ACADEMY OF SCIENCES OF MOLDOVA
BOTANICAL GARDEN (INSTITUTE)

JOURNAL OF BOTANY

VOL. VII NR. 2(11)

Chisinau, 2015

FOUNDER OF THE "JOURNAL OF BOTANY": BOTANICAL GARDEN (INSTITUTE) OF THE ACADEMY OF SCIENCES OF MOLDOVA

According to the decision of Supreme Council for Sciences and Technological Development of ASM and National Council for Accreditation and Attestation, nr. 288 of 28.11.2013 on the approval of the assessment and Classification of scientific journals, "Journal of Botany" was granted the status of scientific publication of "B" Category.

Edition supported by the Supreme Council for Sciences and Technological Development of ASM
Botanical Garden (Institute)

MD - 2002, Padurii str. 18, Chisinau, Republic of Moldova
tel./fax.: (+373 22) 52-35-89; 55-04-43
www.gradinabotanica.asm.md
e-mail: cancelarie.gb@asm.md

CONTENTS

IV. Landscape architecture

I. STRUCTURAL AND FUNCTIONAL DIVERSITY OF PLANT ORGANISMS

GENETIC TRAITS IN PINUS PALLASIANA D.DON TREES WITH DIFFERENCES IN RADIAL GROWTH IN THE PLANTATIONS OF SOUTH-EAST OF UKRAINE

Bagdasarova A.R.[1], Korshikov I.I.[2], Privalikhin S.N.[1,2], Kalafat L.O. [1], Pirko Ya.V.[1]

1. Institute of Food Biotechnology and Genomics NAS of Ukraine, Osipovskogo str.2A, 04123, Kyiv, Ukraine

[2.] Donetsk Botanical Garden of NAS of Ukraine, Pobedy str., 8, 85100, Konstantinovka, Ukraine

Abstract. Using 15 isozyme loci, analysis of 220 trees of Pinus pallasiana D.Don with different radial growth rates (stem diameters) aged 9 to 40 years was performed. The deficit of heterozygous genotypes (5.7 – 32.1%) was found for all of the studied trees samples. The tendency of increasing the level of multilocus heterozygosity in groups of older age trees (40 years) and the larger stem diameter in comparison to smaller stem diameter trees was observed. This tendency was also observed in the analysis of individual loci (namely Got-1, Mdh-2, Mdh-3). Nei's genetic distances coefficient (DN) between groups of trees with larger and smaller stem diameter was insignificant and ranged from 0.003 to 0.008.

INTRODUCTION

Productivity is the most valuable feature of the stand quality. Therefore, management of plantations is carried out to increase the intensity of growth of the most high grade trees (Koba, 2009). In pine stands tending felling is carried out in phases, starting from the age of young trees (20 years), when fast and slow-growing trees become evident in the stand, and ending at the age of 70-80-years (Koba, 2009). Slow-growing trees are usually to be eliminated in the events on clearing of stands.

The role of the genetic component in the productivity of plantations and individual trees has not been fully elucidated yet (Novikov, Sheykina, 2012). The situation is more difficult with variability of many economically important quantitative traits, as it may have adaptive value (Ivanovskaya, 2012). According to some researchers, adaptive and neutral variability exists in the populations and both of its types should be considered in preserving genetic resources of species (Ledig, 1988; Geburek, Turok, 2005; Eriksson et al., 2006; Ivanovskaya, 2012).

However, not knowing how to organize complex economic and important features and properties of the plants is almost impossible to create an adequate tool of genetic analysis (Kochergina, 2009). One set of approaches and methods for genetic analysis that exists today, does not always reflect the real situation. However, the link between molecular and phenotypic variation of several economically important quantitative traits is often complex (Szulkin et al., 2010; Chhatre et al., 2013; Koralewski et al., 2014).

In population genetics of conifers, the isoenzymes are often used as molecular genetic markers up to the present time, despite the rapid development of DNA technology (Geburek, Turok, 2005; Politov, 2007; Korshikov, Privalikhin 2007; Korshikov et al. 2007; Radu 2014). They have established themselves as a convenient tool for early diagnosis of the quality of timber at the stage of seedlings, it is very important for forest species characterized by long periods of cultivation (Zhigunov, 2013). Therefore, the search for the relationship between the nature of variability of molecular genetic markers (isoenzymes) and the parameters of growth of the stem, as well as the quality of wood is one of the priorities of forestry.

The aim of this study was to reveal the genetic characteristics of trees of *Pinus pallasiana* D. Don, which differ in terms of growth rates using isozymes as molecular genetic markers.

The following tasks were set to achieve the objective:

1. To identify the relationship of the level of observed heterozygosity *P. pallasiana* trees from plantations of south-east of Ukraine with variability of the stem diameter.

2. To identify loci that can be used as genetic markers to assess the intensity of the radial growth of *P. pallasiana* trees.

MATERIAL AND METHODS

An analysis for 220 trees of *Pinus pallasiana* D.Don aged 9-40 years was carried out. Material for the study was collected in the Donetsk Botanical Garden of NAS of Ukraine (DBG), as well as in Petrovskoe, Amvrosievskoe and Shakhterskoe forestries. The diameter of each tree was measured at the height of 1.3 m. In the course of data processing the trees were grouped depending on the stem diameter: the first group – the trees with a smaller diameter, the second group – with a larger diameter (Table 1).

To determine the genetic characteristics of selected groups of *P. pallasiana* trees isozymes of 7 enzyme systems were used as markers: glutamate dehydrogenase (GDH, E.C. 1.4.1.2), acid phosphatase (ACP, E. C. 3.1.3.2), glutamate oxaloacetate transaminase (GOT, E.C. 2.6.1.1.), superoxide dismutase (SOD, E.C. 1.15.1.1), malate dehydrogenase (MDH, E.C. 1.1.1.37), leucine aminopeptidase (LAP, E.C. 3.4.11.1) and formiat dehydrogenase (FDH, E. C. 1.2.1.2).

Vegetative buds collected from individual trees in the dormant period were used for electrophoretic studies of isoenzymes. To isolate the enzyme tissue of bud was homogenized in 100 ul of extraction buffer prepared by earlier proposed method (Molotkov, 1982) with some modifications. Electrophoretic separation of isoenzymes and subsequent histochemical staining of gels were performed by standard procedure (Davis, 1964). Allele and loci nomenclature followed Prakash and co-authors (Prakash et al., 1969). Statistical analysis was performed using the software package GenAlex (Peakall, 2006).

RESULTS AND DISCUSSIONS

15 isozyme loci were used in the analysis of genetic polymorphism of *P. pallasiana* trees. Of these, four loci of superoxide dismutase (Sod-1, Sod-2, Sod-3 and Sod-4) were monomorphic for all investigated trees. Locus Fdh for the trees in the plantation of Shakhterskoe forestry was low-polymorphic, while it was monomorphic for all other studied plants. Null alleles have been found for DBG planting at loci Got-3 and Acp-2. Such alleles are absent in other samples. It is known that rare alleles may influence the growth of plants (Blumenröther et al., 2001). In our case, nevertheless, the trees with rare alleles had no differences in growth from other trees in a sample.

It should be noted that the loci Got-1, Gdh and Lap-2 for individual trees in the studied stands were low-polymorphic or monomorphic, meanwhile for a locus Lap-1 low polymorphism is observed in the plantations of Amvrosievskoe (16-year-old trees) and Shakhterskoe forestries. Locus Got-2 turned to be highly polymorphic for all investigated trees while Got-3, Mdh-2, Mdh-3, Acp-1 and Acp-2 loci were low-polymorphic.

The actual distribution of genotypes in all plantations corresponds to the theoretically expected according to the Hardy-Weinberg equilibrium, although there are deviations at some loci. Such deviations were more numerous for the trees with a smaller stem diameter than for the trees with larger diameter. Only a sample of 9-year old trees from Amvrosievskoe forestry is fully consistent with the theoretically expected distribution.

Mean observed heterozygosity (H_O) was lower than expected (H_E) heterozygosity for almost all trees, which is indicative of the evident deficit of heterozygous genotypes ranging from 8.5 to 32.1% (Table. 1). Perhaps this can be explained by the high inbreeding level of seeds used for laying of these plantations. Outstanding excess Wright's fixation index values in groups of trees with smaller stem diameter above groups of trees with a larger stem diameter are also noteworthy. Consequently, a significant excess of homozygous genotypes is typical for the first group (with smaller stem diameter).

It is known that inbreeding accelerates homozygosity level by main genes, which in its turn may reduce adaptability in the expression of deleterious partially recessive alleles and loss of heterozygosity (Hansson B., Westerberg L., 2002). The correlation between the growth rate and heterozygosity should be apparent only among the inbred progeny. This is because of the fact that crossbred trees are likely to have small amount of harmful recessive alleles (Robin, 1987).

Table 1 Values of the main characteristics of genetic polymorphism in plant samples Pinus pallasiana D. Don, differing in growth rate in plantations from the south-east of Ukraine

Group	Percentage of polymorphic loci, P_{99}	Mean number of alleles per locus, A Expected, H_E	Mean heterozygosity, Mm		Wright`s fixation index, F
			Observed, H_O		
Shakhterskoe forestry 40 years					
1	0.667	1.800	0.169±0.050	0.131±0.044	0.225
2	0.733	1.800	0.196±0.048	0.145±0.040	0.260
Whole of the stand	0.733	1.867	0.184±0.049	0.137±0.041	0.255
Amvrosievskoe forestry 16 years					
1	0.533	1.800	0.113± 0.039	0.084± 0.034	0.257
2	0.600	1.733	0.144± 0.044	0.119± 0.036	0.174
Whole of the stand	0.600	1.867	0.131±0.041	0.103±0.034	0.214
Petrovskoe forestry 16 years					
1	0.467	1.600	0.153±0.051	0.106±0.042	0.307
2	0.467	1.533	0.134±0.047	0.113±0.045	0.157
Whole of the stand	0.467	1.667	0.144±0.048	0.110±0.043	0.236
Amvrosievskoe forestry 9 years					
1	0.533	1.733	0.153±0.047	0.140±0.041	0.085
2	0.400	1.533	0.109±0.043	0.119±0.047	-0.092
Whole of the stand	0.533	1.800	0.141±0.045	0.133±0.042	0.057
DBG 9 years					
1	0.533	1.733	0.137±0.044	0.093±0.036	0.321
2	0.400	1.467	0.108±0.041	0.079±0.040	0.269
Whole of the stand	0.571	1.733	0.129±0.043	0.087±0.037	0.326
Group 1					
	0.733	2.400	0.152±0.045	0.111±0.0333	0.270
Group 2					
	0.733	2.333	0.153±0.043	0.119±0.038	0.222

Footnote. 1. – group of trees with small stem diameter 2. – group of trees with large stem diameter

It should be noted that a slight excess of heterozygotes (9.2%) is detected for the group of trees with larger diameter (Group 2) from plantation in Amvrosievskoe forestry (9-year-old trees). A tendency to higher heterozygosity is observed in more mature trees (aged 16 and 40) with a larger diameter (Group 2) compared to the smaller diameter trees (group 1). For younger trees the trend is the contrary, as evidenced by the published data. For example, F. Ledig indicated that the heterozygosity-growth ratio changes from strongly positive (for old plants) to negative (for the young ones) (Ledig, 1983). Also, the degree of influence of heterozygosity on plant growth is strongly dependent on age.

In general, an increase in the level of heterozygosity with age, characteristic of most species of conifers, is related to elimination of inbred progenies and balancing selection toward heterozygotes, which is a key factor in maintaining population polymorphism (Belokon M. et al. 2010).

There have been several studies on genetic differences among trees with different parameters of growth and productivity. Novikov et al. analyzed (using 6 ISSR-primers at 178 loci) the variability of *Pinus sylvestris* L. individuals of different breeding grades in the plus stands of educational-experimental forestry in the Republic of Mari El (Novikov, Sheykina, 2012). Total of 88 trees was analyzed. Their findings showed that plus trees differed in genetic distance from minus (Nei's genetic distance 0.0824) and normal (Nei's genetic distance 0.0520) ones. However, no specific DNA fragments for each category

of individuals in tree breeding were found. Blumenröther et al. (2001) investigated a correlation between genetic characteristics and growth parameters of 47-year-old trees of *Pinus sylvestris* L. in Germany at 16 gene loci using horizontal starch gel electrophoresis (Blumenröther et al., 2001). The authors found differences in average observed heterozygosity between the high-grade and ordinary Scots pine trees and also noted the impact of heterozygosity at 6-PGDH and MDH-C loci on the stem diameter.

Despite the trend towards an increase of heterozygosity in mature trees of *P. pallasiana* with large stem diameter, no significant differences in the level of heterozygosity between trees with different diameters have been detected. According to previously published data, the trend in the change of heterozygosity in trees with larger and smaller stem diameter may vary depending on the particular enzyme locus (Kartavtsev and Zhdanova, 2012). Therefore, we investigated differences in heterozygosity among sampled groups of trees for specific enzyme loci (Table 2).

Table 2 Mean observed heterozygosity of 11 polymorphic loci in plants *Pinus pallasiana* D. Don. differing in growth rates in plantations from South-East of Ukraine

Locus	Heterozygosity									
	Shakhterskoe forestry (40 years)		Amvrosievskoe forestry (16 years)		Petrovskoe forestry (16 years)		Amvrosievskoe forestry (9 years)		DBG (9 years)	
Group	1	2	1	2	1	2	1	2	1	2
Sample size	27	23	27	33	22	30	20	9	18	11
Got-1	0.000	0.043	0.074	0.212	0.045	0.067	0.000	0.000	0.167	0.091
Got-2	0.333	0.304	0.481	0.424	0.500	0.567	0.400	0.444	0.444	0.364
Got-3	0.185	0.217	0.037	0.091	0.318	0.267	0.350	0.222	0.111	0.000
Mdh-2	0.037	0.087	0.111	0.212	0.045	0.100	0.200	0.222	0.222	0.000
Mdh-3	0.370	0.522	0.222	0.273	0.318	0.400	0.400	0.556	0.333	0.455
Acp-1	0.556	0.348	0.148	0.303	0.091	0.200	0.200	0.111	0.056	0.273
Acp-2	0.185	0.217	0.148	0.212	0.273	0.100	0.300	0.222	0.056	0.000
Gdh	0.037	0.043	0.037	0.030	0.000	0.000	0.050	0.000	0.000	0.000
Fdh	0.148	0.217	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lap-1	0.074	0.130	0.000	0.030	0.000	0.000	0.000	0.000	0.000	0.000
Lap-2	0.037	0.043	0.000	0.000	0.000	0.000	0.200	0.000	0.000	0.000

As far as more mature trees are concerned, heterozygosity at Got-1 and Mdh-2 loci was higher for large diameter trees (exclusion DBG) compared to the smaller diameter ones. For a sample of trees from Shakhterskoe forestry, we did not found heterozygotes at Got-1 locus in a group of trees with small diameter. For trees with a large diameter from Amvrosievskoe and Petrovskoe forestries, heterozygosities at locus Got-1 were more than 2.9 times and 1.5 times higher compared to smaller diameter trees. As far as plantations of Shakhterskoe, Amvrosievskoe and Petrovskoe forestries are concerned, heterozygosities at Mdh-2 locus were 1.9; 2.2 and 2.4 times higher for the groups of trees with larger diameters than for the group with smaller diameters.

In the overall sample of trees, heterozygosities were 2 times (Got-1), 2.1 times (Lap-1) and 1.2 times (Mdh-3) higher for tree groups with a large stem diameter (Table 3). Heterozygosity at Lap-2 locus was 4.9 times greater in trees with a smaller stem diameter than for a large diameter trees. This may be explained by the fact that loci Lap-1 and Lap-2 were polymorphic only in some plantings that may lead to misunderstanding of the relationship between heterozygosity at these loci and growth parameters.

Table 3 Mean observed heterozygosity of 11 polymorphic loci in combined sample of plants *Pinus pallasiana* D. Don. differing in growth rates in plantations of South-East of Ukraine

Locus	Observed heterozygosity		
	Group 1	Group 2	In the whole for combined sample
Gdh	0.026	0.019	0.023
Got-1	0.053	0.104	0.077

Got-2	0.430	0.434	0.432
Got-3	0.193	0.170	0.182
Mdh-2	0.114	0.132	0.123
Mdh-3	0.325	0.406	0.364
Acp-1	0.228	0.264	0.245
Acp-2	0.193	0.160	0.177
Lap-1	0.018	0.038	0.027
Lap-2	0.044	0.009	0.027
Fdh	0.035	0.047	0.041

Small differences (in 1.2–1.4 times) are revealed in the observed heterozygosity at Mdh-3 locus between large and small diameter trees in all stands (see Table 3). In this regard, a more detailed study is required on the possibility of using this locus as a marker to evaluate the growth rate of *P. pallasiana*.

Nei's genetic distances coefficient (DN) among cohorts of trees with large and small diameters of the trunk in each of the plantings ranged from 0.003 to 0.008 that indicates insignificant differences in the genetic structure of trees differing in diameter of the stem.

CONCLUSIONS

Thus, the use of such a parameter as mean observed heterozygosity as a marker in selection of the best tree growth is rather difficult, due to the fact that the heterozygosity-stem diameter dependence directly correlates with the age of trees, among which a selection is performed. For this purpose it is better to apply the average observed heterozygosity at individual loci. There is a need in a detailed study of applicability of Mdh-3 enzyme locus as a marker locus to assess the intensity of stem diameter growth of *P. pallasiana*.

BIBLIOGRAPHY

1. Belokon M.M., Belokon Yu.S., Politov D.V. Mating system and allozyme heterozygosity dynamics in dwarf Siberian pine, Pinus pumila (Pall.) Regel, populations // Conifers of the Boreal Area. – 2010. – V. XXVII, № 1–2. – P. 13–17 (in Russian).
2. Blumenröther M., Bachmann M., Müller-Starck G. Genetic characters and diameter growth of provenances of Scots pine (*Pinus sylvestris* L.) // Silvae Genetica. – 2001. – V. 50, № 5–6. – P. 212–222.
3. Chhatre V. E., Byram T. D., Neale D. B., Wegrzyn J. L., Krutovsky K. V. Genetic structure and association mapping of adaptive and selective traits in the east Texas loblolly pine (*Pinus taeda* L.) breeding populations // Tree Genetics & Genomes. – 2013. – V. 9, № 5. – P. 1161–1178.
4. Davis B.J. Disk electroforesis. II. Methods and applications to human serum proteins // Ann. N.Y. Acad. Sci. – 1964. – V. 121. – P. 67–75.
5. Eriksson G., Ekberg I., Clapham D. An introduction to forest genetics // Swedish University of Agricultural Sciences (SLU). – 2006. – Uppsala. Sweden. – 186 p.
6. Geburek, T., Turok J. (eds). Conservation and management of forest genetic resources in Europe. Zvolen: Arbora Publishers. –2005. – 693 p.
7. Hansson B., Westerberg L. On the correlation between heterozygosity and fitness in natural populations // Molecular Ecology. – 2002. – V. 11. – P. 2467–2474.
8. Ivanovskaya S.I. The genetic potential of pines plantations Polessky forest seed region based on molecular genetic analysis // Proceedings BSTU. Forestry. – 2012. – № 1. – P. 68–171(in Russian).
9. Jelinski D.E. Associations between environmental heterogeneity, heterozygosity, and growth rates of *Populus tremuloides* in a Cordilleran landscape // Arctic and Alpine Research. – 1993. – V. 25. – *P*. – 183–188.
10. Kartavtsev Y.Ph., Zhdanova O.L. Numerical simulations of the heterozygosity and quantitative trait relationship: intralocus interactions and multiple-locus averaging // Biological and Biomedical Reports. – 2012. – V. 2, № 5. – P. 301–314.
11. Koba V.P. Bioproductivity and ecological potential of natural populations of species of *Pinus* L. sorts // Scientific Notes

of TNU. Series: Biology, chemistry. – 2009. – V. 22 (61), № 3. – P. 57–62 (in Russian).

12. Kochergina N.V. Ecological and genetic plant productivity improvement procedure // The thesis for the candidate biological sciences degree, specialty 03.00.15 – Genetics. – St. Petersburg. – 2009. – 120 p. (in Russian).
13. Koralewski T.E., Brooks J.E., Krutovsky K.V. Molecular evolution of drought tolerance and wood strength related candidate genes in loblolly pine (*Pinus taeda* L.) // Silvae Genetica. – 2014. – V. 63, № 1–2. – P. 59–66.
14. Korshikov I.I., Privalikhin S.N. Genetic structure of populations of Norway spruce (*Picea abies* (L.) Karst.) from Ukrainian Carpathians // Russian Journal of Genetics. – 2007. – V. 43, № 12. – P. 1364–1372.
15. Korshikov I.I., Pirko N.N., Mudrik E.A., Pirko Ya.V. Maintenance of genetic structure in progenies of marginal mountainous and steppe populations of three species of Pinaceae Lindl. family in Ukraine // Silvae Genetica. – 2007. – V. 56, № 1. – P. 1–10.
16. Ledig F.T. The conservation of diversity in forest trees // Bioscience. – 1988. – V. 38. – P. 471–479.
17. Molotkov P.I. Forest species breeding. – M: Lesnaya promyishlennost, 1982. – 221 p. (in Russian).
18. Novikov P.S. ISSR analysis of *Pinus sylvestris* trees appurtenant to different selection categories // Scientific Journal of KubSAU. – 2012. – № 82, (08). – P. 927–939. (in Russian with English abstract).
19. Peakall R, Smouse P.E. GENALEX 6: genetic analysis in Excel. Population genetic software for teaching and research // Molecular Ecology Notes. – 2006. – V. 6. – P. 288–295.
20. Politov D.V. Population genetic and pine species (family Pinaceae) evolutionary relationships on Northern Eurasia: Abstract of biological science doctor degree dissertation. – M., 2007. – 47 p. (in Russian with English abstract).
21. Prakash S., Lewontin R.C., Hubby T.L. A molecular approach to the study of genetic heterozygosity in natural populations. 4. Patterns of genetic variation in central, marginal and isolated populations of *Drosophila pseudoobscura* // Genetics (USA). – 1969. – V. 61. – P. 841–858.
22. Radu Gh.R., Curtu Al.L., Spârchez Gh., **Şofletea** N. Genetic diversity of Norway spruce (*Picea abies* (L.) Karst.) in Romanian Carpathians // Ann. For. Res. – 2014. – V. 57, № 1. – P. 19–29.
23. Szulkin M., Bierne N., David P. Heterozygosity-fitness correlations: a time for reappraisal // Evolution. – 2010. – V. 64, № 5. – P. 1202–1217.
24. Tush R.**M**. The fitness consequences of multiple-locus heterozygosity: the relationship between heterozygosity and growth rate in Pitch pine (*Pinus rigida* Mill.) // Evolution. – 1987. – V. 41, № 4. – P. 787–798.
25. Zhigunov A.V. Application of biotechnology in forestry Russia // Lesnoy Zhurnal. – 2013. – № 2. – P. 27–35 (in Russian).

MACROSCOPILCALLY AND MICROSCOPICALLY STUDY OF ASWAGANDHA PLANT WITHANIA SOMNIFERA (L.) DUNAL

Calalb T.[1], Ciorchina N.[2], Cutcovschi-Mustuc A.[2], Matveiciuc L.[1],

[1]State University of Medicine and Pharmacy "NicolaeTestemitanu"

[2]Botany Garden (Institute) of Academy of Science of Moldova

Abstract: The study of morphology and anatomy of Withania somnifera (L.) Dunal plants, obtained by biotechnology in vitro, and grown in the conditions of the Republic of Moldova were investigated. It was elucidated the morphological specific characteristics for root and herba (stems, leaves, flowers and fruits). The results of anatomical structure of the root, stem, leaf, flower and fruit of W. somnifera showed that the vascular bundles of root and stem are open, collateral and provide the secondary structure; there are the oxalate calcium as sand in the root cortex and rosette in the leaves and calyx; abundant multicellular, dendroid trichomes on stem, leaves and calyx; rarely secretory hairs on the lower epidermis of leaf; lacuna in the stem cortex and sclerenchymatic fibre pericyclic ring in the stem. Their morphological and anatomical structures have a diagnostic role in taxonomy identification and some adaptive peculiarities may be suitable for Aswagandha plant successful growth in the relative dry conditions of our region.

