the potential of leaves and seeds.

The pie pumpkin is native to Latin America, has a long history and was cultivated by ancient civilizations in Central and South America about 7,000 years ago (Zvalo and Respondek 2007). There is also compelling evidence from archeological sites in Central America and the South that *C. Maxima* were widely cultivated in pre-Columbian times. *Cucurbita pepo* has a common ancestor with *C. moschata* and *C. argyrosperma*, but not with *C. maxima* (Decker-Walters et al., 1990).

We can appreciate that the center of diversity, the edible pumpkin (*Cucurbita maxima*), exists in temperate areas of South America, where agricultural areas have a number of interesting features. Many areas of this species are also found in North America, the Australian continent and different African countries: Nigeria, Zambia, Asia: India, Iran and China, and Europe: Turkey and Spain (Ferriol and Pico 2008).

It was introduced in Europe in the late nineteenth century. Later, the culture spread to neighboring countries in southern Europe, the Mediterranean, and then entered the Balkan countries such as Greece, Turkey and Bulgaria.

Given its proven effects on health, *Cucurbita maxima* Duch. (pumpkin) can be included among other medicinal plants. Among the known pharmacological activities are: antitumor (Hartwell, 1967; Saha et al., 2011), anti-obesity (Das et al., 2010), antidiabetic (Saha et al., 2011), hepatoprotective (Saha et al., 2011), diuretics (Jose et al., 2008), antioxidant (Attarde et al., 2010), antigenotoxic (Villasefior and Lemon, 1996), dewormer and taenicide (Al-Rawi and Chakravarty; Burkill et al., 1966), remedy for anthrax (Al-Rawi and Chakravarty, 1964), used in poultices (Al-Rawi and Chakravarty, 1964; Pitier, 1926), tonic (Al-Rawi and Chakravarty, 1964), wound healing (Hartwell, 1967). In addition, pumpkin seed oil has been recognized for several health benefits such as preventing enlargement and reducing prostate size, thus reducing the symptoms of benign prostatic hyperplasia (Carbin and Eliasson, 1989; Carbin et al., 1990; Koch, 1995; Schiebel -Schlosser and Friedrich, 1998), reduction of bladder and urethral pressure and improvement of bladder function; two unsaturated fatty acids oleic and linoleic acid may be relief of prostate enlargement symptoms.

#### **MATERIAL AND METHOD**

The research took place in 2020, in a locality located in the NW of Romania (Bălaia), in a vegetable garden and the second experiment took place in an ecological microfarm in another locality (Husasău de Tinca). The objective of the research was the production obtained from several pumpkin crops, grown in a conventional and ecological system. The two single-factor experiments had 10 variants, each variant having 5 nests with 2 plants per nest. The placement was done by the method of subdivided blocks, the data processing was done by analyzing the variance. The biological material was represented by 10 varieties, namely: Tudor, Musquee de Provence, Pumpkin Bleu de Hongrie, Pumpkin Vert Olive, Hubbard Vert, Dickinson, Red Kuri, Pleine de Naples, Bush Delicata, Musquee Butternut.

#### **RESULTS AND DISCUSSION**

For the two experiments, conventional culture technologies were applied to the one located in Bălaia, respectively ecological to the one located in Husasău de Tinca. The first aspect analyzed was the production of pumpkins for the 10 varieties in two cropping systems. Analyzing the first table as a whole, it can be seen that in some varieties very high fruit productions were obtained, while in some very small productions. Comparing the yields from the two cropping systems, it is observed that except for the Plaine de Naples variety for all the other varieties, the production in the conventional system was higher compared to the organic production. Compared to the average experience, the largest increase in production was

recorded for the Plaine de Naple variety in the ecological system of 102.49%, the difference being ensured statistically very significant positive. Highly significant statistically positive production increases were also obtained: Plaine de Naple in conventional system, Dickinson in conventional system as well as Musquee de Provence in both culture systems. The lowest production was recorded for the Bush Delicata variety of 1.58 kg / m<sup>2</sup> in the conventional system and 1.32 kg / m<sup>2</sup> in the organic system. In both variants, the difference from the average experience was ensured with a very significant negative statistic. Small amounts of fruit obtained below the average of the experience were found in both systems of the varieties: Musquee Butternut, Red Curry, Hubbard Vert and Potiron Vert Olive.

*Table 1*

Pumpkin production grown in the two cropping systems  
(Husasău de Tinca; Bălaia)

Variant		Production of pumpkin		± d kg/m <sup>2</sup>	The significance of the difference
Variety	System of crop	kg/m <sup>2</sup>	%		
Tudor	Ecologic	4.05	100.99	+0.04	-
	Conventional	4.39	109.47	+0.38	-
Musquee de Provence	Ecologic	6.22	155.11	+2.21	XXX
	Conventional	7.47	186.28	+3.46	XXX
Potiron Bleu de Hongrie	Ecologic	3.81	95.01	-0.2	-
	Conventional	4.57	113.96	+0.56	X
Potiron Vert Oliv	Ecologic	2.72	67.83	-1.29	000
	Conventional	3.02	75.31	-0.99	000
Hubbard Vert	Ecologic	1.41	35.16	-2.6	000
	Conventional	1.97	49.12	-2.04	000
, Dickinson	Ecologic	4.75	118.45	+0.74	XX
	Conventional	6.82	170.07	+2.81	XXX
Red Kuri	Ecologic	2.90	72.31	-1.11	000
	Conventional	3.00	74.81	-1.01	000
Pleine de Naples	Ecologic	8.12	202.49	+4.11	XXX
	Conventional	7.99	199.25	+3.98	XXX
Bush Delicata	Ecologic	1.32	32.01	-2.69	000
	Conventional	1.58	39.40	-2.43	000
Musquee Butternut	Ecologic	1.86	46.38	-2.15	000
	Conventional	2.29	72.81	-1.72	000
Average		4.01	100	0.00	
LSD (P 5%)			0.48		
LSD (P1%)			0.62		
LSD (P 0,1%)			0.82		

Next, the quality of the pumpkin fruits was analyzed. As qualitative parameters, the obtained fruits were compared with the standards described for each variety. Table 2 presents the productions on 2 qualities for the analyzed varieties both in absolute production and as a percentage of the total production. In most varieties, the first quality fruits were superior to the second quality ones. There were a few exceptions, namely: at Musquee Butternut the ecological version, Bush Delicata both variants, Plaine de Naple both variants, Red Curry and Dickinson. The variant that made the most quality I fruit was Potiron Vert Olive of 71.32% of the total. Although, in absolute production it represented 1.94 kg / m<sup>2</sup>. Even if the Plaine de Naple variety obtained the highest quality I production of 3.69 kg / m<sup>2</sup> in percent of the total, it represented only 45.44%. The first quality fruits for the 10 pumpkin varieties registered between 38.17% and 71.32% for the Potiron Vert Olive variety in ecological system.

Table 2

The quality of pumpkin fruits (Husasău de Tinca; Bălaia)						
Variant		1 <sup>st</sup> quality			2 <sup>st</sup> quality	
Variety	System of crop	kg/m <sup>2</sup>	kg/m <sup>2</sup>	%	kg/m <sup>2</sup>	%
Tudor	Ecologic	4,05	2,48	61,23	1,57	48,77
	Conventional	4,39	2,31	52,61	2,08	47,39
Musquee de Provence	Ecologic	6,22	3,75	60,28	2,47	39,72
	Conventional	7,47	3,97	53,14	3,50	46,86
Potiron Bleu de Hongrie	Ecologic	3,81	1,82	47,76	1,99	52,24
	Conventional	4,57	2,15	53,61	2,42	46,39
Potiron Vert Oliv	Ecologic	2,72	1,94	71,32	0,78	28,68
	Conventional	3,02	2,15	71,19	0,87	28,81
Hubbard Vert	Ecologic	1,41	0,88	62,41	0,53	37,59
	Conventional	1,97	1,15	58,61	0,82	41,39
, Dickinson	Ecologic	4,75	2,31	48,63	2,44	51,37
	Conventional	6,82	3,21	47,06	3,61	52,94
Red Kuri	Ecologic	2,90	1,28	44,13	1,62	55,87
	Conventional	3,00	1,41	47,00	1,59	53,00
Pleine de Naples	Ecologic	8,12	3,69	45,44	4,43	54,56
	Conventional	7,99	3,41	42,67	4,58	57,33
Bush Delicata	Ecologic	1,32	0,48	36,38	0,84	63,64
	Conventional	1,58	0,67	42,40	0,91	57,60
Musquee Butternut	Ecologic	1,86	0,71	38,17	1,15	61,83
	Conventional	2,29	1,18	51,52	1,11	48,48

## CONCLUSIONS

Research on the production and quality of pumpkin fruit obtained in two different locations and two different systems has revealed a number of conclusions, namely:

1. The quantity of fruit obtained for the 10 varieties in 20 variants showed varieties with very high production potential, respectively varieties with very low yields per unit area.
2. With one exception, all conventional variants were productively superior to ecological variants.
3. The highest production per unit area was obtained for the ecological variant of the Plaine de Naple variety of 81.2 t / ha, a very high production.
4. The production of 13.2 t / ha obtained for the Bush Delicata variety was the lowest production, and in order to become economically efficient, the fruits must be capitalized at a fairly high price.
5. The variant with the highest percentage of quality I fruit was the organic one of the Potiron Vert Olive variety (71.32%), followed closely by the conventional variant of the same variety (71.19%).
6. The lowest quality fruits were found in the organic version of the Bush Delicata variety and the organic version of the Musquee Buternut variety.

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**COMPARATIVE STUDY ON REGENERATIVE AND  
ORGANOGENIC CAPACITY OF ECHINOCACTUS  
MIHANOVICHII AND ECHINOPSIS (ZUCC.)  
CHAMAECEREUS F. LUTEA CULTIVATION IN VITRO  
IN THE PRESENCE IN THE CULTURAL MEDIUM OF  
3-INDUTYL BUTYRIC ACID (AIB) ADDED IN  
DIFFERENT CONCENTRATIONS**

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**Abstract**

*Cactuses with red epidermis Echinocactus mihanovichii or yellow Echinopsis chamaecereus f. lutea, are part of the group of chlorophyll cacti - deficient due to a mutation that occurs spontaneously in the culture, as a result, they are unable to synthesize chlorophyll and only if they are chlorophyll grafted.*

*In order to establish the in vitro culture of Echinocactus mihanovichii and Echinopsis chamaecereus f. lutea, we took explants represented by mini-cuttings (seedlings) from mother plants grown in the greenhouse. We inoculated the explants on a culture medium consisting of macroelements and Fe EDTA Murashige-Skoog (1962), Heller microelements (1953), supplementation with medium supplemented with 3-indolyl butyric acid (IBA) in different concentrations, respectively 1 mg/l IBA ( $V_1$ ); 1,5 mg/l IBA ( $V_2$ ) and 2 mg/l IBA ( $V_3$ ).*

*The evolution of the explants was monitored for 90 days. At the end of the experiment, we observed that the response of Echinocactus mihanovichii and Echinopsis chamaecereus f. lutea explants differs depending on the composition of the culture medium, as follows: the presence in the culture medium of 2 mg/l AIB ( $V_3$ ) was positively influenced both species, constant increase in diameter at the level of phytinocles with an increase of 33,33% compared to the values of the same parameter recorded in the control group  $V_0$  (medium without growth regulators) in Echinopsis (Zucc.) chamaecereus f. lutea also stimulated the process of callus formation in both species, their average number being 0,3 calluses/ variant in both cactus species, with an average diameter of 0,6 cm in Echinocactus mihanovichii and 0,5 cm la Echinopsis chamaecereus f. lutea.*

*It should be noted that, in this experiment, the process of caulogenesis and rhizogenesis did not take place in any variant and in any of the species used in the experiment*

**Keywords:** cactus, vitro cultures, 3 indolyl butyric acid (IBA), callus, newly formed stems, roots.

**INTRODUCTION**

Deficient chlorophyll cacti such as *Gymnocalycium mihanovichii* and *Echinopsis chamaecereus f. lutea* are a cactus with colored epidermis (fig.1), lacking the ability to synthesize chlorophyll due to the small number of chloroplasts, about 1/3 of all plastids (Shemorakov, 2003).

Pigmentation is caused by the spontaneous appearance in cultures of mutations largely influenced by temperature and light (Shemorakov, 2003).



According to Skoulkin (2000), plants kept at a lower temperature than the optimal one and in the shade rarely or not at all develop such mutations.



Fig.1. Image with chlorophyll-deficient cacti. Where:  
A- *Gymnocalycium mihanovichii*;  
B- *Echinopsis chamaecereus f.*

*lutea*

Russian researchers have shown a special interest in chlorophyll-deficient cacti species, so they have classified them according to the color of the epidermis (Shemorakov, 2003).

According to Shemorakov (2001), the reversible mutation of plastids during meiosis keeps the generative reproduction of these species to a minimum (Kornilov, 2008), thus concluding that plants can retain color only by cloning. This has led to the search for new and economically efficient methods (Son, 2000, Lee et al., 2003) for their rapid multiplication.

3-Indolyl butyric acid (IBA) is an auxin with great efficacy in callus formation and rhizogenesis. In callus culture, auxin provides high friability, facilitating the separation of cells into cell suspensions and somatic embryogenesis.

The aim of the experiment covered by this article is to analyze the reaction variability of vitro cultures of *Gymnocalycium mihanovichii* and *Echinopsis chamaecereus f. lutea*, in the presence in the culture medium of 3-indolyl butyric acid (IBA) in different concentrations, respectively 1 mg/l IBA ( $V_1$ ), 1,5 mg/l IBA ( $V_2$ ) and 2 mg/l IBA ( $V_3$ ).

## MATERIAL AND METHOD

The biological material used in our experiments consisted of regenerated mini-cuttings (seedlings) on strains of *Gymnocalycium mihanovichii* and *Echinopsis chamaecereus f. lutea* (fig.2). The explants were about 1 cm long, 0.5 cm thick and 0.5-1.5 cm in diameter, depending on the area from which they were harvested (Fig. 2).

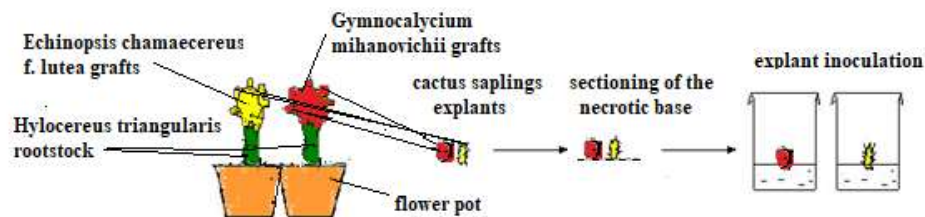


Fig.2. Schematic representation of the exploitation of the fragments of *Gymnocalycium mihanovichii* and *Echinopsis chamaecereus f. lutea*, which will be inoculated on aseptic media.

The vegetable material was aseptitized by immersion, for one minute, in 96° ethyl alcohol, followed by its coating with 0,8% sodium hypochlorite solution, mixed with water in a ratio of 1:2; in the disinfectant solution was added - as a surfactant - three drops of Tween 20 each (Cachiță et al., 2004).

During aseptization, the vegetative material was stirred continuously (Cachiță et al., 2004). After 20 minutes, the disinfectant was removed and the plant material was washed with sterile distilled water, making five consecutive rinses, of five minutes each. Then, the vegetal material was deposited in aseptic conditions, in a hood with horizontal laminar flow, of sterile air, in operation, on the rounds of filter paper sterilized in the oven, introduced in aseptic Petri dishes. Subsequently, the necrotic parts of the future inocula were detached.

Culture medium used for growth explants consisted of: macro Murashige-Skoog EDTA and Fe (1962), Heller microelements (1953), mineral mixture to which was added vitamins: pyridoxine HCl, thiamine HCl and nicotinic acid (containing 1 mg/l each), m-Inositol - 100 mg/l, sucrose - 20 g/l and agar 7 g/l the pH of the medium was adjusted to 5.8, the first to autoclaving. In the base medium (MB) we added 3-indolyl butyric acid in different concentrations as follows: 1 mg/l IBA ( $V_1$  variant), 1,5 mg/l IBA ( $V_2$  variant) and 2 mg/l IBA ( $V_3$  variant), obtaining the following experiments:  $V_0$  - control variant, environment without growth regulators,  $V_1$  - 1 mg/l IBA,  $V_2$  - 1,5 mg/l IBA,  $V_3$  - 2 mg/l IBA.

Culture medium thus obtained was placed in a glass vial with a capacity of 15 ml (each container was placed 5 ml of medium). Medium vials were sterilized by autoclaving for 30 minutes at a temperature of 121°C. After cooling media proceeded to inoculate explants, aseptic room operation performed in a laminar flow hood with sterile air. To obstruction fitoinoculi containers we used polyethylene, immobilized with elastic. Containers were inoculated Transferred to room for growth, under the following Conditions: temperature ranged from 24°C in the range of light

and 20°C during the phase of darkness and light was the regime fotoperiodic 16 hours with light/24h, lighting Achieving cultures with the white light emitted by fluorescent lamps, the intensity of 1700 lux.

Explants and explants reaction progress was monitored for 90 days. In this time period were conducted periodic observations and readings every 30 days. Values thus obtained in the control group ( $V_0$ , phyto inoculi grown on basic medium, without growth regulators) were considered the reference as 100% being reported - every trait - all readings averaged every experimental variant part.

## RESULTS AND DISCUSSION

After 90 days of viticulture, both in the explants of *Echinocactus mihanovichii* and *Echinopsis (Zucc.) chamaecereus f. lutea*, there is a much faster increase in the mean basal diameter of the main stem in phytoinocles belonging to the control sample  $V_0$  (Vidican et al, 2009), so in the first species of cactus the data recorded show that at an average value of stem diameter of 1,1 cm (Fig.3) , this parameter equaled the control (Fig.3), while in the second species of cactus this parameter equal to 1,2 cm (Fig.3) represents an increase of 33,33% (Fig.4), compared to the values of the same parameter recorded in the control group  $V_0$  (environment without growth regulators).

These results are consistent with those reported by Corneanu et al., (1994), who reported that explants represented by fragments of *Dilochothele longimamma*, cultured "in vitro" on Murashige-Skoog medium (1962), without growth regulators, may manifest the phenomenon of morphogenesis.

Regarding the generation of new strains, in both species used in the experiment, it was shown that the presence in the culture medium of different concentrations of AIB inhibited caulogenesis. The presence of new strains is noticeable in both experiments in the control variant  $V_0$  (medium without growth regulators) where in *Echinopsis (Zucc.) chamaecereus f. lutea* generated an average number of 0,3 buds/variant (Fig.3) these having an average basal diameter of 0,4 cm (Fig.3) while in *Echinocactus mihanovichii* the experimental variant  $V_0$  recorded an average number larger than buds/variant, respectively, of 0,5 (Fig.3), with the same average basal diameter, of 0,4 cm (Fig.3).

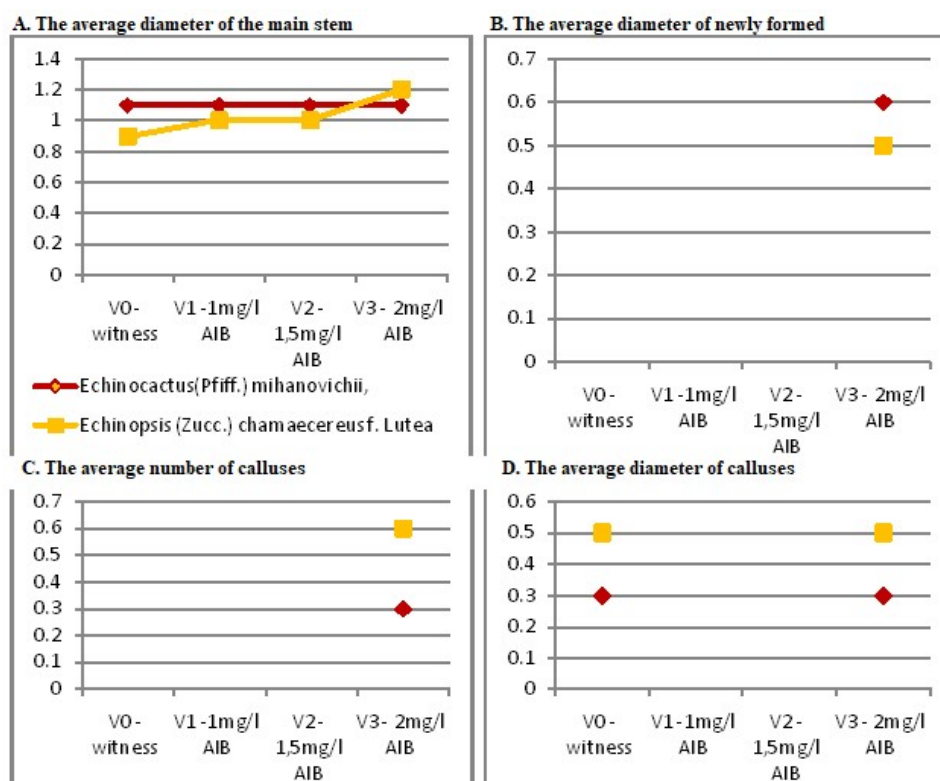


Fig 3. Graphic presentation of the average values corresponding to the in vitro parameters of *Echinocactus (Pfiff.) mihanovichii* and *Echinopsis chamaecereus f. lutea* cultures on basic aseptic medium modified by us - (variant V<sub>0</sub>) - with the addition of 1mg / l AIB (variant V<sub>1</sub>), 1,5 mg/l AIB (variant V<sub>2</sub>) or 2 mg/l AIB (variant V<sub>3</sub>), data expressed in absolute values; (where: A-the average diameter of the main stem; B-the average diameter of newly formed; C-the average number of calluses; D-the average diameter of calluses)

These results are consistent with those obtained by Clayton et al. (1990), which following a study of cacti of the genus *Mammillaria* grown "in vitro" suggests that each species of catus may require a specific recipe for the composition of the culture medium (Johnson et al., 1979a and b Starling et al., 1983; Vyskot et al., 1984, Martinez – Vázquez et al., 1989).

Callus induction was observed in both species at the level of explants of variant V<sub>3</sub> (average supplemented with 2 mg/l AIB) their average number being 0,3 calluses/variant (Fig.3), in both species of cactus, with a average diameter of 0,6 cm (Fig.3) in *Echinocactus mihanovichii* and 0,5 cm in *Echinopsis chamaecereus f. lutea* (Fig.3).

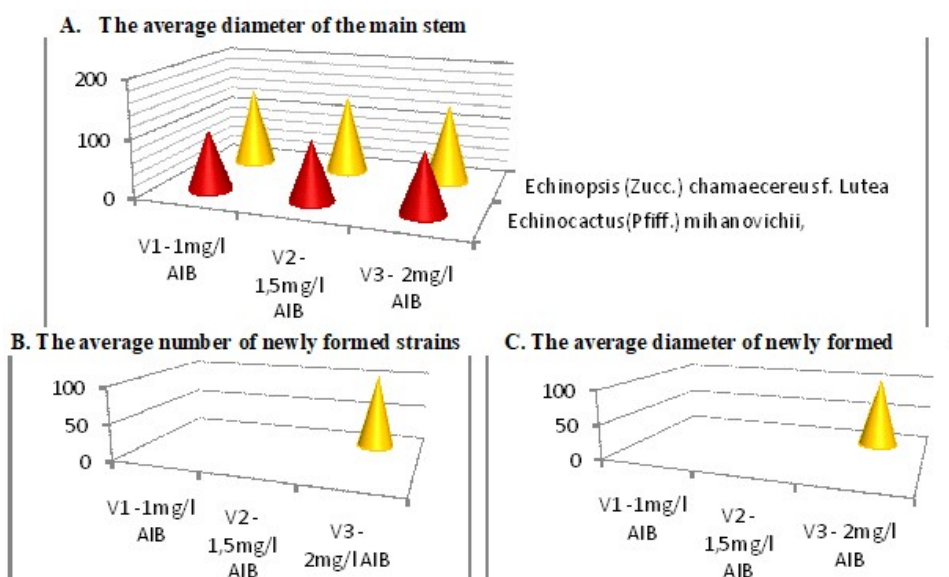


Fig 4. Graphic presentation of the average values corresponding to the parameters in vitro cultures of *Echinocactus (Pfiff.) mihanovichii* and *Echinopsis chamaecereus f. lutea* on aseptic medium modified by us - with the addition of 1mg/l AIB (variant V<sub>1</sub>), 1,5 mg/l AIB (variant V<sub>2</sub>) or 2 mg/l AIB (variant V<sub>3</sub>), data expressed as a percentage, obtained after reporting the values read at the results recorded at the respective parameters in the control group (V<sub>0</sub>), without growth regulators, values considered to be 100%; (where: A-the average diameter of the main stem; B-the average number of newly formed strains; C-the average diameter of newly formed)

In the present experiment it is noted that the cactus species and the variants studied have no reaction, in terms of new root formation, to the presence in the culture medium of auxin - 3-indolylbutyric acid (AIB) - regardless of the concentration used. in the current experiment.

The results are consistent with those reported by Copacescu, after Corneanu, 2001, who reports that in most vitro-cultivated species the process of rhizogenesis is easy on MS environment, supplement with endogenous auxins, but species that have a slow growth rate, create problems special at rooting.

Analyzing the images in figure 5, it is observed that, after 90 days of viticulture, the surviving *Echinocactus mihanovichii* inocula have grown and have well-developed areolas and spines, but the section areas are necrotic, a phenomenon manifested by color change - they become brown (Vidican et al, 2018).

In the phytoinoculates of the experimental variant V<sub>0</sub> (medium without growth regulators) and in V<sub>1</sub> (medium supplemented with 1 mg/l AIB) it is found the existence of some areas in which their initial color changed, from

red turned to a brick, even orange with yellow tint (Fig. 5A and B). In the case of explants grown on medium supplemented with 2 mg/l AIB (V<sub>3</sub>), both the lack of spines and a red callus are noticeable (Fig.5D).

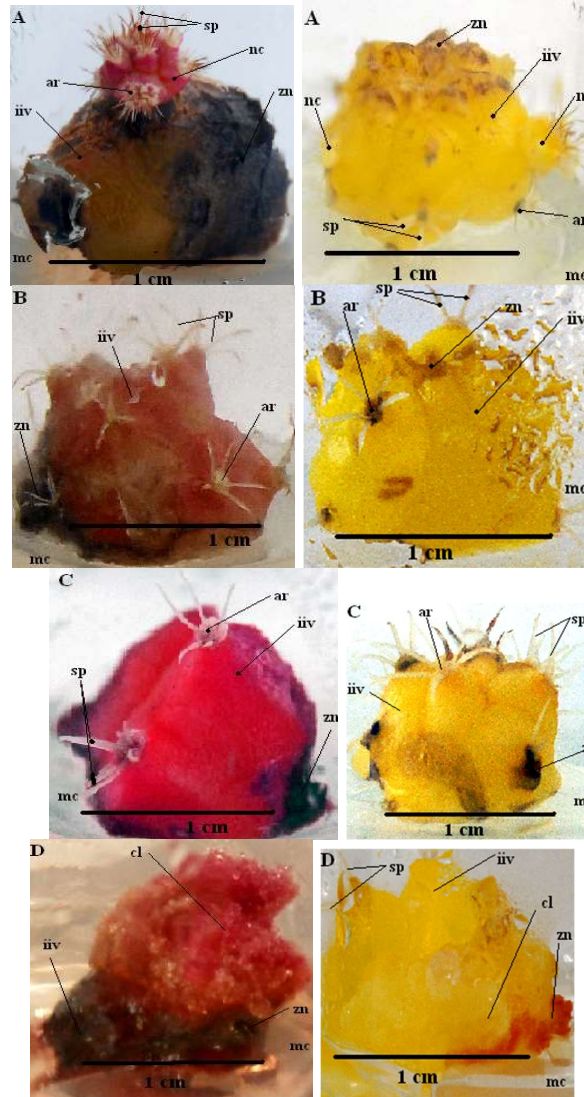


Fig. 5. Inoculi de *Echinocactus*(Pfiff.) *mihanovichii* și de *Echinopsis* (Zucc.) *chamaecereus* f. *lutea*, la 90 de zile de la inocularea explantului „in vitro”, unde: **A**-pe mediu de bază modificat de noi lipsit de regulatori de creștere(V<sub>0</sub>); **B**-pe mediu de bază cu adaos de 1 mg/l AIB (V<sub>1</sub>); **C**-pe mediu de bază cu adaos de 1,5 mg/l AIB (V<sub>2</sub>); **D**-pe mediu de bază cu adaos de 2 mg/l AIB (V<sub>3</sub>); (iiv–inocul inițial viabil; mc–mediu de cultură; ar–areole; sp–spini; cl–calus; zn–zonă necrozată).

According to Cachiță, (2004), the coloration in red or shades of red of the callus, is due to a very high content in anthocyanins, which accumulates in its cells due to its growth regime, species, origin and age; In this case, this pigmentation may also be influenced by the red color of the epidermis of the chlorophyll-deficient cactus *Echinocactus mihanovichii*. A compact red callus, formed on the cut surface of the explants, was also obtained in some species of *Mammillaria*, the color being due to the presence of beta alanine in its cells (Pérez et al., 1998). Unlike *Echinocactus mihanovichii*, in the inocula of *Echinopsis chamaecereus f. lutea* there are no significant changes in terms of morphological characteristics or color regardless of the culture medium used (Vidican et al, 20017).

## CONCLUSIONS

Following, for 90 days, the reaction and evolution of phytoinocles of *Echinocactus mihanovichii* and *Echinopsis chamaecereus f. lutea* grown on culture medium improved with AIB in different concentrations, it is noted that: the values recorded both in control group  $V_0$  of growth regulators) and considered as a reference, as being 100%, as well as of the other experimental variants, no existence of significant differences in their reaction mode was found.

1. There was a steady increase in diameter at the level of phytoinoculi, especially in those grown on medium supplemented with 2 mg/l AIB ( $V_3$ ) and in the control sample  $V_0$ , thus in *Echinocactus mihanovichii* at an average value of stem diameter of 1,1 cm this parameter equaled the control, while in *Echinopsis (Zucc.) chamaecereus f. lutea* this parameter equal to 1,2 cm represents an increase of 33,33% compared to the values of the same parameter registered in the control group  $V_0$  (average without growth regulators)

2. Caulogenesis was inhibited by the presence in the culture medium of different concentrations of AIB, a phenomenon that manifested itself only in the explants of the control group  $V_0$  (environment without growth regulators); where in *Echinopsis (Zucc.) chamaecereus f. lutea* generated an average number of 0,3 buds/variant, and *Echinocactus mihanovichii* recorded an average number of buds/variant, of 0,5 in both cases they had an average basal diameter of 0,4 cm .

3. The presence in the culture medium of 2 mg/l AIB ( $V_3$ ) stimulated the callus formation process in both species, their average number being 0,3 calluse /variant in both cactus species, with an average diameter of 0,6 cm in *Echinocactus mihanovichii* and 0,5 cm in *Echinopsis chamaecereus f. lutea*.



4. The phenomenon of rhizogenesis has not manifested, until this date, in any of the cactus species and the experimental variants studied.

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## **STUDY ON THE CHEMICAL COMPOSITION OF TOMATOES**

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### **Abstract**

*The requirement to increase the production of vegetables in general and tomatoes in particular is intensified by their logical, nutritional, particularly high value. With the establishment of scientific criteria for assessing the nutritional value of consumer products, with the appreciation above all of their nutritional content, increased interest in expanding the consumption of tomatoes due to their nutritional value, but also therapeutic. Vegetables are among the agri-food products with priority importance, and of these tomatoes occupy the first place (Petrescu, 1997).*

**Key words:** tomatoes, dry substance, vitamin C, minerals.

### **INTRODUCTION**

According to existing research, the food requirements of the human body can be met by an average daily food ration, consisting of foods of animal origin 714g and 1225 g of foods of plant origin, of which 400g must be vegetables (Gontea, 2011).

If in 1995, in the world production of tomatoes on the first place is Europe with 15.5 million tons per year, followed by North America with over 14.2 million tons per year, in 2015 on the first place is Asia with 34.4 million tons per year, followed by Europe with 17.7 million tons and North America with 16.7 million tons (FAO 2017).

In 1977 the area occupied by the globe was 2.2 million hectares with a production of 45 million tons, so that in 1994 it reached 2.9 million hectares with a production of 77.5 million tons, and in 2017 it increased to 3.7 million hectares with a production of 95.5 million tons.

The production of tomatoes in the main cultivating countries in Europe, generally registers increases as a result of the improvement of the technologies of culture, intensifying trade and widening the range of use (Potter 2015).

## MATERIAL AND METHOD

Chemical analyzes of tomato fruit composition were performed on plants grown in a bifactorial experiment.

Factor A - place of culture -  $a_1$  in the field;  
-  $a_2$  in solar.

Factor B - fertilization regime -  $b_1$ - unfertilized plants  
-  $b_2$ - fertilized plants when the level of the three macro elements (N, P, K) decreases to critical levels.

By combining the factors, four experimental variants were made, placed in blocks divided into four repetitions.

The surface of the experimental plot was 10 m<sup>2</sup>, and of the whole experience 160 m<sup>2</sup>. The number of plants harvested at the experimental plot was 27.

## RESULTS AND DISCUSSION

Chemical analyzes of the composition of tomato fruits show that the place of cultivation and fertilization regime changes the content of dry matter, vitamin C and essential minerals (N, P, K).

It was found that the fruits with the highest dry matter content were those of fertilized solarium plants, when the level of macro elements fell to critical levels (Velicica Davidescu 1992).

Fertilization of tomato crops in the field and in the sun is based on soil analysis, and the content of normal mineral substances in the soil will be achieved and maintained for their optimal fruiting development, which also depends on the nature of the soil and its organic matter content (Lacatus 1989). Due to the influence of environmental factors such as brightness, temperature, soil and air humidity regime and nutrient requirements specific to cultivated varieties and hybrids, it is necessary that the nutrients are found in the soil solution in a certain ratio that differs during vegetation period. (Verkerek 1989).

The application of chemical fertilizers both to basic fertilization and during vegetation is done with caution so as not to raise the content of soluble salts, because tomatoes do not support concentrations above 0.17% (Berstein1990). The specific consumption of nutrients necessary to achieve high yields in tomatoes grown in solarium differs from that of tomatoes grown in the field. (Table 1)

Table 1

Specific consumption of tomato mineral substances in field and solar crops

Culture	Production t/ha	Specific consumption (kg per tons of commercial product)				
		N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	CaO	MgO
Tomatoes in the field	40	2.7	0.6	3.7	3.3	-
	35	3.14	1.1	4.0	4.0	-
	30	2.8	0.8	4.0	-	0.5
Tomatoes in solarium	80	3.1	0.6	7.7	-	0.63
	70	3.2	0.64	3.4	-	0.86
	50	3.8	0.94	6.3	5.3	-

The highest content of vitamin C was in the field of fertilized plant fruits only when N, P and K fell to critical levels of 22.5mg / 100g fresh tomatoes.

Table 2

The content of dry matter, vitamin C and minerals in tomato fruits under the influence of the place of cultivation and the fertility regime

Variants	Dry substance %	Variant C Mg/100g	Mineral substances % of dry substance		
			N	P	K
V1 - unfertilized field culture	6.0	20.5	2.58	1.55	5.31
V2 - fertilized field culture when the macro elements N, P, K they have fallen to critical levels	6.21	22.5	2.62	1.63	5.41
V3 - unfertilized solar culture	6.11	21.1	2.60	1.58	5.37
V4 - culture in solar fertilized when N, P, K have dropped to critical levels	6.37	21.8	2.75	1.71	5.49

The content of vitamin C is lower in the fruits of plants grown in solarium, a situation that can be attributed to the fact that the sun was shaded between July and August and that here had the highest values of growth elements.

Regarding the content in mineral substances, the highest value of nitrogen is found in the fruits of plants grown in solarium fertilized when the three macro elements have decreased to critical levels and the lowest in the fruits of plants grown in the field unfertilized regarding phosphorus and potassium.

## CONCLUSIONS

The commercial quality of tomato fruits and their content in dry matter, vitamin C and mineral substances (N, P, K) do not differ essentially in the fruits of plants grown in solarium from those grown in the field.

The growth and development of tomato plants is much more accentuated in solarium cultivation than in field cultivation.

The dynamics of tomato fruit harvest extends over a period of five months in the solarium compared to three months in the field.

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## WOODY VEGETATION OF *MYRICARIA GERMANICA* WITH *SALIX PURPUREA* ALONG THE LEUCA VALLEY

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### Abstract

The phytocenoses of the association *Salici purpureae-Myricarietum* develop as clumps, on periodically flooded gravel, from the upper course of the Leuca Valley (Arad County).

The floristic inventory of the association gathers 63 species in the 5 phytosociological surveys carried out, see Table 1. The species characteristic of the association and edifying the phytocenosis are *Myricaria germanica* with an average coverage of 47%, maximum constancy ( $K = V$ ), and *Salix purpurea* with an average coverage of 25.5%, maximum constancy ( $K = V$ ), both in codominance. The phytocenoses of the association are completed by species belonging to the alliance *Salicion elaeagno-Daphnoides*, the order *Salicetalia purpurea* and the class *Salicetea purpurea*, as well as other transgressive species belonging to the classes *Molinio-Arrhenatheretea*, *Quercu Fagetea*, *Artemisietea vulgaris*, and *Betulo-Sesenietea*.

The study of this association found in the surveyed territory, together with the review of bioforms, floristic elements, ecological indices, together with the economic analysis and interpretation of cytogenetic characters, provides important information on habitat conditions, economic importance, and ecological and scientific relevance of the phytotaxa encountered.

**Key words:** phytocenoses, bioforms, floristic elements, ecological indices, karyotype

### INTRODUCTION

The research of and knowledge building on the vegetation of the Biharia Massif are a challenge that responds to current scientific and practical needs.

While carrying out the exploring endeavour of the Biharia Massif area, we conducted a phytosociological, ecological and bioeconomic study of its vegetation. On the occasion of the vegetation research carried out in 2019 along the Leuca Valley from Lazuri village, Vârfurile Commune, Arad County, we found the association *Salici purpureae- Myricarietum*, Moor 1958, part of the class *Salicetea purpureae*, Moor 1958.

### MATERIAL AND METHOD

The material subjected to research consists of the woody vegetation of the mountain valleys, especially Leuca Valley (Arad County, Romania). Five studies (phytosociological surveys) were performed on the most representative phytocenoses. In the Association Table (see Table 1) there

are recorded all the plant species we found, included in the corresponding cenotaxa units (i.e. suballiance, alliance, order, classes), depending on the constancy (K), according to the indications of the renowned scholars (Borza et Boşcaiu, 1965), (Cristea et al., 2004), with the criteria of the ecological-floristic systems elaborated by (Tüxen, 1955), (Braun-Blanquet, 1964), and on the basis of the information of some more recent works belonging to the authors (Borhidi, 2003), (Sanda et al., 2008), (Chifu et al., 2014). The quantitative criterion followed in the research of phytocenoses is the abundance and dominance index, according to the system elaborated by (Braun-Blanquet et Pavillard, 1928), with the establishment of constancy classes ( $K = I-V$ ). Phytocenosis of the association *Salici purpureae-Myricarietum*, was surveyed and characterized ecologically, phytosociologically, cytogenetically based both on the Association Table (see Table 1), and histograms with reference to the distribution of bioforms, floristic elements, ecological indices and genetic karyotypes.

Finding and description of the association were made based on the floristic criteria, with the help of characteristic, edifying, dominant and differential species. The name of the associations is in accordance with the provisions established by the Code of Phytosociological Nomenclature developed by (Weber et al., 2000).

Information on the value of ecological indices, bioforms and phytogeographical elements is presented according to the following authors: (Sanda et al., 2003), (Cristea et al., 2004), (Burescu et Toma, 2005). We made use of data on species karyotype from (Majovsky et Murin, 1987), (Sanda et al., 2003), (Ciocârlan, 2009), (Moare, 2009).

To assess the economic importance of plants we used information from the "Flora of Romania" (1952-1976) as well as information from (Ciocârlan, 2009), to which we added our observations and findings on the use of plants by locals of the area.

To establish the status of rare, vulnerable, endangered, endemic species we used the so-called "Red Lists" prepared by (Boşcaiu et al., 1994), (Dihoru et Negrean, 2009), and the "European Red List and the IUCN Endangered Species List" (Bilz et al., 2011).

## RESULTS AND DISCUSSION

Within the surveyed territory we found the association subject to research in the Leuca Valley, Lazuri Village, Vârfurile Commune, Arad County. The phytocenoses of this association develop along mountain valleys as clumps, on gravel subject to periodic flooding.

The floristic inventory of the association contains 63 species in the five phytosociological surveys performed, see Table 1. The species characteristic of the association and which edifices the phytocenosis are

*Myricaria germanica* with an average coverage of 47%, maximum constancy (K = V), and *Salix purpurea* with average coverage of 25.5%, maximum constancy (K = V), found in codominance. The phytocenoses of the association are supplemented by species of the alliance ***Salicion elaeagno - Daphnoides***, order ***Salicetalia purpurea*** and class ***Salicetea purpurea***: *Salix elaeagnos*, *Calamagrostis pseudophragmites*, *Calystegia sepium*, as well as other transgressive species belonging to the classes ***Molinio - Arrhenatheretea*** (*Mentha longifolia*, *Equisetum arvense*, *Leontodon hispidus*, *Prunella vulgaris*, *Carex hirta*, *Epilobium parviflorum*, *Hypericum perforatum*), ***Quercu Fagetea*** (*Salvia glutinosa*, *Tanacetum corymbosum* ssp. *corymbosum*, *Brachypodium sylvaticum*, *Carex pendula*, *Mycelis muralis*, *Telekia speciosa*), ***Artemisietea vulgaris*** (*Verbascum phlomoides*, *Erigeron annuus*, *Anchuza officinalis*, *Melilotus alba*), ***Betulo - Adenostyletea*** (*Angelica archangelica*, *Digitalis grandiflora*, *Campanula abietina*) and ***Seslerietea mediae*** (*Oxalis stricta*, *Erigeron canadensis*, *Sonchus arvensis*).

In the spectrum of bioforms (see Fig. 1 below) hemicryptophytes are dominant (61.90%), followed at a great distance by therophytes (17.45%) and geophytes (11.11%).