Keywords: Withania somnifera, macroscopy, microscopy , special features

INTRODUCTION

Withania somnifera (L.) Dunal is commonly known Aswagandha, it is Indian Ginseng and it is member of family Solanaceae. The genus *Withania* is reported to have 23 species out of which, *W.somnifera* is of high medicinal value [6,7]. *W.somnifera* is cosmopolitan and grows throughout the drier parts and subtropical regions. The wild growth of this species has also been reported from India, Pakistan, Afghanistan, Philistine, Egypt, Jordan, Morocco, Sri Lanka, Spain, Canary Island, Eastern Africa, Congo, Madagascarand South Africa on the areas with wide variations of soil, rainfall, temperature and altitude [3].

The aim of present paper is to study the morphological and anatomical (types and distribution of stomata, trichomes, oxalate crystals and vascular bundles; type of fundamental and mechanical tissiues) features of *W.somnifera* root, stem, leaf, flower and fruit and elucidate those which could be utilized to identify with precise the vegetables drugs derived from *W.somnifera*.

MATERIAL AND METHOD

The plants used for morphological and anatomical investigations were obtained in *Embryology and Biotechnology Laboratory of Botany Garden of Academy of Science of Moldova* by *in vitro* micropropagation [1], after that were planted in open field and adapted under the climate of the Republic of Moldova. The morphological description of root, stem, leaf and fruit was provided on the complex of morphological feathers.

For microscopically analyse the required sample of root, stem, leaf and fruit were cut and cleared in chloral hydrate. The sections (stained for cellulose, lignin, fatty globules and starch grains) and surface preparations obtained by classical method were analysed in microscope *Micros* (Austria) connected with soft computer.

RESULTS AND DISCUSSIONS

The native centre of Aswagandha plant is India with special climate conditions, which differ of those from the Republic of Moldova. The plants used for analyses were obtained by biotechnology *in vitro* and adapted to open field. These served the support to provide macro- and microscopical study of aswagandha plants.

The macroscopical exam provides analysis (morphological type, form, surface relief, colour, odour, taste) on entire or fragmented plant organs with the naked eye or through a magnifying glass.

Withaniae root. Fragmented vegetable drug consists from root specimens of 5-6 cm in length and 1,0 to 2,5 cm in diameter. Outer surface is gray yellow with longitudinal wrinkles. The dried roots are

cylindrical, gradually tapering down with a brownish white surface and pure creamy white inside when broken. They have a short and uneven fracture. Odour, characteristic; mucilaginous bitter and acrid taste.

Withaniae herba. This vegetable drug includes fragmented stems, fragmented and entire leaves, separated flower or cymose inflorescenses, fragmented and entire fruits. Specimens of stem are cylindrical and may be branched of variously thickened, the nodes prominent only on the side from where petiole arises, cylindrical, greenwith longitudinal wrinkles. Outer surface is covered with hairs, at length somewhat glabrous. Fracture is white-yellowish, short and uneven.

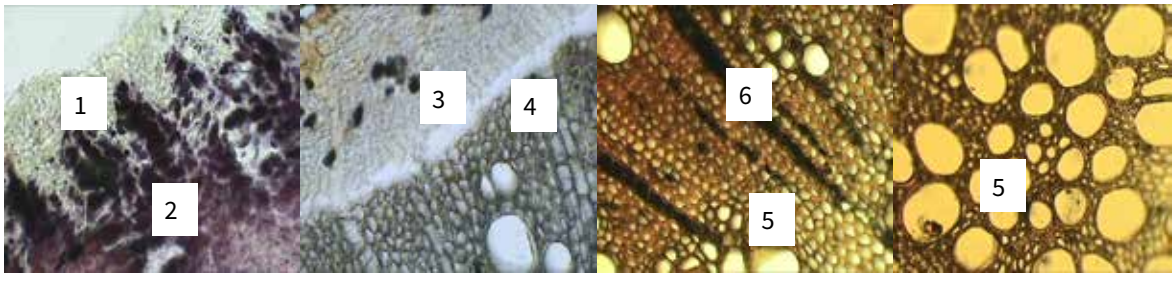
Leaves are cauline, simple, exstipulate, petiolate, ovate, acute, entireand up to 10 cm long. Petioles up to 1.2 cm long. The leaves on vegetative shoots are alternate and large while those on floral branches are opposite, rounded or somewhat produced at base, pubescent on lower surface and glabrous on upper surface unicostate, pennate-reticulate nervation. Arranged in pairs of one large and one small leaf and arranged somewhat laterally, having in their axil a cymose cluster of 5-10 small flowers.

The flower is pedicellate, complete, hermaphrodite, pentamerous, actinomorphic and hypogynous, gamosepalous, 4-6 mm in diameter, lucid-yellow or greenish. Calyx of five fused **s**epals, tubular, persistent, green, hairy. Corolla of five petals, united, tubular, gamopetalous, lobes spreading or recurved, acute, pubescent and greenish yellow. Androecium of five stamens, attached near the base of the corolla, epipetalous, anthers oblong, dehiscing longitudinally, introrsely, dithecous, filament deeply inserted in corolla tube, linear slender. Gynoecium is bicarpellary, syncarpous, composed of minute swollen superior ovary, with many ovules in each locule, style simple, stigma shortly bifid.

Fruit is a berry enclosed in the persistent gamosepalous calyx, specific and for other g. *Physalis*, also from family Solanaceae [8], 5 mm in diameter, smooth, more or less globose, green when unripe, orange-red coloured in ripening stage. Odour, characteristic; bitter and acrid.

The microscopical exam were provided on the cross sections or on the surface preparations of the Aswagandha organs.

Root. The view in section is circular with rough surfaced periderm. The principal anatomical characteristics are in figure 1. The periderm is narrow, not well defined and easily exfoliate. The cortex consists of radially compressed thin walled parenchyma cells. The specific feature is the presence of calcium oxalate sands in the cortex cells, characteristic and for other species from family Solanaceae (*Atropa belladonna, Scopolia carniolica, Nicotiana tabacum*) [3,8,10]. The secondary structure of central cylinder is characterized by two concentric rings with well shaped strip ring of cambium between them: one is outer, represented by phloem, rich in starch and another internal, much thicker from lignified wood vessels. The wood, represented by vessels of different diameter, is crossed by numerous medullar rays, frequent filled with granules of starch. The advanced histological area of vascular bundles depicting rapid absorption of water along with minerals from the soil tocompensate the rapid loss of water in the dry climate conditions [4,9]. The central part of root consists from wide wood vessels, regular in diameter and sclerenchymatic fibers.



A. B. C. D.

Fig. 1. Cross section of *Withania somnifera* root (stained with Lugol solution): A. (100x) 1 –cortex; 2 – phloem with starch; B. (100x) 3 – oxalic cells; 4 – cambium; C. (100x) 5 – xylem vessels; 6– medullar ray; D. (100x) 7 – central xylem vessels.

Stem. The view of stem in cross section is circular with shallow ridges. On the cross section (fig.2) we distinguish a thin epidermis, fairly wide cortex and the largest zone of central cylinder and wide pith. The typical secondary structure is built just by cambium activity like some species from family Lamiaceae

[6]. The epidermal cells are small, izodiametric, having a thick cuticle layer. The surface is pubescence by multicellular, brunched and dendroid trichomes with random in distribution. The trichomes are erect, consisting from wide rectangular cells in vertical plane and relative thick walled. The brunched trichome are short with corner apex. The multilcellular trichomes were present in many species of medicinal plants from family Solanaceae [3,8,10], but trichomes like dendroid [6], only for *W.somnifera*, and this feature will be distinguish to identify their vegetable drugs. The outer zone of cortex consists of several layers of clorenchim with large lacuna. The parenchyma of inner zone is interspersed by oxalic sand cells. Sclerenchymatic fibre periciclic ring is well pronounced. Vascular bundles are represented by a phloem ring (primary and secondary) and xylem in which the secondary wood is much thicker. The wood vessels are large with lignified walls. The wood is crossed by numerous medullar rays rich in starch granules.

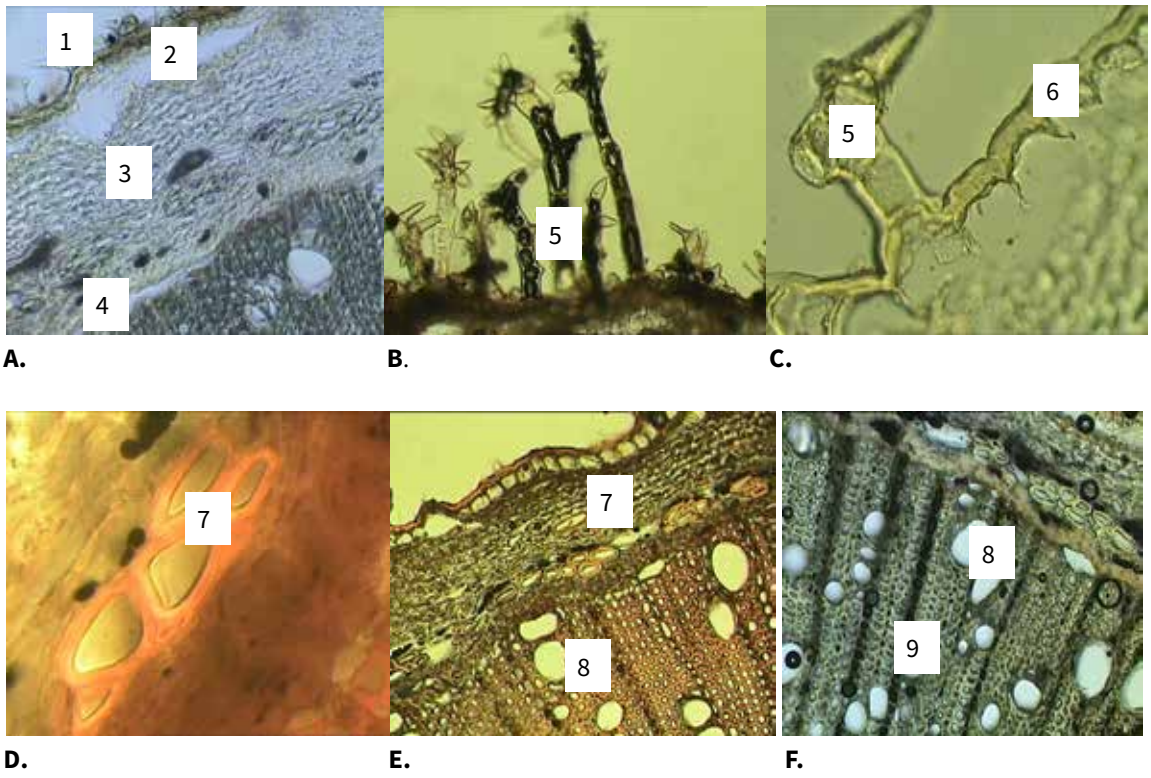


Fig.2. Cross section of *Withania somnifera* stem: A. (100x) 1 – epidermis with trichomes; 2 – lacuna; 3 – oxalate sand cells; 4 – cambium. B. (400x) 5 – multicellular denroid trichomes. C. (400x) 5 – multicellular denroid trichome; 6 – cuticle. D. (400x); E,F (100x) cortex and wood (stained with ClZnI) 7 – sclerenchymatic lignified fibres; 8 – xylem vessels, 9 – medullar ray.

Leaf. The anatomical structure of the leaf is bifacial, dorsiventral. The both epidermis are covered with multicellular, dendroid trichomes like on the stem with pitted terminal cells and the pits are not prominent, but shorter and more abundant on the lower epidermis (fig.3 A,B). The lower epidermis, also, is characterized by rarely secretory hairs (with uni- or multicellular glands on the unicellular stalk) (fig. 3C). The anomocytic stomata surrounded by 4–6 epidermal cells are on the both epidermis, more on the lower (fig.3D. In the spongy mesophyll we distinguish a lot of calcium oxalate rosettes, (fig.3 E) like in leaves of *Datura stamonium, Hyosciamus niger, Scopolia carniolica* [5,8,10]. On the young leaves geometrical wax crystals are distinguished (fig. 3F). The vascular bundles are collateral and in the midrib region enclosed in an endodermis with collenchyma above and below. Various degrees of secondary thickening of the midrib bundle were seen.

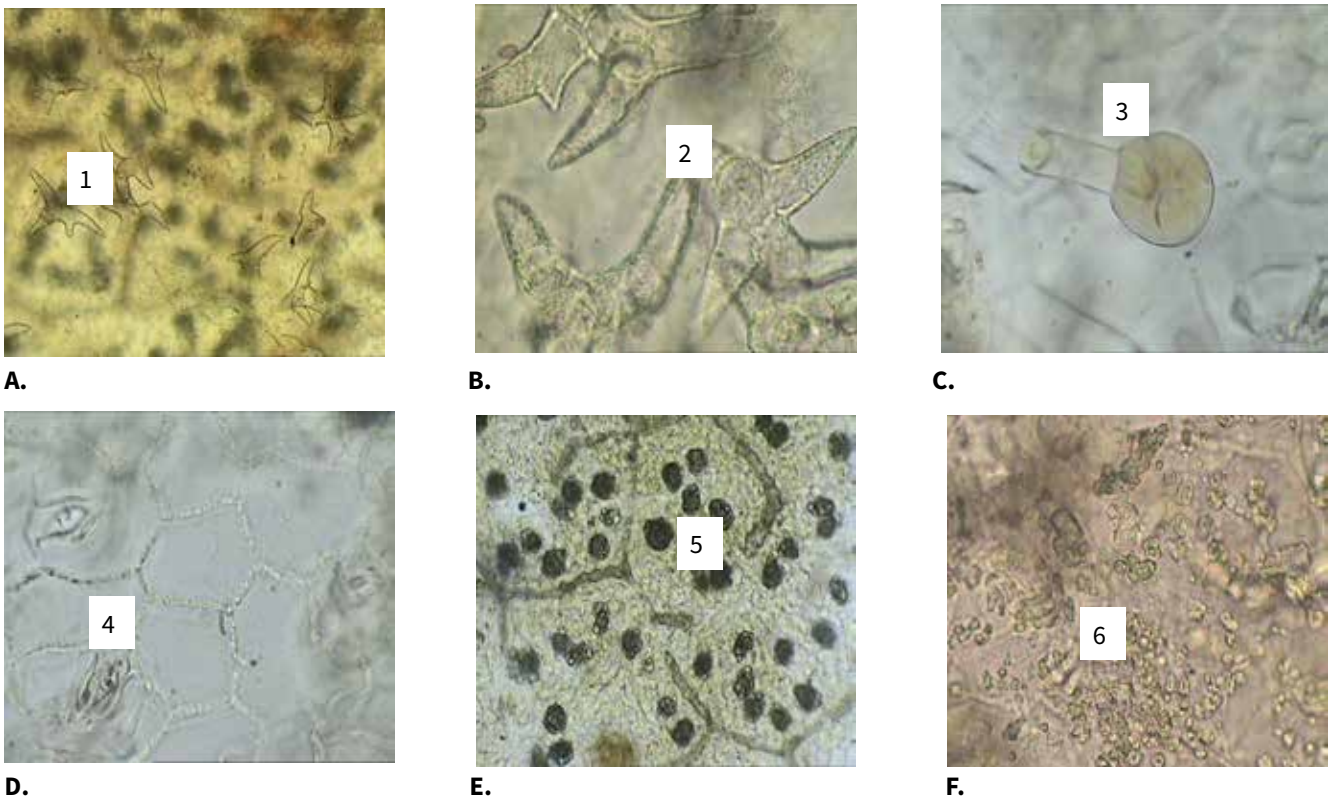


Fig. 3. Surface preparations of *Withania somnifera leaf*: A. (100x) 1 – epidermis with multicellular denroid trichomes; B. (400x) 2 – multicellular denroid trichomes; C. (400x) 3 – secretory hair; D. (400x) 4 – anomocytic stomata; E. (100x) 5 – oxalate rosettes; F. (400x) 6 – was crystals.

Flower. Gamosepalous ancrescent calyx which enclosed the mature fruit develops external and internal epidermis with anomocytic stomata (rarely) and two types of trichomes: unicellular and long (rarely) and multicellular (dense), branched, like on the leaf but shorter (fig. 4 A,B,C). Were seen the geometrical, often polygonal wax formations (fig. 4 D,E,F). The delicate petals have a leaf structure and develop higher and lower epidermis with rarely stomata, small trichomes and mesophyll between these.

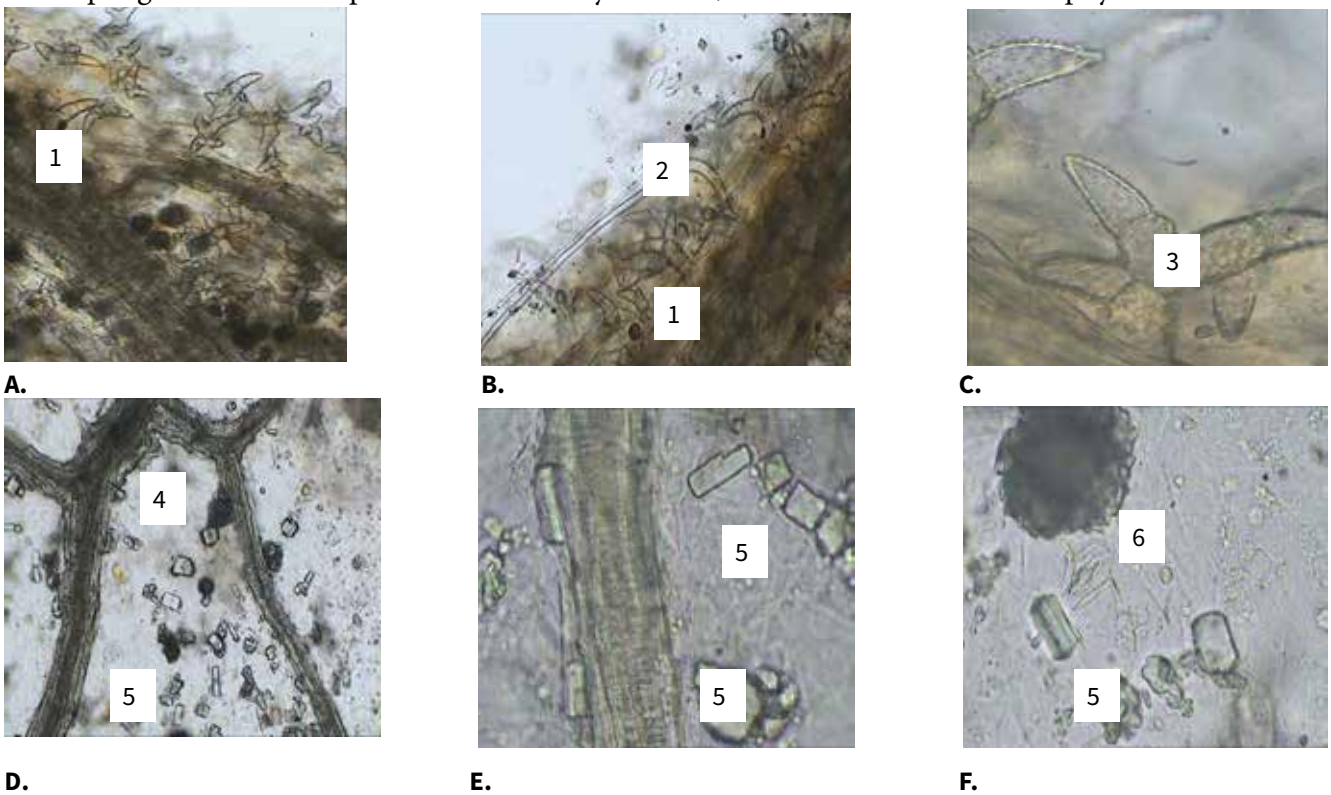


Fig. 4. Surface preparations of *Withania somnifera* flower calyx: A. (100x) 1 – epidermis with multicellular denroid trichomes. B. (100x) 2 – unicellular long trichomes. C. (400x) 3 – multicellular dendroid trichome. D. (100x); E , F (400x) 4 – venation; 5 – wax crystals. E. (400x) 4 – wax crystals, 6 – oxalate rosette.

Fruit. The pericarp of berry-fruit is bounded by outer epidermis consisting from polygonal cells, cell walls with punctuations, covered by thick colorless cuticle layer and interrupted by anomocytic stomata on the basal region of fruit (fig. 5.A,B,C). The internal tissue is mainly parenchimatous, resembling the spongy mesophyll of leaves, but with higher degree of vacuolization. The mesophyll cells are rich in orange to red carotenoidoplasts, fatty globules and sometimes were seen the oxalate rosettes (fig. 5.A-D). The endocarpic lobes adhere to the placental false septa and enclose the individual seeds in separate chambers [2].

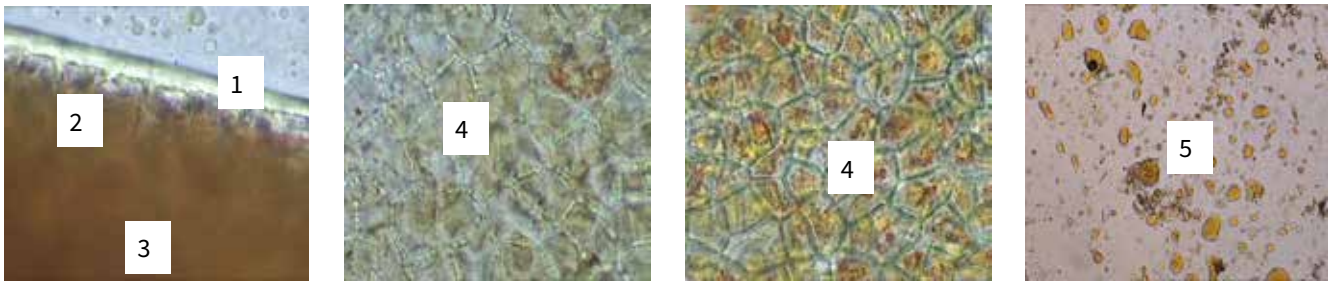


Fig. 5. Fruit of *Withania somnifera*: A. (100x) cross section - 1 – cuticle; 2 epidermis; 3 – mesocarp. B.C. (100x) surface image 4 – polygonal epidermis cells with punctuations. D. (400x) 5 – fatty globules (stained Sudan III).

The presence of sand calcium oxalate crystals in the root and stem and rosette in the leaf, flower calyx and fruit is an interesting feature in solving taxonomic problems [6].

Developing of special anatomic structures like abundant thichomes, glandular hairs, wax crystals, sclerenchymatic fibre rings, colenchyma and prominent lignified wood were mentioned also in other articles [6,9] and will permit to classify *W.sominifera* as xerophyte with large adaptive possibilities to grow in the climate conditions which differ from that characteristics in the origin regions like India. Our results could help understand some adaptive mechanism developed by *W. somnifera* and contribute to the understanding biosynthesis and accumulations of some useful secondary metabolites in the plant organs yield under other climate regime.

CONCLUZIONS

1. The specific macroscopical feathers (morphological type, form, color, relief surface, odour, taste) were determinated for two vegetable drugs: Withaniae roots and W.herba.
2. The following anatomical special structures for plant organs were established and can be used to identify the W.somnifera vegetable drugs:
   a. root – exfoliate periderm, secondary structure of central cylinder, phloem rich in starch and wood from lignified vessels, crossed by numerous medullar ray with starch.
   b. stem – epidermis with multicellular, brunched and dendroid trichomes with random in distribution, cortex with large lacuna, interspersed by oxalic sand cells with sclerenchymatic fibre pericyclic ring; the typical secondary structure is built just by cambium activity.
   c. leaf–dorsiventral anatomical structure, both epidermis with anomocytic stomata and multicellular, dendroid trichomes like on the stem, more on the lower; rarely secretory hairs (uni- or multicellular glands on the unicellular stalk) on the lower; wax crystals on young leaf; mesophyll with calcium oxalate rosettes; collateral vascular bundles.
   d. Flower – gamosepalous ancrescent calyx which enclosed the mature fruit with anomocytic stomata (rarely) and two types of trichomes: unicellular and long (rarely) and multicellular (dense), branched, like on the leaf but shorter; polygonal wax formations.
   e. Fruit – epidermis covered by thick colorless cuticle layer and interrupted by anomocytic stomata on the basal region of fruit; fundamental parenchyma cells vacuolated, with carotenoidoplasts, fatty globules and oxalate rosettes. The endocarpic lobes enclose the individual seeds in separate chambers.
3. The presence of special anatomic structures like abundant thichomes, glandular hairs, wax formations, sclerenchymatic fibre, colenchyma and prominent lignified wood permit to classify *W.sominifera* (L.) Dunal as xerophyte with large adaptive possibilities to grow in the climate conditions of Moldova.

BIBLIOGRAPHY

1. Ciorchină N., Cutcovschi A.: „Withania somnifera (L.) Dunal аспекты интродукции и культирования „in vitro" и „ex situ"". Conferinţa internaţională: „Introducerea şi selecţia plantelor aromatice şi medicinale", 2009, Ialta, Ukraina, pp. 208-209.
2. Dave Y., Patel N., Menon A. The pericarpic structure of *Withania somnifera* (L.) Dunal. Plant Sciences . June 1985, Volume 94, Issue 4-6, pp. 677-682.
3. Mehsud A., Mehmood S., Muhammad A., Khan U.,Khan S., Khan H., Wazir R.,Hussain Z. Morphology and anatomy of some weeds from flora of district Bannu, Pakistan. Pak. J. Weed Sci. Res., 19(4), 2013, pp. 437-445.
4. Menssen H. G. , Staesche K. Morphology and anatomy of Indian roots of Withania somnifera. Planta Med 1974; 26(7), pp. 269-278.
5. NIIR BOARD OF CONSULTANTS AND ENGINEERS. The Complete Book on Jatropha (Bio-Diesel) with Ashwagandha, Stevia, Brahmiand Jatamansi Herbs (Cultivation, Processing & Uses). Publisher: Asia Pacific Business Press Inc., 2008, ISBN: 8178330040, 592 pag.
6. Senthil Kumar M.*et al.,* Anatomical Studies in *Withania somnifera* L. (Dunal) – an Important Medicinal Plant. 43 l Advanced Biotech. Vol. 10 Issue, 2010, pp. 44-46.
7. Senthil K., Vinoth K., Saravana K., Aslam A, Shajahan A. The Phytochemical Constituents of *Withania somnifera* and *Withania obtusifolia* by GCMS Analysis. International Journal of Pharmacognosy and Phytochemical Research 2011;3(3), p.31-34.
8. Symon D. The Solanaceous genera, Browalma, Capsicum, Cestrum, Cyphomandra, Hyoscyamus, Lycopersicon, Nierembergia, Physalis, Petunia, Salpichroa and Withania, naturalised in Australia, J. Adelaide Bot. Gard. 3(2), 1981, pp. 133-166.
9. Shah S., Saravanan R., Gajbhiye N. A., Phytochemical and physiological changes in Ashwagandha (*Withania somnifera* Dunal) under soil moisture stress. Braz. J. Plant Physiol., 22(4), 2010, pp. 255-261.
10. Toma C., Rugină R. Anatomia plantelor medicinale. Atlas. Ed. Academiei Române, Bucuresti, 1998, 320 p.

STUDY OF THE WILD, SPONTANEOUS HEMP FORMS AND LOCAL POPULATIONS REGARDING THE CONTENT OF THC AND THEIR USE IN THE BREEDING PROCESS OF THE MONOECIOUS HEMP

Constantin Găucă[1], Diana Popa[1], Alexandra Buburuz[1], Cătălina Druţu[1],

Simona Pochişcanu[1], Marieta Naie[1], Teliban Gabriel[2]

[1]Agricultural Research and Development Station Secuieni, Neamt

[2]University of Agricultural Science and Veterinay Medicine, Iasi

Abstract. The study presents a synthesis of collected data regarding the wild, spontaneous hemp and local populations. The expeditions undertaken during 1991 – 1992 and 1996 – 2009 revealed the coverage area of the spontaneous forms of hemp in Romania, the associated characteristics, including the THC content, the taxonomic framing and their influence on the cultivated forms. Wild varieties have a THC content rated 9 and 10, content that decreases from south to north, while, when we refer to the local population the content is variable, the inclusion in the improving process requires the reduction of THC content below 0.2%. Both forms belonging to spontanea, adapted to excessive weather conditions and stable local populations, genetically and phenotypically uniform, constitute valuable genetic resources useful in the breeding process.

Keywords: monoecious hemp, chromatographic method, THC content

INTRODUCTION

The cultivation laboratory of textiles plants, flax and hemp, at ARDS Secuieni was established to improve the cultivation technologies, in order to extend the occupied areas.

The varieties of dioecious hemp, like Fibramulta 151, and some foreign varieties have not satisfied in terms of strains, fiber and seed production, so from 1980, within the laboratory, it was imposed the introduction in culture of the monoecious hemp varieties, improvement and creation of new varieties with higher productivity (Arnoux and al., 1969).

The first achieved varieties Secuieni 1 (1984) and Irene (1995) have satisfied the growers, the annual occupied area reaching 10 000 hectares (Gauca and Berea, 1997).

After 1989, Europe was gripped by the hemp cultivation euphoria, returning the plant in actuality, however limited in its use as a drug.

The increased content in cannabinoids, of which the THC (tetrahydrocannabinol) is responsible for the main psychoactive effects, acting as an euphoric, psyhozomimetic or as sedative and hypnotic, was limited to a maximum of 0.3%.

The introduction of the law 143/2000 imposed also in our country a limit of 0.2%, orienting the research to obtain and approval of lines and varieties in accordance with the legal requirements, the Secuieni 1 and Irene varieties exceeding this limit, the content being of 0.4 – 0.6%.

Reducing the content in cannabinoid, and maintaining the monoecious in the new creations, under the conditions existing in the research area of dioecious hemp forms, spontaneous, local populations or derived from former cultivated varieties with dominant characters on monoecious and THC content has proved very difficult. The hemp pronounced alogamy, the pollen high viability and resistance to the spread by air currents have led us t0o become involved in a study on the prevalence of these forms (Ceapoiu, 1976).

Collecting and characterizing the forms of *spontanea* ssp., adapted to the excessive drought soil, atmospheric heat and lack of rain during the growing season, could provide valuable genetic resources, in the context of climate change predictions (Cristea, 1988).

The numerous local populations, developed in ecological niches clearly defined, formed in time with adaptive characters, stabilized, genetic and phenotypic uniforms, by operation of law 143/2000, they are in danger of extinction.

The 2009 collecting expedition in the Carpathian foothills and northern Moldova resulted in the collection of seven resources considered populations, of which only one can be characterized as such and useful in the improvement process, the rest being sourced from recent crop varieties.

MATERIAL AND METHOD

Identify the distribution areas and collecting new genetic resources from spontaneous and cultivated flora was conducted by organizing two scientific expeditions in 1991 and 1992, and for the cultivated forms that became spontaneous and local populations, in 1996 and 2009.

The distribution area identification was conducted on work points of 5 – 10 km^2, centered in the area of maximum infestation. The seed collection was conducted on a large number of plants in mixture, for maximum potential variability coverage of the area, and on individual plants analyzed for highlighting the genetic and phenotypic characteristics in the experimental field.

The collected hemp forms are taxonomically classified after Serebriakova and Sizov, quoted by Ceapoiu (1958), *Cannabis* genus is made up from species, subspecies, varieties and forms. *Cannabis sativa* L. Species includes *culta* and *spontanea* subspecies, widespread in our country.

Part of the collected forms were studied in the research laboratory from ARDS Secuieni, in order to identify the specific characters, as well as those useful in the species improving.¬

The cannabinoid content was indicative determined by the colorimetric method, which consists of a color scale, with grades from 1 to 10, corresponding to 0.00 – 1.0% THC content. The maximum grade was awarded to the maximum intensity of color with shades of purple. The method has been approved and the improving process regarding the low content in cannabinoid gave satisfactions, obtaining the Dacia Secuieni and Secuieni Jubileu varieties, with an unidentifiable content through quantitative chromatographic method.

RESULTS OBTAINED

The identification expeditions of spontaneous hemp forms had as purpose the establishment of their spread on Romanian territory, taxonomic classification and their influence on cultivated forms.

The pronounced alogamy and the dominant dioecious character have caused the formation of genotypes with adaptability to stressful environmental conditions, the soil drought and the atmospheric heat, which were consolidated as wild and primitive populations occupying vast areas in some areas of the country.

The natural selection, under the influence of the environmental factors from the south of the country, have determined stabilized phenotypes, with specific characters to *spontanea* subspecies (Serebr.), with the two varieties, *ramosa* and *intermedia*, which occupies separate areals in some areas or overlapping in others.

Ramosa (Serebr.) variety include phenotypes typical to the wild form. The stems are short of 1 – 1.5 m, branching from the base with short internodes. The leaves are small, with 3 – 5 folioles, rarely seven, linear oblong, covered with fine hairs. The leaves epidermis is thickened, the leaves surface towards maturity is light gray, typical to xerophyte species. The fruits are small 6 – 8 g, of variable color, from gray to black. The funicul is very well developed (table 1).

Table 2 **The characterization of wild hemp varieties *Cannabis sativa* L. Serebr. (Emend) *spontanea* ssp.**

Characteristics	Variety	
	Ramosa	***Intermedia***
Distribution areals	Danube left bank until 44°50' N and longitude 22°30' – 28°30' E	44°50' – 46°10' N 26°50' – 28°10' E
Maximum pl. no./m^2	50 – 70	80 – 100
Strains height (m)	0.4 – 2.0	0.6 – 3.0
No. of folioles	3 – 7	5 – 11
The folioles shape and surface	elongated covered with hairs color gray to maturity	elongated green color, gray to maturity
Internodes	short, with branches from base	average, with opposite leaves up to80 – 100 cm
The fruit	Developed funicul Dark gray to black	funicul less developed seed with mosaic
TGW(g)	6.0 – 8.0	7.0 – 12.0
Fiber (%)	7 – 10	8 – 12
Germination (%)	4 – 6	10 – 20

The distribution area of *ramosa* variety is located between Danube and 44°50'northern latitude, and as eastern longitude between 22°30' and 28°30', occupying a vast area, with maximum temperatures in excess, pronounced atmospheric drought and low amounts of rainfall during the vegetation season.

In Dobrogea there are two areas occupied by the *spontanea* ssp., *ramosa* variety in the south, between Danube and Black Sea, and to center and north interwines with *intermedia* variety. The latter is characterized by stems with medium and large height (3 m), more or less branched, depending on the crop density that sometimes reached to 60 – 80 pl./m^2. The leaves are medium size, 5 – 9 narrow folioles, sometimes with xerophyte look. The *intermedia* variety occupies adjacent areals with the *ramosa* variety, occupying large areas in the central and eastern area of Baragan, reaching eastern Moldova until 45°35' N (Hanu Conachi) and 46°10' in Spiru Haret area, considered as the extreme northern limit for *spontanea* ssp.

Research continued on the entire surface of the country, but the *spontanea* ssp. has never been found, instead was identified the *culta* ssp. with different varieties *vulgaris* belonging to different varieties grown in the vecinity of the former foundry or local populations strictly delimited in ecological niches. Such areas were identified in Banat, Oradea, Satu-Mare, in central Transilvania and in the central and northern Moldova area between Siret and Prut rivers (fig. 1).

In the submountainous area have been identified local populations, distinct, formed in ecological niches strictly delineated in peasant households, as in the Apuseni mountains and in Moldova between the submountainous area and the Siret and Moldova river.

Fig. 1 – The zoning of the hemp forms on Romanian territory

Checked in culture, both spontaneous forms, and the collected populations could be characterized in terms of characters correspondence, according to the taxonomic classification, and highlight the characters to be used as genetic resources in the improvement process (table 2).

The *spontanea* ssp. with the two varieties *ramosa* and *intermedia* was characterized by TGW of 7.0 – 9.0%, germination between 4.0 – 9.5% and the fiber content of 7.8 – 9.4%. It highlights a very low germination, as an effect of the dominance characteristic to wild forms. Also, TGW and the fiber content are difficult to applied in the improvement process, involving several generations or the transfer of favorable genes through genetic manipulation.

The conditions in which determinations were performed did not corresponding with the collection area, to highlight the drought resistance, character useful in achieving improved forms, in order to extend the hemp cultivation in the southern area.

Table 2 **Results regarding the study of wild varieties and local populations, in ARDS Secuieni experimental field**

The collection site	Latitude	Longitude	Subspecies	Variety	Quality characteristics			
					TGW (g)	Germination (%)	Fiber content (%)	THC grade
Wild varieties								
Basarabi (Constanta)	44°10’	28°24’	*spontanea*	*ramosa*	7.3	7.3	7.8	9
Daneasa (Olt)	44°09’	24°34’	*spontanea*	*ramosa*	7.0	4.0	9.4	9
Drobeta-Turnu Severin (Mehedinti)	44°38’	22°33’	*spontanea*	*ramosa*	8.2	4.0	8.4	9
Slobozia(Ialomita)	44°34’	27°22’	*spontanea*	*intermedia*	8.1	5.0	8.4	9
Ciucurova (Tulcea)	44°54’	28°29’	*spontanea*	*intermedia*	9.0	9.5	9.0	8
Hanu Conachi (Galati)	45°35’	27°36’	*spontanea*	*intermedia*	8.5	7.3	8.9	7
Local populations								
Unirea (Bistrita Nasaud)	47°09’	27°32’	*culta*	*vulgaris*	15.6	86	14.6	7
De Arieş (Aries Valley)	47°20’	23°15’	culta	vulgaris	12.5	83	14.5	6

Manea (Neamt)	47°11'	26°34'	*culta*	*vulgaris*	14.2	81	16.9	5
Botosani	47°44'	26°41'	*culta*	*vulgaris*	16.8	76	17.3	5

The characters stability, especially the uniformity, reduced size of the plants and the advanced precocity of De Arieş and Manea populations corresponded to the requirements of the improvement process.

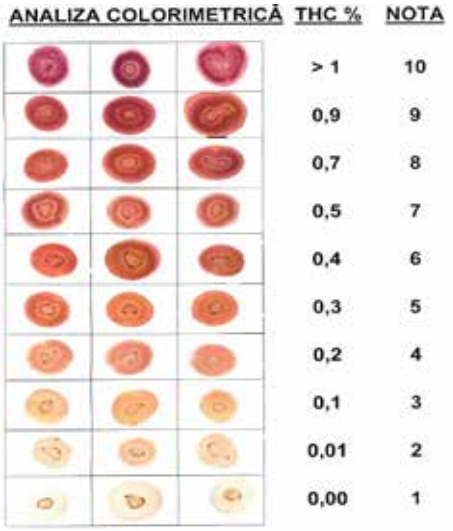


Fig. 2 – The color scale for determining the cannabinoid content

The Aries population belonging to *medioruthenica* proles *vulgaris* variety, identified at an altitude of 600 m on Aries Valley, precocious form and with reduced height of 1.5 – 2.0 m, was constituted as maternal genitor in obtaining the most precocious and productive cultivar, created at Secuieni under the name of Zenit.

The THC content at *spontanea* ssp. is constant and has high values, marked with grades from 7 – 9 through the individual colorimetric analysis, corresponding to a content of 0.5 – 0.9% by the chromatographic analysis, in steady decline from south to north (fig. 2).

At *culta* ssp. *vulgaris* variety, the cannabinoid content is much lower, marked with 5 and 6, values identified for the traditional cultivated varieties or local populations (fig.3).

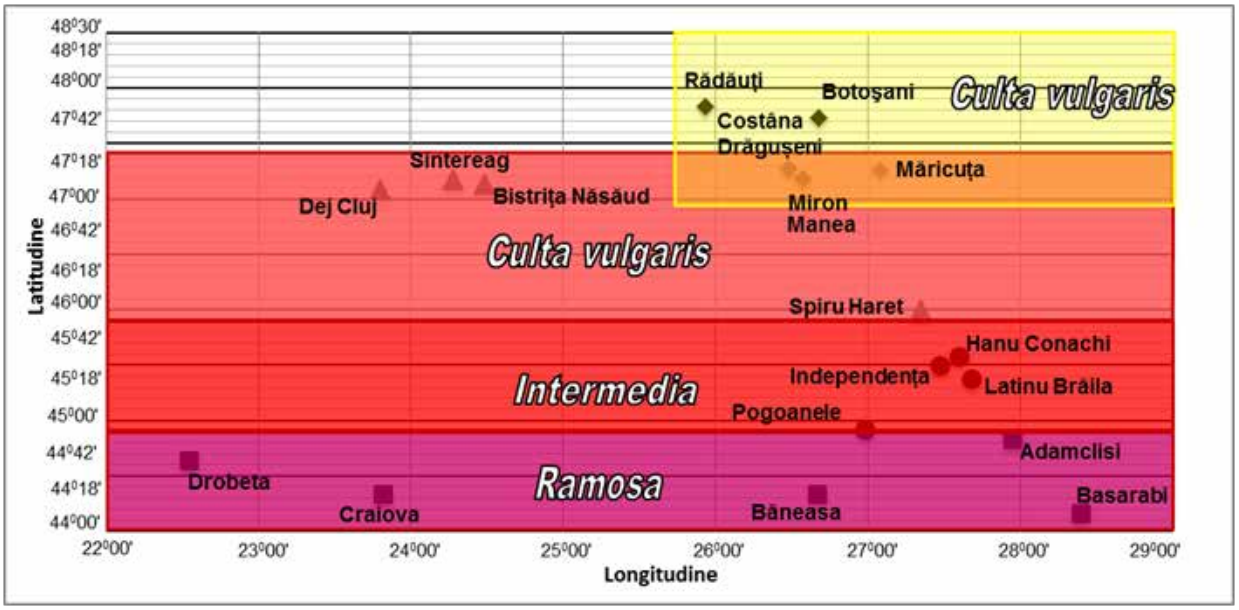


Fig. 3 – The spread of the spontaneous hemp forms and local populations depending on the geographical coordinates

Reducing the cannabinoid content in the improvement process was done by direct hybridization, the dioecious form with high content - maternal genitor and the monoecious lines or varieties with low content as paternal genitor. Through backcrossing B1, B2 and individual selection, the content was reduced below 0.01% or even unidentifiable through the chromatographic methods at the new creations of ARDS Secuieni, the cultivars Dacia Secuieni for fiber and Secuieni Jubileu for seed production.

CONCLUSIONS

1. The *spontanea* sp. *ramosa* var. has specific characters for the area between the Danube and 44°50'latitude, and as eastern longitude between 22°30' and 28°30'. The *intermedia* var. is specific for some areas from central and northern Dobrogea, the northern part of Baragan and the central and eastern area of Moldova, until at 46°10' latitude.

2. In the areas occupied by the *ramosa* and *intermedia* varieties, the multiplication of the cultivated varieties can not be approved, due to their rapid degeneration caused by mutual pollination.

3. The collection and storage of local populations is an ongoing concern in order to avoid their extinction, given the useful characters in improving and producing new hemp varieties.

4. The spontaneous *ramosa* and *intermedia* varieties have a THC content noted with 9 and 10, content that decreases from south to north, and at local populations, the content is variable, noted with 5 and 6, the inclusion in the improvement process requiring a reduction of THC content below 0.2%.

REFERENCES

1. ARNOUX M., CASTIAUX J., MATHIEU G. – *Sur l'amélioration de la productivité en fibres chez le chanvre* (*Cannabis sativa* L.). Annales l'amélioration des plantes 19 (4), 1969, p. 405 – 418;

2. CEAPOIU N. – *Hemp – monographic study*. Ed. R.P.R. Academy Bucuresti, 1958, p. 416 – 468;

3. CEAPOIU N. – *Genetics and evolution of biological populations*. Ed. Academy Bucuresti, 1976.

4. CRISTEA M. – *The evaluation and use of plant genetic resources*. Ed. Academy Bucuresti, 1988.

5. GĂUCĂ C., BEREA N. – *Collection and characterization of some forms of wild hemp and local populations. 35 years of research – development at ARDS Secuieni*, Secuieni, 1997, p. 71 – 76.

XYLEM ANISOTROPY OF *PICEA ABIES* KARST. GROWING IN THE UKRAINIAN CARPATHIANS

PhD student Ivan Kharyton

Associate Professor, Doctor of Science Ivan Sopushynskyy

Department of Botany, Wood Science and Non-Wood Forest Products,

Institute of Forestry and Horticulture

Ukrainian National Forestry University, Lviv, Ukraine

Abstract. In the research materials, the issues of xylem anisotropy and wood macrostructure have been reviewed. It involves the wood specimens of the Norway spruce growing at altitudes 630-1190 m asl in the Ukrainian Carpathians. The research emphasis has been focused on the estimation of key figures of wood properties and its multiple comparisons using one-way analysis of variance. It has been defined three homogeneous wood groups by the annual ring width for the visual selection and prediction of wood quality.

INTRODUCTION

Biological knowledge of xylem anisotropy explains an evolutionary optimization in its structure as the living plant system that takes place over a long biological life of the tree. Natural evolution of tree species due to the improvement of its xylem allows them to adapt to the environment through genetics and the selection [1, 2, 5]. The process of natural competition is the combination of traits that result in intraspecific variability and environmental influence [8, 10, 12]. Thus, under the influence of various factors, the nature of self-sufficient living plant system has been formed and developed its ordered xylem structure. One of the best natural laboratories to research the biological features of xylem (wood) formation is the forest stands in the mountain area where latitudinal and altitudinal patterns match each other's [3, 4, 7]. In terms of biological evolution, conifers (Norway spruce, Scots pine etc.) have simpler anatomical structure of xylem compared to deciduous tree species, which is an important prerequisite for the study of xylem that is closely related to its heterogeneity. In connection with the above, the issue of xylem anisotropy of Norway spruce is unexplored in the context of the correlation between wood macrostructure and shrinkage.

MATERIALS AND METHODS

Silvicultural and dendrometrical characteristics of conifer forest stands were collected by field studies with focus on in-depth understanding of xylem structure as well as its forestry potential. Altogether, 21 sampling trees of Norway spruce were cut in the seven mature stands of Ukrainian Carpathians (Table 1), which grew at altitudes 630-1190 m asl (48°45′12′′N, 23°45′39′′E).

Table 1 **Estimated silvicultural features of Norway spruce stands**

Altitude [m]	Stand composition	Age [years]	Stand quality	Stocking	H [m]	**D [cm]**
630	10PIA	103	1	0,70	30	34
820	7PIA3ABA	100	1	0,73	30	34
975	9PIA1ABA	110	2	0,70	31	34
1190	10PIA	95	2	0.75	26	28
1000	10PIA	116	1	0,80	28	32
800	8PIA2ABA	120	1	0,60	30	36
650	6PIA4ABA	100	1	0,80	30	34

Notes: *Picea abies* **Karst.** – **PIA***; Abies alba* **L.** – **ABA; H – average tree height, D – average tree diameter.**

To represent the whole tree, the wood characteristics were collected at three points: at breast height,

2/3 of length of bole and 1 m before the beginning of tree crown. The annual ring width is measured by software AutoCAD 14 on the digital photos of fine wood discs. The wood shrinkage is established according to the international standards [4, 6, 9]. The statistical analysis is based on procedure Excel, SPSS 13.0 and **Statistica 10**. T-test is applied for the analysis of variance which analyses the difference in means of a continuous variable between two groups. Null hypothesis has no difference in the mean values and the alternative hypothesis has a difference in the mean values (significant at <0.05).

RESULTS AND DISCUSSIONS

The internal stress in the xylem depends on its index of inhomogeneity ($\gamma_{(\beta t/\beta r)}$) which is determined by ration tangential (β_t) and radial (β_r) shrinkage. The descriptive statistics of full wood shrinkage (β_v – by volume and β_l – along–the–grain) by $W_{abs.}$=125 % (absolute average moisture content) and annual ring width ($S_{ring\ width}$) of Norway spruce is shown in Table 2.