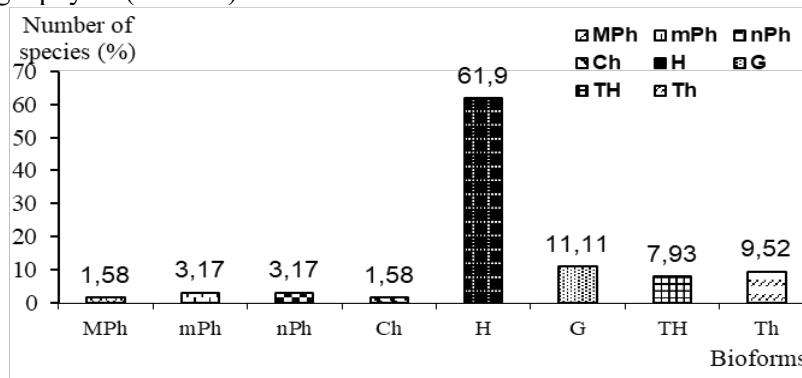


Fig. 1 Spectrum of bioforms of the association *Salici purpureae* – *Myricarietum*

Legend: MPh = Megaphanerophytes; mPh = Mesophanerophytes; nPh = Nanophanerophyte; Ch = Chamaephyte; H = Hemicryptophytes; G = Geophytes; TH = Annual Therophytes; Th = Biannual Therophytes.

The spectrum of floristic elements (see Fig. 2 below) shows an increased dispersion in terms of the origin of the plants belonging to this association, the majority being Eurasian (53.96%), followed at a great distance by European (11.11%), Central European (7.93%), circumpolar (7.93%), cosmopolitan (6.34%), adventitious (4.76%), Carpathian-Balkan (3.17%), endemite-Carpathian (1.58%), Atlantic (1.58%), and Balkan & Pontic (1.58%) species.



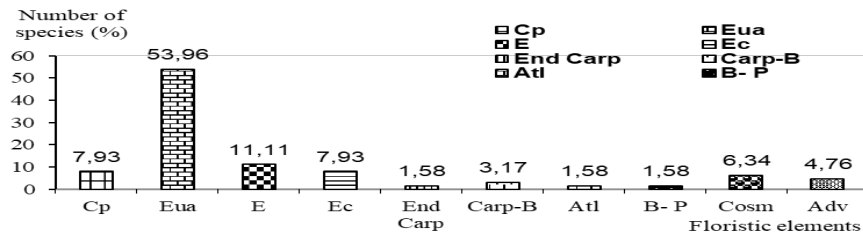


Fig. 2 The spectrum of floristic elements from the association *Salici purpureae* – *Myricarietum*

Legend: Cp = Circumpolar; Eua = Eurasian; E = European; Ec = Central European; End Carp = Endemite-Carpathian; Carp-B = Carpathian-Balkan; Atl = Atlantic; B-P = Balkan & Pontic; Cosm = Cosmopolitan; ADV = adventitious.

From the humidity point of view (see Fig. 3), the most numerous plant species are the mesophiles (41.6%), followed by the mesohygrophiles (22.21%), xeromesophiles (17.45%) and hygrophiles (12.96%). Depending on their behaviour towards temperature, more than half are micro-mesotherms (55.54%), followed by eurytherms (20.63%), microtherms (17.45%) and moderate thermophiles (4.76%). The chemical reaction of the soil favours the development of euryionic species (36.50%), succeeded by weak neutrophilic (28.57%), acid-neutrophilic (26.98%), acidophilic (6.34%) and strongly acidophilic (1.58%) species.

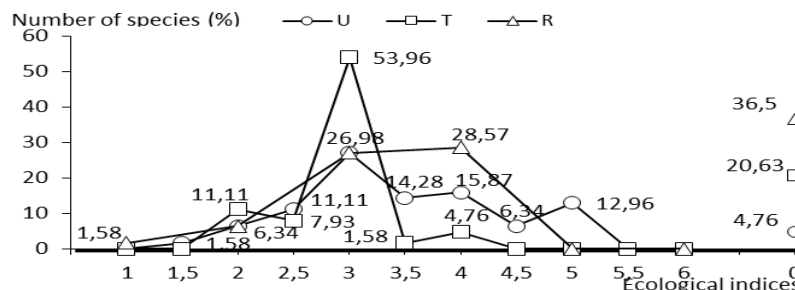


Fig. 3 Chart of ecological indices for the association *Salici purpureae* – *Myricarietum*

Analysis of chromosomal karyotypes (see Fig. 4 below), highlights the dominance of polyploid (52.38%), compared to diploid (38.09%) and diplo-polyploid (9.52%) species. The diploid index has a value of 0.72.

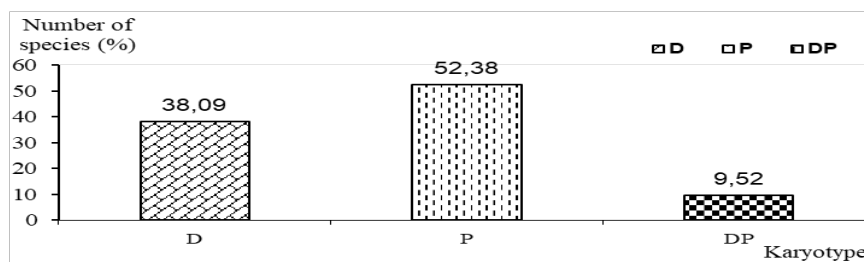


Fig. 4 Cariological spectrum of the association *Salici purpureae* – *Myricarietum*  
Legend: D = Diploid; P = Polypoid; DP = Diplo-polyploid species

Importance: In the phytocenoses of the association there is an endemic species i.e. *Leuchanthemum walsteinii*, a vulnerable species i.e. *Angelica archangelica*, and the species characteristic for the association i.e. *Myricaria germanica* has tinctorial properties, from its bark being extracted a black paint that can be used local household industries without endangering the cenoses of the association. At the same time, medicinal plants are found in this phytocenosis.

Table 1

*Salici purpureae* – *Myricarietum*, Moor 1958

		Survey no.						
		Altitude (mamsl)						
		Exposition						
		Slope (°)						
		Vegetation cover (%)						
		Surface (sq.m.)						
Bio-form	Fl. el.	U	T	R	G		K	ADm
mPh	Eua	5	3	4,5	D	<i>As. Salix purpurea</i>	V	25.5
nPh	Eua	0	0	4	P	<i>As. Myricaria germanica</i>	V	47.0
<b>Salicion elaeagno- Daphnoides, Salicetalia purpurea et Salicetea purpurea</b>								
mPh	Ec	4	3	4,5	D	<i>Salix elaeagnos</i>	IV	0.4
H	Ec	5	0	2	P	<i>Epilobium dodonei</i>	IV	0.4
H	Eua	3	3	0	D	<i>Saponaria officinalis</i>	III	0.3
G	Eua	2	3	0	P	<i>Calamagrostis pseudophragmites</i>	I	0.1
G-H	Eua	5	3	4	D	<i>Calystegia sepium</i>	I	0.1
<b>Molinio- Arrhenatheretea</b>								
H	Eua	4,5	3	4	P	<i>Mentha longifolia</i>	V	0.5
G	Cosm	3	3	0	P	<i>Equisetum arvense</i>	III	0.3
H	Eua	2,5	0	0	D	<i>Leontodon hispidus</i>	II	0.2
H	Cosm	3	3	0	P	<i>Prunella vulgaris</i>	II	0.2
G	Cp	0	3	0	P	<i>Carex hirta</i>	II	0.2
Biof.	Fl. el.	U	T	R	G	Survey no.	K	ADm
H	Eua	5	3	4,5	P	<i>Epilobium parviflorum</i>	II	0.2
H	Eua	3	3	0	P	<i>Hypericum perforatum</i>	II	0.2

Table 1 (continuation)

Ch	E	4	3	3	P	<i>Lysimachia nummularia</i>	+	.	.	.	.	I	0.1
H	Eua	3,5	0	0	D	<i>Ranunculus acris</i>	+	.	.	.	.	I	0.1
H	Cp	5	0	2	P	<i>Epilobium palustre</i>	+	.	.	.	.	I	0.1
H-TH	Eua	3	0	0	D	<i>Trifolium pratense</i>	.	+	.	.	.	I	0.1
H	Eua	3	0	0	P	<i>Lotus corniculatus</i>	.	.	+	.	.	I	0.1
H	Cosm	3,5	3	0	D	<i>Verbena officinalis</i>	.	.	+	.	.	I	0.1
H	Eua	3	0	4	P	<i>Dactylis glomerata</i>	.	.	+	.	.	I	0.1
H	Cosm	4,5	3	3	P	<i>Juncus effusus</i>	.	.	+	.	.	I	0.1
H	Eua	3,5	4	4	P	<i>Potentilla reptans</i>	.	.	+	.	.	I	0.1
H	Eua	4	3	0	P	<i>Rumex crispus</i>	.	.	+	.	.	I	0.1
H	Eua	3	2,5	3	D	<i>Galium molugo</i>	.	.	.	+	.	I	0.1
H	Cp	3	2	0	P	<i>Juncus articulatus</i>	.	.	.	+	.	I	0.1
Th	Ec	3	3	2	P	<i>Centaurium erythraea</i> <i>ssp. erythraea</i>	.	.	.	+	.	I	0.1
H-HH	Eua	5	2	0	DP	<i>Lysimachia vulgaris</i>	.	.	.	+	.	I	0.1
H-HH	Eua	4	3	3	P	<i>Epilobium hirsutum</i>	.	.	.	+	.	I	0.1
H	Eua	3	0	3	D	<i>Cichorium intybus</i>	.	.	.	.	+	I	0.1
<b>Quercus-Fagetum</b>													
H	Eua	3,5	3	4	D	<i>Salvia glutinosa</i>	+	+	.	.	+	III	0.3
H	Eua	2,5	2,5	3	P	<i>Tanacetum corymbosum</i> <i>ssp. corymbosum</i>	.	+	.	+	+	III	0.3
H	Eua-M	3	3	4	DP	<i>Brachypodium sylvaticum</i>	+	+	.	.	.	II	0.2
H	Atl-M	4	2	3	P	<i>Carex pendula</i>	.	+	+	.	.	II	0.2
H	E	3	3	3	D	<i>Mycelis muralis</i>	.	+	.	+	.	II	0.2
H	Carp-E	4	2	0	D	<i>Telekia speciosa</i>	.	.	+	+	.	II	0.2
H	Cp	3,5	3	3	DP	<i>Milium effusum</i>	.	+	.	.	.	I	0.1
MPh	Eua	3,5	3	3	DP	<i>Populus alba</i>	.	.	+	.	.	I	0.1
H	End	4	2	3	D	<i>Leucanthemum waldsteinii</i>	.	.	+	.	.	I	0.1
TH-H	B-P	1,5	4	1,5	P	<i>Digitalis lanata</i>	.	.	+	.	.	I	0.1
H	E	3,5	3	3	P	<i>Stellaria nemorum</i>	.	.	.	+	.	I	0.1
Th	E	3	3	0	D	<i>Galeopsis tetrahit</i>	.	.	.	+	.	I	0.1
H	Ec	4,5	2,5	4,5	P	<i>Carduus personata</i> <i>ssp. personata</i>	.	.	.	+	.	I	0.1
H	Eua	2	3	3	P	<i>Origanum vulgare</i>	.	.	.	.	+	I	0.1
nPh	E	3	2,5	3	P	<i>Rubus hirtus</i>	+	.	.	.	.	I	0.1
<b>Artemisietum vulgaris</b>													
TH	E	2,5	3,5	4	P	<i>Verbascum phlomoides</i>	+	.	.	+	+	III	0.3
Th-TH	Adv	4	0	4	P	<i>Erigeron annuus</i>	+	+	.	.	+	III	0.3
TH-H	E-M	2	3	0	D	<i>Anchusa officinalis</i>	.	+	.	+	.	II	0.2
Biof.	Fl.e.l.	U	T	R	G	Survey no.	1	2	3	4	5	K	ADm
Th-TH	Eua	2,5	3	0	D	<i>Melilotus alba</i>	.	+	+	.	.	II	0.2
<b>Betulo-Adenostyletum</b>													
TH-Th	Eua-Bc	4,5	2,5	0	D	<i>Angelica archangelica</i>	.	+	.	+	.	II	0.2
H	Ec	2,5	3	3	P	<i>Digitalis grandiflora</i>	.	.	+	+	.	II	0.2
H	Carp-E	3,5	2	2	P	<i>Campanula abietina</i>	.	.	.	+	.	I	0.1
<b>Stellarietum mediae</b>													

Table 1 (continuation)												
H	Adv	3.5	0	0	D	<i>Oxalis stricta</i>	.	+	+	+	.	III 0.3
Th	Adv	2.5	0	0	D	<i>Erigeron canadensis</i>	.	+	.	.	+	II 0.2
G	Eua	3	0	0	P	<i>Sonchus arvensis</i>	.	+	.	.	.	I 0.1
Variae Syntaxa												
H	Eua	4	3	3	D	<i>Eupatorium cannabinum</i>	+	+	+	+	+	V 0.5
G	Eua	0	3	4	P	<i>Tusilago farfara</i>	1	1	+	1	.	IV 3.1
H-HH	Eua	5	3	0	D	<i>Lycopus europaeus</i>	+	+	.	+	.	III 0.3
G-HH	Eua	5	4	4	P	<i>Carex riparia</i>	+	.	.	+	.	II 0.2
H-G	Eua	3	2	4	DP	<i>Euphorbia cyparissias</i>	.	.	.	+	+	II 0.2
Th	Cp	5	3	4	D	<i>Polygonum hydropiper</i>	.	.	.	+	.	I 0.1
TH	Eua	2	3	4	DP	<i>Echium vulgare</i>	.	.	.	.	+	I 0.1
H	Eua	4	3	3	D	<i>Hypericum maculatum</i>	.	.	.	.	+	I 0.1

**Place and date of surveying:** 1-5. Leuca Valley, 08.08.2019, GPS 462338.1, 223619.1, 462339.1, 223617.8, 462340.3, 223616.3, 462340.3, 223613.9, 462345.2, 223607.5.

## CONCLUSIONS

1. The phytocenoses of Dacian deciduous shrubs with small sea buckthorn (*Myricaria germanica*) have a high conservative value, making a natural habitat of community interest which conservation requires the declaration of Special Areas of Conservation (SACs).

2. In the spectrum of bioforms, hemicryptophytes predominate (61.90%), followed at a great distance by therophytes (17.45%) and geophytes (11.11%).

3. In terms of geographical area, the Eurasian species are dominant (53.96%), followed at a great distance by the European (11.11%) species.

4. Regarding the ecological indices and in relation with humidity, the most numerous plant species are the mesophilic (41.6%), compared to the micro-mesothermal species (55.54%), while the euryionc are dominant species (36.50%) in terms of the chemical reaction of soil.

5. The analysis of chromosomal karyotypes highlights the dominance of polyploid (52.38%), compared to diploid (38.09%) and diplopolyploid (9.52%) species.

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## ASPECTS REGARDING THE PROCESS OF WOODEN SURFACES ON 3-AXIS CNC MILLING MACHINES WITH SPHERICAL TOOL

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### **Abstract**

*The paper deals with the geometry of wood surfaces processed on 3-axis CNC milling machines.*

*It analyzes everything that means CNC driven equipment with or without hierarchical control by external computer; generating parts through CAD-CAM procedures that are more and more efficient, modeling and simulating the virtual generation of the part on the future machine tool and using future equipment expected technologies, the software with which the machine tools are endowed in order to be able to lead the processing process.*

**Key words:** CNC, wooden surfaces, 3-axis processing

### **INTRODUCTION**

In the case of machining wooden surfaces on 3-axis CNC milling machines, during machining the direction of the tool axis remains constant.

The movement of the tool can be uniquely determined by the movement of an arbitrary point C (t) chosen on the axis of rotation.

The problems to be solved are:

- how to position the piece on the table;
- how to design trajectories that minimize processing time.

The 3-axis programming methods are divided into 3 categories:

1. Processing of surfaces whose slope varies substantially, e.g.  $0^\circ < \alpha < 90^\circ$ . A spherical tool can be used, but for  $\alpha < 10^\circ$ , the cutting speed decreases drastically. (Ganea, M., 2010, Ganea, M., 2000)

2. Processing of almost horizontal surfaces ( $\alpha \approx 0$ ). The widest width of the strip (between tools with the same diameter) is obtained by using a toroidal tool with radius  $r < 0.2$ , but this is limited by the appearance of thinning when processing concave surfaces.

3. Processing of almost glass surfaces ( $70^\circ < \alpha < 110^\circ$ ). To obtain wide strips, the barrel tool can be used, but thinning can occur if the surface has a curvature comparable to that of the tool. (Derecichei et al., 2014, Derecichei et al., 2015, 2016)

## MATERIAL AND METHOD

### Spherical tool machining

It is assumed that the tool has a unit radius for simplification.

The processed region (Derecichei L. et al., 2017, Lucaci, C., 2017)

Let the tool be positioned tangentially to the surface P (u, v) as seen in fig. 1.

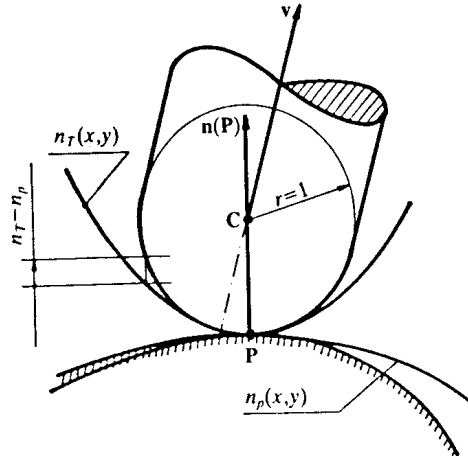


Fig. 1 Spherical tool

Let be the coordinate system (P, x, y, n), so that the vertices x and y are parallel to the main directions in P. (Marciniak K., 1991; Yoshimi I., 2008)

If the main curves of the surface are  $k_x$  and  $k_y$ , then the surface can be approximated with the oscillating paraboloid:

$$n_p = \frac{1}{2} \cdot (k_x \cdot x^2 + k_y \cdot y^2)$$

The surface of the tool represented by the equation:

$$x^2 + y^2 + (n_T - 1)^2 = 1$$

can be turn in approximated with the oscillating paraboloid in P:

$$n_T = \frac{1}{2} \cdot (x^2 + y^2)$$

It results that the coordinates (x, y) of the points of the processed region satisfy the condition:

$$0 \leq n_T - n_P \leq h,$$

where h is the processing tolerance. (Derecichei L. et al., 2016)

The edge of the processed region can be approximated with the equation  $n_T - n_P = h$ , or equivalent:  $(1 - k_x) \cdot x^2 + (1 - k_y) \cdot y^2 = 2h$ .

Result, the curvature of the tool is greater than that of the surface ( $k=1/r=1$ ), so the undercutting does not appear, and the equation represents an ellipse:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

where:  $a = \sqrt{2h/(1-k_x)}$  si  $b = \sqrt{2h/(1-k_y)}$  are the semiaxes. It should be noted that the shape of the region:

$$\varepsilon = \frac{a}{b} = \sqrt{\frac{1-k_y}{1-k_x}}$$

does not depend on tolerance  $h$ . The size of the ellipse is approximately equal to  $\sqrt{h}$ . (Derecichei L. et al., 2014, Derecichei L. et al., 2015)

## RESULTS AND DISSCUSIONS

The effect of a small change in tolerance on the processed region of wooden parts. (Derecichei L. et al., 2015)

Because the shape of the ellipse is independent of tolerance, we can limit ourselves to any linear dimension, for example  $a$ . We have the relation:

$$\frac{\Delta a}{a} \cong \frac{da(h)}{dh} \cdot \frac{\Delta h}{a} = \frac{\Delta h}{2h}$$

valid for small values of  $\Delta h$  in relation to  $h$ . (Derecichei L. et al., 2017, Derecichei L. et al., 2018 ).

Errors in approximating the processed region

The elliptical processed region resulted due to the approximation of the tool and the piece with the oscillating paraboloid. To show how the error is estimated in this approximation, we will study the normal section of the part in the  $x$  direction. The other intersections are analyzed similarly.

It is assumed that the point of contact moves along the surface, so that the slope  $Pt$  tangential to a contact curve makes the angle  $\gamma$  with the slope  $x$  of the main direction of the surface. The width of the processed strip is defined by:

$$d(\gamma) = 2\sqrt{a^2 \sin^2 \gamma + b^2 \cos^2 \gamma}$$

It is assumed that  $k_x \leq k_y$ , then for  $\gamma = 0$  the function has a maximum  $d_{\max} = 2b$  and for  $\gamma = \pi/2$  it has a minimum of  $2a$ .

The widest band ( $2b$ ) is obtained when the point of contact moves along the main direction  $x$ . (Derecichei et al., 2018, 2019)

If the point of contact moves in an inclined direction with respect to  $x$  with the angle  $\gamma$ , then the width of the strip is reduced by the factor:

$$\varepsilon(\gamma) = d/d_{\max} = \sqrt{\varepsilon^2 \sin^2 \gamma + \cos^2 \gamma}$$

In most situations the curves of the surfaces satisfy the condition -



$0.3 < k_x < 0.3$ , which implies  $0.73 < \varepsilon < 1.0$ .

It can be seen that for these values of  $\varepsilon$  the effect of the direction of the tool movement on the machined belt can be neglected in practice. However, there may be concave-convex surfaces for which  $\varepsilon$  is small.