Table 2 **Key figures of wood properties**

Variables	N [units]	min	$M^{\pm m}$	max	V [%]	P [%]
$ß_{t125\%}$ [%]	179	6,1	$8,5^{\pm 0,06}$	10,1	9,9	0,7
$ß_{r125\%}$ [%]	179	2,4	$4,2^{\pm 0,06}$	5,8	18,3	1,4
$ß_{l125\%}$ [%]	179	0,1	$0,4^{\pm 0,02}$	1,1	58,8	4,4
$ß_{v125\%}$ [%]	179	9,5	$12,7^{\pm 0,09}$	15,3	9,7	0,7
$S_{ring\ width}$ [mm]	179	0,6	$2,3^{\pm 0,11}$	7,0	63,8	4,8

Notes: N – number of samples; min – minimum; $M^{\pm m}$ – mean and its standard deviation; max – maximum; V – coefficient of variation; P – accuracy figure.

Wood anisotropy of Norway spruce is characterized by a wide range of tangential, radial and linear shrinkage. Tangential shrinkage varies from 6,1 to 10,1 % by the coefficient of variation of 9,9 % and it is insignificant (V<10 %).The coefficient of radial shrinkage variation is 18,3 %; it indicates the key influence of the annual ring width in the radial section. The value of linear shrinkage and annual ring width are represented by the highest coefficient of variation accordingly 58,8 and 53,8 %. The last value of wood properties ($S_{ring\ width}$) shows the strong correlation with the environmental factors of Carpathian Mountains that needs the additional multiple comparisons using one-way analysis of variance. The value of less than 3-5 % accuracy indicates statistical reliability of the obtained results. Therefore it is the biological and practical importance to analyze the shrinkage –macrostructure functions (Figure).

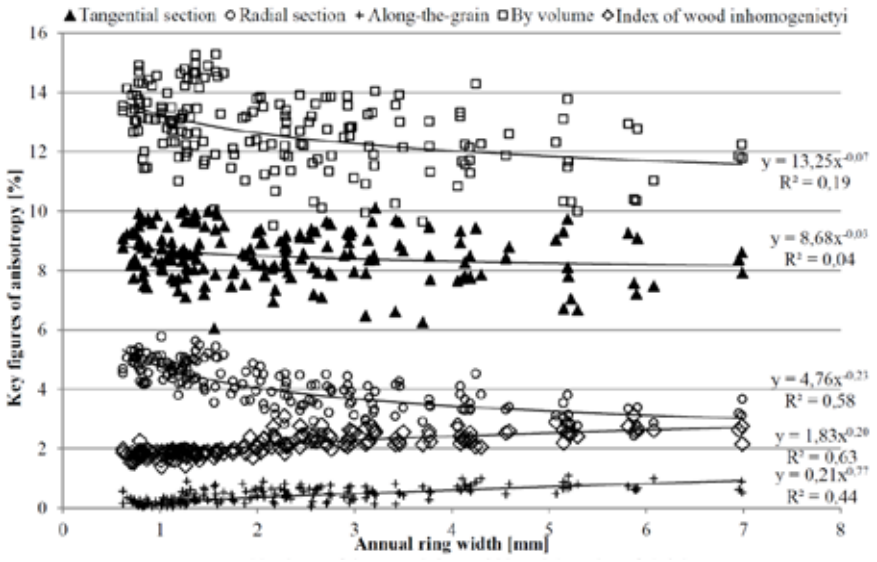


Figure. Graphic charts of the annual ring width and the value of shrinkage

Graphic charts of the annual ring width and the value of shrinkage demonstrate the power-law

relation of those parameters with coefficient of determination from 0,44 <R^2 <0,63. Therefore the wood macrostructure in radial section has a significant impact on wood anisotropy. Thus the relation between index of wood inhomogeneity and annual ring width is represented by the equation $y=1,83x^{0,20}$ (R^2=0,63). According to the theoretical and applied biological point of view it is important to classify the wood into homogeneous groups by the annual ring width to analyze the changes in anatomical xylem characteristics. The classified groups of Norway spruce wood can be used on practice for visual selection and prediction of wood quality (Table 3).

Table 3 **Multiple comparisons of key figures using one-way analysis of variance**

Dependent variables	Groups		Mean difference	Standard error	Significant at the 0.05 level	95% Confidence interval	
					Lower bound	Upper bound	
$S_{ring\ width}$	1	2	-1,55	0,09	0,000	-1,77	-1,33
		3	-3,88	0,11	0,000	-4,16	-3,60
	2	3	-2,32	0,12	0,000	-2,62	-2,03
$\beta_{t125\%}$	1	2	0,13	0,14	0,642	-0,21	0,48
		3	0,45	0,18	0,048	0,01	0,89
	2	3	0,31	0,19	0,258	-0,15	0,78
$\beta_{r125\%}$	1	2	0,99	0,08	0,000	0,79	1,19
		3	1,40	0,10	0,000	1,14	1,66
	2	3	0,40	0,11	0,002	0,13	0,68
$\beta_{l125\%}$	1	2	-0,21	,032	0,000	-0,29	-0,13
		3	-0,45	,041	0,000	-0,55	-0,35
	2	3	-0,24	,043	0,000	-0,35	-0,14
$\beta_{v125\%}$	1	2	0,85	0,19	0,000	0,38	1,31
		3	1,30	0,246	0,000	0,70	1,90
	2	3	0,45	0,26	0,209	-0,18	1,09
$\gamma\ (_{\beta t/\beta r)}$	1	2	-0,47	0,04	0,000	-0,56	-0,39
		3	-0,66	0,05	0,000	-0,77	-0,55
	2	3	-0,18	0,05	0,001	-0,30	-0,06

Table 3 results denote that the tangential shrinkage of Norway spruce wood belong to the one group of values and doesn't depend on the annual ring width. The procedure of comparison mean values of wood characteristics is performed using one-way analysis of variance. Independent variables were tested by the Scheffe criterion. Results show the significant 0,05 level for annual ring width, index of wood inhomogeneity, radial and linear shrinkage for the three groups. The outcome of the research results is the xylem structure in the radial section has controlling influence on wood anisotropy figures of Norway spruce.

CONCLUSIONS

Wood anisotropy of Norway spruce is characterized by a wide range of tangential ($\beta_{t125\%}$=6,1-10,1 %), radial ($\beta_{r125\%}$=2,4-14,2 %), linear ($\beta_{l125\%}$=0,1-1,1 %) shrinkage and by volume ($\beta_{v125\%}$=9,5-15,3 %). The value of the annual ring width varies from 0,6 to 7,0 mm. The relation between index of wood inhomogeneity and annual ring width is represented by the equation $y=1,83x^{0,20}$ (R^2=0,63). The visual selection and prediction of wood quality could be based on the analysis of three homogeneous wood groups defined by the annual ring width using multiple comparisons of one-way analysis of variance.

BIBLIOGRAPHY

1. Bauch J. *Variation der Holzstruktur aufgrung sekundaerer Veraenderungen.* Mitt. Bundesforschungeanstalt Hamburg 131, 1980, S. 87-97.
2. Barnett J., Jeronimidis G. *Wood quality and its biological basis*. Blackwell, Oxford, 2003, 226 p.
3. Herushynskyy Z.Yu. *Forest Typology of Ukrainian Carpathians*. Piramida, Lviv, 1998, 208 p.
4. Kollmann F. P., Cote W. A. *Principles of wood science and technology*. Springer-Verlag, New York, 1968, 591 p.
5. Lindstrom H. *Basic density in Norway spruce*. Part I. A literature review. Wood and Fiber Science 28, 1996, p. 15–27.
6. *Normen für Holz*: DIN-Taschenbuch 31. [8te Aufl.]. Beuth, Berlin, 2009, 604 S.
7. Rosner S., Konnerth J., Plank B., Salaberger D., Hansmann C. *Radial shrinkage and ultrasound acoustic emissions of fresh versus pre-dried Norway spruce sapwood*. Trees 24(5), 2010, p. 931–940.
8. Rozenberg P., Cahalan C. *Spruce wood quality: genetic aspects (a review)*. Silvae Genetica 46, 1997, p. 270–279.
9. Sopushynskyy I., Vintoniv I. *Wood Science*. Liga-Press, Lviv, 2014, 144 p.
10. Skrøppa T. *Norway spruce (Picea abies Karst.)*: *Technical guidelines for genetic conservation and use* EUFORGEN, Rome, 2003, 6 p.
11. Zhang S. Y. *Wood quality: its definition, impact and implications for value-added timber management and end uses*. Proceedings of the CTIA/IUFRO International Wood Quality Workshop. Part I. Quebec City, 1997, p. 17–39.
12. Zobel B. J., van Buijtenen J. P. *Wood variation, its causes and control*. Springer, New York, 1989, 363 p.

MORPHOLOGICAL AND BIOLOGICAL ASPECTS ON BLACKBERRY VARIETIES ACCLIMATIZATION IN EX VITRO

Lozinschii Mariana,Ciorchină Nina, Trofim Mariana

Botanical Garden (I) of the Academy of Sciences of Moldova

Abstract. This paper presents the research results of the ex-vitro phase acclimatization of the thornless blackberry (Rubus sp.) cultivars, Cester, Loch Ness, Evergreen, Smoothstem, Remontana. The plant material consisted of propagated plants having a Murashighe-Skoog medium (MS) 100% at 0.5 mg / l benzyl adenine (BAP) and MS 50%. The rooting shoots were grown in a sterile medium and were acclimated on three types of substrate. The most successful substrate turned to be the commercial peat one. The research has yielded good results regarding the rooting and acclimatization percentage of these precious varieties of thornless blackberry.

INTRODUCTION

Shrubs constitute a separate category of fruit plants that provide to the human a rich biological source for a good nutrition. Besides their role in nourishment, fruit trees are used in pharmaceutical and cosmetic industry, also as an additional source of food and as a medicine in the zoo veterinary [1,3].

The micropropagation of shrubs has been investigated by many researchers Gajdosova et al, 2006; Meng, 2004 Mihalache, 1996 Zawadska M. and T. Orlikowski 2006. Ex vitro acclimatization is the final phase of the micropropagation, whereas the micropropagated seedlings are gradually getting accustomed to the normal living conditions that are similar to those of the natural environment (greenhouse, field).

At the Fruit Research Station in Cluj, an effective method was obtained to do a direct ex vitro rooting and to manage the acclimatization of blackberry shoots in hydroculture flotation based on floating hydrophonics technology (Ross 1995) and to manage the ex vitro acclimatization of Loch Ness blackberry [2]. A substantial number of micropropagated plants don't survive the transfer from in vitro conditions to field or greenhouse conditions. Therefore, in this reasearch we want to emphasize some acclimatization problems of valuable varieties of blackberry. The aim of the research was the testing of various effective and economical substrates in the ex vitro phase and the efficient acclimatization without losing any uniform and resistant seedlings.

MATERIAL AND METHOD

The research took place in the Biotechnology and Embryology Laboratory of Botanical Garden (I) of the Academy of Sciences of Moldova. There were studied and researched valuable varieties of thornless blackberry Loch Ness, Evergreen, Smoothstem, Remontana. A major problem in applying micropropagation technology on a large-scale is the high necrotizing transition from the ex vitro conditions to the in vitro ones. The acclimatization of blackberry plantlets is a very meticoulous and intensive process that contributes largely to the quality and cost of production. Loch Ness, Cester, Smoothstem, Evergreen, Remontana blackberry plantlets were propagated in vitro according to a standard protocol, investigated in the laboratory [4].

When the shoots or plantlets are transplanted from the culture chamber to greenhouse conditions, the plant material can easily dehydrate or wither and die rapidly as a result of changing the environmental conditions, so precautions are taken to protect them in this case. Traditionally, ex vitro acclimation mode is adjusted to match the transplantation of each culture, by gradually matching the level of relative humidity and light. Blackberry transplants must undergo a period of acclimatization, to be more exact, a transition period in which both physiological and anatomical performance features get rid of the in vitro conditions influence (Donnelly et al., 1984). The plants grown in vitro are sensitive to the transplantation shock which leads to high necrotizing during the final stage of micropropagation (Dhawan and Bhojwani, 1986). Therefore, after ex vitro plants are transplanted, they usually need a period of acclimatization with gradual decrease of humidity (Bolar et al., 1998). Temperature, humidity, ventilation, and air flow control were adjusted for blackberry plants acclimatization [3].

RESULTS AND DISCUSSIONS

During the ex vitro acclimatization process, the substrate in which we plant is taken in great consideration. For the ex vitro transfer, the plantlets were taken from culture tubes multiplcated on a 100% MS medium supplemented with 0.5 mg/l BAP and rooted on a 50% MS medium, their base has been washed with hot water in order to remove the culture medium and the base roots were slightly cut (shaped) to better stimulate the rooting process. The plantlets previously passed through a weak pink solution of KMnO4 are transferred onto a solid substrate, previously sterile autoclaved at 2 atm for 30 min. The first type of sterile substrate consists of lawn soil, peat, perlite, sand in proportions of 1: 1: 0.25: 0.25.

The second type consists of lawn soil and commercial peat in relation of 1:1, the third type of substrate is composed only of commercial peat. Blackberry rootless seedlings are planted in a perlite substrate in order to root (Fig.2). Plants with substrate are planted in palettes composed of cells provided with holes. These cells are filled with a mixture of substrate in advance. The plant material is planted in the palettes for the ex vitro process, the palettes are enwrapped in transparent sheets to maintain humidity. For all cultivars it is very important the substrate to be as drained as possible, otherwise the percentage of plant survival is minimal.

The most appropriate and optimal substrate for plant growth and development was composed only of commercial peat with a pH of 5.8-6.5. In vitro plantlets are generally grown in low intensity light (1.200 to 3.000 lux) and temperature (23 ± 2 ° C), thus the transfer to direct sunlight with broad spectrum (from 4.000 to 12.000 lux) and temperature (26-36° C) may cause the carbonization of leaves and the wilting of cuttings. Therefore, to avoid this phenomenon the plants adapt to indoor conditions, much more shaded and cool temperature 20-25°C. It is necessary for the plant to become accustomed to natural conditions through a hardening or acclimatization process. So, blackberry cuttings with a length of 2.5 cm are planted in a palette which consists of 104 cells, the cell volume being 25-30 ml.

Culture containers can be kept in the greenhouse with loose caps or covered with transparent polyethylene sheets, but provided with ventilation. Plant containers can be left in natural diffuse shade for 3-6 days to adapt to new environmental conditions in the first week after transplantation. The effective blackberry adaptation is going through 3 steps:

1) They are placed in containers of 104 cells kept under sheets for 10 days until the first two leaflets appear in the apex of the plant. The ventilation is done 2-3 times a day. It is being sprayed with deionized water and air temperature in which the culture adapts to is taken into consideration. (Fig.1.a).

2) The second step is to place the plants in containers aside with older cells of 125-155ml for a more effective development of the root, stem and leaves, but the palettes are not covered in a transparent pellicles or lids, while the temperature and humidity conditions are being taken into consideration (Fig.1.b).This stage lasts 2-3 weeks in a protected shaded space.

3) The third stage is to transfer the palettes with plants that have reached 8-10 cm in length and 6-8 leaves were formed under the sun but with a skeleton of canvas, built in a way for the sun to penetrate only from one direction for a total acclimatization, here the plants are kept 2-3 weeks (Fig. 3).

Another important factor is to protect them from pests because after 15 days of acclimatization the plants are largely exposed to the outside conditions and they can be damaged by pests as they are young and attractive. One of the pests that damages the young blackberry is the white butterfly. One of the varieties of blackberry, to be more exact, the Cester type, is often damaged by mites. To protect them fromt pests, the Actara mixture is being used.

Powdery mildew is a disease that affects the blackbery and it lowers its leaves' beauty. One cause of mildew occurence is poor ventilation, and it is not recommended to water the plants in the second half of the day because at night the fungus spores multiply intensively. It is a fungus that covers the leaves

with a white or gray dust and can spread throughout the plant. It is recommended to spray it at the first signs of disease and repeat the procedure every 10 days. The fungicides that contain sulfur and copper are being used. The treatment with claret juice of 1%, Topaz is also very effective. Note that these blackberry varieties are affected by diseases and pests only during the acclimatization period while the plants that are transferred to field conditions weren't affected by pests and diseases for a period of three years of research.

For a normal development is recommended to apply organic fertilizers that contain NH4NO2 7%, 10% P2O5, K2O 12%. The fertilizer is applied at the root area every two weeks in amounts of 10 ml in 1 liter of water, and foliage once a month 5 ml to 1 liter of water.

a)  b) 

Fig.1 Cester a) and Loch Ness b) types in their first and second stages of acclimatization

Fig. 2. Rooting plants in perlite substrate

Fig.3 Cester type in its third stage of acclimatization

Analyzing Table 1 we can determine the adaptability of plants with a lower rate in the first months of January, February varying between 80% and 90%. Beginning with March the vitality of the acclimatized plants is increasing from 90% to 98%, especially observed at the 'Smothstem' type. At the beginning of May the acclimatization percentage is greater than 97% and 'Remontana' and 'Smothstem' types reach the a maximum acllimatization percentage of 99%. The best months of the year for the plants to get adapted are June, July, August, when the percentage of vitality and survival of blackberry plants in ex vitro conditions reach 99%.

Table No1. Share vitality of blackberry varieties throughout 2014

Types; Months of the year	Cester	Loch ness	Smothstem	Evergreen	Remontana
January	80,5±1,29	85,25±1,7	89,5±1,29	84,5±2,51	92,5±2,0
February	89,7±0,5	92,0±1,4	93,5±1,2	90,0±1,4	92,5±1,2
March	89,7±1,7	91,7±1,7	97,7±0,9	91,2±1,2	95,2±1,7
April	95,2±0,9	96,5±1,2	97,7±1,2	95,2±1,2	98,2±0,9
May	96,5±0,5	96,7±0,5	98,5±0,5	96,7±0,9	98,7±0,5
June	98,7±0,5	98,5±0,5	98,2±0,9	98,7±0,5	98,2±0,9
July	98,5±1,0	99,5±0,2	98,5±0,5	99,5±0,5	99,2±0,5
August	99,7±0,5	98,5±0,5	99,2±0,5	99,5±0,5	98,7±0,5

*** The calculations were made for batches of one hundred plants.**

CONCLUSIONS

1. Loch Ness,Cester, Evergreen, Smoothstem, Remontana varietes can be successfully acclimatized at a vitality rate of 99%. The best acclimatization period is during spring and summer months.

2. The most appropriate and optimal substrate for plant development and growth turned out to be the one consisting only of commercial peat with a pH of 5.8-6.5. In order to root the plantlets without roots, the perlite substrate was used.

3. The average temperature for acclimation is 20 -25^{o} C. The acclimation duration is 2 weeks for each stage described above.

4. In the second and third stages of acclimation it is highly recommended to use fungicides and herbicides to protect them from pests and diseases. Also, it is beneficial to apply organic foliar fertilizers to the root during this period.

BIBLIOGRAPHY

1. The Micropropagation Of Some Thornless Blackberry Cultivars, Clapa Doina1, Catita Plopa, A. Vescan, Fruit Research Station Cluj, Romania 2012

2. Direct Ex Vitro Rooting And Acclimation In Blackberry Cultivar Loch Ness ,Alexandru Fira, Doina Clapa, Liviu A.Vescan , Fruit Research Station Cluj, Romania 2012

3. Morphophysiologicals Problems In Acclimatization Of Micropropagated Plants In - Ex Vitro Conditions- A Reviews, Kshitij Kumar* And I. U. Rao,Department Of Botany, University Of Delhi, India, 2012

4. The Micro-Cloning Particularities Of Thorless Blackberry Cester And Loch Ness, Mariana Lozinschii, Nina Ciorchina, Journal Of Botany, Vol. V, Nr.1 (6) Pag15-24

MORPHO-ANATOMICAL PECULIARITIES OF GENERATIVE ORGANS OF INTERGENERIC HYBRIDS CYDONIA X MALUS

Onica Elisaveta

Botanical Garden (Institute) of the ASM, Chisinau

Abstract. This article describes the peculiarities of morphological and anatomical structure of generative organs of intergeneric hybrids Cydonia x Malus. Distant hybrids differ in the number of flowers in an inflorescence: 1-4, but solitary flowers predominate in 50-65% of paternal triploids. Solitary flowers predominate in 97-99% of maternal triploids and tetraploids and 1-3% of them have inflorescences with 2 flowers. Solitary flowers predominate in 75% of diploids and 25% have inflorescences with 2 flowers. It has been established a directly proportional correlation between the polyploidy level and the size of the pollen grain. Tetraploid plants are distinguished by higher pollen viability (56-67%) as compared with other hybrids, the viability of the pollen of which reaches 10%. The similarities and differences of characters in the structure of the pericarp of hybrids Cydonia x Malus are highlighted. The studied hybrids differ qualitatively (in the uneven thickening of the cell walls of epidermal cells, in the location and density of sclereids in the subzones of the mesocarp, in the shape of the exocarp and endocarp) and quantitatively, in the size of cells from the zones and subzones of the pericarp.

INTRODUCTION

Conservation, mobilization and rational use of plant resources are and will always be a strategic problem in the relations of humankind with nature. Distant hybridization is a promising way of plant improvement. The distant hybrids Cydonia x Malus blend differently the traits of quince and apple, and in order to assess their value, the possibilities of using them, it is necessary to study biological properties.

This article describes the inheritance of morpho-anatomical characters of generative organs and the capacity of intergeneric hybrids quince x apple, which grow in the Botanical Garden (Institute) of the ASM, to produce flowers and fruits. The qualitative and quantitative characteristics of flowers and fruits of 8 hybrid forms of Cydolus are highlighted in comparison with genitors and with other hybrid plants.

MATERIALS AND METHODS

8 mature plants aged 12-14, in the period of abundant flowering and fruiting, served as objects of study. The biological material necessary for fixation was taken from mature fruits collected from the middle of the tree crowns, from 4 triploid hybrid forms of quince x apple (2-69, 4-72, 7-72, 15-74), 2 tetraploid forms (1-72, 33-72), 2 diploid forms (no.1 and no.25), from the collection of the Botanical Garden (I) of the ASM, and from parental forms; micropreparations were prepared according to the methodology [1, 9, 10,12]. The results of the study on quantitative anatomy of the pericarp of the fruit of the hybrid plants were statistically processed according to the methodology [7]. The viability and the size of pollen grain of distant hybrids were determined in accordance with the methodology [5, 6].

RESULTS AND DISCUSSIONS

The polyploid hybrid forms, included in research, inherit morphological and anatomical characters of generative organs differently, analogously to the structural peculiarities of leaf blade and petiole [2, 4, 8, 10]. The characters of apple flowers prevail in these hybrids, but their flowers are bigger. Flowers are 3.5-4.5 cm in diameter. The flower peduncle occupies an intermediate position according to its length which is 2.5-3 cm. A distinguishing feature of the paternal triploid and diploid hybrids is the number of flowers in an inflorescence – from 1 to 4; solitary flowers predominate – 50-65%. The number of inflorescences with 2-3 flowers constitutes 31-47%, which allows us to conclude that these hybrid plants inherit this character from both genitors. 75% of the flowers of diploids are solitary and only 25% are inflorescences with 2 flowers. In tetraploids and paternal triploids, solitary flowers predominate (97-99 %) and inflorescences with 2 flowers are very rarely observed (Fig.1).

The results of the research show that the triploid intergeneric hybrids quince x apple differ from other hybrid forms in the number of flowers in inflorescences and the flowering period, which coincides with the flowering of late varieties of apple. Quince varieties start flowering later and the pollen of apple varieties with late flowering period can be used to improve these hybrid forms. The diameter of the

pollen grain of diploid forms was 23 mm, and in tetraploids, its diameter reached 39.5-50.4 mm, which was 1.7-2 times larger than the diameter of pollen of diploids. Triploids are characterized by a medium diameter, from 48.1 to 49.8 μm. It has been established a directly proportional correlation between the polyploidy level and the size of the pollen grain. Pollen viability of tetraploids is higher (56-67%) than of triploids, which constitutes 3.1-10.2%. The studied tetraploids are distinguished from other hybrid forms by the high viability of the pollen, the larger size of pollen grains and cells from the zones and subzones of the pericarp. The pollen of diploids proved to be sterile in all variants. The paternal triploid hybrids inherit the characters of initial forms, mostly the characters of apple fruits (shape, taste and colour of the epicarp), but also specific features of quince (mostly solitary flowers – more than 50%, stable crops, presence of sclereids in fruit parenchyma). The studied distant hybrids differ in shape, size and intensity of fruit colour. Fruit size was 6.5-7.5 cm and fruit weight ranged from 120 g (form 4-72) to 530 g (form 7-72), on average 180-200 g. The yellow colour of epicarp prevails, only the form 7-72 has fruits with a reddish hue on the side of the tree exposed to the sun. The triploids' fruits don't contain seeds; few of them have 1-2 underdeveloped seeds, unlike tetraploid forms which contain 10-22 viable seeds in a fruit. In cross section, fruits and loculi are oval in shape.

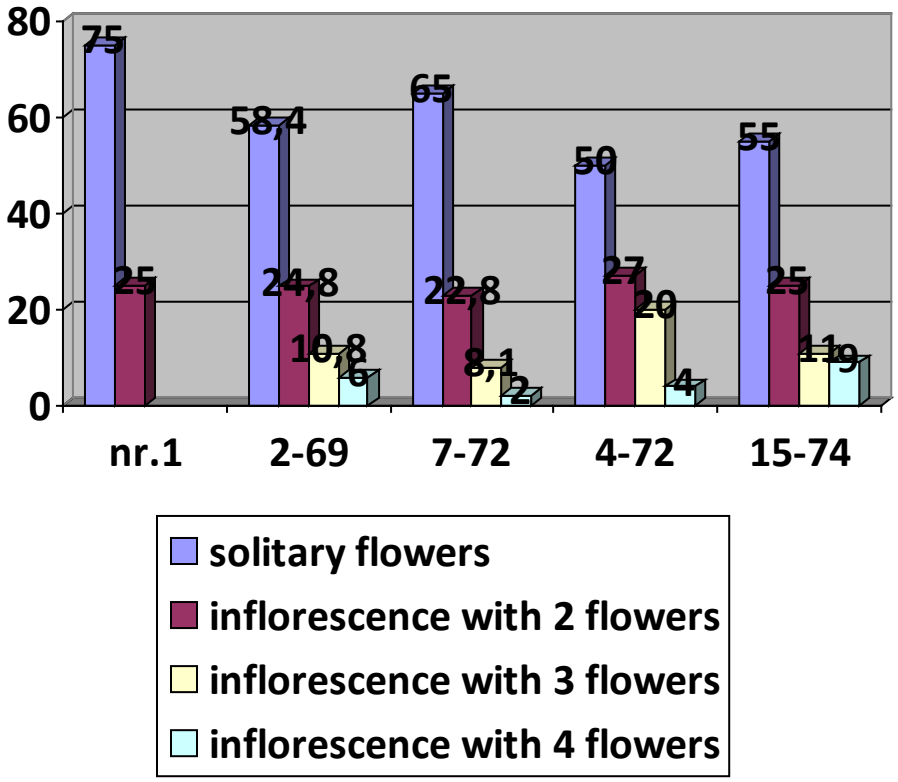


Fig.1. The percentage of flowers in inflorescence

On the basis of examination of cross sections of the pericarp of mature fruits of distant hybrids, it has been found out that they bear certain similarities in tissue zoning from outside to inside (epicarp, mezocarp, differentiated into 4 subzones, and endocarp) to the parental forms. The epicarp of a mature fruit is represented by single layered external epidermis covered by a relatively thick cuticle which constitutes 16.9-34.2 μm, of external-internal type, with the degree of spread from 1/3 up to 1/2 among epidermal cells. The epidermis is composed of polygonal parenchymal cells, tangentially elongated. The mezocarp is the middle tissue layer, the most voluminous part of the pericarp, made up of parenchymal cells. In the fruit mezocarp of the studied hybrids (similar to quince and apple), from outside to inside, there are 4 subzones which succeed one another easily without definite boundaries: the hypodermis, the external subzone of oval-rounded cells, the subzone of radial oval-elongated cells and the internal

subzone of oval-rounded cells. The endocarp of the fruits of distant hybrids Cydonia x Malus is the internal histological zone, represented by the internal epidermis consisting of a layer of cells of 28-35 μm, well wrapped, elongated on the tangential axis and arranged in the form of parquet, with thickened cell walls. The results of this study show that the pericarp of hybrids blends diversely the characteristic traits of both parents. Analyzing data from Tab.1, we can conclude that the studied progenies differ from each other and from other hybrid forms in the thickness of cuticle and parchment layer, the size of epidermal cells (tangential and radial) and parenchymal cells from the subzones of the mezocarp (hypodermis, the subzone of oval-rounded and oval-elongated cells), the density and arrangement of sclereids in mezocarp.

In paternal triploids, the uneven thickness of the cell walls of epidermal cells, the absence of sclereids in the external subzone of oval-rounded cells and the shape of endocarp cells typical of apple dominate in the structure of pericarp, and the size and the shape of cells from other subzones of the mezocarp was inherited intermediary. Tetraploids are distinguished from other hybrid forms by larger pericarp cells (Tab.1).

Our research confirms the similarities (dominance of characters of generative organs of apple) in the morpho-anatomical and biochemical peculiarities of vegetative and reproductive organs (seeds) of paternal triploid distant hybrids (2, 3, 4, 8, 10, 11, 13, 14).

Tab.1. Anatomical characters of the fruit pericarp of quince x apple hybrids

	Epicarp			Mesocarp (fundamental parenchyma)				
		Cell size, μm		Parenchymal cell size (μm)				
						S/zone of oval-elongated cells		
		Diameter						
Hybrid forms	Thickness of the cuticle, μm	tangential	radial	hypoderm	s/external zone of oval-rounded -cells	Radial diameter	Tangential diameter	S/internal zone of oval-rounded -cells
2-69	17,1-28,5	19,9-28,5	28,5-39,9	57,1-102,1	279,3-404,7	199,5-211,6	114,2-171,3	85,5-114,1
7-72	17,1-28,9	17,1-25,7	22,8-38,9	28,5-68,4	193,1-285,2	68,4-188,1	114,1-142,5	51,3-85,5
4-72	16,9-34,2	11,4-17,1	34,2-39,8	51,3-85,5	387,1-477,9	68,3-142,1	68,4-108,2	57,2-86,5
15-74	17,0-29,1	18,2-27,4	28,3-37,8	52,4-88,3	362,3-453,6	70,5-167,3	103,5-132,3	56,8-92,3
13-72	17,0-22,8	17,1-22,8	34,2-39,9	57,1-60,2	108,2-165,0	239,4-399,0	91,2-142,0	96,9-114,0
Nr.25	17,1-28,6	17,1-28,5	22,8-45,6	45,6-68,4	85,5-205,2	228,1-427,0	46,2-68,3	74,0-119,7
33-72	22,8-34,2	28,5-39,9	45,4-68,4	51,3-62,7	114,0-199,5	210,9-319,2	79,8-114,0	102,6-114,1
1-72	17,1-28,5	25,6-39,9	39,9-45,6	45,6-68,4	142,5-199,5	319,2-484,5	57,1-114,1	68,4-85,5

CONCLUSIONS

The studied hybrids differ qualitatively (in the uneven thickening of the cell walls of epidermal cells, in the location and density of sclereids in the subzones of the mesocarp, in the shape of the exocarp and endocarp) and quantitatively, in the size of cells from the zones and subzones of the pericarp.

A distinguishing feature of distant hybrids is the number of flowers in an inflorescence: 1-4, but solitary flowers predominate in 50-65% of paternal triploids. Solitary flowers predominate in 97-99% of maternal triploids and tetraploids and 1-3% of them have inflorescences with 2 flowers. It has been established a directly proportional correlation between the polyploidy level and the size of the pollen grain. Tetraploid plants are distinguished by higher pollen viability (56-67%) as compared with other hybrids, the viability of the pollen of which reaches 10%.

The researched hybrid plants differ in the shape, size and colour intensity of fruits.

The results of the morpho-anatomical research can be used to develop a program on fruit tree improvement and further testing of resistance of hybrids from (subfam. Pomoideae) fam. Rosaceae.

BIBLIOGRAPHY

1. Codreanu V. Anatomia comparată a viţei de vie (Vitis L.). Chişinău 2006. – 252 p.
2. Onica E. Moştenirea caracterelor morfo-anatomice ale peţiolului frunzei la hibrizi distanţi F2 gutui x măr (Cydonia x Malus).Genetica şi ameliorarea plantelor şi animalelor în Republica Moldova,Materiale ştiinţifice ale Congresului VII (jubiliar) a Societ.Ştiinţ. a Geneticienilor şi Amelioratorilor din Republica Moldova.Chişinău.10-11 decembrie.1998.P.308-310.
3. Onica E. The inheritance of traits of pericarp in intergeneric hybrids guince x apple (Cydonia x Malus). Abstracts XXV International Horticultural Congress „Science and Horticulture Interfaces and Interactions. Brussels.2-7 august 1998.P.470.
4. Onica E. Anatomia comparată a peţiolului frunzei la hibrizii distanţi F2 Cydonia x Malus de tip patern. Mater. Simp. Şt. intern. „Conservarea diversităţii plantelor consacrat aniversării a 60-a de la fondarea Grădinii Botanice (I) a A.Ş.M.,Chişinău. 2010. P. 88-91.
5. Габриелян-Бекетовская Э. А. О прорастаемости пыльцы айвы. Изв.АН Арм.ССР.Биол. и с-х. науки.1950 . Т.III. №6
6. Голубинский И.Н. Биология прорастания пыльцы.Киев.1974.
7. Лакин Г.Ф. Биометрия.Изд.4-е. М. Высшая школа.1990.
8. Негру Е.И.Руденко И.С. Особенности анатомического строения черешка и листа разногеномных гибридов айва х яблоня .Тезисы локладов.1 Всесоюзная конференция по анатомии раастений.Л.1984.С.114-115.
9. Никитин А. А., Панкова И.А. 1982. Анатомический атлас полезных и некоторых ядовитых растений. Л.:Наука, С. 13-31.
10. Оника Е.И. Особенности анатомической структуры гибридов айва х яблоня. Автореф. дисс. канд. биол. наук. Кишинэу, 1993, 20 с.
11. Руденко И. С. 1978. Отдаленная гибридизация и полиплоидия у плодовых растений. Кишинев:Штиинца, 196 с.
12. Фурст Г. Г. 1979. Методы анатомо-гистохимического исследования растительных тканей. М.:Наука, 156 с.
13. Руденко И.С.,Ротару Г.И. Морфология и анатомия семян разногеномных гибридов айва х яблоня. Интродукция,отдаленная гибридизация растений и озеленение. Ботанические исследование. Вып.2.,Кишинев.1992. С. 46-52.
14. Руденко И.С.,Рихтер А.А. Биохимический состав плодов гибридов между айвой, яблоней и грушей. Интродукция,отдаленная гибридизация растений и озеленение. Ботанические исследование. Вып.2.,Кишинев.1992. С. 52-63.

II. CONSERVATION OF BIOLOGICAL DIVERSITY

CZU: 633.582:635.5(478)

BIO-ECOLOGICAL PECULIARITIES OF *NEPETA PANNONICA* L. UNDER *IN SITU* AND *EX SITU* CONDITIONS

[1]Veaceslav Ghendov, [1]Nina Ciocarlan, [2]Doina Danila

[1]Botanical Garden (Institute) of the Academy of Sciences of Moldova

[2]"Stejarul" Biological Research Centre, Piatra Neamt, Romania

Abstract: The paper presents biological and ecological peculiarities of Nepeta pannonica L. (syn. Nepeta nuda L.) under in-situ and ex-situ conditions in Republic of Moldova. Two types of natural habitats were identified and characterized. The domestication performance as a method of conservation and for the future demand of plant production was evaluated. Trial on phenology and biomorphological peculiarities of the plants were set up in order to elucidate the effects of cultivation.

Key words: Lamiaceae, N. pannonica, natural habitat, biology, ecology, cultivation

INTRODUCTION

The genus Nepeta L. (Lamiaceae family) includes over 250 predominantly herbaceous species widespread in Eurasia, North Africa, North and Central America and the Canary Islands [15, 17]. It is one of the largest and economically important genera in the Nepetoideae subfamily.

In spontaneous flora of the Republic of Moldova Nepeta L. genus is represented by three species (Nepeta cataria L., N. pannonica L. and N. parviflora Bieb.) [12].

Foto 1. Nepeta pannonica (Landscape reservation "Carbuna")

Present study refers to N. pannonica L. (syn. Nepeta nuda L.) (foto 1.) species distributed from Mediterranean, central and Eastern Europe and extends to central Russia, Caucasus, south-west and Middle Asia, Siberia, Mongolia and China [6, 17].

N. pannonica L. is an herbaceous, perennial plant, stems erect 50–120 cm. Leaf blade oblong-ovate or oblong-elliptic to lanceolate, 3.8–6.5×1.8–2.5 cm, adaxially greenish, sparsely puberulent or subglabrous, abaxially pale, pubescent, base truncate or shallowly cordate, margin crenate or serrate, apex obtuse to acute or acuminate. Cymes numerous, axillary, many flowered, in terminal panicles 3–8.5×2.5 cm; bracts and bracteoles linear, 1.5–2.5 mm. Calyx tubular, 3–4×1–1.2 mm, pubescent; teeth subequal, 1.1–1.3 mm. Corolla purplish, 5.5–8.5 mm, sparsely pubescent. Nutlets brown, oblong, 1.6×1.1 mm, glabrous, sparsely hairy.

In local flora grows in grasslands of the forest zone (central and northern districts), along valley streams, forming groups of (5)10-30(100) individuals.

Bibliographic data indicate numerous studies on chemical composition of the essential oil obtained from *N. pannonica* and its therapeutic importance [2, 4, 8, 11, 13, 16]. Documentary study confirm also that the aerial part of the plant possesses laxative, febrifuge, tonic, antiseptic, anti-inflammatory, antispasmodic, antimicrobial, and antioxidant activities [1, 2, 7, 18] of this species indicated by traditional medicine.

Despite being widely used as medicinal plant, the bio-ecological peculiarities and chemical composition of this species growing in Republic of Moldova was not investigated. No floristic inventories regarding the distribution and ecological characteristics of this species in local flora have been performed.

The investigations reveal the natural distribution and habitat preferences of *N. pannonica* in the native flora and the behavior of this plant in *ex situ* conditions at the experimental fields of the Botanical Garden (I) of ASM.

MATERIALS AND METHODS

This research was initiated in the spring of 2013. Fieldwork was carried out in the central and southern parts of the republic in order to identify the sites of the species occurrence. The field studies were preceded by an extensive literature survey regarding this medicinally important species. An ample revision of voucher specimens from the Herbarium of the Botanical Garden (I) of ASM was performed.

The designation of Habitat types were made according to NATURA 2000 (Interpretation Manual of EU Habitats, 2007, Directive 92/43/EEC) on the basis of scientific criteria defined in Annex III of the Directive [9].

In order to determine the abundance of the species in studied locations the DAFOR scale (an internationally recognized abundance scale for counting wildlife and other populations. The following is a quantitative definition of frequency: dominant: >250; abundant: 51-250; frequent: 21-50; occasional: 6-20; rare: 1-5; absent: 0) were used [14].

The biological forms and flora elements have been ascertained according to the V. Ciocarlan [3] and the values of the ecological indices have been establish using the works signed by Ellenberg H. [5] and Kovács J.A. [10].

The field experiments were carried out in the growing seasons 2013 and 2014 at the experimental section of medicinal plant collection of Botanical Garden (I) of ASM in order to evaluate its domestication performance.

Plant material

The vegetal material (parts of plants) for creating *ex situ* experimental plots were collected in April 2013 (third decade) from Scientific reservation "Codru", near Lozova village, Straseni district and in the second decade of May near Zloti village.

Plant row arrangement experiment

A two-factorial experiment based on randomized complete block design with three replicates was set up with row spacing of 40 and 50 cm and inters row spacing of 30 and 40 cm. Plant transplanting was followed by immediate irrigation and then further irrigation every week. Weeds were controlled by hand when needed.

Phenological observations

For recording phenological phases (initial growth, budding, start of flowering, full flowering, start of seed setting, full seed set, fully mature) on a weekly basis, ten plants were selected and marked from each experimental plot. The phenological stages were determined when 50% of all individuals in each experimental variant reached that stage.

Fig 1. • Landscape reservation "Carbuna", Cimislia district
• Garnetz forest, Miresti village, Nisporeni district

RESULTS AND DISCUSSIONS

During the field expeditions two growing sites for *Nepeta pannonica* were identified and described natural habitat: Eastern white oak woods (code number 91AA). The study was performed in two locations: Landscape reservation "Carbuna", Zloti village, Cimislia district (N 46° 42' 04", E 28° 54' 36") and Garnetz forest with *Quercus pubescens* near Miresti village, Nisporeni district (N 46° 59' 48", E 28° 16' 22") (Fig. 1).

The abundance of the *N. pannonica* species according to DAFOR scale in all recorded sites was

determined as frequent in first location and abundant in second one. This abundance index indicates the possibility for this species to be harvested in the wild without any damage to the species subpopulations.

The natural habitat of *N. pannonica* (Eastern white oak woods with *Quercus pubescens*) is represented by phytocenosis edified by Sub-Mediterranean species. Tree layer is composed exclusively of downy oak (*Quercus pubescens*) or oak (*Quercus robur*) and rare specimens of *Tilia tomentosa, Acer campestre, Pyrus pyraster, Sorbus domestica, Carpinus orientalis.* It has low coverage (20-50%) and 8-10 m height. Shrub stratum, always vigorously developed is composed almost exclusively of *Cotinus coggygria,* covering up to 70%, but locally with high patches of *Prunus spinosa* and *Crataegus monogyna*. Herbaceous and under shrubs layer variable developed, depending on the coverage of shrub layer is composed from xerophytes species (*Lithospermum purpurocoeruleum, Asparagus verticillatus, A. tenuifolius, Carex michelii* etc.).

The floristic composition includes edifying species: *Quercus pubescens, Cotinus coggygria.* Other important species (*Asparagus tenuifolius, A. verticillatus, Bromus inermis, Brachypodium sylvaticum, Carex michelii, Dactylis polygama, Filipendula vulgaris, Fragaria viridis, Geum urbanum, Lathyrus niger, Melica uniflora, Mercurialis perennis,* ***Nepeta pannonica***, *Poa nemoralis, Polygonatum hirtum, Tanacetum corymbosum, Teucrium chamaedris, Thlaspi perfoliatum, Thalictrum minus, Vicia tenuifolia, Vinca herbacea, Vincetoxicum hirundinaria* etc.) were identified.

The ecological studies reveal that according to ecomorphs, the most numerous group is hemichriptophytes with 77 species that represent cca 49% of registered taxa (fig. 2).

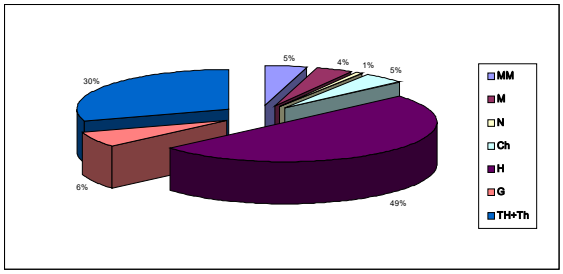


Fig. 2. Spectrum of bioforms

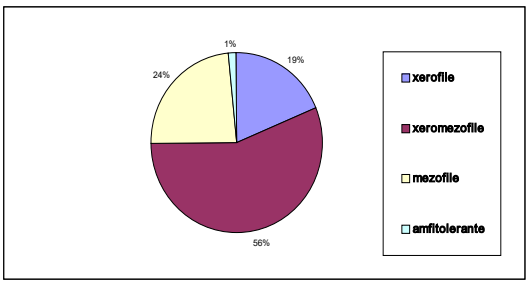


Fig. 3. Spectrum of humidity

Therophytes requirementsare represented by 46 species (29,9%), followed by geophytes with 10 species (6,5%), chamaephytes and megaphanerophytes represented by 7 species (5%) each, microphanerophytes and nanophanerophytes with 6 and 1 species respectively.

The domination of xeromesophytes (with 86 species or 55,8%) and xerophytes (29 species or 18,8%), followed by mesophytes represented by 37 species (24%) and amphytolerant with 2 species (1,3%) represents the arid nature of Ponto-Sarmatic forest vegetation (fig. 3).

With respect to the temperature the natural habitat of *N. panonnica* are characterized by the absolute presence of the mesotherm species (38,96% – 60 species) followed by moderate-thermophile (27,27% - 42 species) and thermophile (25,97% - 40 species). The amphytolerant and microtherm species are represented by 9 species (5,84%) and 3 species (1,95%) respectively (fig. 4).

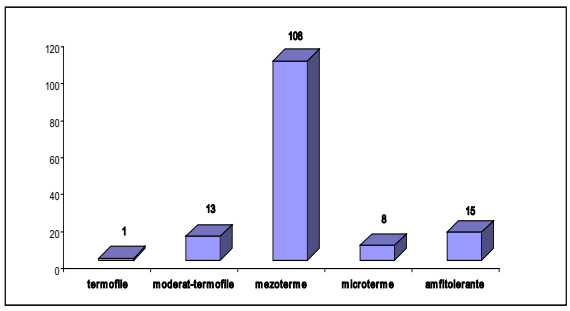


Fig. 4. Spectrum of temperature requirements

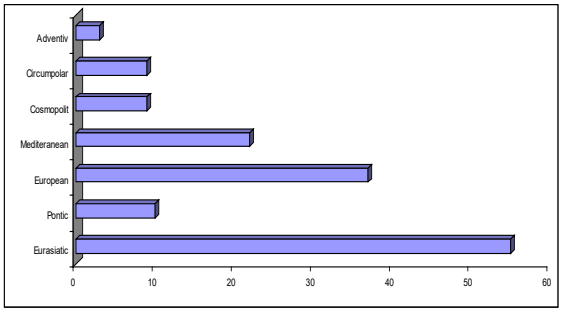


Fig. 5. Spectrum of phytogeographic elements

From a phytogeografic point of view, it is noticed high presence of submediterranean floristic elements (Mediterranean – 25,97% with 40 species), Pontic – 18,83% (29 sp.) and Balcanic – 3,25%)

characteristic to thermophilous, sub-Mediterranean *Quercus pubescens* woods of the west pontic regions including central and southern parts of republic. The Eurasiatic (32,46% – 50 species) and European (16,23% – 25 species) elements denotes a characteristic natural geographic features with highly divers landscape and rich natural flora. Less in number are cosmopolite and adventive elements with 2 species (1,3%) and 1 species (0,65%) respectively (fig. 5).

Foto 4. Nepeta pannonica (Collection of medicinal plants, July, 2013)

The results of the first experiments on domestication of *N. pannonica* show that this species can be cultivated and established successfully in artificial conditions outside its natural habitat.

The initial growth of the plant in the first vegetative period was slow and only after the formation of two or three pairs of leaves the growth enhanced. By the third decade of June the plant height reached 10-12 cm. In early July the height of adult vegetative individuals ranged from 40 to 45 cm. Some of them remained in a vegetative state until the end of the growing season, as they have developed more slowly.

The major part of the individuals (87%) reached the generative phase. Four life periods (latent, pregenerative, generative, postgenerative) and 6 stages (plantlets, juvenile, immature, virginal, generative, senile) in the cycle of the development of *N. pannonica* were highlighted.

Height of plants varies from 95 cm to 130 cm (foto 2.). On experimental plots species develops bushy plants of 4-7 stems. The flowering period started 20-22 days after transplanting (table 1.) in the field. At flowering stage plant diameter reaches up to 35 cm. The whole growth period of the species was nearly 123-125 days under field conditions.