Fig. 2 shows a model that can be processed on CNC in 3 axes and post-processing sequences for the processing operation in 3 axes CNC generated by the SprutCam program (www.sprutcam.com, 2020):

CRUCIFIX02\_18  
( GENERATED BY SprutCAM )  
( DATE: 27.02.2020 )  
( TIME: 15:01:02 )

.....  
X151.66Y19.288Z-92.454  
X153.631Y18.939Z-93.449  
X154.143Y18.85Z-93.715  
X156.044Y18.517Z-94.738  
X156.431Y18.45Z-94.952  
X160.981Y17.669Z-97.616  
X161.253Y17.623Z-97.784

.....  
X33.534Y-10.551Z-25.544  
G01X34.25Y-8.701

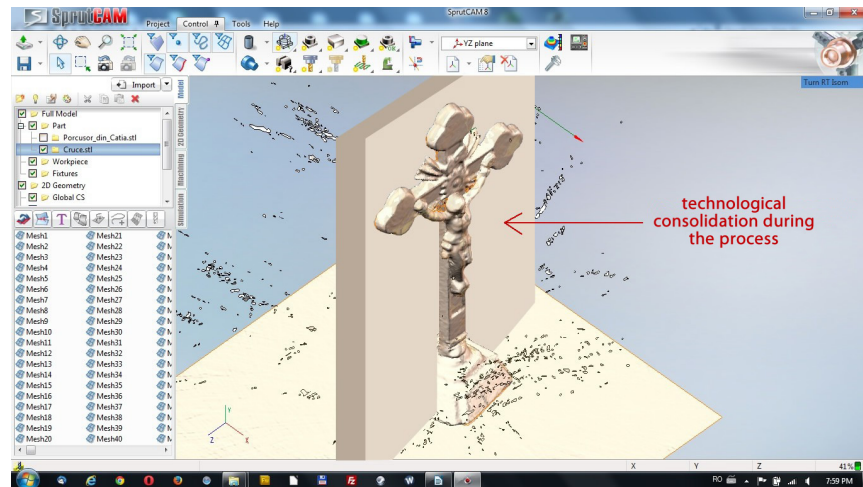


Fig. 2 Geometric model imported in the Sprutcam program - watermark surfaces; 1-additional addition of soft wood (lime) for technological consolidation during surface processing

## CONCLUSIONS

It can be seen that small changes in tolerance lead to twice as small changes in the size of the processed region.

Cutting time can be reduced by using small machining steps, but this increases the cutting time and as a result decreases the cutting efficiency.

The problem of collision between the non-cutting element (mandrel) and the workpiece must be taken into account.

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## FAGUS SYLVATICA HABITAT SUITABILITY IN THE APUSENI MOUNTAINS

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### Abstract

*The Fagus sylvatica L., or European beech, is one of the valuable and widespread broadleaved trees in Romania and the Apuseni Mountains. There are numerous studies regarding European beech habitat distribution, but these are made on a larger scale, especially at the continental level, and with low resolution. Species distribution models incorporating bioclimatic, topographic, soil properties, geology, and vegetation variables were used as predictors to assess Fagus sylvatica habitat suitability under current conditions. We used data from the National Forest Inventory of Romania (NFI) to model pure and mixt beech habitat stands in the Apuseni mountains using MaxEnt software. The results revealed that the main factors influencing beech spatial distribution in the Apuseni Mountains are elevation for pure beech stands and clay content in the soil for mixt beech stands. The pure beech stand's optimal habitat suitability has a lower extent than mixt stands with beech in composition, but both record highest habitat suitability values between 450 - 1200 m altitude in Apuseni Mountains.*

### INTRODUCTION

European beech is the most important and widespread broadleaved trees in Romania and covers more than 2 million ha. In Romania, European beech covers about 30.53 % of forest surface and 37.44 % of total wood volume. It is a valuable deciduous tree that can maintain its high growth rate in very different environmental conditions. In Europe, it extends from southern Scandinavia to the south of Italy, from Spain in the west to the Anatolian peninsula in the east (Durrant et al. 2016).

In Romania, it extends outside of its habitat in few areas in Romania plain (Snagov county), to high elevations in the Carpathian Mountains, reaching 1600 m in altitude. The European beech in the Apuseni Mountains records a wide range of environmental conditions according to National Forest Inventory (NFI) observations, making the first appearance in low hills at 125 m altitude near Tinca village, to around 1400 m elevation in Vladeasa Mountains. Though not demanding of any specific soil type, beech prefers a humidity with precipitation well distributed throughout the year and soils with sandy-silty texture. Fagus sylvatica is a challenging species, and it can be founded very often in shady situations (it is one of the most shade-tolerant broadleaved trees in its range) (Praciak et al. 2013) so that natural regeneration is possible in forestry systems with continuous crown coverage as the seedlings can survive and grow below the canopy of dominant trees.

The predominance of beech reduce light level in the understorey vegetation, and beech seeds have more survival chances than those of other tree species. European beech is not particularly sensitive to soil-specific soil properties (Walthert et al. 2013) and grows on a wide variety of soils, especially on Cambisols; with a pH range from 3.2 to 8.4 cannot tolerate the most acidic conditions. Beech shows a moderate soil-acidifying ability (Augusto et al., 2013). It prefers moderately fertile ground, calcified or slightly acidic, and is also sensitive to late frosts (Paule, 2002), and it is found more often in soils with a sandy texture. It grows well on drained soils with a sizeable edaphic volume.

Excessive water content and compacted soils negatively influence beech growth (Packham et al. 2012, Gebler 9\*et al. 2007). The only limiting factor that influences beech growth is shallow soils and steep slopes. Beech trees conserve the soil's productive capacity better than any other tree species due to the high content of litter provided to the soil. The primary usage of beech wood in Romania is for firewood because it is strong and available in numerous regions and is also used to make furniture or musical instruments.

Another impact on future habitat is competition, dispersal, disturbance, and biotic interaction between different species. Unfortunately, the temperature change degree will significantly impact tree species from the Carpathian Mountains, even in an optimistic scenario. Some tree species will gain new areas in habitat, and others will lose depending on the species adaptability to the new environment. In this paper, we model the habitat suitability of *Fagus sylvatica* in the Apuseni Mountains.

## **MATERIAL AND METHOD**

Species distribution models (SDMs) project species habitats based on statistical correlations between species presence or abundance and environmental (predictor or covariate) variables thought to influence habitat suitability.

For modeling beech niche and distribution in the Apuseni Mountains, we used Maxent software that uses a machine learning technique called maximum entropy modeling. MaxEnt is usually used for modeling species distributions from presence-only species records. Initially, MaxEnt was used to estimate the landscape's presence (Phillips et al., 2006). Density estimation assumes that individuals have been randomly sampled across the landscape, i.e., samples in rapport to population density. Such models predict the occurrence rate in a cell, defined as the expected number of individuals in that cell (Fithian and Hastie, 2012).

The soil samples and data regarding the beech stand characteristics were collected based on a systematically designed grid of sampling plots during the first National Forestry Inventory (NFI) cycle, undertaken in Romania between 2008 and 2012. The NFI survey was done on a sampling grid with cells measuring 4x4 km, forested sites located in the hills or mountains, and 2x2 km in the plain. The larger sampling density was established according to the smaller forest vegetation cover in the low land area. At the end of the first NFI cycle, 28.204 sample plots with forest were visited in the field, and 15.734 soil samples had been collected. For better modeling of beech habitat, we divided the database into two components, plots with pure beech stands and beech plots in their composition.

Our goal was to create a high-resolution distribution model of beech habitat, and with this, in mind, we used a high-resolution covariates map. Bioclimatic variables were generated from the ROCADA (a gridded daily climatic dataset over Romania) made for nine meteorological variables for 1961–2013 (Dumitrescu and Barsan, 2015). Twenty bioclimatic (bio1-bio19+bio4a) variables were modeled using DEM as a predictor at a resolution of 100x100m, with a random forest algorithm. The relief covariates were generated from the DEM of Romania using SAGA GIS software (System for Automated Geoscientific Analyses - is a Geographic Information System software for geodata processing). The parent material information was taken from the 1:200.000 geologic map of Romania. Soil properties maps were generated from NFI soil sampling plots using an RF algorithm.

## RESULTS AND DISCUSSION

The prediction accuracy of *Fagus sylvatica* shows an excellent prediction for pure beech stands (AUC = 0.915) and for forest stands where beech appears in composition with other species having a good prediction (AUC = 0.887). Among the fifty environmental variables used, the contribution of the first eleven variables, that have a contribution more significant de 2 %, accounted for almost 83.5% of the model prediction in the case of pure beech stands (PBS) and 88.1 % in the case of all beech stands (ABS) (Fig.1).

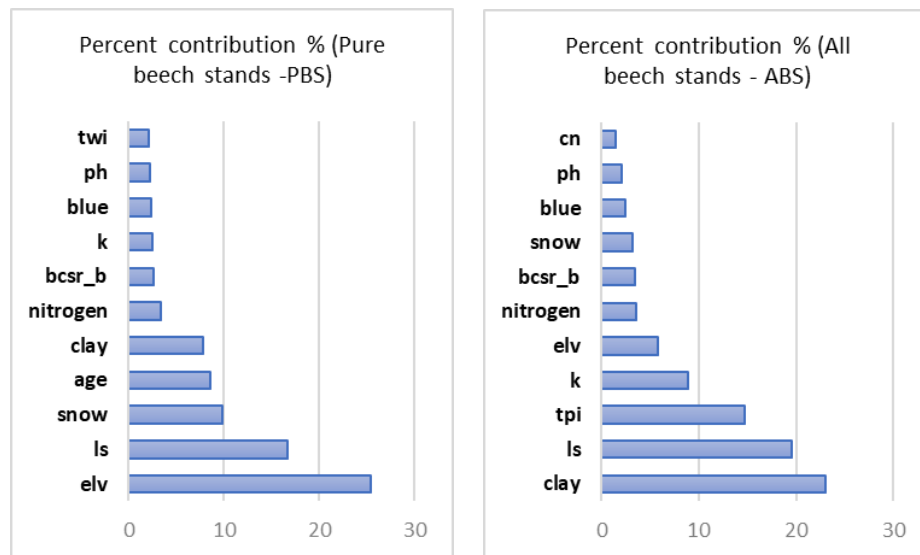


Fig.1. - Variables contribution to the model

The influence of predictor variables is different for pure beech stands than mixt beech forest stands. Except for age (geologic age), TPI (topographic position index), TWI (topographic wetness index), and C/N (the ratio between Carbon and Nitrogen), both models have common predictors. In the ABS model, the soil and relief factors (ls - length of slope and TPI) have a greater contribution mainly due to other species in composition with beech, and they are more soil specific forest stands. The PBS model is a subsample from the larger beech habitat and where more site-specific influence gains greater importance than general influences. From the soil perspective, clay (clay content %), K (Potassium), and BCSR (base cation exchange ratio), and pH(potential of hydrogen) have an impact on beech distribution. Beech stands prefer soils with a relatively low clay concentration, around 20 %, well-drained, and a moderate concentration in BCSR. Using ArcGIS 10.3, the potential distribution of *Fagus sylvatica* in the Apuseni Mountains based on observed occurrences and current environmental conditions projected by the MaxEnt model is shown in Fig. 2. We divided the legend in Marginal/no presence < 5%, colored in grey, Low presence 5% - 10%, Mid-low presence 10% - 30%, Medium presence 30% - 50%, Mid-high presence 50% - 70%, High presence 70% - 90% and Very-high presence > 90%.

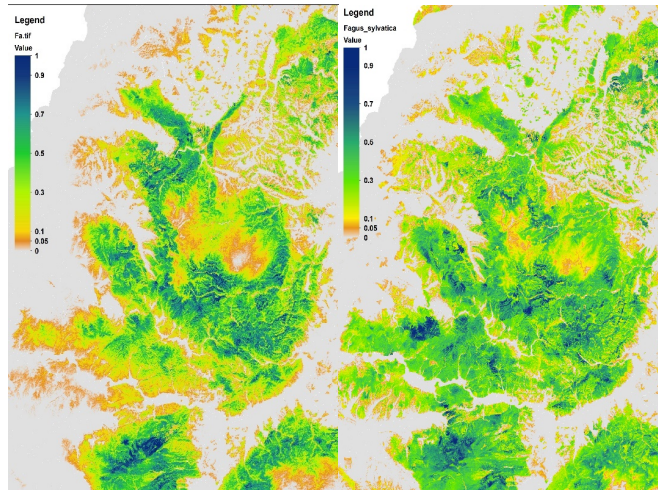


Fig.2. - Maxent model for *Fagus sylvatica* in Apuseni Mountains, left PBS model and in the right the ABS model

There are many similarities between the models, but we can notice that the PBS model has a lower extent in high occurrence as a function of altitude than the ABS model. The models' differences can be explained by the fact that *Fagus sylvatica* can extend in mixture with other species beyond his natural habitat, mainly on lower altitudes in association with *Quercus petraea* and higher altitudes with *Picea abies*. The High presence ( $> 0.7$ ) in the PBS model follows to a reasonable extent a specific range of elevation (Fig.3) with greater density than the ABS model in 300 – 1200 m altitude range.

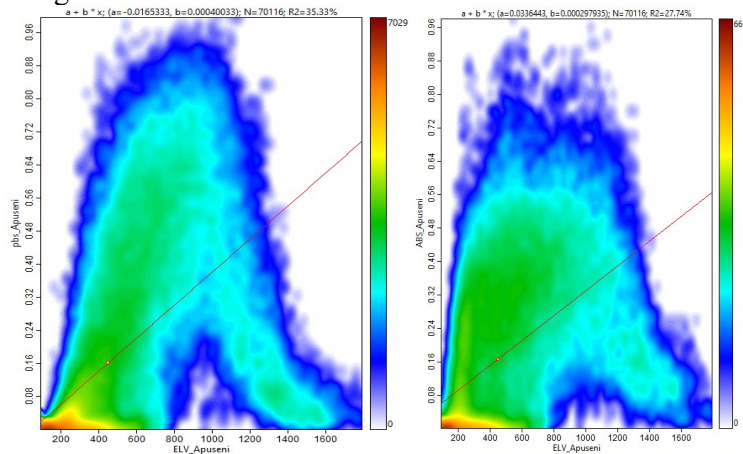


Fig. 3. – Scatterplot between Elevation and PBS model (left) and ABS model (right)



PBS model has a better correlation with elevation ( $R^2 = 0.35$ ) than the ABS model ( $R^2 = 0.22$ ), and from the density scatterplot, we can observe a lack of low values in habitat susceptibility, especially in the PBS model in the range of 800 -1200 m. The main advantage of high-resolution maps can be that it can surprise local influences like slope, parent material, soil type, aspect in habitat sustainability.

## CONCLUSIONS

*Fagus sylvatica* is not a very demanding tree species and has many habitats in the Apuseni Mountains. The habitat is influenced mainly by elevation that affects other bioclimatic factors and the slope or soil properties like the clay content and base cation exchange ratio. Pure beech stands have a smaller extent in elevation than mixt beech stands, but in their optimal range of 500 -1200 m, records highest values of habitat susceptibility than mixt beech forest stands. The resulted high-resolution habitat susceptibility map can be used in forest management practices.

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## ESTABLISHING THE LINKS BETWEEN THE WIDTH OF THE PLATFORM AND THE AREA WIDTH TO THE FOREST ROADS. CASE STUDY

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### Abstract

*The paper proposes to establish links between the width of the forest road platform and their area width*

*For this purpose, a number of 72 pairs of values of the mentioned geometric elements were taken into account, in transversal profile.*

*In order to find solutions regarding their design, execution, maintenance and rational operation, in this paper were studied a series of correlative links in order to identify the existence of influences of the width of the road platform on the width of the area.*

*The study was carried out on the forest road Valea Mare-Sohodol, respectively a section with a length of 1158 m, located in Sohodol, in the U.P. III Sohodol, Beiuș Forest District, within the Oradea Forestry Department.*

*The regression equation obtained with the help of the polynomial correlation, which is statistically significant, shows the existence of a close interdependence between the width of the forest road platform and the width of the area.*

**Key words:** forest roads, width of the platform, area width, links;

### INTRODUCTION

In order to establish the links between the width of the forest road platform and their extent, a series of correlative analyzes were proposed between them.

In forest management, taking into account the complexity of the functions performed by forest roads (Gucinski H. et al., 2001), the future strategy for expanding road networks must primarily aim at strict compliance with forest management in order to ensure continuity of forest production on the one hand and the exercise of the protective role of forests along with a more efficient accessibility of the forest fund (Ungur et al, 2003, Iovan, 2017).

The need for the construction of forest roads as well as the maintenance of existing ones is motivated by the need to ensure a transport network capable of serving all the needs of the forestry sector in close accordance with current ecological requirements (Lugoa AE, et al 2000, Lazăr Ș., Et al. 2008), all the more so as it is not recommended at all to start the execution of a single road in the absence of a project for the entire road network in an area (Ungur, 2005, Iovan, 2017)

In order to find solutions regarding their design, execution, maintenance and rational exploitation, in this paper were studied a series of correlative links in order to identify the existence of correlations between the width of the forest road platform and their area width.

For this purpose, a section with a length of 1158 m from a forest road was considered, on which are located a number of 72 pickets, respectively transverse profiles, and as a result a series of 72 pairs of values, which are presented in table no. 1.

The communication routes, which represent the basic ways to open the forest basins, are represented by the forest roads. A rational management of the forest fund must respect the technical, managerial, economic and ecological principles (Murphy, A., 1985, Crețu O., et al., 2006).

#### **MATERIAL AND METHOD**

The study was carried out on the forest road Valea Mare-Sohodol, respectively a section with a length of 1158 m, located in Sohodol, in the U.P. III Sohodol, Beiuș Forest District, within the Oradea Forestry Department (17\*\*\*). The road is located in a mountainous region, with sloping and moderately sloping slopes. The entire route takes place in the forest, forcing a surface to be removed from the production circuit.

The area width of forest roads represents the entire width of the lateral area in cross section. When fixing the road junction, special attention must be paid to the maximum reduction of the occupation of productive lands and the avoidance of the demolition of some constructions. Thus, solutions can be adopted to support, sustain and consolidate the slopes of high embankments and deep embankments. (Olteanu N., 1996).

The road platform consists of the roadway and the two sidewalks (A.C.F., 2006). It has variable widths, depending on the road category (main, main and secondary) as well as other needs or situations in the field.

To obtain a link between the width of the forest road platform and the width of their area in sectional profile, a number of 72 pairs of their values were taken, which are shown below in table 1:

*Table 1*

The value of the widths of area road and the platform in transversal profile, on the forest road Valea Mare-Sohodol

<b>Crt. no.</b>	<b>Hectometric position</b>	<b>Area width (m)</b>	<b>Platform width (m)</b>	<b>Crt. no.</b>	<b>Hectometric position</b>	<b>Area width (m)</b>	<b>Platform width (m)</b>
<b>1</b>	36+45.00	10.2	7.2	<b>37</b>	41+69.00	8.8	5.5
<b>2</b>	36+55.00	11.4	7.9	<b>38</b>	41+87.00	11	5
<b>3</b>	36+72.00	9.1	4.2	<b>39</b>	42+04.00	15.1	5.7
<b>4</b>	36+87.00	11	7.6	<b>40</b>	42+23.00	14.2	9.2
<b>5</b>	36+96.00	14.7	11.4	<b>41</b>	42+39.00	13.6	6.3
<b>6</b>	37+03.00	11.5	8.7	<b>42</b>	42+51.00	14.9	9.7
<b>7</b>	37+13.00	13.4	9.4	<b>43</b>	42+65.00	21	12.2
<b>8</b>	37+32.00	8.3	5.5	<b>44</b>	42+81.00	8.5	3.3
<b>9</b>	37+51.00	8.7	5.4	<b>45</b>	42+99.00	13.7	8
<b>10</b>	37+69.00	11.6	8	<b>46</b>	43+23.00	8.8	5.3
<b>11</b>	37+76.00	11.7	8.7	<b>47</b>	43+36.00	10.6	7.4
<b>12</b>	37+85.00	11.3	7.8	<b>48</b>	43+52.00	8.6	3.8
<b>13</b>	38+01.00	6.4	5.3	<b>49</b>	43+72.00	6.4	2.2
<b>14</b>	38+13.00	7.4	4.5	<b>50</b>	43+94.00	8.1	3.1
<b>15</b>	38+25.00	4.7	5.4	<b>51</b>	44+13.00	8.3	4
<b>16</b>	38+41.00	6	5.2	<b>52</b>	44+35.00	8	4.1
<b>17</b>	38+58.00	5.7	5.3	<b>53</b>	44+64.00	11.3	3
<b>18</b>	38+72.00	7.4	5.8	<b>54</b>	44+90.00	8.6	6.2
<b>19</b>	38+92.00	5.1	4.8	<b>55</b>	45+09.00	8.4	6.3
<b>20</b>	39+18.00	24.8	5	<b>56</b>	45+29.00	10.1	9
<b>21</b>	39+35.00	24.3	6.1	<b>57</b>	45+48.00	9.5	7.2
<b>22</b>	39+50.00	23.3	7	<b>58</b>	45+66.00	9.1	5.4
<b>23</b>	39+63.00	20.4	6.5	<b>59</b>	45+80.00	15.1	7.8
<b>24</b>	39+73.00	19.4	7.3	<b>60</b>	45+95.00	17.6	10.7
<b>25</b>	39+80.00	12.3	9	<b>61</b>	46+11.00	13.6	6.2
<b>26</b>	39+91.00	18.6	7.5	<b>62</b>	46+29.00	12.1	5.5
<b>27</b>	40+07.00	17.4	5.5	<b>63</b>	46+47.00	12	5.8
<b>28</b>	40+26.00	12.4	5.2	<b>64</b>	46+66.00	9.9	5.6
<b>29</b>	40+47.00	18.4	5	<b>65</b>	46+82.00	10.3	7.3
<b>30</b>	40+66.00	18.1	5.4	<b>66</b>	46+96.00	11.7	6.6
<b>31</b>	40+87.00	17.3	5.4	<b>67</b>	47+14,50	13.5	10.4
<b>32</b>	40+02.00	10.9	5.3	<b>68</b>	47+31.00	10.3	5.8
<b>33</b>	41+17.00	16.4	9.4	<b>69</b>	47+48.00	7.8	4.8
<b>34</b>	41+29.00	16.4	9.9	<b>70</b>	47+70.00	10.7	5.6
<b>35</b>	41+39.00	13.1	8.1	<b>71</b>	47+87.00	12.6	6
<b>36</b>	41+53.00	7.9	5.7	<b>72</b>	48+03.00	13.5	8.5

In order to describe the correlative links between the width of the forest road platform and the width of their area in sectional profile, all types of regression equations were tested, so that interdependence between them

could be established, which would help to improve the forest road design process. aspects related to this activity (Horvat, 1994).