Table 1. Phenological phases of *N. pannonica* under *ex situ* conditions

Phenological phase	plant trans-planting	vegetative growth-budding	start of flower-ing- full flowering	full flower-ing- start of seed setting	start of seed set-ting-full seed set	full seed set-final stage
Date	28 April – 16 May	16 May – 5 June	5 June – 26 June	26 June – 3 July	3 July – 1 August	1 August – 20 September
Number of days	20	21	17	15	27	20

For the large scale cultivation of this species, more research in different agronomical aspects (fertilization, harvesting techniques, harvest processing etc.) is required.

CONCLUSIONS

• The natural habitat for *Nepeta pannonica* (Eastern white oak woods with *Quercus pubescens,* code number 91AA) were identified and described.

• The abundance of the species in the recorded sites was determined as frequent in one location and abundant in other one. This abundance index indicates the possibility for this species to be harvested in the wild without any damage to the species subpopulations.

• The ecological studies reveal that the most numerous group is hemichriptophytes with 77 species that represent 49% of registered taxa; the distribution of the species according to humidity preferences show domination of xeromesophytes (with 86 species or 55,8%) and xerophytes (29 species or 18,8%), representing the arid nature of Ponto-Sarmatic Forest vegetation; with respect to the temperature were noted an absolute presence of the mesotherm species (38,96% – 60 species) and from a phytogeografic

point of view high percentage of submediterranean floristic elements (Mediterranean – 25,97% with 40 species), Pontic – 18,83% (29 sp.) and Balcanic – 3,25%) is characteristic to thermophilous, sub-Mediterranean *Quercus pubescens woods of the west pontic regions including* central and southern parts of republic.

• The primary results on cultivation of *N. pannonica* show that this species can be cultivated and established successfully in artificial conditions outside its natural habitat with acceptable bio-morphological parameters.

Acknowledgment: The research was supported by the Bilateral Collaboration Project MD-RO "Assessment and characterization of genetic resources of *Lamiaceae* species with anti-inflammatory potential in order of their *in situ* and *ex situ* conservation" (Nr. 04/RoA/2013-2014).

REFERENCES

1. Alim A., Goze I., Çetin A. et al. Chemical Composition and *in vitro* antimicrobial and antioxidant activities of the essential oil of *Nepeta nuda* L. ssp. *albiflora* (Boiss.) Gams., 2009, A. J. M. R., vol. 3, p. 463.
2. Baser K.H.C., Kirimer N., Kurkcuoglu M., Demirci B. Essential oil of *Nepeta* species growing in Turkey. Chemistry of Natural Compounds, 2000, vol. 36, nr. 4, p. 356-359.
3. Ciocârlan V. Flora ilustrată a României – *Pteridophyta et Spermatophyta*. București: Edit. Ceres. 1138 p.
4. De Pooter H.L., Nicolai B., De Buyiuk L.F. et al. The essential oil of *Nepeta nuda.* Identification of a new nepetalactone diastereoisomer. Phytochemistry, 1987, vol. 26, nr. 8, p. 2311-2314.
5. Ellenberg H. Indicator values of vascular plants in Central Europe. Göttingen: Scripta Geobotanica. Band 9. Verlaf Erich Goltze KG, 1974, 97 p.
6. Gladkova V. N. *Nepeta* L. In Flora partis europaeae URSS, in An. A. Fedorov (eds.), Ed. Nauka, Leningrad, 1978, t. 3, p. 144-149.
7. Gkinis G., Bozin B., Mimica-Dukic N., Tzakou O. Antioxidant activity of *Nepeta nuda* L. ssp. *nuda* essential oil rich in nepetalactones from Greece. J of Med Food, 2010, vol.13, nr. 5, p 1176-1181.
8. Handjieva H. V., Popov S. S., Evstatieva L.N. Constituents of the essential oils from *Nepeta cataria* L., *N. grandiflora* M. B. and *N. nuda* L. Journal of Essential Oil Research, 1996, vol. 8, nr. 6, p. 639-643.
9. Interpretation Manual of European Union Habitats – EUR 27. European Commission DG Environment. Nature and biodiversity. July 2007. 142 pp.
10. Kovács J.A. Indicatorii biologici, ecologici și economici ai florei pajiștilor. M. A. I. A. Acad. Șt. Agr. și Silv. Staș. centr. de cerc. pentru cult. paj. Măgurele – Brașov. București: Centrul de material didactic și propagandă tehnică agricolă. 1979, 50 pp.
11. Kökdil G., Kurucu S., Yildiz A. Essential oil composition of *Nepeta pannonica* L. Flavour Fragr., 1998, vol.13, p. 99-101.
12. Negru A. Determinator de plante din flora Republicii Moldova. Chișinău: Edit. Universul, 2007, 391 pp.
13. Padure I.M., Mihaiescu D., Badulescu L., Burzo I. Chemical constituients of the essential oils of *Nepeta nuda* L. ssp. *nuda* (*Lamiaceae*) from Romania. Rom. J. Biol., 2008, vol. 53, nr. 1, p. 31-38.
14. Padure I.M., Mountford O., Negrean G., Anastasiu P., Bita-Nicolae C. Floristic biodiversity in Vitosha Nature Park, Bulgaria. Acta Horti Bot. Bucurest., 2008, vol. 35, p. 26-35.
15. Pojarkova A.I. *Nepeta* L. In Flora U.R.S.S., in B.K. Shishkin and S.V. Yuzepchuk (eds.), Ed. Akad. Nauk SSSR, Moscva-Leningrad, 1954, t. 20, p. 286-437.
16. Sarer E., Konuklugil B. Composition of the essential oil from *Nepeta nuda* L. ssp. *albiflora* (Boiss.) Gams. J. Ess. Oil. Res., 1996, vol. 8, nr. 6, p. 687-88.
17. Turner C. Nepeta L. In Tutin T. G. et al. (Eds.) *Flora Europaea.* Cambridge: Cambridge University Press, vol. 3, p. 158-160.
18. Zenasni L., Bouidida L., Hancali A. et al. The essential oils and antimicrobial activity of four *Nepeta* species from Morroco. Journal of Medicinal Plant Research, 2008, vol. 2, nr. 5, p. 111-114.

HYPOCHOERIS RADICATA L. (*ASTERACEAE* DUMORT.) IN THE FLORA OF REPUBLIC OF MOLDOVA

Olga Ioniţa

Botanical Garden (Institute) of the ASM, Chisinau

e-mail: o_ionita@mail.ru

Abstract: The paper contains information on the genus Hypochoeris L. in the flora of Republic of Moldova. The field investigations registered Hypochoeris radicata L. – species indicated in the specialized literature, but not confirmed until now in the local flora. The brief taxonomic, bio-ecological, distributional and habitat characteristics of the species are given.

Key words: Hypochoeris radicata L., Asteraceae, taxonomy, flora, Republic of Moldova.

INTRODUCTION

The genus *Hypochoeris* L. (*Asteraceae* Dumort.), in the world flora, includes about 15 species widespread in Europe, Mediterranean region, Asia Minor and South America [10].

The opinion of authors about the taxonomic composition of *Hypochoeris* L. genus differs. In *Flora Europaea*, this genus includes 9 species [2], but in the flora of Romania – 4 species [1, 5], including also *Hypochoeris maculata* L. (=*Achyrophorus maculatus* (L.) Scop.; =*Trommsdorfia maculata* (L.) Bernh.), a taxon assigned to *Trommsdorfia* Bernh. genus, in the flora of the Republic of Moldova [3, 4]. Eastern European fundamental floristic papers assign two species to *Hypochoeris* genus: *H. glabra* L. and *H. radicata* L. [10, 11].

For the flora of the Republic of Moldova, this genus was cited in 1954, by Gheideman T. [7], but in the subsequent basic systematic papers [4, 8, 9], it doesn't appear on the list of generic taxa present in the region. The herbaria collections of the Botanical Garden (I) of the ASM and of the State University of Moldova do not hold exsiccata of the representatives of *Hypochoeris* genus collected in the studied area.

MATERIALS AND METHODS

The determination of the taxonomic belonging of the collected and herbarized botanical material was done according to the classical comparative-morphological method [12]. In carrying out morphological, bioecological and chorological description of taxa, keys for determining species and basic floristic literature regarding the researched territory were consulted [1, 2, 4-7, 10, 11]. The correctness of plant determination was checked by comparison with the exsiccatae collected from the areas near St. Petersburg, in the Russian Federation, and determined by academician N. Tzvelev, stored in the General Herbarium of the Botanical Garden (I) of the ASM. The nomenclature of the taxa was given according to the monograph developed by Cerepanov S. [13].

RESULTS AND DISCUSSIONS

As a result of the floristic field research carried out during 2013-2014, in the wooded districts from the central region of the Republic of Moldova, near Rădenii Vechi commune (Ungheni district), there was found a population of the species *Hypochoeris radicata* L., which occupied about 50 m^2. The total number of specimens was about 20 plants that grew in groups of 2-5 specimens per 1 m^2. They were recorded during the fruiting phase, in a stand of oak with hornbeam and sweet cherry, plot 20 within "Plaiul Fagului" Scientific Reserve.

On the basis of the data obtained in the field, critical analysis of herbarized plant collections and study of specialized literature, the description of *Hypochoeris* L. genus, the synonyms, morphological and bioecological description of the species *Hypochoeris radicata* were prepared and presented below:

Hypochoeris L.

1753, Sp. Pl. : 810 (*Hypochaeris*); id. 1754, Gen. Pl., ed. 5 : 352.

Herbaceous, annual, biennial or perennial plants. They have simple or branched stems. Basal leaves are arranged in rosette, entire or sinuous-toothed to runcinate-pinnate-finely divided, attenuated at the base; cauline leaves scale-like. One or several anthodia, arranged solitarily at the tips of branches. Involucre campanulate, 10-20 mm long; involucral bracts imbricate. Receptacle flat, with many scarious scales. Flowers hermaphrodite, ligulate, yellow. Achenes cylindrical, at least the median ones, usually rostrate. Pappus whitish, with simple or featherlike hairs, arranged within 1-2 rows.

Typus: *H. glabra* L.

***H. radicata* L.** 1753, Sp. Pl. : 811; Гейдеман, 1954, Опред. Раст. Молд. ССР : 297; Васильев, 1964, Фл. СССР, 29 : 200; Катина, 1965, Флора УРСР, 12 : 191; De Filipps, 1976, Fl. Europ. 4 : 309; Гельтман, 1989, Фл. евр. части СССР, 8 : 24; Катина, 1999, Опред. высш. раст. Укр., изд. 2 : 367; Ciocârlan, 2009, Fl. Ilus. Rom. : 851. – *Achyrophorus radicatus* (L.) Scop. 1772, Fl. Carn., ed. 2, 2 : 117. – **Catsear**, **flatweed**, **false dandelion** (Fig. 1).

It is a perennial which may grow up to 20-80 cm tall. Vertical rhizome. Stem glabrous, finely sulcate, branched at the top. Leaves cauline, scale-like, the basal ones arranged in rosette, elliptical or oblanceolate, 5-20 cm long, toothed to runcinate-pinnate-finely divided, usually, hispid. Anthodia cylindrical or campanulate, 20-30 mm in diameter, solitary at the tip of the branches. Involucral bracts glabrous or with hairs on the midrib, arranged in several rows. Flowers ligulate, exserted from involucre. Ligules yellow, sometimes adaxial with a reddish-brown stripe. Achenes ellipsoidal slightly warty, 8-18 mm long, rostrate. Pappus with bristles arranged in two rows: the external ones – 3-6 mm long, scabrous, rarely feathery, the internal ones – 8-12 mm long, feathery. 2n = 8, 16 [1, 10].

Fig. 1. Hypochoeris radicata L. – general aspect

This species is a hemicriptophyte, identified in glades, edge of forests, pastures, sometimes as ruderal plant on roadsides, agricultural fields [5, 10]. It blossoms and bears fruit in June-August. This plant is pollinated by insects. Anemochorous. It belongs to the European geoelement. A mesophilic, mesothermal species that prefers soils with neutral-acid reaction. The specific spreading area of this species includes Western, Central and Eastern Europe, Scandinavian Peninsula, Mediterranean region, Caucasus, Asia Minor, America and Australia [10].

It differs from *Hypochoeris glabra L.* species with similar taxonomic characteristics, in the presence of hispid leaves, long rostrate achenes and perennial character.

CONCLUSIONS

After six decades since the species *Hypochoeris radicata L.* was first cited for the territory of the Republic of Moldova, without indicating any information concerning the places where this taxon had been found, a location where this species grew was recorded and confirmed by the herbarized botanical material

from the collections of the Herbarium of the Botanical Garden (I) of the ASM. During subsequent field investigations, *Hypochoeris radicata L.* may be found in other habitats with similar ecological conditions, which will contribute the chorological data on the spread of this species in the researched area.

BIBLIOGRAPHY

1. Ciocârlan V. Flora ilustrată a României: *Pteridophyta et Spermatophyta*. Bucureşti: Ceres, 2009, p. 851.
2. De Filipps R. A. *Hypochoeris* L. In: Tutin T. G. et al. *Flora Europaea*. Cambridge: Cambridge University Press, 1976, vol. 4, p. 308-310.
3. Ioniţa O. Structura taxonomică şi particularităţile ecologo-corologice ale subfamiliei *Cichorioideae* Kitam. (spaţiul dintre Prut şi Nistru). Autoreferatul tezei de doctor în ştiinţe biologice. Chişinău, 2014, 30 p.
4. Negru A. Determinator de plante din flora Republicii Moldova. Chişinău: Universul, 2007, 391 p.
5. Nyárády E. *Hypochoeris* L. In: Flora Republicii Populare Române, v. 10, Bucureşti: Editura Academiei Republicii Populare Române,1965, p. 35-44.
6. Popescu A., Sanda V. Conspectul florei cormofitelor spontane din România / Acta Botanica Horti Bucurestiensis. Bucureşti: Ed. Universităţii din Bucureşti, 1998, p. 231.
7. Гейдеман Т. С. Определитель высших растений Молдавской ССР. Москва-Ленинград: Изд. Академии Наук СССР, 1954, с. 296-306.
8. Гейдеман Т. С. Определитель высших растений Молдавской ССР. Кишинев: Штиинца, 1975, 2-е изд., с. 515-533.
9. Гейдеман Т. Определитель высших растений МССР. Кишинев: Штиинца, 1986, 3-е изд., с. 567-586.
10. Гельтман Д. Род *Hypochoeris* L. В: Флора европейской части СССР. Ленинград: Наука, 1989, т. 8, с. 24-26.
11. Катина З. Род *Hypochoeris* L. Определитель высших растений Украины. Киев: Фитосоциоцентр, 1999, 2-е изд., с. 367.
12. Коровина О. Н. Методические указания к систематике растений. Ленинград: ВИР, 1986, 210 с.
13. Черепанов С. Сосудистые растения России и сопредельных государств. Санкт-Петербург: Мир и семья-95, 1995. 990 с.

SYNOPSIS ON GENUS *ASTRAGALUS* L. *(FABACEAE)* SPECIES IN DNIESTER-PRUT RIVER REGION

T. Izverscaia

Botanical Garden (I) of ASM, Chisinau, Republic of Moldova

Abstract: The article brings the list of the biggest genus in the Fabaceae Lindl. family – Astragalus L., which embodies 20 species in the Dniester-Prut region. The dichotomic key for genera Astragalus, as well as the brief ecological and habitat characters for each species are given.

Key words: flora, Fabaceae, Astragalus, biology, ecology.

INTRODUCTION

The maintenance of floristical diversity nowadays is based on fundamental monographic studies and knowledge (in fundamental and practical aspect) on separate taxonomic groups. Genus *Astragalus* L. – ancient, heterogeneous, variable in morphology and ecological characteristics, takes tone of the central position in system of family *Fabaceae* Lindl. It plays a significant role in vegetation cover and is an important component in structure of the grassland cover of the region. There are many fodder, melliferous, decorative and medicinal species in the given genus.

MATERIAL AND METHODS

During our investigation concerning genus *Astragalus* for the flora of Dniester-Prut region we performed all necessary research on field and laboratory examination. Firstly we reviewed all published information on the presence of species in the territory, and consulted specimen materials in different scientific herbaria (Herbarium of the Botanical Garden (Institute) of ASM, Herbarium of the State University of Moldova (Chisinau), Herbarium of the Botanical Institute Komarov (Sankt-Petersburg, Russian Federation), Herbarium of National Museum of Ethnography and Natural History of Moldova (Chisinau), etc.

RESULTS AND DISCUSSIONS

Genus *Astragalus* L. is the largest in the family *Fabaceae* which comprises over 2200 species, represented world wide, with exception of Australia [3,7]. In the local flora it embodies 20 species.

Genus ***Astragalus*** L. – **Coșaci. – Астрагал.**
Linnaeus, 1753, Sp. Pl. : 755
LT.: ***A. christianus*** L.

Key to species of *Astragalus*

1. Hairs on leaves and stems simple 2
– Hairs on leaves and stems medifixed 8
2. Plants caulescent or almost so (stems with height up to 3 cm), the peduncles or racemes arising from a rosette of leaves 3
– Plants caulescent, with leaves separated by well-developed inter nodes 4
3. Standard glabrous ..... 4. ***A. exscapus***
– Standard hairy on back ..... 3. ***A pubiflorus***
4. Legume curved to form a ±complete ring, wrinkled ..... ***A. contortuplicatus***
– Legume not forming a ring, smooth 5
5. Legume 3-4 cm, slightly curved. Leaves with (3-)4-6(-7) pairs of leaflets. Calyx glabrous or with black hairs on the teeth ..... 1. ***A. glycyphyllos***
– Legume 0,7-2 cm, straight. Leaves with 8-20 pairs of leaflets. Calyx entirely hairy 6
6. Racemes with peduncles up to 1,5 cm. Legume 7 x 4 mm ..... 7. ***A. ponticus***

– Racemes with peduncles 5-15 cm. Legume 10-20 x 8-10 mm 7
7. Calyx black hairy. Standard 12-16 mm, glabrous. Legume ovoid-globose, inflated, with short, black and white hairs ..... 5. ***A. cicer***
– Calyx white villous. Standard 17-20 mm, hairy on back. Legume ovoid, trigonous, uninflated, white villous ..... 2. ***A. dasyanthus***
8(1). Calyx strongly inflated in fruit 9
– Calyx scarcely inflated in fruit 12
9. Corolla (vexil and wings) purple with white keel ..... 18. ***A. albidus***
– Corolla whitish or light-yellow 10
10. Calyx-teeth up to 7 mm. Legume only with white hairs ..... 17. ***A. glaucus***
– Calyx-teeth 2-4 mm. Legume with white long and black short hairs 11
11. Plants 15-20 cm. Leaflets 4-5 mm wide. Calyx 10-15 mm. Standard obovate ..... 20. ***A. pseudoglaucus***
– Plants 25-40 cm. Leaflets 1,5-2 mm wide. Calyx 7-8 mm. Standard oblong..19. ***A. pastellianus***
12(8). Calyx with 2 bracts at base ..... 12. ***A. monspessulanus***
– Calyx without bracts at base 13
13. Plants with basal rosette. Racemes with peduncles very short or absent ..... 11. ***A. dolichophyllus***
– Plants without basal rosette. Racemes with peduncles long 14
14. Racemes umbelliform-globose or globose 15
– Racemes umbelliform-globose or globose 16
15. Racemes 1,5-2 cm, lax, umbelliform-globose, with 3-5 flowers. 2-3 mm ..... 13. ***A. corniculatus***
– Racemes 1,5-5 cm, dense, globose, elongate in fruit, with 10-20 flowers. Stipules up to 12 mm..... 10. ***A. onobrychis***
16. Corolla bicolorous (blue and violet) 17
– Corolla unicolorous (white, blue or purple) 18
17. Leaflets 8-15 pairs, oblong or eliptic-lanceolate, subglabrous, 1-3 mm wide. Calyx 2-3 mm. Corolla 5-8(10) mm. Legume 5-12 mm ..... 9. ***A. austriacus***
– Leaflets 2-7 pairs, narrowly linear up to filiform, appressed-hairy beneath, glabrous above, up to 1 mm wide. Calyx 8-12 mm. Corolla 17-23 mm. Legume 15-35 mm ..... 14. ***A. subuliformis***
18. Racemes elongate up to 30 cm in fruit. Corolla purple ..... 15. ***A. varius***
– Racemes elongate up to 10-12 cm in fruit. Corolla white or yellow **19**
19. Corolla white. Leaflets 0,7-1,2 cm. Flowers in racemes lax ..... 6. ***A. pallescens***
– Corolla yellow. Leaflets 1,5-3 cm. Flowers in spikes dense ..... 8. ***A. asper***

Subgenus 1. ***PHACA*** (L.) Bunge

1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 25, p. p. – ***Phaca*** L. 1753, Sp. Pl. : 755

LT.: ***A. frigidus*** (L.) A. Gray.

Sectio 1. ***Glycyphylla*** Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 25.

LT.: ***A. glycyphyllos*** L.

1. *A. glycyphyllos* L. 1753, Sp. Pl. : 758; Гонч. и Борис. 1946, Фл. СССР, 12 : 91; Вісюл. 1954, Фл. УРСР, 6 : 455; Guşul. 1957, Fl. RPR, 5 : 273; Chater, 1968, Fl. Europ. 2 : 115; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3 : 317; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 58; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 195; Negru, 2007, Determ. plant. fl. R. Moldova : 154; Ciocârlan, 2009, Flora ilustrată a României : 386. – **C. glicifil. – А. сладколистный.**

The area of distribution is most parts of Europe, except the extreme north, but mainly on mountains in the south, Asia Minor, the Caucasus, Western Siberia (EuaV [1]). It is common for the Dniester-Prut river region (with exception of southern parts). Grows in the forest areas, under the trees, in clearings and forest edges, in meadows, sometimes on limestone slopes. Flowers in May-July.

Subgenus 2. ***ASTRAGALUS***

Subgen. ***Caprinus*** Bunge, 1880, Изв. Общ. любит. естествозн. антроп. этногр. 26, 2 : 218. – Subgen. ***Phaca*** Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 18, p.p.

T.: ***A. christianus*** L.

Sectio 2. ***Erionotus*** Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 39.

LT.: ***A. erionotus*** Benth.

2. *A. dasyanthus* Pall. 1776, Riese, 3 : 749; Гонч. и Борис. 1946, Фл. СССР, 12 : 114; Вісюл. 1954, Фл. УРСР, 6 : 456; Guşul. 1957, Fl. RPR, 5 : 274; Chater, 1968, Fl. Europ. 2 : 116; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3 : 317; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 58; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 194; Negru, 2007, Determ. plant. fl. R. Moldova : 154; Ciocârlan, 2009, Flora ilustrată a României : 386. – **Zăvăcustă.** – **А. шерстистоцветковый**.

The area of distribution is South-Eastern Europe (Balc-Pont). It is met in all parts of the local flora excluding extreme South. Grows in steppe slopes with chernoziomic soil, sometimes on sandy and limestone grounds, in clearings of arid forests and shrub stands. Flowers in May-July.

Protection status: protected in Republic of Moldova (ELRM[12]), Romania (RBR [3]) and Ukraine (RBU[24]).

3. *A. pubiflorus* DC. 1802, Astrag. : 216; Гонч. и Борис. 1946, Фл. СССР, 12 : 117; Вісюл. 1954, Фл. УРСР, 6 : 458; Guşul. 1957, Fl. RPR, 5 : 277; Chater, 1968, Fl. Europ. 2 : 116; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3 : 317; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 59; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 194; Negru, 2007, Determ. plant. fl. R. Moldova : 154. – *A. exscapus* L. subsp. *pubiflorus* (DC.) Soó: Ciocârlan, 2009, Flora ilustrată a României : 386. – **C. pubiflor.** – **А. пушистоцветковый**.

The area of distribution covers Ukraine and adjacent regions of Southern and Central Russia; outlying stations in East Romania and Bulgaria (Balc-Pont). The species is rare in local flora, met only on steppe slopes in the center and south. Flowers in April-May.

Protection status: protected in Republic of Moldova (ELRM, RBRM[35]) and Romania (RBR).