## RESULTS AND DISCUSSION

In order to identify possible correlative links between the width of the forest road platform and the width of area in sectional profile corresponding to this forest road, 2 strings of values were considered, which were tested using the most known regression equations, respectively linear, logarithmic , polynomial, power and exponential.

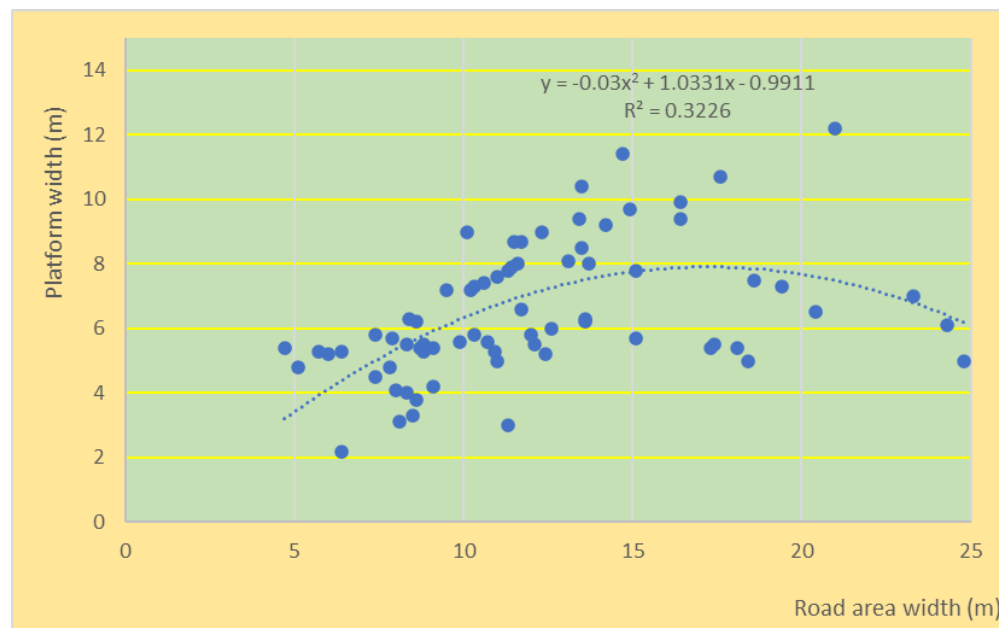


Fig. 1-Graphical representation of the polynomial correlation between the width of the forest road platform and the width of their area

The values of the correlation ratios obtained for these value ranges show the existence of a polynomial correlation, with a correlation ratio  $R^2 = 0.3226$  (figure 1), so statistically significant (Giurgiu V., 1972), in terms of the interdependence between these geometric elements of the forest road.

This polynomial correlation, with the resulting regression equation  $y = -0.03x^2 + 1.0331x - 0.9911$ , shows that there is a very direct link between the width of the forest road platform and the width of their area (figure1).

## CONCLUSIONS

In order to increase the efficiency of the administration in order to practice sustainable forestry, it is necessary a reorientation regarding the design, execution but also the maintenance of forest roads. From the results obtained in this study it can be proposed to use GIS technology in the future, in order to increase the accuracy and quality of design well correlated with the choice of forest roads and then make practical and efficient decisions on the maintenance of these roads (Martínez-Zavala L., et al,2008; Tamaş Ş. et al., 2006).

The regression equation obtained with the help of the polynomial correlation, which is significant, shows the existence of a close interdependence between the width of the forest road platform and the width of the area.

It should also be noted that when determining the width of the embankment, a wider range of factors must be taken into account, not only the width of the platform, such as the area removed from the production circuit, various objectives to be achieved, road stability, ease of operation, etc.

Carrying out much larger studies could significantly contribute to obtaining the most concrete and efficient methods for the long-term exploitation and maintenance of forest roads.

By establishing a significant correlation between the analyzed geometric elements, it can be said that they directly influence the quality of the infrastructure and superstructure of forest roads, (Dodson Coulter E., et al, 2006).

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17. \*\*\* Amenajamentul O.S. Beiuș

## PHYTOCOENOLOGICAL STUDY OF ROCKY VEGETATION FROM CODRU-MOMA MOUNTAINS BASED ON ECOLOGICAL INDICES

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### Abstract

In this paper the ecological factors for the rocky associations from Codru-Moma Mountains are studied (humidity, temperature, chemical reaction of soil). The study was done during 2008-2018, a number of 5 rocky associations being identified: *Asplenietum rutae-murariae-trichomanis* R. Tüxen 1937 (25 relevées), *Asplenio quadrivalenti-Poëtum nemoralis* Soó ex Gergely et al. 1966 (17 relevées), *Asplenietum septentrionali-adianti-nigri* Oberdorfer 1938 (9 relevées), *Asplenio trichomani-Poëtum nemoralis* Boșcaiu 1971 (25 relevées), *Ctenidio-Polypodietum* Jurko et Peciar 1963 (25 relevées).

In Codru-Moma Mountains the phytocoenoses of these associations have been identified at altitudes of 330-950 m, on siliceous or calcareous rocks, with large inclination (30-90°) and shaded exposition (N, E, V, NV, NE), along some valleys and streams on the edge of hornbeam and beech forests. Vegetation covers 25-100%, and due to the fact that on these cliffs humidity is high all year round, a series of bryophytes appear (1-40%).

**Key words:** ecological factors, humidity, temperature, chemical reaction of soil, relevées

### INTRODUCTION

The rocky phytocoenoses represent the pioneer vegetation that develops in the cracks of calcareous and siliceous rocks from Codru-Moma Mountains. Due to the nature of the substrate and the restrictive climatic conditions, the floristic composition of these associations is characterized by an abundance of species of *Quercus-Fagetum*, *Festuco-Brometum*, *Rhamno-Prunetum* classes.

The main plant rocky associations identified in the Codru-Moma Mountains and analyzed in this paper from the ecological point of view are:

*Asplenietum trichomanis* Class (Br.-Bl. in Meier et Br.-Bl. 1934)  
Oberdorfer 1977

*Tortulo-Cymbalarietalia* order Segal 1969

*Cymbalario-Asplenion* alliance Segal 1969 em. Mucina 1993

1. *Asplenietum rutae-murariae-trichomanis* association R. Tüxen 1937

*Cystopteridion* alliance Richard 1972

2. *Asplenio quadrivalenti-Poëtum nemoralis* association Soó ex Gergely et al. 1966

*Androsacetalia vandelli* order Br.-Bl. in Maier et Br.-Bl. 1934

*Asplenion septentrionalis* alliance Oberdorfer 1938



3. *Asplenietum septentrionali-adianti-nigri* association Oberdorfer 1938

4. *Asplenio trichomani-Poëtum nemoralis* association Boşcaiu 1971

*Hypno-Polypodium* alliance Mucina 1993

5. *Ctenidio-Polypodietum* association Jurko et Peciar 1963

Older studies related to the rocky vegetation from Codru-Moma Mountains were made by Paucă (1941). More recent publications relating to the rocky vegetation from Codru-Moma Mountains were made by Pășcuț (2010, 2013), Burescu and Pășcuț (2010).

In our country and in Europe, these rocky associations were studied by Pascal and Mititelu (1971), Pop et al., (2002), Rațiu et al., (1984), Ștefan et al., (1997), Sârbu et al., (1997), Chifu et al., (2006), Chifu et al., (2014), Oprea and Sîrbu (2009), Rațiu and Gergely (1976), Schneider-Binder (1968, 1969, 1972), Mihăilescu (2001), Karácsonyi, (2011), Groza, (2008), Niculescu (2006), Stancu (2005), Răduțoiu (2006), Drăgulescu (1985, 1988), Diaconescu (1973), Alexiu (1998), Peia, (1978), Kolbek et al., (2015), Pott (1995), Borhidi (2003), Pignatti and Pignatti (2014), Świerkosz (2004).

## MATERIAL AND METHOD

For the study of the identified associations we used ecological spectra that take into account the presence of the species in the association, as well as humidity, temperature and chemical reaction of soil for each species (Sanda et al., 1983). The phytocoenological description of the associations is followed by comparative analysis in order to outline the requirements of each association on ecological factors.

In the table constancy (K) is mentioned for each identified species. The constancy (K) outlines the general presence of a species in all the relevés analysed, belonging to the same type of phytocoenose (Cristea et al., 2004).

In the reports of the relevés information regarding altitude, herbaceous layer coverage, bryophytes layer coverage, exposition and slope was introduced.

Information concerning life forms, floristic elements and ecological indices is given based on Sanda et al., (1983), Cristea et al., (2004).

Nomenclature adopted for the identified species is in accordance with the work developed by the Ciocârlan (2009) și Sârbu et al., (2013).

## RESULTS AND DISCUSSION

The rocky associations identified in the Codru-Moma Mountains are presented as follows:

**1. *Asplenietum rutae-murariae-trichomanis* association** R. Tüxen 1937

The phytocoenose of *Asplenietum rutae-murariae-trichomanis* association (figure 1), develops in the form of clumps among the cracks and on shelves of heavily skewed limestone rocks (30-90°), mainly with north, northwest or northeast exposition. It is widespread on the rocks along the intermountain valleys and creeks at altitudes of 400-680 m.

Thanks to the nordic exhibition of the rocks and the inclusion of these phytocoenoses in beech forests, a shaded microclimate with moderate humidity almost all year round has been created, as well as lower temperature in summer. This has allowed the installation of bryophytes of the genus *Ctenidium* and *Syntrichia* within these phytocoenoses.

Considering life forms, the hemycryptophytes (59.37%) dominate, followed by terophytes (17.19%) and chamaephytes (10.94%).

The most numerous floristic elements are eurasian (35.94%), followed by european (20.31%), central-european (15.63%) and mediterranean (7.8%) ones.

**2. *Asplenio quadrivalenti-Poëtum nemoralis* association** Soó ex Gergely et al. 1966

The association phytocoenoses vegetate on shaded limestone rocks, with high slope (40-90°), located at altitudes of 410-800 m, set on shaded slopes (N, NV, NE). The physiognomy of the association is given by the two edifying species *Asplenium trichomanes* ssp. *quadrivalens* and *Poa nemoralis*, in terms of codominance.

The life forms are dominated by hemycryptophytes (52.38%), followed by phanerophytes (23.8%), geophytes and terophytes (11.91%) having an equal share.

The floristic elements show the predominance in the association of the eurasian species (38.09%), followed by european (23.81%), central-european (16.67%), cosmopolitan (9.53%) and south european (4.76%) ones.

In this association the bryophytes layer consisting of *Ctenidium molluscum* and *Marchantia polymorpha* plays an important role in maintaining moisture.

**3. *Asplenietum septentrionali-adianti-nigri* association** Oberdorfer 1938

In Codru-Moma Mountains the phytocoenoses of this association (figure 2), have been identified at altitudes of 350-590 m, on siliceous rocks with great slope (40-80°), along some valleys and streams on the edge of hornbeam and beech forests. They develop on superficial soil, poor in organic substances and with a low acid neutrophile PH.

The life forms outline the presence of a large number of hemycryptophyte species (75%), followed by chamaephytes (10.71%) and nanophanerophytes (7.14%).

Floristic elements with the largest share in the association are the eurasians (42.86%), followed by european species (14.29%), central-european species (10.71%), cosmopolitan (10.71%) and circumpolar (10.71%) ones.

On these rocks there is high humidity all year round, demonstrated by the presence of *Ctenidium molluscum* species.



Fig. 1. *Asplenietum rutae-murariae-trichomanis* (Râposu Brook, Bihor County)



Fig. 2. *Asplenietum septentrionali-adianti-nigri*, (Briheni Valley, Bihor County)

#### 4. *Asplenio trichomani-Poëtum nemoralis* association Boşcaiu 1971

It is an association found on siliceous rocks, with great slope (30-90°), at altitudes between 350-945 m. The phytocoenoses of this association (figure 3), prefer the rocks in shady valleys, located on slopes with northern and north-western exposition.

Considering life forms hemycryptophytes (52.38%) have the highest share, followed by the phanerophytes (25.39%), terophytes (12.7%) and geophytes (9.52%).

Among the floristic elements in the phytocoenoses analyzed the eurasian species (34.92%) dominate, supplemented by european (19.05%), central-european (17.46%) and south european (9.53%) ones.

Bryophytes layer is well represented, consisting of *Ctenidium molluscum*, *Hypnum cupressiforme*, *Marchantia polymorpha*, *Polytrichum commune*.

An important feature is a large fluctuation of coincidental species generated by the variability of vegetation conditions.

#### 5. *Ctenidio-Polypodietum* association Jurko et Peciar 1963

The *Ctenidio-Polypodietum* phytocoenoses (figure 4), develop in the cracks and on shaded rocks, on lower hills and up to the top of Codru-Moma Mountains, at altitudes of 330-1000 m, on terrains with a shady exposition (N, NV, NE) and high slope (30-90°). Humidity is the determining factor, the association being mainly found on the lower third of steep and shady slopes, near the mountain valleys and creeks.

In the case of life forms one can observe the presence of the large number of hemycryptophyte species (57.81%), followed by phanerophytes (17.19%), geophytes (12.5%) and terophytes (12.5%).

Considering floristic elements, you can see the share of eurasian species (26.56%), european ones (23.44%), followed by central-european (15.62%), cosmopolitan (12.5%) and south european (9.37%) species.



Fig. 3. *Asplenio trichomanis*-*Poëtum nemoralis* (Urviş Valley, Arad County)



Fig. 4. *Ctenidio-Polypodietum* (Finiş Valley, Bihor County)

The following table presents in detail the floristic composition of the associations identified, as well as the constancy (K) for each species.

Indices of species constancy for the analyzed associations					Table 1
The number of the association	1	2	3	4	5
Altitude (m.s.m.)	400-680	410-800	350-590	350-945	330-950
The coverage of vegetation layer (%)	25-80	30-85	40-80	40-80	50-100
The coverage of bryophytes layer (%)	1-25	5-40	5-20	1-25	1
Exposition	N, NE, NV	N, NE, NV, E	N, V, NV	N, V, E, NV, NE	N, V, NE, NV
Slope (°)	30-90	40-90	80-90	30-90	30-90
	0	1	2	3	4
<b><i>Asplenietea trichomanis</i></b>					
<i>Asplenium trichomanes</i> ssp. <i>quadrivalens</i>	V	V	.	.	II
<i>Asplenium trichomanes</i> ssp. <i>trichomanes</i>	.	.	V	V	III
<i>Asplenium ruta-muraria</i>	V	I	.	.	I

0	1	2	3	4	5
<i>Asplenium septentrionale</i>	.	.	V	I	I
<i>Asplenium adiantum-nigrum</i>	.	.	V	I	I
<i>Poa nemoralis</i>	II	V	IV	V	III
<i>Sedum maximum</i>	II	III	V	IV	IV
<i>Polypodium vulgare</i>	II	II	II	IV	V
<i>Valeriana tripteris</i>	II	II	.	I	I
<i>Cystopteris fragilis</i>	I	II	.	I	I
<i>Sile nutans</i> ssp. <i>dubia</i>	.	.	II	.	.
<i>Cardaminopsis arenosa</i>	I	I	.	I	I
<i>Asplenium adulterinum</i>	.	I	I	.	I
<i>Sedum hispanicum</i>	I	.	.	.	.
<i>Calamagrostis arundinacea</i>	.	.	.	.	I
<i>Ceterach officinarum</i>	.	.	.	.	I
<b>Festuco-Brometea</b>	.	.	.	.	.
<i>Teucrium chamaedrys</i>	II	.	III	.	.
<i>Sedum acre</i>	I	.	III	.	.
<i>Thymus glabrescens</i>	I	.	III	.	.
<i>Euphorbia cyparissias</i>	I	.	II	.	.
<i>Hypericum perforatum</i>	I	.	II	.	.
<i>Potentilla argentea</i>	I	.	II	.	.
<i>Achillea collina</i>	I	.	.	.	.
<i>Agrimonia eupatoria</i>	I	.	.	.	.
<i>Asperula cynanchica</i>	I	.	.	.	.
<i>Brachypodium pinnatum</i>	I	.	.	.	.
<i>Centaurea biebersteinii</i>	I	.	.	.	.
<i>Dianthus carthusianorum</i>	I	.	.	.	.
<i>Festuca valesiaca</i>	I	.	.	.	.
<i>Fragaria viridis</i>	I	.	.	.	.
<i>Geranium pusillum</i>	I	.	.	.	.
<i>Poa compressa</i>	I	.	.	.	.
<i>Potentilla arenaria</i>	I	.	.	.	.
<i>Sanguisorba minor</i>	I	.	.	.	.
<i>Sedum sexangulare</i>	I	.	.	.	.
<i>Stachys germanica</i>	I	.	.	.	.
<i>Teucrium montanum</i>	I	.	.	.	.
<i>Thymus comosus</i>	I	.	.	.	.
<i>Thymus pannonicus</i> ssp. <i>pannonicus</i>	I	.	.	.	.
<i>Trifolium arvense</i>	I	.	.	.	.
<i>Viola arvensis</i>	I	.	.	.	.
<i>Vincetoxicum hirundinaria</i>	I	.	.	.	.
<b>Querc-Fagetea</b>					
<i>Geranium robertianum</i>	II	III	II	III	IV
<i>Lamium galeobdolon</i>	II	III	.	III	IV
<i>Asplenium scolopendrium</i>	III	IV	.	II	II
<i>Rubus hirtus</i>	.	II	.	IV	III
<i>Mycelis muralis</i>	II	III	II	III	III
<i>Moehringia muscosa</i>	II	III	II	II	II
<i>Dryopteris filix-mas</i>	I	I	II	III	II
<i>Hedera helix</i>	III	II	.	I	II
<i>Cruciata glabra</i>	.	.	III	I	.
<i>Campanula persicifolia</i>	II	I	II	II	II
<i>Asarum europaeum</i>	I	I	.	II	II
<i>Oxalis acetosella</i>	I	.	.	II	II
<i>Galium schultesii</i>	I	II	.	I	I
<i>Polygonatum odoratum</i>	.	I	.	I	II
<i>Athyrium filix-femina</i>	.	.	.	I	II
<i>Galium odoratum</i>	.	.	.	I	II
<i>Luzula luzuloides</i>	.	.	.	I	II
<i>Polystichum aculeatum</i>	.	II	.	.	I

0	1	2	3	4	5
<i>Clinopodium vulgare</i>	.	.	II	.	.
<i>Campanula rapunculoides</i>	I	I	.	I	I
<i>Moehringia trinervia</i>	I	I	.	I	I
<i>Daphne mezereum</i>	I	I	.	I	.
<i>Euonymus latifolius</i>	.	I	.	I	I
<i>Acer pseudoplatanus</i>	.	.	.	I	I
<i>Alliaria petiolata</i>	.	.	.	I	I
<i>Carpinus betulus</i>	.	.	.	I	I
<i>Hepatica nobilis</i>	I	I	.	.	.
<i>Lamium maculatum</i> ssp. <i>maculatum</i>	.	.	.	I	I
<i>Polystichum setiferum</i>	.	.	.	I	I
<i>Stellaria holostea</i>	.	.	.	I	I
<i>Brachypodium sylvaticum</i>	.	.	.	I	.
<i>Carex pilosa</i>	.	.	.	.	I
<i>Dentaria bulbifera</i>	.	.	.	.	I
<i>Fagus sylvatica</i>	.	I	.	.	.
<i>Festuca drymeja</i>	.	.	.	.	I
<i>Glechoma hirsuta</i>	.	.	.	I	.
<i>Pulmonaria officinalis</i>	.	.	.	.	I
<i>Sanicula europaea</i>	.	.	.	I	.
<i>Tilia platyphyllos</i>	.	.	.	.	I
<i>Viola reichenbachiana</i>	.	.	.	I	.
<b>Rhamno-Prunetea</b>					
<i>Sambucus nigra</i>	I	.	.	II	III
<i>Corylus avellana</i>	.	I	.	I	II
<i>Galeopsis speciosa</i>	.	I	.	I	II
<i>Clematis vitalba</i>	.	I	.	I	.
<i>Acer campestre</i>	.	.	.	I	I
<i>Cornus sanguinea</i>	.	.	.	I	.
<i>Crataegus monogyna</i>	.	.	.	I	.
<i>Evonymus europaeus</i>	.	.	.	I	.
<i>Salix caprea</i>	.	.	.	I	.
<i>Ulmus glabra</i>	.	.	.	.	I
<i>Verbascum nigrum</i>	.	.	.	I	.
<b>Variae Syntaxa</b>					
<i>Salvia glutinosa</i>	II	I	II	I	III
<i>Fragaria vesca</i>	.	I	III	I	.
<i>Doronicum austriacum</i>	II	I	.	.	II
<i>Galium album</i>	II	I	.	I	I
<i>Chamaecytisus hirsutus</i> ssp. <i>leucotrichus</i>	.	.	II	I	.
<i>Chelidonium majus</i>	.	.	.	I	II
<i>Genista ovata</i>	.	.	II	.	.
<i>Arabis turrata</i>	I	.	.	I	I
<i>Melampyrum bihariense</i>	.	I	.	I	I
<i>Tamus communis</i>	.	.	.	I	I
<i>Urtica dioica</i>	.	.	.	I	I
<i>Vincetoxicum hirundinaria</i>	.	I	.	.	I
<i>Achillea millefolium</i>	I	.	.	.	.
<i>Cytisus nigricans</i>	.	.	.	I	.
<i>Dianthus spiculifolius</i>	I	.	.	.	.
<i>Festuca pallens</i>	.	.	.	.	I
<i>Galium mollugo</i>	I	.	.	.	.
<i>Gentiana asclepiadea</i>	.	.	.	I	.
<i>Hieracium pilosella</i>	I	.	.	.	.
<i>Hieracium umbellatum</i>	.	.	.	.	I
<i>Medicago lupulina</i>	I	.	.	.	.
<i>Melittis melissophyllum</i>	.	.	.	.	I
<i>Peucedanum longifolium</i>	I	.	.	.	.