Sectio 3. ***Myobroma*** (Stev.) Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 33.

LT.: ***A. exscapus*** L.

4. *A. exscapus* L. 1771, Mant. Pl. Alt. : 275; Гонч. и Борис. 1946, Фл. СССР, 12 : 213; Guşul. 1957, Fl. RPR, 5 : 278; Chater, 1968, Fl. Europ. 2 : 116; Гейдеман, 1975, Опред. высш. раст. Молд. ССР, изд. 2 : 287; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 59; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 194; Ciocârlan, 2009, Flora ilustrată a României : 385-386, pro syn. *A. exscapus* L. subsp. *exscapus*. – **C. acaul.** – **А. бесстебельный**.

The area of distribution includes Central and south-western parts of Eastern Europe, Mediterranean region (Medit-Pan-Pont). Rare in Dniester basin and in southern parts of the region. Grows on steppe and limestone slopes. Flowers in April-May.

Protection status: protected in Ukraine (RBU).

Subgenus 3. HYPOGLOTTIS *Bunge*

1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 46. – ***Cystium*** Stev. 1856, Bull. Soc. Nat. Moscou, 29, 3 : 147

LT.: ***A. hypoglottis*** L.

Sectio 4. ***Hypoglottioidei*** DC. 1825, Prodr. 2 : 281, s. restr. – Sect. ***Eu-Hypoglottis*** Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 47, 50, nom. illeg.

T.: ***A. hypoglottis*** L.

5. *A. cicer* L. 1753, Sp. Pl. : 757; Гонч. и Борис. 1946, Фл. СССР, 12 : 249; Вісюл. 1954, Фл. УРСР, 6 : 461; Guşul. 1957, Fl. RPR, 5 : 281; Chater, 1968, Fl. Europ. 2 : 114; Гейдеман, 1986, Опред. высш.

[1] geoelement is given by references [3, 6, 7, 8, 11]

[2] Environmental legislation of Republic of Moldova (1996-1998)

[3] Red Book of Romania (2009)

раст. МССР, изд. 3 : 317; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 60; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 194; Negru, 2007, Determ. plant. fl. R. Moldova : 154; Ciocârlan, 2009, Flora ilustrată a României : 386. – **C. năutiu.** – **А. нутовый**.

Distributed from Belgium and North-Central Russia southwards to Northern Spain, Bulgaria and Crimea; occasionally naturalized further north (Eur-Medit). The species is widely distributed in the region in various habitat conditions (forest margins, clearings, shrub stands and different types of grasslands, along roadsides). Flowers in June-August.

Subgenus 4. TRIMINIAEUS *Bunge*

1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 6, p.p.

LT.: ***A. oxyglottis*** L.

Sectio 5. ***Cycloglottis*** Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 8, 17.

Monotipical section.

6. *A. contortuplicatus* L. 1753, Sp. Pl. : 758; Гонч. и М. Поп. 1946, Фл. СССР, 12 : 281; Вісюл. 1954, Фл. УРСР, 6 : 464; Guşul. 1957, Fl. RPR, 5 : 261; Chater, 1968, Fl. Europ. 2 : 111; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3 : 317; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 61; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 193; Negru, 2007, Determ. plant. fl. R. Moldova : 154; Ciocârlan, 2009, Flora ilustrată a României : 385. – **C. răsucit.** – **А. свернутый**.

Distributed in Eastern and Central Europe, extending to North Bulgaria and South-Eastern Russia (Eua). In the region met only in the south (Danube estuary in meadows, wetlands, sometimes on sandy and salty grounds. On the territory of Republic of Moldova this species is probably extinct. Flowers in June-August. Protection status: protected in Romania (RBR).

Subgenus 5. CALYCOPHYSA Bunge

1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 56

LT.: ***A. coluteoides*** Willd.

Sectio 6. ***Alopecias*** (Stev.) Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 58. – ***Alopecias*** Stev. 1856, Bull. Soc. Nat. Moscou, 29, 3 : 143.

LT.: ***A. alopecias*** Pall.

7. *A. ponticus* Pall. 1800, Spec. Astrag. : 14; Горшк. 1946, Фл. СССР, 12 : 387; Вісюл. 1954, Фл. УРСР, 6 : 466; Guşul. 1957, Fl. RPR, 5 : 285; Chater, 1968, Fl. Europ. 2 : 118; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3 : 317; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 65; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 194; Negru, 2007, Determ. plant. fl. R. Moldova : 154; Ciocârlan, 2009, Flora ilustrată a României : 386. – **C. pontic.** – **А. понтийский**.

Distributed in South-East Europe from Bulgaria to South-Eastern Russia (Pont-Medit). It is met through the region as rare species, in arid oak forests, on steppe and limestone slopes. Flowers in May-June.

Protection status: protected in Ukraine (RBU).

Subgenus 6. ***CERCIDOTRIX*** Bunge

1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 94

LT.: ***A. incanus*** Willd.

Sectio 7. ***Pedina*** (Stev.). Bunge, 1868, Mém. Acad. Sci. Péretsb. (Sci. Phys. Math.), sér. 7, 11, 16 : 96. – ***Pedina*** Stev. 1856, Bull. Soc. Nat. Moscou, 29, 3 : 144.

LT.: ***A. asper*** Jacq.

8. *A. asper* Jacq. 1781, Misc. Austr. Bot. 2 : 335; Гонч. 1946, Фл. СССР, 12 : 443; Вісюл. 1954, Фл. УРСР, 6 : 467; Guşul. 1957, Fl. RPR, 5 : 286; Chater, 1968, Fl. Europ. 2 : 120; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3 : 319; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 66; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 195; Negru, 2007, Determ. plant. fl. R. Moldova : 154; Ciocârlan, 2009, Flora ilustrată a României : 390. – **C. aspru.** – **А. шершавый**.

Area of distribution covers Central Europe and southern parts of Eastern Europe (Pont-Pan-Cauc). It is more frequently met in the central parts of the region on steppe and limestone slopes, in forest margins and clearings, shrub stands, rarely in arid grasslands. Flowers in May-September.

Sectio 8. ***Craccina*** (Stev.) Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 97. – ***Craccina*** Stev. 1856, Bull. Soc. Nat. Moscou, 29, 3 : 144.

LT.: ***A. austriacus*** Jacq.

9. *A. austriacus* Jacq. 1762, Enum. Stirp. Vindob. : 263; Гонч. и Борис. 1946, Фл. СССР, 12 : 449; Вісюл. 1954, Фл. УРСР, 6 : 469; Guşul. 1957, Fl. RPR, 5 : 289; Chater, 1968, Fl. Europ. 2 : 120; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3 : 319; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 66-67; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 195; Т.В. Васильева и С.Г. Коваленко, 2003, Консп. флори Півден. Бессарабії : 113; Negru, 2007, Determ. plant. fl. R. Moldova : 154; Ciocârlan, 2009, Flora ilustrată a României : 389. – **C. austriac.** – **А. австрийский**.

Area covers Central and Eastern Europe, Central and Asia Minor, Caucasus, Western Siberia (EuaV). The species is widely met in the region, grows in margins and clearings of arid forests as well as in steppe. Flowers in June-August.

Sectio 9. ***Onobrychium*** Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 100.

LT.: ***A. onobrychis*** L.

10. *A. onobrychis* L. 1753, Sp. Pl. : 760; Борис. 1946, Фл. СССР, 12 : 484; Вісюл. 1954, Фл. УРСР, 6 : 472; Guşul. et Nyár. 1957, Fl. RPR, 5 : 293; Chater, 1968, Fl. Europ. 2 : 120; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3 : 319; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 69; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 196; Negru, 2007, Determ. plant. fl. R. Moldova : 154; Ciocârlan, 2009, Flora ilustrată a României : 391. – **Unghia găii.** – **А. эспарцетный**.

Area of distribution covers Europe, eastwards to Central Ural (EuaV). The species is common in the region, inhabiting margins and clearings of arid forests, steppe slopes, pastures. Flowers in June-September.

Sectio 10. Trachycercis Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 114.

LT.: ***A. dolichophyllus*** Pall.

11. *A. dolichophyllus* Pall. 1800, Spec. Astrag. : 84; Săvul. et Rayss, 1934, Mat. Fl. Bas. 3 : 100; Гонч. и Борис. 1946, Фл. СССР, 12 : 589; Вісюл. 1954, Фл. УРСР, 6 : 476; Guşul. 1957, Fl. RPR, 5 : 295; Chater, 1968, Fl. Europ. 2 : 121; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3 : 318; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 72; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 196; Negru, 2007, Determ. plant. fl. R. Moldova : 154; Ciocârlan, 2009, Flora ilustrată a României : 389. – **C. longifil.** – **А. длиннолистный**.

Distributed in the Central (Romania) and South-Eastern Europe, Caucasus, Central Asia, Western Siberia (Pont-Sarm). In the region met only in the southern districts. Grows on steppe slopes. Flowers in June-July.

Protection status: protected in Romania (RBR).

Sectio 11. ***Proselius*** Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 116.

LT.: ***A. monspessulanus*** L.

12. *A. monspessulanus* L. 1753, Sp. Pl. : 761; Борис. 1946, Фл. СССР, 12 : 606; Вісюл. 1954, Фл. УРСР, 6 : 477; Guşul. 1957, Fl. RPR, 5 : 296; Chater, 1968, Fl. Europ. 2 : 122; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 72; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 196; Ciocârlan, 2009, Flora ilustrată a României : 389. – ***C. montpellier.*** – ***А. монпелийский***.

Distributed in the Central and south-western part of Eastern Europe, Mediterranean region (Pont-Medit). In the region met only in the north on limestone slopes. Flowers in April-September.

Protection status: protected in Romania (RBR).

Sectio 12. ***Xiphidium*** Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 123.

LT.: ***A. xiphidium*** Bunge.

13. *A. corniculatus* Bieb. 1810, Cent. Pl. 1 : tab. 45; Гонч. и М. Поп. 1946, Фл. СССР, 12 : 698;

Вісюл. 1954, Фл. УРСР, 6 : 478; Guşul. 1957, Fl. RPR, 5 : 303; Chater, 1968, Fl. Europ. 2 : 122; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3 : 319; Л. Васил. 1987, Фл. Европ. ч. СССР, 6 : 73; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 197; Negru, 2007, Determ. plant. fl. R. Moldova : 154; Ciocârlan, 2009, Flora ilustrată a României : 389. – **C. corniculat.** – **A. рожковый**.

Area of distribution covers Pontic region, Balkan peninsula, Caucasus (Pont-Balc-Cauc). Species is rarely met in central and southern parts of the region in steppes. Flowers in June-July.

Protection status: protected in Romania (RBR).

14. *A. subuliformis* DC. 1802, Astragal. : 134; Chater, 1968, Fl. Europ. 2 : 122, p. p.; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3 : 319; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 73; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 197; Negru, 2007, Determ. plant. fl. R. Moldova : 154; Ciocârlan, 2009, Flora ilustrată a României : 389. – *A. subulatus* Pall. 1800, Spec. Astrag. : 23, p. p., non Desf. 1799; Гонч. и М. Поп. 1946, Фл. СССР, 12 : 699, cum auct. Bieb.; Guşul. 1957, Fl. RPR, 5 : 304. – *A. pseudotataricus* Boriss. 1946, Фл. СССР, 12 : 701; Вісюл. 1954, Фл. УРСР, 6 : 479; Л. Васил. 1987, l. c. : 73. – *A. ucrainicus* M. Pop. et Klok. 1947, Бот. журн. АН УРСР, 3, 1-2 : 22; Вісюл. 1954, Фл. УРСР, 6 : 479; Л. Васил. 1987, l. c. : 73. – **C. subuliform.** – **A. шиловидный**.

Distributed in the Central (Macedonia, Romania) and South-Eastern Europe, Crimea, Mediterranean region, Caucasus, Minor Asia (Pont-Medit). In the region met only in the south. Grows on steppe slopes. Flowers in June-July.

Protection status: protected in Republic of Moldova (ELRM) and Romania (RBR).

15. *A. varius* S.G. Gmel. 1770, Riese Russl. 1 : 116; Chater, 1968, Fl. Europ. 2 : 123; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3 : 318; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 74; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 197; Negru, 2007, Determ. plant. fl. R. Moldova : 154; Ciocârlan, 2009, Flora ilustrată a României : 390. – *A. virgatus* Pall. 1800, Spec. Astrag. : 20; Гонч. и М. Поп. 1946, Фл. СССР, 12 : 733; Вісюл. 1954, Фл. УРСР, 6 : 483; Guşul. 1957, Fl. RPR, 5 : 299. – **C. variat.** – **A. изменчивый**.

Distributed in Southern parts of Eastern Europe, extending to Eastern Hungary and Bulgaria, Caucasus, Central Asia, Western Siberia (Pont-Sarm). It is rarely met in central and southern parts of the region. Grows on steppe slopes, vineyards and sandy terrain along the Black Sea. Flowers in May-July.

Protection status: protected in Romania (RBR).

16. *A. pallescens* Bieb. 1819, Fl. Taur.-Cauc. 3 : 489; Гонч. и М. Поп. 1946, Фл. СССР, 12 : 735; Вісюл. 1954, Фл. УРСР, 6 : 484; Chater, 1968, Fl. Europ. 2 : 123; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3 : 318; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 74; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 197; Negru, 2007, Determ. plant. fl. R. Moldova : 154. – **C. palescent.** – **A. бледноватый**.

Distributed in southern parts of Eastern Europe (Pont (endemic). The species is rare and met in the region only in the south. Grows in steppes on loess soil, often on sandy grounds. Flowers in May-July.

Protection status: protected in Republic of Moldova (ELRM).

Subgenus 7. ***CALYCOCYSTIS*** Bunge

1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 138

LT.: ***A. cysticalyx*** Ledeb.

Sectio 13. ***Cystoides*** Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 133.

LT.: ***A. vesicarius*** L.

17. *A. glaucus* Bieb. 1808, Fl. Taur.-Cauc. 2 : 186; Guşul. 1957, Fl. RPR, 5 : 308; Chater, 1968, Fl. Europ. 2 : 123; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 76; Negru, 2007, Determ. plant. fl. R. Moldova : 154; Ciocârlan, 2009, Flora ilustrată a României : 390. – *A. dealbatus* Pall. 1800, Spec. Astrag. : 26, p. p., nom. illeg.; Гонч. и Борис. 1946, Фл. СССР, 12 : 711; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3 : 318; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 196. – **C. glauc.** – **A. сизый**.

Area of distribution covers Balkan peninsula, South-Eastern Europe, Crimea (Pont-Balc). It is met in Dniester basin and in the south of the region, mainly on steppes. Flowers in April-June.

Protection status: protected in Ukraine (RBU).

18. *A. albidus* Waldst. et Kit. 1800-1801, Descr. Icon. Pl. Rar. Hung. 1 : 39; Вісюл. 1954, Фл. УРСР, 6 : 486; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3 : 318; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 76; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 197; Negru, 2007, Determ. plant. fl. R. Moldova : 154. – *A. vesicarius* auct. non L.: Гонч. и М. Поп. 1946, Фл. СССР, 12 : 785. – *A. vesicarius* L. subsp. *vesicarius* Chater, 1968, Fl. Europ. 2 : 123, p. p.; Ciocârlan, 2009, Flora ilustrată a României : 390, pro syn. *A. vesicarius* L. subsp. *albidus* (Waldst. et Kit.) Br.-Bl. – **C. alburiu. – А. беловатый**.

Distributed in Central (south-east) and South-Eastern Europe, Crimea, eastern parts of Mediterranean region (Pont-Medit). The species is sporadically met throughout the region, on steppes and limestone slopes. Flowers in April-June.

19. *A. pastellianus* Pollini, 1816, Hort. prov. Veron. plant. nov. : 19; Pânzaru, 2006, Boll. Mus. reg. Sci. nat. Torino, 23, 2 : 723. – *A. vesicarius* L. subsp. *pastellianus* (Pollini) Arcangeli, 1882, Comp. Fl. Ital. : 186; Chater, 1968, Fl. Europ. 2 : 123. – **C. pastelian – А. пастеллийский.**

Distributed in Central (France, Romania) and South-Eastern Europe, Mediterranean region – Italian Alps, Bulgaria (Pont-Medit). The species is rarely met throughout the region on steppes. Flowers in June-August.

Protection status: protected in Republic of Moldova (RBRM).

20. *A. pseudoglaucus* Klok. 1953, Бот. мат. (Ленинград), 15 : 152; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3 : 288; Л. Васил. 1987, Фл. европ. ч. СССР, 6 : 76; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2 : 197; Ciocârlan, 2009, Flora ilustrată a României : 390, pro syn. *A. vesicarius* L. subsp. *pseudoglaucus* (Klok.) Ciocârlan. – **C. pseudoglauc. – А. ложносизый**.

Area of species comprises Pontic region (Pont). The taxa is distributed mainly in the central and southern parts of the region. Grows in steppes, limestone steppe slopes, clearings of the arid oak forests. Flowers in May-June.

BIBLIOGRAPHY

1. Cartea Roşie a plantelor vasculare din România /Dihoru Gh., Negrean G. București: Editura Academiei Române, 2009. 630 p.
2. Cartea Roşie a Republicii Moldova. Chișinău: Ştiinţa. Ed. III. (in edition).
3. Chater A.O. *Astragalus* L. /Flora Europaea, Cambridge University Press, 1968. Vol. 2. P. 108-124.
4. Ciocârlan V. Flora ilustrată a României: *Pteridophyta et Spermatophyta*. București, 2009. 851.
5. Negru A. Determinator de plante din flora Republicii Moldova. Chișinău: Universul, 2007. 391 p.
6. Pânzaru P. Note sistematiche e distributive relaive a *Astragalus pastellianus* Pollini e a *A. peterfii* Jáv. (*Leguminosae*) // Mus. reg. Sci. nat. Torino. Vol. 23, n. 2. P. 721-727.
7. Васильева Л.И. Астрагал – *Astragalus* L. /Флора европейской части СССР. Л.: Наука, 1987. Т. 6. С. 47-76.
8. Вісюліна О.Д. *Astragalus* L. /Флора УРСР. Київ, Видавництво АН УРСР, 1954. Т. 6. С. 449-487.
9. Гейдеман Т.С. Определитель высших растений МССР. Изд. 3-е, Кишинев, Штиинца, 1986. 636 с.
10. Крицкая Л.И. Определитель высших растений Украины. Изд. 2. Киев: Фитосоциоцентр, 1999. С. 193-197.
11. Флора СССР /под ред. Комарова В.Л. М.-Л.: Издательство АН СССР, 1946. Т. 12. 918 с.
12. Червона книга України. Рослинниі світ /під ред. Дідуха Я.П. Київ: Глобалконсалтинг, 2009. 900 с.

BIOECOLOGICAL CHARACTERISATION OF VASCULAR FLORA OF „CODRII" RESERVE

Jardan Natalia

„Codrii" Reserve

Summary: The current flora composition of "Codrii" Reserve was established on the basis of researches carried out in the field and herbarium from the "Codrii" Reserve, Botanical Garden (Institute) of the ASM, State University of Moldova, Tiraspol State University. The reserve`s flora is analyzed under the taxonomical, the bioforms, ecological and phytogeographical aspects.

INTRODUCTION

To research the flora of „Codrii" Reserve have contributed T. Gheideman, L. Nikolaeva and others. (1980); Гавриленко Н. А. (1988), V. Chirtoacă, A. Istrati, Şt. Manic (1996); P. Pînzaru, N. Sturza (1993); A. Negru, N. Jardan. (2011) and others [16, 2, 9, 8]. However the presence in the field of vascular plant species has not been confirmed and no herbarium of plant species indicated by some authors on the "Codrii" Reserve territory. Therefore it was necessary to make an inventory of flora of the "Codrii" Reserve. These works were carried out in the period of years 2008-2013.

MATERIAL AND METHODS

The researches were performed within the "Codrii" Reserve`s boundaries (area of 5170.7 ha). The current flora composition of "Codrii" Reserve was established on the basis of researches carried out in the field and herbarium from the "Codrii" Reserve, Botanical Garden (Institute) of the ASM, State University of Moldova, Tiraspol State University. In the field was used itinerary method. During the research and study process the comparative – morphological method was used [19]. For the determination of the plants were consulted: Флора СССР (1934-1960), *Flora R. P. Române* (1952-1976), Флора Европейской Части СССР (1974-1994), Флора Восточной Европы (1996, 2001, 2004), *Flora Europaea* (2001), Т. Гейдеман. Определитель высших растений Молдавской ССР (1986), A. Negru. *Determinator de plante din Flora Republicii Moldova* (2007), V. Ciocârlan. *Flora Ilustrată a României* (2009) ş. a. [23, 6, 22, 21, 5, 17, 7, 3].

The values of ecological categories, bioforms and phytogeographical elements of vascular plants species were taken over and specified according to the fundamental works: A. Popescu, V. Sanda (1998), V. Sanda, and others (2003) [10, 11]. Elaboration of bioforms spectra, ecological groups and phytogeographical elements was performed according to methods described in the ecological and geobotanical study of vegetation from Romania [4].

RESULTS AND DISCUSSIONS

Taxonomical analysis. Based on the investigations the taxonomic composition of the flora of "Codrii" Reserve has been established, which includes 808 species of vascular plants assigned to phylums *Equisetophyta*, *Pteridophyta* and *Magnoliophyta*.

The highlighted species of plants belong to 95 families and 393 genera. The most reprezentative families are: *Asteraceae* – 118 species (14,6%), *Poaceae* - 69 species (8,5%), *Fabaceae* –56 species (6,9%), *Lamiaceae* – 49 species (6,1%), *Scrophulariaceae* – 37 species (4,6%), *Brassicaceae* – 35 species (4,3%), *Rosaceae* – 33 species (4,1%), *Apiaceae* – 32 species (3,9%), *Cyperaceae* – 30 species (3,7%), *Caryophyllaceae*, *Polygonaceae* with 22 species each (with 2,7% each), *Boraginaceae* – 21 species (2,6%), *Ranunculaceae* – 20 species (2,5%) (figure 1.). Therefore 13 families (of the 95 represented in the reserve`s flora) include 544 species of vascular plants, which constitute the majority of plant species (67,2%) of the reserve`s flora.

The most numerous genera are: *Carex* (24 species), *Veronica* (19 species), *Vicia* (15 species), *Lathyrus* (14 species), *Euphorbia*, *Galium*, *Rumex* (with 12 species each), *Viola* (11 species), *Geranium* (10 species), *Potentilla*, *Cirsium*, *Poa* (with 9 species each), *Ranunculus* (8 species), *Salix*, *Epilobium*, *Campanula*, *Pilosella* and *Juncus* (with 7 species each). The species of these 18 genera make up 24,6% of

all reserve`s flora (figure 2).

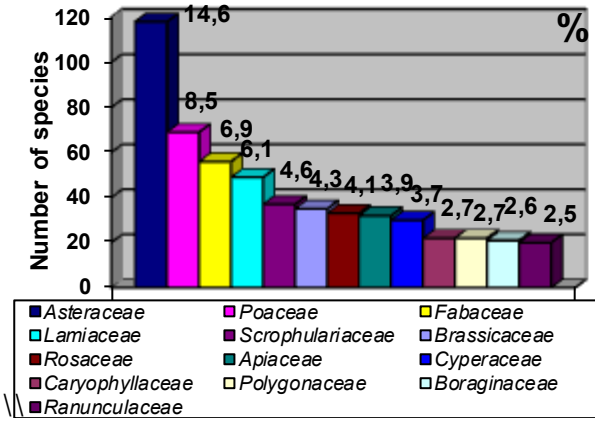


Fig. 1. The most representative families

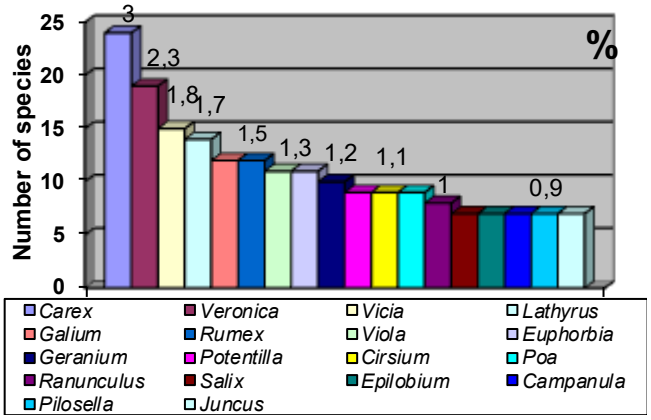


Fig.2. The most representative genera

Bioforms analysis highlights some features of the natural biotopes and the influences exerted on them by various factors, how plants adapt to specific environmental conditions. The plant species highlighted on the territory of the reserve are grouped into 6 categories of vital forms (figure 3.A). The most species belong to the groups of hemicryptophytes representing 46.5% and the annual and biennial terrophytes with 29.6%. Other groups participate unessential in the formation of bioforms spectrum (geophytes with 10,1%, phanerophytes – 7,2% helohidatophytes – 4,2% and chamaephytes – 2,4%).