0	1	2	3	4	5
<i>Primula elatior</i> ssp.	I	.	.	.	.
<i>leucophylla</i>	I	.	.	.	.
<i>Rosa canina</i>	.	.	.	.	I
<i>Sedum cepaea</i>	.	I	.	.	.
<i>Sambucus nigra</i>	.	.	.	I	.
<i>Solidago virgaurea</i>	.	I	.	.	.
<i>Valeriana officinalis</i>	I	.	.	.	.
<i>Verbascum phlomoides</i>	.	.	.	I	.
<i>Veronica chamaedrys</i>	.	.	.	.	.
<b>Bryophyta</b>					
<i>Ctenidium molluscum</i>	III	IV	IV	II	V
<i>Marchantia polymorpha</i>	.	I	.	I	I
<i>Hypnum cupressiforme</i>	.	.	.	I	.
<i>Polytrichum commune</i>	.	.	.	I	.
<i>Syntrichia ruralis</i> var.	I	.	.	.	.
<i>calcicola</i>					

Place and date of relevés: 1 - *Asplenietum rutae-murariae-trichomanis* association, Brook of Râposu (7 relevés), Morilor Valley (5 relevés), Ormanu Valley (2 relevés), Briheni Valley (2 relevés), Șopotesei Valley, Câmp Moți village (2 relevés), Țarinii Valley, Bănișoara Sfârș, Ponoare Meadow, Crișului Văratec Valley (1 relevé) (Bihor County), Moneasa Valley (1 relevé) (Arad County). 2 - *Asplenio quadrivalenti-Poëtum nemoralis* association, Brook of Râposu (2 relevés), Tărcăița Valley (5 relevés), Șaua Bălănescu to Summit of Tisa, Moara Dracului-Briheni village, Șopotesei Valley (4 relevés), Rock of Șopotesei, Ponoare Meadow, Șesuța Valley, Summit of Caprei (1 relevé) (Bihor County). 3 - *Asplenietum septentrionali-adianti-nigri* association, Mic Valley (4 relevés), Briheni Valley (5 relevés) (Bihor County). 4 - *Asplenio trichomani-Poëtum nemoralis* association, Șerbanu Valley, Mic Valley, Cusuiș Valley (2 relevés), Briheni Valley, Zărzag Valley (3 relevés), Crișului Văratec Valley, Caselor Hill, Toaca Hill, Tărcăița Valley (Bihor County), Urviș Valley (3 relevés), Archișel Valley, Boroaia Valley (3 relevés), Clit Valley (3 relevés), Zugău Valley, Summit of Izoiu Mic, Răului Valley, Hășmaș Valley (Arad County). 5 - *Ctenidio-Polypodietum* association, Brook of Râposu, Ormanu Valley, Șerban Valley, Morilor Valley - La Stan, Șoim Valley, Moșcoru Valley, Cusuiș Valley, Zărzag Valley, Pont Valley, Finiș Valley, Moara Dracului - Briheni village, Mic Valley, Crișului Văratec Valley, Mare Hill (1 relevé) (Bihor County), Urviș Valley, Clit Valley, Hășmaș Valley, Moneasa Valley, Boroaia Valley, Summit of Izoiu Mic, Summit of Osoiu Mare, Megheș Valley - Piatra Mică, Brook of Osoi, Summit of Merișoara, Răului Valley, Summit of Moma (1 relevé) (Arad County).

In the following table there are shown the values of ecological indices (humidity, temperature, chemical reaction of soil), for the rocky associations studied.

Table 2

The distribution of the species on ecological categories depending on humidity (U), temperature (T), chemical reaction of soil (R)

Asociations	Ecological categories(%)	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6	0
As. 1	U	3,12	7,81	28,12	15,63	25	12,5	6,25	-	-	-	-	1,56
	T	-	-	4,69	3,12	50	14,06	15,62	-	1,56	-	-	10,94
	R	-	-	1,56	-	25	-	43,75	-	6,25	-	-	23,44
As. 2	U	-	2,38	7,14	11,91	47,62	21,43	7,14	-	-	-	-	2,38
	T	-	-	9,52	7,14	66,67	2,38	2,38	-	-	-	-	11,91
	R	-	-	-	-	35,71	-	35,71	-	4,76	-	-	23,81
As. 3	U	3,57	-	28,57	14,29	32,14	10,71	7,14	-	-	-	-	3,57
	T	-	-	7,14	7,14	64,29	7,14	7,14	-	-	-	-	7,14
	R	3,57	-	10,71	-	21,43	-	35,71	-	-	-	-	28,57
As. 4	U	1,59	-	7,94	19,05	46,03	17,46	7,94	-	-	-	-	-
	T	-	-	7,94	7,94	68,25	3,17	1,59	-	-	-	-	11,11
	R	-	-	4,76	-	34,92	-	38,1	-	1,59	-	-	20,63
As. 5	U	1,56	4,69	6,25	21,87	37,5	18,75	9,38	-	-	-	-	-
	T	-	-	7,81	6,25	62,5	3,12	6,25	1,56	-	-	-	12,5
	R	-	-	6,25	-	32,81	-	39,06	-	4,69	-	-	17,19

Association: As. 1 - *Asplenietum rutae-murariae-trichomanis*, As. 2 - *Asplenio quadrivalenti-Poëtum nemoralis*, As. 3 - *Asplenietum septentrionali-adianti-nigri*, As. 4 - *Asplenio trichomani-Poëtum nemoralis*, As. 5 - *Ctenidio-Polypodietum*.

Comparative analysis of rocky phytocoenoses behavior from Codru-Moma Mountains is presented in the following ecological spectrum.

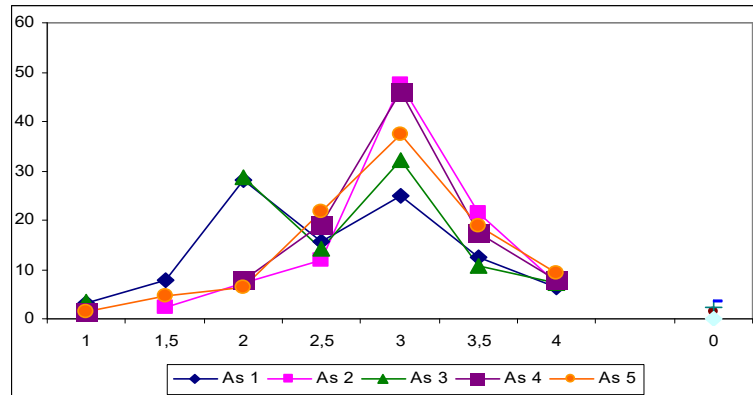


Fig. 5 Ecological comparative spectrum, for humidity

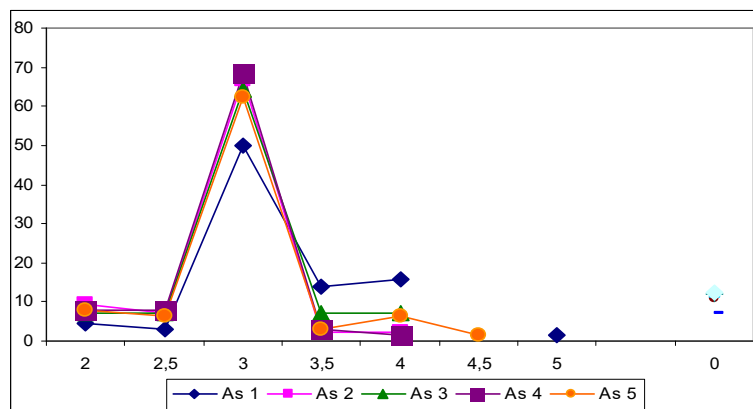


Fig. 6 Ecological comparative spectrum, for temperature

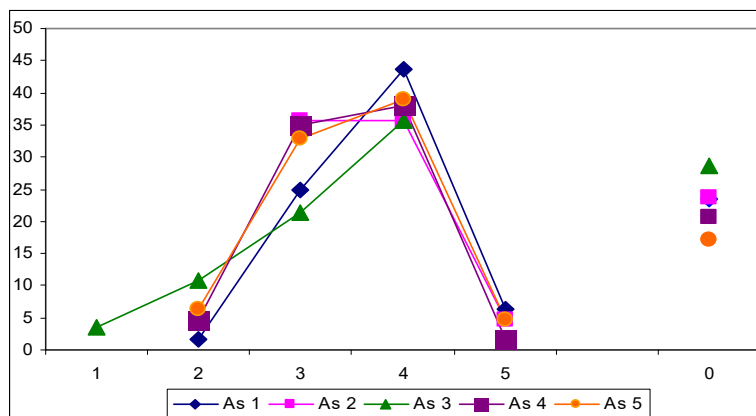


Fig. 7 Ecological comparative spectrum, for chemical reaction of soil



## CONCLUSIONS

Considering humidity requirements (figure 5), it is observed that for *Asplenio quadrivalenti-Poëtum nemoralis*, *Asplenio trichomani-Poëtum nemoralis* and *Ctenidio-Polypodietum* associations the dominant species are mesophytes ( $U_{3-3.5}=56.25-69.05\%$ ), being the major components of rocky vegetations. The main species for *Asplenietum rutae-murariae-trichomanis* association are the xero-mesophytes ( $U_{2-2.5}=43.75\%$ ), and for *Asplenietum septentrionali-adianti-nigri* association the xero-mesophytes ( $U_{2-2.5}=42.86\%$ ) and mesophytes species ( $U_{3-3.5}=42.86\%$ ) dominate in equal share.

Considering temperature the micro-mesothermophilous species dominate for all the 5 associations studied (figure 6). Thus, on associations, values for the temperature index appears as follows: *Asplenietum rutae-murariae-trichomanis* ( $T_{3-3.5}=64.06$ ), *Asplenio quadrivalenti-Poëtum nemoralis* ( $T_{3-3.5}=69.05$ ), *Asplenietum septentrionali-adianti-nigri* ( $T_{3-3.5}=71.43$ ), *Asplenio trichomani-Poëtum nemoralis* ( $T_{3-3.5}=71.43\%$ ), *Ctenidio-Polypodietum* ( $T_{3-3.5}=65.62\%$ ).

Analysis of species considering the chemical reaction of the soil, highlights the weak acid neutrophylous character for the most part of rocky phytocoenoses identified in the Codru-Moma Mountains (figure 7). The share of weak acid neutrophylous species in the 5 associations studied appears as follows: *Asplenietum rutae-murariae-trichomanis* association ( $R_4=43,75\%$ ), *Asplenio quadrivalenti-Poëtum nemoralis* association ( $R_4=35,71\%$ ), *Asplenietum septentrionali-adianti-nigri* association ( $R_4=35,71\%$ ), *Asplenio trichomani-Poëtum nemoralis* association ( $R_4=38,1\%$ ), *Ctenidio-Polypodietum* association ( $R_4=39,06\%$ ). The large share of basiphile species is explained by the existence of a limestone substrate on extensive areas in Codru-Moma Mountains. Also the presence of the acidophile species is related to the acid substrate, met on high peaks.

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## **FOREIGN INVESTMENTS IN THE FIELD OF WASTE MANAGEMENT AT THE ROMANIAN-HUNGARIAN BORDER**

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### **Abstract**

*At present, waste management has become a priority and the measures and solutions for very efficient waste control must be provided by both the population and the companies in the field.*

*The Romanian-Hungarian border area benefits from attracting foreign investments, including in the field of waste management. There are a number of important companies that stand out for the quality and originality of the services offered, and this can be seen in their turnovers.*

*In terms of turnover, some of the foreign companies established in this area are on the first places in the ranking of waste field companies.*

*The German, Hungarian, Austrian, Italian, even Russian, Swiss and Chinese capital stand out in this area. Within the border area, we find the largest foreign companies in Arad County, followed by a company from Bihor.*

*Taking into account the foreign companies in the border area that cross the threshold of turnover of EUR 500,000, we find foreign investments, presented in this paper, with a turnover located between EUR 750,000 and over EUR 120 million. Each of these companies has between 0 and about 150 employees.*

**Key words:** foreign investment, waste, recovery, border, romanian-hungarian border

### **INTRODUCTION**

Direct investment is considered a category of cross-border investment made by a resident in an economy (direct investor) in an enterprise (direct investment enterprise) resident in an economy other than that of the direct investor, in order to establish a long-term strategic relationship with a significant degree of influence by the direct investor in the management of the direct investment enterprise. Owning at least 10% of the voting power of the direct investment enterprise by the direct investor reflects the long-term interest. (OECD, 2008)

Waste management provides a hierarchy that is applied in the following priority: prevention; preparation for reuse; recycling; other recovery operations, for example energy recovery; elimination. (Official Gazette, 2014)

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## **MATERIAL AND METHOD**

In this paper we referred to foreign direct investment as companies with a foreign capital of at least 10 %.

Although we are discussing the area of the Romanian-Hungarian border, we refer only to the „Romanian” part of the border, made up of the counties of Satu Mare, Bihor, Arad and Timiș.

In the attention of our analysis were the companies with foreign capital with a participation of at least 10%, taking into account for presentation the companies with a turnover of at least EUR 500,000 at the end of 2019, having NACE codes from subgroups 381, 382, 383 and 467 - Collection of non-hazardous waste; Treatment and disposal of non-hazardous waste; Dismantling of wrecks; Recovery of sorted materials; Wholesale of waste and scrap. (Official Gazette, 2011)

We collected the financial data of the companies from websites such as the official page of the Ministry of Public Finance. ([www.mfinante.gov.ro](http://www.mfinante.gov.ro)) For a better understanding of companies' activity, we used also relevant information available on companies' websites.

Our research is a quantitative research. In interpreting the data, we relied on comparisons and rankings.

## **RESULTS AND DISCUSSION**

Brela Int is a German-Romanian company, located in Satu Mare County, which deals with the recycling of pallets and metal packaging. The company has a turnover of over EUR 1,5 million and has offices both in Romania (Sibiu, Mureș, Arad, Brașov, Hunedoara counties) and in Germany (Weistrach). ([www.brelaint.ro](http://www.brelaint.ro)) This is also the only important foreign company in the county, the next company that follows it having a turnover of approximately EUR 2,500.

In Bihor county there are two large companies in the waste field. The largest company, under the name of Eco Bihor, has a turnover of over EUR 8 million, and the next one has a turnover of almost EUR 2 million, being represented by Ave Bihor. Both companies represent Hungarian foreign investments.

Established in 2004, Eco Bihor manages the county ecological waste landfill, the recyclable waste sorting station, the technology for producing artificial aggregates, the composting station for organic waste, the mechano-biological treatment plant for household and similar waste, the treatment plant

water and biogas plant. The company also has a working point in Covasna County. ([ecobihor.ro](http://ecobihor.ro))

Founded in 2008, the Hungarian company Ave Bihor has as activity the collection of different types of household waste from the population, markets and places not allowed for their storage (recyclable, residual, bio-waste, bulky, hazardous, construction materials). In addition to collection, the company aims to sort, compost and treat waste. ([www.ave-bihor.ro](http://www.ave-bihor.ro))

In Arad County, the three largest foreign companies have Austrian capital. Hammerer Aluminum Industries Santana stands out with a turnover of over EUR 120 million. Also, over EUR 18 million and EUR 10 million have the companies that follow it in the ranking: Remat M.G. and FCC Environment Romania. We note that they are followed by the Hungarian company Eva Recuperari with a turnover of only EUR 118,826.

In the waste field, the Austrian group Hammerer Aluminum Industries owns in Romania the company Hammerer Aluminum Industries Santana. The company from Santana, Arad County, owns a foundry, considered among the most modern and flexible foundries in Europe. Within it and the foundry from Austria, 180,000 tonnes of wrought and cast alloys are produced annually. ([www.hai-aluminium.com](http://www.hai-aluminium.com))

Remat M.G. focuses on electrical and electronic waste, non-ferrous metals and cable recycling. In 2005, the Müller-Guttenbrunn Group acquired a majority of shares of Remat Arad and in 2011 Remat MG merged with the Group.

FCC Environment Romania is one of the subsidiaries of FCC Austria Abfall Service AG, stands out in the field of waste management and operates the first compliant landfill in Romania. It has an ecological landfill, a sorting line, three transfer stations, a composting station, a cogeneration station and a water treatment plant. The company also has offices in Bihor, Timiș, Cluj and Bucharest counties. ([www.fcc-group.eu](http://www.fcc-group.eu))

In Timiș County we find several large foreign companies, starting with turnovers of over EUR 500,000 and reaching almost EUR 6 million.

With a turnover of almost EUR 6 million, the largest foreign company in the county is represented by Ecorec Tim, with Romanian-German capital, which operates in the field of recovery of sorted recyclable materials. It is followed by the Italian company Erre P Engineering, with the same field of activity, with a turnover of over EUR 3,5 million.

Also, the Russian company Total Recover has a turnover of over EUR 3 million and deals with the collection and recycling of waste, but also has a production line of plastic granules, obtained from LDPE / HDPE. The company has, in addition to the one in Timișoara, a collection and sorting point in Arad County (Arad) and Bihor County (Oradea). Also, in Timiș County (Deta), we find an industrial property. ([www.totalrecover.ro](http://www.totalrecover.ro))

With a turnover of almost EUR 1,5 million, the company Pro Air Clean Ecologic also stands out, mainly dealing with the treatment and disposal of hazardous waste, but also offering greening services, laboratory analyzes, research-innovation projects and ADR transport. (proairclean.ro)

In the Romanian-Hungarian border area, we identified a single company with foreign capital in the field of wholesale trade of waste and scrap. This is the Chinese company Bang Da Plast, founded in 2018, which has a turnover of over EUR 700,000.

It is worth mentioning that the three companies from Arad County (Hammerer Aluminium Industries Santana, Remat M.G. and FCC Environment Romania) are the largest in the Romanian-Hungarian border area, being followed by the company Eco Bihor from Bihor and the companies Ecorec Tim and Erre P Engineering from Timiș County. (see Table 1)

*Table 1*

Companies with foreign capital in the field of waste management at the Romanian-Hungarian border (with a turnover at the end of 2019 of at least 500,000 eur)

<b>Company</b>	<b>County</b>	<b>Turnover 2019 EUR</b>	<b>Employees 2019</b>
Hammerer Aluminium Industries Santana SRL	AR	120265813	122
Remat M.G. SA	AR	18674776	151
FCC Environment Romania SRL	AR	10344237	144
Eco Bihor SRL	BH	8392896	68
Ecorec Tim SRL	TM	5998005	35
Erre P Engineering SRL	TM	3637078	0
Total Recover SRL	TM	3207452	91
Ave Bihor SRL	BH	1945482	60
Brela Int SRL	SM	1553138	29
Pro Air Clean Ecologic SA	TM	1480122	43
Bang Da Plast SRL	TM	761844	2

What is noteworthy is the position of these foreign companies among all companies, including Romanian capital companies, with a similar activity, regardless of the existing turnover at the end of 2019.

Thus, in the ranking of all companies with the same NACE code, the foreign companies Pro Air Clean Ecologic, Ecorec Tim, Fcc Environment Romania, Remat M.G and Hammerer Aluminum Industries Santana each occupy the first place in the counties they come from, in terms of turnover.

Total Recover and Erre P Engineering are in second place, and Eco Bihor, Brela Int and Bang Da Plast are in third place.

Finally, Ave Bihor ranks fifth in the ranking of similar companies.

The origin of the capital of the presented companies is diverse. In Table 2, there are the companies with the afferent capital.

*Table 2*

The origin of capital of companies with foreign capital in the field of waste management at the Romanian-Hungarian border (with a turnover at the end of 2019 of at least 500,000 eur)

<b>Company</b>	<b>County</b>	<b>The origin of capital</b>
Hammerer Aluminium Industries Santana SRL	AR	Austria
Remat M.G. SA	AR	Austria
FCC Environment Romania SRL	AR	Austria
Eco Bihor SRL	BH	Hungary
Ecorec Tim SRL	TM	Germany, Romania
Erre P Engineering SRL	TM	Italy
Total Recover SRL	TM	Russia, Bulgaria
Ave Bihor SRL	BH	Romania, Hungary
Brela Int SRL	SM	Germany, Romania
Pro Air Clean Ecologic SA	TM	Romania, Switzerland
Bang da Plast SRL	TM	China

## CONCLUSIONS

The field of waste management has received increased attention from foreign investors. Foreign-owned companies are among the largest waste field companies in the counties in which they are based. Some foreign companies are notable for positioning themselves in the first place.

If we consider foreign companies with a turnover of at least EUR 500,000 (at the end of 2019), we can see the prevalence of German capital in Satu Mare, of Hungarian capital in Bihor, of Austrian capital in Arad and a diversified one in Timiș.

As we stated at the beginning, we approach in this paper the "Romanian" part of the border, consisting of the counties of Satu Mare, Bihor, Arad and Timis. We would also like to continue the research on the other side



of the border, on the "Hungarian" part, consisting of the counties of Szabolcs-Szatmár-Bereg, Hajdú-Bihar, Békés and Csongrád-Csanád.

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## STUDY ON THE CALCULATION ALGORITHM FOR THE PARAMETERS OF THE POWER CURVES OF THE VERTICAL AND HORIZONTAL AXIS WIND TURBINES

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### Abstract

*This paper presents the calculation algorithm of the parameters of the power curves for the calculation of energy in the case of horizontal axis wind turbine (HAWT) and vertical axis wind turbine (VAHT), and the indicative calculation of the energy generated - E (kW / hm<sup>2</sup> / year). Errors made in the assessment of the average annual wind speed are of great importance in these calculations. The installed capacity at the swept area is evaluated, and thus resulting the indicator "equivalent hours of installed capacity utilisation". Energy production depends on the location of the turbine.*

**Key words:** wind turbine, parameters, power curves, characteristic number, power coefficient

### INTRODUCTION

Specific parameters of the power curves, which are conceived according to wind speed,  $v$ =m/s, tip speed  $u$ , air density  $\rho$ , exposed area  $S$ , materialized in the unit power form equation at the turbine shaft level:

$$P_{arb} = C_p \cdot \rho \cdot \frac{v^3}{2} \cdot S$$

Starting from the values of constant speed ( $n = 50$ -400 rpm) and wind speed considered as a reference  $v = 5, 12, 15$  m/s, the following parameters  $\lambda$ ,  $C_p$ ,  $P_{arb}$  were calculated. In the case of VAHT,  $S = D \cdot H = 7,5\text{m}^2$  where  $D = 2.5$  m,  $H = 3$ ,  $\lambda = \frac{u_R}{v} = \frac{\omega \cdot R}{v}$  where  $n$  is the rotational speed of the wind turbine (rpm).

When calculating the wind turbine shaft power, and taking into account that the speed value was considered as a calculation benchmark, the constant  $A = \rho \cdot \frac{v^3}{2} \cdot S$  is defined. The procedure is similar to HAWT by making use of specific mathematical relationships.

### MATERIAL AND METHOD

The calculation algorithm of the power curve parameters for VAWD is as follows:

- Wind speed  $v$  is considered within the range  $v = 3$ -19m / s,

- Turbine rotational speed of turbine  $n$  has constant values for different calculation levels ( $n = 50, 100$ , etc.),

- Characteristic number  $\lambda$ , where  $\lambda = \frac{u}{v} = \frac{R \cdot \omega}{v}$ ,  $\omega = \frac{\pi \cdot n}{30}$ , it follows

$$\text{that } \lambda = \frac{R \cdot \pi \cdot n}{30 \cdot v}$$

- Power coefficient  $C_P$  is to be calculated using the mathematical relationship:  $C_{P_{arb}} = a \cdot \lambda^a - b \cdot \lambda^b$ .

In the case of VAWT, in the above relationships we make use of the following coefficients:  $a=2$ ,  $a=0.11666$ , respectively  $\beta=3.5$ ,  $b=0.01283$ .

-Wind turbine shaft power is calculated according to the following relationship:

$$P_{arb} = C_P \cdot \rho \cdot \frac{v^3}{2} \cdot S$$

As far as VAWD is concerned, we calculate the swept area by making use of the following relationship  $S = D \cdot H$ , where  $D = 2.5\text{m}$  and  $H = 3\text{m}$ . Capping of the turbine shaft power at  $P_{arb}=3,500\text{W}$  was considered

Following the above calculation algorithm, the parameters were subjected to recalculation in the following order  $P_{arb} = 3,500 \rightarrow C_P \rightarrow \lambda \rightarrow n$ , using the following calculation equation for Power coefficient  $C_P$ , namely  $C_P = \frac{P_{arb}}{\rho \cdot \frac{v^3}{2} \cdot S}$ ,

Characteristic number  $\lambda$  was calculated from the graph  $C_{P_{arb}} = f(\lambda)$  by using the graphical method (for each  $C_P$  calculated, the correspondence of the characteristic number  $\lambda$  was determined by reading the graph).

Wind turbine rotational speed  $n$  for turbine shaft power levels  $P_{arb} > 3,500$  was calculated based on  $\lambda$  which was determined from the graph using the mathematical relationship:  $n = \frac{30 \cdot \lambda \cdot v}{\pi \cdot R}$

The calculation algorithm for the power curve parameters for the HAWT is described below. The parameters of the power curves, which are conceived according to wind speed  $v = 3 \dots 19 \text{ m / s}$ , tip speed  $u$ , air density  $\rho$ , and exposed area  $S$ , shaped in the unitary power formula of turbine shaft power as follows:

$$P_{arb} = C_P \cdot \rho \cdot \frac{v^3}{2} \cdot S$$

Where:

- Wind speed  $v$  is considered within the range  $v = 3 \dots 19 \text{ m / s}$  for all values in that range,

- Wind turbine rotational speed  $n$ , for each table the speed was set constant for different calculation levels ( $n = 50, 100$ , etc.),

- Characteristic number  $\lambda$ , where  $\lambda = \frac{u}{v} = \frac{R \cdot \omega}{v}$ ,  $\omega = \frac{\pi \cdot n}{30}$  it results that

$$\lambda = \frac{R \cdot \pi \cdot n}{30 \cdot v}$$

- Power coefficient  $C_P$  is to be calculated with the relationship

$$C_{P_{arb}} = a \cdot \lambda^\alpha - b \cdot \lambda^\beta$$

In the case of HAWT, we use the following coefficients:  $\alpha = 2$ ,  $a = 0.2255$ ,  $\beta = 3.5$ ,  $b = 0.024805$

- HAWT shaft power  $P_{arb}$  is to be calculated using the following mathematical relationship:  $P_{arb} = C_P \cdot \rho \cdot \frac{v^3}{2} \cdot S$  where the swept area  $S$  is determined using the equation  $S = \frac{\pi \cdot D^2}{4}$ , where  $D = 3.1m$ ; capping of the turbine shaft power at  $P_{arb}=3,500W$  was considered.

Following the algorithm above, the parameters were recalculated in the following order  $P_{arb} = 3500 \rightarrow C_P \rightarrow \lambda \rightarrow n$ , using the following calculation formulas: Power coefficient  $C_P$  is

$$C_P = \frac{P_{arb}}{\rho \cdot \frac{v^3}{2} \cdot S},$$

Characteristic number  $\lambda$  was calculated from the graph  $C_{P_{arb}} = f(\lambda)$  using the graphical method (for each calculated  $C_P$ , the correspondence of the characteristic number  $\lambda$  was determined by reading the graph).

Wind turbine rotational speed  $n$  for shaft power values  $P_{arb} > 3,500$  was calculated as a function of  $\lambda$  established from the graph using the following relationship:  $n = \frac{30 \cdot \lambda \cdot v}{\pi \cdot R}$ .

For the indicative calculation of the energy generated  $E$  [kWh / m<sup>2</sup> / year] =  $2.5 v^3$  [m/s] ( $v$ : average annual wind speed at turbine axis elevation); errors made in the evaluation of the average annual wind speed are of particular importance. Should the installed power at the swept area is evaluated, it results the indicator we call "equivalent hours of installed capacity utilisation". Therefore, the energy production substantially depends on the location of the turbine.

## RESULTS AND DISCUSSION

Results of  $P_{arb}$  calculation at constant rotational speeds ( $n = 50$  rpm) are presented hereunder. In the case of VAWT, for the following parameters:  $v$ ,  $\lambda$ ,  $C_P$ ,  $P_{arb}$  at  $n = 50$  rpm we obtain the values presented the table below.

Table 1

VAWT $P_{arb}$ calculation			
$v$	$\lambda$	$C_p$	$P_{arb}$
3	2.18	0.36	46.82
5	1.31	0.17	100.96
7	0.93	0.09	152.40
9	0.73	0.06	202.73
11	0.59	0.04	252.50
13	0.50	0.03	301.92
15	0.44	0.02	351.13
17	0.38	0.02	400.17
19	0.34	0.01	449.11

As for HAWT, considering the following parameters:  $v$ ,  $\lambda$ ,  $C_p$ ,  $P_{arb}$  at  $n = 50$  rpm we obtain the values presented the table below.

Table 2

HAWT $P_{arb}$ calculation			
$v$	$\lambda$	$C_p$	$P_{arb}$
3	2.71	0.84	110.75
5	1.62	0.46	279.29
7	1.16	0.26	436.64
9	0.90	0.17	589.46
11	0.74	0.11	739.93
13	0.62	0.08	888.99
15	0.54	0.06	1037.12
17	0.48	0.05	1184.62
19	0.43	0.04	1331.64

## CONCLUSIONS

Considering the values aforementioned of the  $P_{arb}$  parameter specific to the power curves of the wind turbines, the tip speeds are extremely high ranging from 40 to 130 m/s. The solutions put forward will probably lead to excessive aerodynamic noise. As these wind turbines are located near human settlements, this state of play can be annoying in terms of people's comfort. The specific masses of the rotors (kg/kW) also have large dispersion i.e. between 4 and 133 kg/kW, probably generated by some non-rigorous definitions. If compared to the statistical data, the specific indicative data are as follows:

- › *Diameter* is slightly smaller (up to 3.8 m and it is competitive);
- › *Tip speed* is much lower which is substantiated by noise protection;
- › *Reference mass* for the *rotor* would be 30-40 kg / kW.

By reducing the tip speed our focus shifts towards slower turbines than those currently operating on the market. One of the issues for which more careful analysis is required is the soundness of the blading suitable for such slow turbines ( $\lambda_0 = 2 \dots 3$ )

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## STUDY REGARDING THE IMPLEMENTATION OF THE MATRIX MATERIAL CALCULATION PROGRAMS IN DETERMINING THE DEFORMATIONS OF THE BENDED BEAMS

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### Abstract

*The analysis of the mechanical behavior of different wooden structures in order to determine the safety limits in their operation of wood was, is and will remain one of the reference concerns of engineers in their various fields of applicability. Regardless of the type of structure studied (beam, plate, or lattice beam), the problems are related to ensuring safety rules depending on the loads imposed on them. It was found that the application of analytical calculation methods requires increased attention and a rather laborious mathematical apparatus and also does not ensure sufficiently rigorous results. Thus, the paper tries to present the elaboration of a numerical calculation program of the displacements by the method of direct integration using the Matlab program.*

**Key words:** analytical, numerical integration, beam, deflections.

### INTRODUCTION

This paper presents a comparative analysis on determining the displacements of the main sections of a bar with a circular section (arrows and rotations) using the method of direct integration of the differential equation of equilibrium of the deformed axis applied analytically and numerically. For the analytical and numerical analysis of the displacements from the main sections of the bar, the same bar was considered having the same supports, external loads, the same cross section as shape and size. For both cases the stiffness of the bending bar is considered to be the constant  $E \cdot I = \text{const.}$

Analytically, we will start from the calculation of the binding forces, of the efforts, the dimensioning and the verification of the bar, after which the displacements and rotations of the main sections will be determined using the direct integration method (Marțian, 1999), (Fetea, 2010). The comparison was made with the same method but its application was done numerically using matrix calculus (Muntenu, 1998). Thus each static or kinematic parameter, respectively dimensional element will be written in the form of a vector or matrices with  $n \times m$  rows and columns.

The studied wooden bar has the following characteristics:

- the length of the bar is 3.0 [m];
- the beam section is circular with initially unknown diameter "D";

- the beam is considered to be embedded in the structure of a roof of a family home;
- the permissible calculation stress for oak parallel to the fibers at a humidity of 12% is,  $\sigma_{adm} = 15 \text{ [N/mm}^2\text{]}$ ;
- the longitudinal modulus of elasticity for humidity of 12% is  $E = 0.1 \cdot 10^5 \text{ [N/mm}^2\text{]}$ ;
- density of wood material (oak),  $\rho = 700 \text{ [Kg/m}^3\text{]}$ ;
- the moment of axial inertia of the section,  $I = (\pi \cdot D^4)/64 \text{ [m}^4\text{]}$ ;
- the allowable arrow was considered to be,  $L/1000 = 2 \text{ [mm]}$
- allowable rotation,  $\varphi_{adm} = 1^\circ$
- uniformly distributed load having intensity  $q = \rho \cdot g \cong 20 \text{ [kN/m]}$ .

#### MATERIAL AND METHOD

The analytical study of the considered bar presents the following calculation algorithm:

- the connecting forces in the supports were determined;
- the sectional efforts (bending moments and shear forces) from the main sections of the bar were determined;
- the most requested cross section was dimensioned starting from the resistance condition to the written bending stress in normal stresses;
- the most requested section was checked;
- using the direct integration method, the expressions of displacement and rotation were determined on the variation intervals of the bending moment (Ciofoaia E., 2001), (Ivan M., 1997);
- the maximum arrow and the maximum rotation are checked depending on the admissible arrow and the admissible rotation for the studied case;

$$\begin{aligned}\sum M_A &= 0 \\ -V_B L + q \frac{L^2}{2} &= 0 \\ V_B &= q \frac{L}{2} \\ V_B = V_A &= 20 \text{ [KN]}\end{aligned}$$

The analysis follows the classic stages of mechanical calculation of the bars, determining according to the calculation algorithm the following parameters:

The efforts in the main sections beam (Catargiu, 2001), (Missir V., 2002):

$$\begin{aligned}M_B &= M_A = 0[KNm] \\M_C &= 10[KNm]\end{aligned}$$

The shear forces in A and B sections

$$\begin{aligned}T_A &= V_A = 20[KN] \\T_B &= V_B = -20[KN]\end{aligned}$$

The dimensioning of the dangerous section will be done using the resistance condition in normal mechanical stresses (Catarig., 2001), (Ille V., 1981)

$$\begin{aligned}\sigma_{max} &= \frac{M_{max}}{W_{nec}} \leq \sigma_{adm} \\&\quad \downarrow \\D_{nec} &= 189.7[mm] \\D_{ef} &= D_{nec} + 5 = 194.7[mm]\end{aligned}$$

Checking the dangerous section of the beam in normal mechanical stresses leads to the result (Missir V., 2002):

$$\sigma_{max} = \frac{M_{max}}{W_{ef}} = 13.87\left[\frac{N}{mm^2}\right] \leq \sigma_{adm}$$

To determine the expressions of rotation and displacement along the axis of the bar, the method of direct integration of the differential equation of the deformed axis of the bar was used (Hadar A., 1998). Starting from the expression of the bending moment along the beam axis, written according to the independent parameter "x", by two successive integrations the expressions of rotation and displacements were determined. The expressions do not allow their direct determination being a function of two integration constants (Catarig., 2001), (Goia I., 2000). By imposing the conditions at the limits, the two integration constants C2 = 0 and C1 = 6.66 were determined

$$\begin{aligned}\varphi &= \frac{dv}{dx} = -\frac{1}{EI} \int \left( V_A x - q \frac{x^2}{2} \right) dx + C_1 \\v &= \frac{d\varphi}{dx} = -\frac{1}{EI} \int \left( V_A \frac{x^2}{2} - q \frac{x^3}{6} + C_1 \right) dx + C_2\end{aligned}$$

Imposing for x=0 [m] and x=2 [m] result:

$$C_1 = 6.66$$



$$C_2 = 0$$

## RESULTS AND DISCUSSION

For the case studied. a numerical calculation program was designed in Matlab, aiming to determine the same parameters as in the case of the analytical study of the beam (Muntenu Gh.,1998). The following calculation program designed by the author and named - deflectionbeamssolve -MSF was made.

```
% Name program – “Deflectionbeamssolve – MSF”
% Effort study

% L – beam length [m]

% q - uniformly distributed load intensity [KN/m^2]
% VA, VB - forces
% R, mechanical resulting force of uniformly distributed force

% Vadm, allowable displacement[mm]

Sigmaadm=15

L=0:.2:2
Vadm=(L(1,11)*10^3)./1000
q=20
% Determination of sectional efforts

% Shear forces - TA, TB

R=20*L(1,11)
VA=R./2
VB=VA
TA=VA
TB=-VB
syms T(x)
T(x) = VA-q*x
sol = vpasolve(T)
for x=L(1,6)
    T(x)
end
TC=T(x)
T=[TA TC TB]
% Bending moments
% MA, MB, MC –bending moments
MA=0
```

```

MB=0
syms M(x)
M(x)=VA*x-(q*x^2)/2
solMx = vpasolve(M)

for x=L(1,6)
    M(x)
end
MC=M(x)
% Analysis of the mechanical strength condition

Sigmaadm=15
syms x
g(x)=x-((32*MC*10^6)/(pi*Sigmaadm))^(1/3)
solgx=vpasolve(g)
Dnec=solgx
Def=Dnec+5
M=[MA MC MB]
% Mechanical determination of the diameter of the dangerous section.

Sigmaadm=15

% “ Sigmaadm” Admissible mechanical stress in [N/mm^2]
% Def - the effective diameter of the dangerous section

% Verification of dangerous section

% W - the effective mechanical resistance module of dangerous section
Wef = (pi*Def^3)/32
Sigmamax = (MC*(10^6))/Wef
% Check the mechanical stress allowed by 15 [N/mm^2]

% Beam stiffness calculation

% E – Young’s modulus [daN/cm^2]
% I - moment of axial inertia [mm^4]

E=0.1*10^5
I=(pi*Def^4)/64
syms rot(x)
ode=diff(rot,x) == -(VA*x-(q*x^2)/2)
rotSol(x) = dsolve(ode)
x=0:.2:2
rot=6.66 + (10*x.^2.*(x - 3))./3

```

```

plot(x,rot)
% Mechanical check of rotation in the middle of the beam opening= 0
for x=1
    rotSol(x)
end
C1=6.66
% Determining the equation of displacement by integrating the first
derivative of the rotation, respectively the second derivative of the bending
moment.
syms v(x)

ode=diff(v,x) == C1 + (10*x^2*(x - 3))/3
vSol(x) = dsolve(ode)
x=0:.2:2
v=((5*x.^4)/6 - (10*x.^3)/3 + x.*C1 + C2)
plot(x,v)

for x=2
    for C1=6.66
        vSol(x)
    end
end
C2=0
% Determining the displacement equation by integrating the second order
differential equation of the deformed axis and imposing boundary
conditions on the ends of the bar for x = 0 and x = 2
syms v(x)
Dv = diff(v);
ode = diff(v,x,2) == -(VA*x-(q*x^2)/2)
cond1 = v(0) == 0;
cond2 = v(2) == 0;
conds = [cond1 cond2];
vSol(x) = dsolve(ode,conds)
vSol = simplify(vSol)
for C1=6.66
    for C2=0
        vSol(x)
    end
end
end
for x=1000
    (vSol(x)/(E*I))
end

```

```

% Mechanical determination of maximum rotation
rotation= C1 + (10*x^2*(x - 3))/3
for x=2000
    rotation/(E*I)
end
f1=rotation/(E*I)
% maximum rotation in degrees
maximumrotation=f1*360/(2*pi)

% Check the maximum rotation being 1 degree!

```

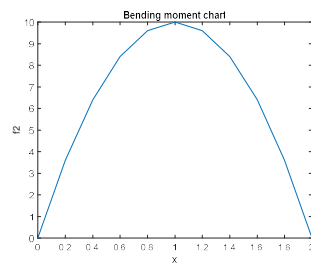


Fig.1.Bending moment chart

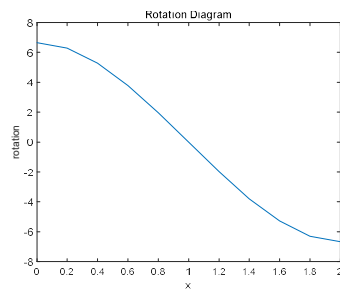


Fig. 2. Rotation diagram along the x-axis

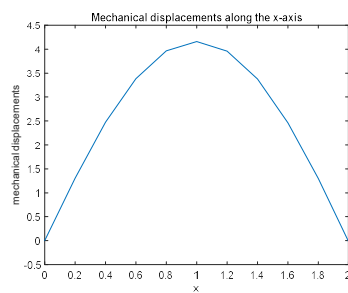


Fig. 3. Mechanical displacements along the x-axis

## CONCLUSIONS

The conclusions that can be drawn from this comparative study are the following:

1. The elaboration of this program by the author represents an element of novelty, which allows solving any problem of static calculation of wooden beams, regardless of the external forces acting, the type of wood material, its mechanical-physical characteristics. The problem is easy to solve just by changing the values in the program. This feature will make the work of any engineer easier, being necessary to apply only the calculation program used.
2. As a conclusion, the „smart program” use to solve the deflections beams problem can be use in the light wood construction fields because will reduce significantly the time necessary to determine the correct values for the dimensioning of the section, its verification, the determination of the maximum displacements and rotations or in any section of the bar.
3. The practical implementation of numerical calculation methods is certainly in the future the only viable methods in quickly and accurately solving computational problems in engineering.

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## **PHENOLOGICAL ANOMALIES OBSERVED AT THE BIRDS (VERTEBRATA: AVES) FROM DIFFERENT PARTS OF ROMANIA**

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### **Abstract**

*The paper presents the researches regarding the phenological anomalies observed at the birds from different parts of Romania, during 2015-2020. These anomalies were observed at 42 bird species belonging to 35 generations. The majority of these data are not mentioned in the scientific literature.*

**Key words:** phenological, anomalies, birds, Romania.

### **INTRODUCTION**

The big migrations, the presence of the bird species in nature have always been pursued by both researchers and nature lovers. These anomalies have been observed over time, but, most of the times, they have only been observations, sporadic occurrences.

Recent climatic changes consequences of global warming, have led to an accentuation of these anomalies being able to estimate that if these climatic changes will continue or increase, these anomalies can become processes or phenomena common in nature.

In Romania, data about phenological anomalies of birds have been published sporadically in different articles or specialized books (Ilie 2016, 2016a, 2016b, 2017, 2017a, 2018, 2018a, 2019; Ilie & Ilie, 2018; Ilie, Marinescu, 2019) but a synthesis paper referring exclusively to this topic has not been published so far thus being a national premiere.

### **MATERIAL AND METHOD**

The researches were carried out in different areas of Romania between the years 2015 -2020, during January- December. Some of these observations were made sporadically, spontaneously as they were not the strictly objective of these trips. The observations were made with the help of a 8 X 25 and 20 X 50 binoculars, being supplemented with direct observations. For the identification of species there were used different guides of SOR (1999, 2017).

## RESULTS AND DISCUSSION

During 2015-2020 have been observed phenological anomalies of birds to the following species:

- *Pelecanus onocrotalus* Linnaeus, 1758 - one specimen on Rogoaze lake, Râpa (BH), January 10, 2016; six specimens, Tinca (BH), Crișul Negru river, November 19, 2016; one specimen, Tinca (BH), Crișul Negru river, November 23, 2016; one specimen, Rogoaze lake (BH), February 2, 2019. Summer visitor, rarely in winter at national level.
- *Ardeola ralloides* Scopoli, 1769 - one specimen, Tinca spa (BH), near Crișul Negru river, December 15, 2015,  $t = 150^{\circ}\text{C}$ . Summer visitor in Romania.
- *Ciconia nigra* Linnaeus, 1758 - one specimen, Râpa (BH), January 19, 2017. Summer visitor or passage species in Romania.
- *Cygnus cygnus* Linnaeus, 1758 - seven specimens, Miersig (BH), April 15, 2019. Winter visitor in Romania.
- *Falco vespertinus* Linnaeus, 1758 - two male specimens, Oradea (BH), near airport, February 3, 2015. It is a surprising appearance of this species, because is summer visitor at national level.
- *Falco columbarius* Linnaeus, 1758 - one male specimen, Sinaia (PH), September 14, 2018; one male specimen, Tinca (BH), September 4, 2019. Very early presences, winter visitor in Romania.
- *Buteo rufinus* Cretzschmar, 1829 - two specimens, Tinca (BH), near Crișul Negru river, January 11, 2017; three specimens, Tinca (BH), February 8 and 14, 2017; one specimen, Cheșa (BH), November 12, 2017. Summer visitor in Romania.
- *Circus macrourus* Gmelin, 1776 - one male specimen, Tinca (BH), February 11, 2017. Passage species in Romania.
- *Recurvirostra avosetta* Linnaeus, 1758 - one specimen, Tinca (BH), December 21, 2016; one specimen, Tinca (BH), Crișul Negru river, January 11, 2017.
- *Charadrius dubius* Scopoli, 1786 - one specimen, Tinca (BH), Crișul Negru river, January 9, 2017. Summer visitor or passage species at national level.
- *Himantopus himantopus* Linnaeus, 1758 - two male specimens, Tinca (BH), Crișul Negru river, January 25, 2017. Summer visitor or passage species in Romania.
- *Gelochelidon nilotica* Gmelin, 1789 - one specimen, Tinca (BH), December 27, 2016; one specimen, Gurbediu (BH), December 30, 2016. Summer visitor or passage species in Romania.
- *Apus apus* Linnaeus, 1758 - ten specimens, Tinca (BH), November 3, 2016; two specimens, Cheșa (BH), November 19, 2017; five specimens,

Cheşa (BH), December 14, 2017; twenty specimens, Râpa (BH), February 16, 2019; one specimen, Cheşa (BH), February 25, 2020. Summer visitor species in Romania.

- *Apus pallidus* Shelley, 1870 - one specimen, Cheşa (BH), January 24, 2018. Summer visitor at national level.

- *Apus melba* Linnaeus, 1758 - one specimen, Cheşa (BH), November 19, 2017. Summer visitor in Romania.

- *Hirundo rustica* Linnaeus, 1758 - one specimen, Tinca (BH), November 21, 2015 (probably one of the latest mentions from Romania). Summer visitor in Romania.

- *Ceryle rudis* Linnaeus, 1758 - one specimen, Râpa (BH), February 13, 2018. This is the first mention of this species in winter at national level. Accidental species, very rare in Romania, mentioned in summer at national level (Ilie, 2016).

- *Upupa epops* Linnaeus, 1758 - one specimen, Râpa (BH), February 5, 2016; one specimen (probably the same), Râpa (BH), February 9, 2016; one specimen, Cheşa (BH), March 5, 2020. Summer visitor at national level.

- *Merops apiaster* Linnaeus, 1758 - one specimen, Tinca (BH), October 17, 2016 (probably, the latest mention in Romania); four specimens, Tinca (BH), March 13, 2018. Probably this is the earliest mention of this species in Romania. Generally, the species arrives in Romania in May, being summer visitor.

- *Jynx torquilla* Linnaeus, 1758 - one specimen, Tinca (BH), near protestant church, February 18, 2015; one specimen, Tinca (BH), same place, February 27, 2019. Summer visitor in Romania.

- *Caprimulgus europaeus* Linnaeus, 1758 - one specimen, Cheşa (BH), November 1, 2018 (probably this is the latest mention of this species in Romania, being summer visitor).

- *Ficedula hypoleuca* Pallas, 1764 - one male specimen, Tinca (BH), January 3, 2017; one male specimen, Râpa (BH), January 20, 2017; one male specimen, Tinca (BH), January 25, 2017. Summer visitor or passage species in Romania.

- *Ficedula albicollis* Temminck, 1815 - one male specimen, Cheşa (BH), November 2, 2017. Summer visitor or passage species in Romania. The presence of both species of *Ficedula* genus in winter could be explained by their food: generally - insects but in autumn and in winter - little fruits.

- *Oriolus oriolus* Linnaeus, 1758 - two male specimens, Râpa (BH), February 10, 2015; two male specimens (probably the same), Râpa (BH), February 22, 2015; one male specimen, Râpa (BH), January 30, 2016; one male specimen, Râpa (BH), December 3, 2016; one male specimen, Tinca (BH), March 8, 2017; one juvenile specimen, Cheşa (BH), November 11, 2017; one male specimen, Gurbediu (BH), November 28, 2017; one



juvenile specimen, Cheşa (BH), December 11, 2017 (the latest mention in Romania); one male specimen, Belfir (BH), March 2, 2019; one male subadult specimen, Tinca (BH), January 7, 2020; one male specimen, Tinca (BH), February 6, 2020. Summer visitor in Romania.

- *Oenanthe hispanica* Linnaeus, 1758 - one male specimen (the form with black neck), Cheşa (BH), November 15, 2017. Summer visitor or accidental species in Romania.

- *Oenanthe pleshanka* Lepechin, 1770 - one male specimen, Râpa (BH), January 25, 2020. The relatively warm autumn and winter determined the observation of the species now, being summer visitor at national level.

- *Luscinia megarhynchos* Brehm, 1831 - one specimen, Cheşa (BH), November 19, 2017; one specimen, Cheşa (BH), December 7, 2017 (the latest mention of this species in Romania); two specimens, Râpa (BH), February, 13, 2018 (the earliest mention in Romania). Summer visitor in Romania.

- *Lanius collurio* Linnaeus, 1758 - one male specimen, Râpa (BH), January 14, 2015. Summer visitor in Romania.

- *Lanius senator* Linnaeus, 1758 - one specimen that threw his food into thorns: a mouse, Tinca (BH), December 2, 2016. Summer visitor or passage species in Romania.

- *Motacilla flava* Linnaeus, 1758 - one male specimen, Râpa (BH), January 12, 2016. Summer visitor in Romania.

- *Anthus trivialis* Linnaeus, 1758 - three specimens, Tinca (BH), January 13, 2019. Summer visitor or passage species in Romania.

- *Parus cyanus* Pallas, 1776 - one specimen, at the edge of Cociuba Mare forest (BH), September 26, 2019; one specimen, Râpa (BH), October 3, 2019 (probably the earliest mentions in Romania). Winter visitor, accidental species in Romania.

- *Iduna pallida* Hemprich & Ehrenberg, 1833 - one specimen, Oradea (BH), October 15, 2019 (probably the latest mention in Romania). Summer visitor in Romania.

- *Hippolais icterina* Vieillot, 1817 - one specimen, Tinca (BH), October 26, 2016. Summer visitor, this isolated specimen is probably from the northern Europe, being in migration.

- *Phylloscopus collybita* Vieillot, 1817 - one male specimen singing, Tinca forest (BH), October 6, 2018. It is surprising the song of the species at this date, probably plays a role in marking the territory.

- *Sylvia atricapilla* Linnaeus, 1758 - two male specimens, Tinca (BH), February 15, 2017; one male specimen, Cheşa (BH), December 2, 2018. Very strange presences, summer visitor in Romania.

- *Serinus serinus* Linnaeus, 1758 - one male specimen, Râpa (BH), February 26, 2019 (probably this is the earliest mention in Romania).

- Tarsiger cyanurus* Pallas, 1773 - one male specimen, Cociuba Mare (BH), October 14, 2019. Passage species or winter visitor, very rare species in Romania.
- *Plectrophenax nivalis* Linnaeus, 1758 - one male specimen, Husasău de Tinca (BH), May 12, 2018 (probably the latest mention in Romania); one female specimen, Tinca (BH), October 7, 2019 (probably the earliest mention in Romania). Winter visitor in Romania.
- *Eremophila alpestris* Linnaeus, 1758 - one male specimen, Râpa (BH), May 11, 2019; one male specimen, Belfir (BH), May 21, 2019; one male specimen, Râpa (BH), May 27, 2019. Species characteristic of the high mountain areas where it nests, in winter it migrates to the low areas (plain, hill). The presence of the species at this time in the lowlands is surprising.

## CONCLUSIONS

Following the observations regarding the phenological anomalies of the bird species from different parts of Romania during 2015 - 2020, the following were found:

- these phenological anomalies were founded at 42 bird species belonging to 35 genera.
- most of these anomalies were observed in winter at 25 bird species, many of them being summer visitors.
- there were recorded earliest and latest mentions at 16 bird species from Romania.

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## **THE ANNUAL RAINFALL REGIME IN THE AREA OF VAD-BOROD DEPRESSION**

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### **Abstract**

*The multiannual average rainfall in the Vad-Borod Depression is 723.9 mm. The lowest rainfall total was recorded in 2011, a value of only 464.6 mm/year, as a result of atmospheric circulation occurring mainly in the southeastern sector, which carried to Romania's latitudes tropical dry air masses. The highest annual rainfall total was recorded in 1980, 1083.8 mm/year. Thus, the amplitude for the period included in the study is 619.2 mm.*

*Positive rainfall deviations against the multiannual average occurred in 44% of the years included in the study, while negative deviations in 56% of the cases.*

*In the 50 years included in the study only three years (1985, 2002 and 2019) were regarded as normal in respect of the rainfall amount. The exceedingly droughty years made up 48% of the total number of years, while the exceedingly rainy years represented 40%.*

**Key words:** exceedingly droughty, exceedingly rainy, rainfall totals

### **INTRODUCTION**

Over a year, the evolution of monthly rainfall totals changes from one month to another depending directly on the interactions between the large baric centres which determine the atmospheric circulation and control the air masses and the atmospheric fronts (with the baric formations that accompany them) (Godard, Tabeaud, 1993; Măhăra, 2001; Giuliacci M., 2003; Gaceu, 2005; Dumiter, 2007; Lucchetti, 2009).

The Vad-Borod depression is under the influence of air masses coming from the west and the northwest, that is, maritime air masses.

The rainfall regime depends to a great extent on the particularities of the general atmospheric circulation over Romania and, implicitly, over the Vad-Borod Depression (Moza, 2008, 2009; Köteles, Pereș, 2011; Pereș, 2012; Pereș, Köteles, 2013, 2015).

### **MATERIAL AND METHOD**

In order to perform an as real and exact analysis as possible of the distribution in time of rainfall amounts, data recorded at the Borod weather station between 1970 and 2019 were used.

## RESULTS AND DISCUSSION

The multiannual average rainfall in the Vad-Borod Depression is 723.9 mm.

From one year to another, the rainfall totals in the Vad-Borod Depression vary on an extremely wide range. An ascending or descending evolution of rainfall against the multiannual average, considered as normal, over larger areas, is determined by the dynamics of air masses (Gaceu O., 2005; Moza A. C., 2008, 2009).

The lowest rainfall total was recorded in 2011, only 464.6 mm/year, as a result of atmospheric circulation occurring mainly in the southeastern sector, which carried to Romania's latitudes tropical dry air masses. The highest amount of rainfall was recorded in 1980, reaching a value of 1083.8 mm/year, a year with intense frontal activity caused by the high frequency of air masses coming from the west and northwest of the continent, belonging to cyclones developed on the northern dorsal of the Azores High, but also to those belonging to the mobile cyclones developed in the area of the Mediterranean Sea.

Thus, in Borod, the amplitude for the period of the study is 619.2 mm (Fig. 1).

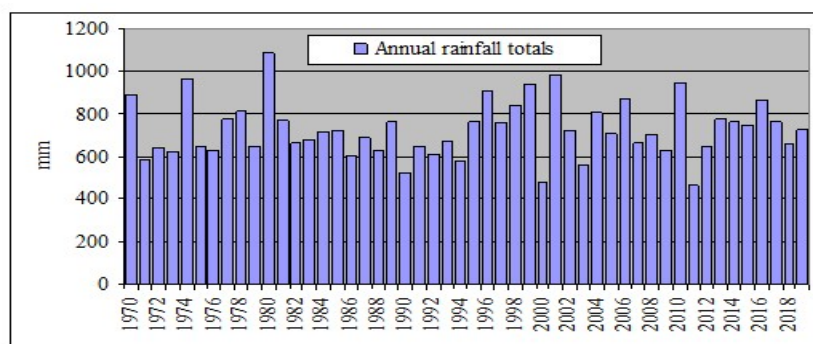


Fig. 1. Annual rainfall totals in Borod, 1970-2019

The reason of no atmospheric precipitations or of very low amounts is the prevalence of anticyclonic weather, with the high frequency of some stationary anticyclonic baric formations which develop over central, northeast or southeast Europe and which can join with the anticyclonic dorsal from the north of the Atlantic Ocean. The onset of anticyclonic weather results in clear sky, atmospherically calm, with high insolation and temperatures, especially in the warm season of the year, with no or with very little precipitations in these years (Stoica C., 1960; Ciulache S., 2002; Pereş A. C., Costea M., 2015).

Looking at the deviations of annual values from the multiannual average, it can be seen that in the period included in the study there were 22 years with positive deviations, which gives 44% of the years included in the study and 28 years with negative deviations, that is 56% of the cases (Fig. 2).

Looking at the negative and positive deviations from the multiannual average rainfall, it can be seen that the positive deviations show higher values. The highest positive deviations, in years with excess of rainfall, were recorded in 1980 (+359.9) and 2001 (+254.9). The highest negative deviations recorded the highest values in 2000 (-248.5) and 2011 (-259.3) (Fig. 2).

The lowest positive deviation occurred in 2019, 1.8 mm over the multiannual average.

The lowest negative deviation was recorded in 2002, -3.0 mm.

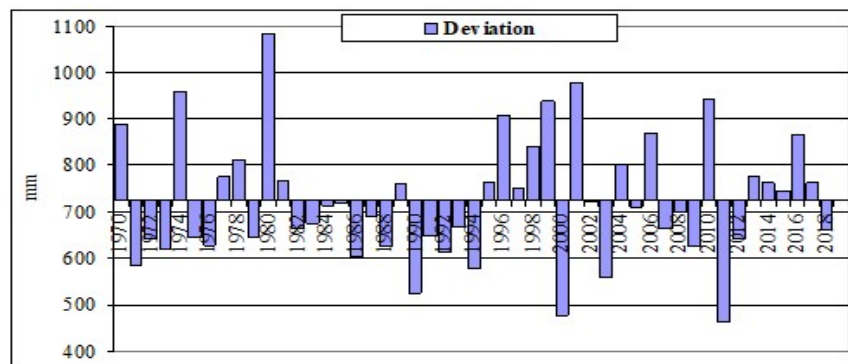


Fig. 2. Deviations of annual rainfall totals from the multiannual average in Borod, 1970-2019

By calculating the frequency of various annual rainfall totals, the probability of their occurrence could also be studied. Thus, the rainfall totals between 601-650 mm were the most frequent ones, being recorded eleven times, which makes up 22.0% of the total number of years included in the study.

The lowest frequency, and, accordingly, the lowest probability to occur, is represented by the totals between 501-550 and 1001-1500 mm/year, out of the 50 years included in the study there was only one annual year for each of these limits, which means a probability of 2.0%. There were no years with rainfall totals that fell between 401-450 mm (Table 1, Fig. 3).

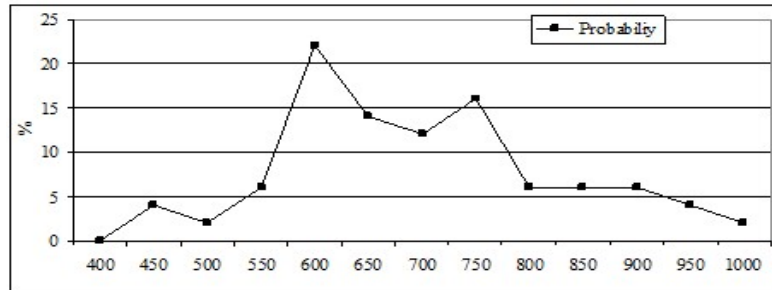


Fig. 3. The occurrence probability of various rainfall totals in Borod, 1970-2019

Table 1

The frequency of annual rainfall totals and their probabilities in Borod, 1970-2019

Rainfall totals (mm)	No. Of cases	Probability
401-450	0	0
451-500	2	4.0
501-550	1	2.0
551-600	3	6.0
601-650	11	22.0
651-700	7	14.0
701-750	6	12.0
751-800	8	16.0
801-850	3	6.0
851-900	3	6.0
901-950	3	6.0
951-1000	2	4.0
1001-1500	1	2.0
Total number of cases	50	

Source: data provided for processing by the A.N.M. Archives

In order to show the non-periodic variations of the annual rainfall totals, their deviations from the multiannual average were calculated and expressed as percentages, which made possible to establish the rainfall characteristics of the years according to the Hellman criterion (Table 2).

It can be seen from the table that in the 50 years included in the study only three years (1985, 2002 and 2019) can be regarded as normal from a rainfall point of view, as well as that there was a high number of exceedingly droughty years, 48% out of the total number of years. The frequency of exceedingly rainy years was 40% (Table 2).

The high rainfall totals in the years when they occurred were the result of intense atmospheric circulation from the west, northwest and southwest of the continent.

Table 2

Rainfall characteristics of years according to the Hellman criterion in Borod, 1970-2019

Deviation against average %	Rating	No. of cases	Years
<-20	exceedingly droughty	24	1971, 1972, 1973, 1975, 1976, 1979, 1982, 1983, 1986, 1987, 1988, 1990, 1991, 1992, 1993, 1994, 2000, 2003, 2007, 2008, 2009, 2011, 2012, 2018
-20.0...-15.1	very droughty	1	2005
-15.0...-10.1	droughty	1	1984
-10.0...-5.1	moderately droughty	-	-
-5.0...+5.0	normal	3	1985, 2002, 2019
5.1...10.0	moderately rainy	0	-
10.1...15.0	rainy	0	-
15.1...20.0	very rainy	1	2015
>20.0	exceedingly rainy	20	1970, 1974, 1977, 1978, 1980, 1981, 1989, 1995, 1996, 1997, 1998, 1999, 2001, 2004, 2006, 2010, 2013, 2014, 2016, 2017

Source: data provided for processing by the A.N.M. Archives

Furthermore, the high amounts of rainfalls recorded in the area of the Vad-Borod depression can also be explained by the influence the relief, as a whole, has upon its own climate.

## CONCLUSIONS

The multiannual average rainfall is 723.9 mm. In the period included in the study, the positive and negative deviations from the multiannual average made up 44% and 56% of the years respectively.

In the 50 years included in the study only three years (1985, 2002 and 2019) were regarded as normal in respect of the rainfall amount, while the exceedingly droughty years made up 48% of the total number of years, and the exceedingly rainy ones 40%.

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