Ecological analysis. The amplitude of ecological tolerance of the plant species largely reflects the soil and climatic conditions of the biotope. From the ecological point of view of the reserve`s flora was analyzed based on moisture indices (U), temperature (T) and soil reaction (R) (figure 3.B).

Analyzing their requirements to moisture factor (U), we see that the most numerous are mesophytes ($U_{3-3,5}$) with 35.6% and the xeromesophytes ($U_{2-2,5}$) with a share of 34,8%. The mesohygrophytes species ($U_{4-4,5}$) recorded 13.6%. The hygrophytes ($U_{5-5,5}$) and hydrophytes ($U_{6-6,5}$) with 6,9% and respectively 2,1%. The xerophytes species ($U_{1-1,5}$) represent 5,3%, recorded on dry soils to dry-wet of the glades and meadows and anthropogenic territories within the reserve. The species adapted to large fluctuations in moisture regime - euryphytes (U_0) have a low percentage (1.7%).

Acording to the requirements for the air temperature (T), predominant are the mesothermal plants ($T_{3-3,5}$) - 65,4%, which constitute more than half of the specific composition of the flora. The moderate thermophilic species ($T_{4-4,5}$) consisting 15,8%, the amphitolerant (T_0) totals 11,7%. The microthermal ($T_{2-2,5}$) – 5,8%, thermophilic ($T_{5-5,5}$) – 1,2% and cryophilic species ($T_{1-1,5}$) – 0,1% are represented by a small number of species, share of which represents only 7,1% of all species.

Taking into account the preferences for the soil reaction (R) a large representation of the light acid-neutrophilic ($R_{4-4,5}$) – 43,1%, euryonic (R_0) – 27,4% and acid-neutrophilic species ($R_{3-3,5}$) – 21,5% has been noticed. A less important role have the neutro-basiphilic ($R_{5-5,5}$) – 4,9% and acidophilic species ($R_{2-2,5}$) – 3,1%.

Geoelements spectrum. The spectrum of floristical elements provides information about the climate in which the species developed, about phytogeographical interferences and others.

The share examination of phytogeographical elements within the reserve highlights the predominance of Eurasian species with 47% (figure 3.C). The group of European plants is 15,3%, the Pontic and Cosmopolitan species meet with 7,9% each. The circumpolar and central European species represent 7,5% and respectively 7,3%. The Mediterranean (3,5%), adventitious (1,9%), Atlantic (1,3%) and Carpathian elements (0,4%) have a less percentage.

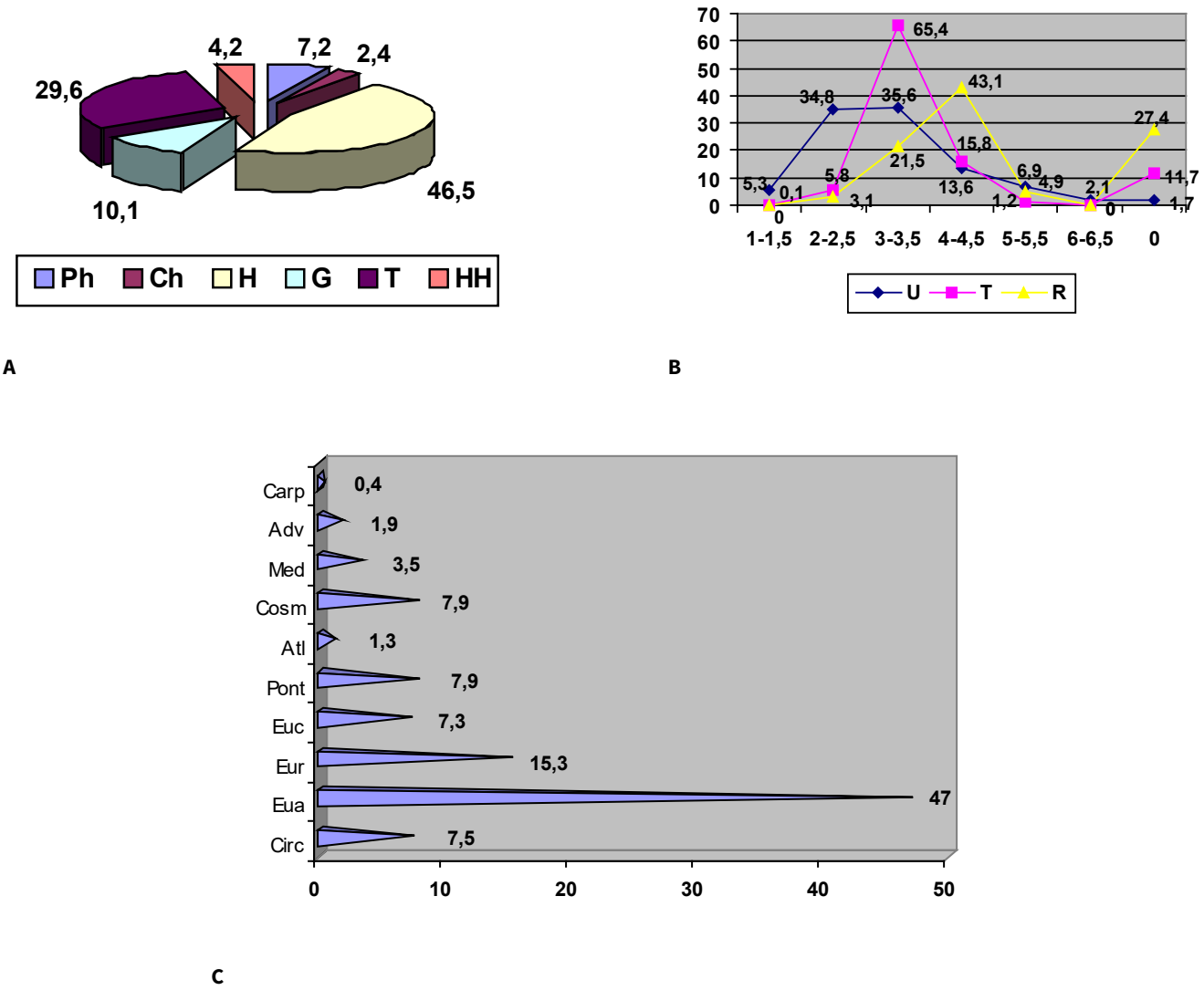


Fig. 3. The bioforms (A), ecological (B) and geoelements spectrum (C), (%)

On the territory of the „Codrii" Reserve are found 8 species of allochtone plants: *Acer negundo* L., *Amorpha fruticosa* L., *Caragana arborescens* Lam., *Fraxinus lanceolata* Borkh, *F. pennsylvanica* Marsh., *Phellodendron amurense* Rupr., *Pinus sylvestris* L., *Robinia pseudoacacia* L. and 6 species which are cultivated: *Helianthus tuberosus* L., *Hesperis cladotricha* Borbas., *Medicago sativa* L., *Onobrychis viciifolia* Scop., *Rumex patientia* L., *Sorghum saccharatum* (L.) Maench.

CONCLUSIONS:

The flora of „Codrii" Reserve includes 808 species of vascular plants, which belong to 393 genera, 95 families and 3 phylums. The most numerouse families are: *Asteraceae* (118 species), *Poaceae* (69 species), *Fabaceae* (56 species), *Lamiaceae* (49 species), *Scrophulariaceae* (37 species), *Brassicaceae* (35 species). The most representative genera are: *Carex* (24 species), *Veronica* (19 species), *Vicia* (15 species), *Lathyrus* (14 species), *Euphorbia*, *Galium*, *Rumex* (with 12 species each).

The bioforms analysis shows that in the reserve`s flora the predominant species are hemicryptophytes (46,5%), followed by annual and biennial terrophytes (29,6%).

The ecological analysis indicates the predominance of the mesophytes (35,6%) and xeromesophytes (34,8%). The mesothermal species represent 65,4% but the light acid-neutrophilic 43,1%.

Taking into account the geographical aspects, the most numerous are the species of the Eurasian element (47%).

BIBLIOGRAPHY

1. *Analele Naturii ale Rezervaţiei „Codrii”.* Lozova, 1991-1995.
2. Chirtoacă V., Istrati A., Manic Şt. *Plantele rare în colecţia Rezervaţiei „Codrii”.* În: Realizări, probleme, perspective. Tezele conferinţei jubiliare Rezervaţia „Codrii” – 25 ani. Lozova, 1996, p. 136-138.
3. Ciocârlan V. *Flora ilustrată a României*. Bucureşti: Ceres, 2009. 1141 p.
4. Cristea V. *Fitocenologie şi vegetaţia României.* Îndrumător de lucrări practice. Cluj-Napoca, 1991, 149 p.
5. *Flora Europaea*. On CD-ROM, v. 1-5, 2001.
6. *Flora R. P. R.* Vol. I-XIII, Bucureşti, 1952-1976.
7. Negru A. *Determinator de plante din flora Republicii Moldova*. Chişinău, 2007. 391 p.
8. Negru A., Jardan N. *Flora.* În: Conspectul diversităţii biologice. Rezervaţia”Codrii”. Ştiinţa, 2011, p. 78 – 184.
9. Pînzaru P., Sturza N. *Noi specii de plante în flora Rezervaţiei „Codrii”.* În: Buletinul Academiei de Ştiinţe a Republicii Moldova. 1993, nr. 5, p.16 – 17.
10. Popescu A., Sanda V. *Conspectul florei cormofitelor spontane din România*. Editura universităţii din Bucureşti, 1998. 336 p.
11. Sanda V. şi alţii. *Flora cormofitelor spontane și cultivate din România*. Bacău: Ion Borcea, 2003. 316 p.
12. Sturza N. *Noi completări la lista speciilor de plante din Rezervația „Codrii”.* În: Materialele Simpozionului ştiinţific internaţional 13Rezervaţia „Codrii”: Rezervaţia „Codrii” 40 ani. Chișinău: Î.E.P. Ştiinţa, 2011, p. 376-378.
14. Sturza N. *Specie nouă din genul Crepis L. (C. pulchra L) în flora Republicii Moldova*. În: Materialele Simpozionului ştiinţific internaţional Rezervaţia „Codrii”: Rezervaţia „Codrii” 40 ani. Chișinău: Î.E.P. Ştiinţa, 2011, p. 378-380.
15. Sturza N., Jardan N. *Hieracium auricula Lam. et Dc – specie nouă pentru flora Republicii Moldova.* În: Materialele simpozionului jubiliar international “Mediul şi dezvoltare durabilă” 70 de ani de la fondarea facultatii Geografie. Chisinau: Editura Labirint, 2009, p. 103-104.
16. Гавриленко Н. А. Дополнение к перечню видов растений заповедника «Кодры». În: Ботанические исследования. Флора, геоботаника и палеоэтноботаника. Кишинев: Штиинца, 1988, с. 103-106.
17. Гейдеман Т.С., Маник С.И., Николаева Л.П., Симонов Г. П. Конспект флоры заповедника “Кодры”. Кишиневн „Штиинца”, 1980. 236 с.
18. Гейдеман Т. Определитель высших растений Молдавской ССР. Кишинёв, 1975, 1986. 575 с., 638 с.
19. Гейдеман Т. Анализ флоры сосудистых растений. În: Природа заповедника «Кодры». Кишинев: Штиинца, 1984, с 27-32.
20. Коровина О.Н. Методические указания к систематике растений. Ленинград, 1986. 211 с.
21. Стурза Н. Новые виды флоры Заповедника «Кодры». În: Актуальні питання збереження та відновлення степових екосистем. Асканія-Нова, 1998, 224-226.
22. Флора Восточной Европы. Т. 9-11, 1996, 2001, 2004.
23. Флора Европейской Части СССР. Т. 1-8, Ленинград, 1974-1994.
24. Флора СССР. Т. I-XXX, Москва, 1934-1960.

CZU:630*114.67.:582.24(478)

CONTRIBUTIONS TO THE KNOWLEDGE OF MACROMYCETES FROM REPUBLIC OF MOLDOVA (MACROMUCETE MYCORRHIZA)

Ştefan Manic

Botanical Garden (Institute) of the Academy of Sciences of Republic of Moldova

SUMMARY

This paper mentions the data about ecological diversity of macromycetes mycorrhiza inventoried on the territory of Republic of Moldova. It was established that their spatial distribution is closely related to the composition of the forest fitocenoza, which shows specific fungus-plant relationship.

Among the 287 species of macromycete mycorrhiza, inventoried in the forest fitocenoza on the territory of Republic of Moldova, their distribution spectrum in the investigated forest fitocenoza reflects a numerical superiority of taxa associated with oak (183), followed by those with beech performed mycorrhizae (138) poplar (63), hornbeam (48), lime (6) and various other species (16).

Tables: 1. Bibliographic Sources: 16.

Keywords: Macromycete, Ecology, simbiotrof, mycorrhizae.

INTRODUCTION

The presence of mycorrhizas gives different and numerous advantages, including those related to nutrition, development and protection against pathogens, which are most often highlighted.

Mycorrhizas are functioning as true radicular absorptive organs. Since mycelia network is forming a large area of contact with the plant cells, the absorption of nutrients is much higher than that by the root hairs. Mycorrhizal mushrooms have a very active role in nutrient uptake. They are secreting metabolites which increase the solubility of mineral ions tied into the ground and also increase their mobility [5].

Widespread in the soil fungal hyphae crosses the regions poor in nutrient or with inaccessible nutrients near the root, to ramify out and explore new areas inaccessible for the plant. With time, hew zones with nutrients deficit appear around the mushrooms produces of mycorrhiza, but the ramification and continuous growths of hyphae and their connections with the soil allow its extensive exploitation. The process is more energy advantageous per unit absorbent area than the growth and ramification of the root [6].

Some authors claim that there was even a phenomenon of host addiction of mycorrhizae, meaning higher biomass accumulation (enhanced photosynthesis and the amount of fixed carbon passing to fungi).

RESEARCH METHODS

The research of this group of fungi were carried out over more than three decades throughout the entire territory of Moldova within the research themes of Botanical Garden of ASM.

The methodical guidance "Руководство по сбору высших базидиальных грибов для научного их изучения» [4] was used for sampling the biological material for the investigation. Under this guideline, macromycetes were collected at various development stages from different biotypes on the territory of Moldova. This was preceded by macroscopic analysis on-site of carpophores with registration of all phenotypic characters, following the methodical recommendations from "Guide De France Et Des Champignons D'europe" [9]. The harvest must be observed and studied carefully in order not to omit some transient character as follows: place of species growth, slope, vegetation type, nature of habitat, substrate, relative abundance of each taxon, observations of some morphological and physiological characters of macromycete species from different microhabitats. For mycorrhizal mushrooms it is necessary to note as accurately as possible on the ground, under what type of tree the harvested mushroom grows. It is useful to note some information about macro-chemical reactions of the mushroom (surface, pulp). [9].

Macroscopic analyses are supplemented with microscopic-photonic ones detailing the structure of

hymeneal layer, with particular emphasis on characteristics of asce and ascospores, respectively basidium and basidiospores, targeting in particular the colour, size, ornamentation and amyloidal reaction of spores, phenotypic characters of great taxonomic value. Particular attention is given to biometrics which is useful in determining many species, especially those of *Cortinarius* genus.

Macromycete samples were collected, identified and systematised in collections, following the methodology promoted by the specialized literature [1, 4, 9].

RESULTS AND DISCUSSION

Simbiotrofe macromycetes from reserched territory form a fairly large group (287 species). Symbiotic links with various trees and shrubs are characteristic for them. Through symbiosis mycelium brings water, minerals, and different metabolites to the tree, receiving in exchange organic material indispensable for their nutrition.

Separately are distinguished mycorrhizae endotrofe and mycorrhizae ectotrofe which are surrounding the roots with a more or less dense felting.

These mycorrhizae are impossible to identify in the soil, because one and the same root is almost always covered by mycelium of several species of macro- and micromycetes.

To distinguish saprotrophic mushrooms from mycorrhiza ones, Becher [124], from his own experience, proposed to studied thoroughly the leg ending. All mushrooms whose leg ends are covered by a clear and cortical area to the basic extremes (Boletus, Hygrophorus, Lactarius, Russula, etc.) are likely to be mycorrhiza for the following reasons: deeply buried mycorrhiza when forming the sporous body, delegates at the soil surface micelles filaments, often voluminous, at which tops the primordia is formed. While saprotrophic mushrooms which are fed by their own mycelium have a ruffle stem base of micelle filaments, often made of rhizoids. This distinction is obvious, especially in the genera *Agaricus, Macrolepiota, Coprinus, Panaeolus*, etc.

According P.V. Lobanov [6] and A.I. Bunkina [5] for different species of trees and shrubs the need of simbiotrofic links is different. On this basis the woody species and shrubs, based on the attitude towards ectotrophic mycorrhiza, fall into three categories:

1. High intensity mycorrhiza;
2. Low intensity mycorrhiza;
3. Non-mycorrhizal.

In Moldova forests tree species with high intensity mycorrhiza are oak, beech, hornbeam, poplar and lime. With low intensity Mycorrhiza are maple, willow, trees and shrubs of rosacea family. Non-mycorrhizal are ash, privet, elm, and acacia.

No special research to determine the species of woody symbionts of mycorrhizal mushrooms were made public, but based on data from the literature [7, 8, 10, 11, 12, 14, 16, 17] and based on our observations taken in the field, we highlighted the specific composition of simbiotrofe mushrooms in the forest fitocenoza which mostly belongs to the following genres: *Amanita, Boletus, Cantharellus, Choiromyces, Chroogomphus, Clitopilus, Cortinarius, Gomphidius, Gyroporus, Entoloma, Hebeloma, Hydnum, Hygrophorus, Lactarius , Leccinellum, Leccinum, Naucoria, Paxillus, Russula, Suillus, Tricholoma, Tuber, Xerocomellus (Table 1).*

Tab. 1. Distribution of mycorrhiza macromycetes according to associated trees

Species	Oak	Beech	Horn-beam	Lime	Poplae	Other species
1	2	3	4	5	6	7
Amanita battarrae (Boud.) Bon	+					
Amanita ceciliae (Berk. & Broome) Bas	+	+	+			
Amanita citrina Pers.	+	+				

Species	Oak	Beech	Horn-beam	Lime	Poplae	Other species
Amanita crocea (Quel.) Singer	+	+				
Amanita excelsa (Fr.) Bertill.	+	+				
Amanita fulva Fr.	+	+				
Amanita fulvoides Neville & Poumarat	+	+				
Amanita gemmata (Fr.) Bertill.	+	+				
Amanita muscaria (L.) Lam.					+	
Amanita nivalis Grev					+	
Amanita oblongospora Contu	+					
Amanita ovoidea (Bull.) Link	+					
Amanita pantherina (DC) Krombh.	+	+				
Amanita phalloides(Vaill. ex Fr.) Link	+	+	+			
Amanita regalis (Fr.) Michael	+		+			
Amanita rubescens Pers.	+	+	+	+	+	
Amanita solitaria (Bull.) Fr.	+	+				
Amanita strobiliformis (Paulet ex Vittad.) Bertill	+		+			
Amanita vaginata (Bull.) Lam.	+	+	+		+	
Boletus aereus Bull.	+					
Boletus badius (Fr.) Fr.	+	+	+			
Boletus calopus Pers.	+	+	+			
Boletus depilatus Redeuilh	+					
Boletus edulis Bull.	+	+	+		+	
Boletus erythropus Pers.	+	+				
Boletus ferrugineus Schaeff.	+	+	+			
Boletus impolitus Fr.	+	+	+		+	
Boletus legaliae Pilát -	+					
Boletus luridus Schaeff.	+	+	+			
Boletus luteocupreus Bertéa & Estadès	+					
Boletus pseudoregius (Heinr. Huber) Estadès	+	+				
Boletus pulchrotinctus Alessio	+	+				
Boletus pulverulentus Opat.	+	+				
Boletus queletii Schulzer	+					
Boletus radicans Pers.	+	+				
Boletus regius Krombh**.**		+				
Boletus reticulatus Schaeff.	+	+	+		+	
Boletus rhodopurpureus Smotl**.**	+					
Boletus satanas Lenz	+	+				
Boletus subtomentosus L.	+					
Boletus xanthocyaneus (Ramain) Romagn.	+	+				
Cantharellus cibarius Fr.		+				
Cantharellus cinereus (Pers.) Fr.		+				
Choiromyces meandriformis Vittad.	+					
Chroogomphus rutilus (Schaeff.) O.K. Mill.						+
Clitopilus prunulus (Scop.) P. Kumm.	+					

Species	Oak	Beech	Horn-beam	Lime	Poplae	Other species
Cortinarius alboviolaceus (Pers.) Fr.	+	+				
Cortinarius aleuriosmus Maire	+					
Cortinarius amoenolens Rob. Henry ex P. D. Orton	+	+				
Cortinarius anomalus (Pers.) Fr.	+					
Cortinarius arcuatorum Rob. Henry	+	+				
Cortinarius balteatocumatilis Rob. Henry ex P. D. Orton	+	+				
Cortinarius barbatus (Batsch) Melot	+	+				
Cortinarius bergeronii (Melot) Melot	+					
Cortinarius boudieri Rob. Henry	+					
Cortinarius brunneofulvus Fr.	+	+		+		
Cortinarius bulliardii (Pers.) Fr.	+	+				
Cortinarius caerulescens (Schaeff.) Fr.	+	+				
Cortinarius caesiostramineus Rob. Henry	+					
Cortinarius cephalixus Secr. ex Fr.	+					
Cortinarius cinnabarinus Fr.		+	+			
Cortinarius collinitus (Pers.) Fr.	+					
Cortinarius cotoneus Fr.	+	+				
Cortinarius cyaneus (Bres.) M. M. Moser	+	+				
Cortinarius decipiens (Pers.) Fr.	+					
Cortinarius dibaphus Fr.	+				+	
Cortinarius elatior Fr.	+	+				
Cortinarius flexipes (Pers) Fr.	+	+				
Cortinarius fulmineus Fr.		+			+	
Cortinarius galeobdolon Melot	+					
Cortinarius glaucopus (Schaeff.) Fr.					+	
Cortinarius hinnuleus Fr.	+				+	
Cortinarius infractus **(**Pers.) Fr.	+	+			+	
Cortinarius largus Fr.		+				
Cortinarius malachius (Fr.) Fr.					+	
Cortinarius meinhardii Bon	+	+				
Cortinarius ochroleucus (Schaeff.) Fr.	+				+	
Cortinarius olearioides Rob. Henry	+	+				
Cortinarius platypus (M.M. Moser) M.M. Moser					+	
Cortinarius pseudoprivignus Rob. Henry		+				
Cortinarius rickenianus Maire					+	
Cortinarius rufo-olivaceus (Pers.) Fr.	+	+				
Cortinarius saporatus Britzelm.	+	+				
Cortinarius sodagnitus Rob. Henry	+	+				
Cortinarius sordescentipes Bidaud, Moënne-Locc. & Reumaux	+		+			
Cortinarius subgracilior Bidaud & Carteret	+		+			
Cortinarius Suillus Fr.	+	+				
Cortinarius tabularis (Fr.) Fr.	+	+				
Cortinarius talus Fr.	+		+			

Species	Oak	Beech	Horn-beam	Lime	Poplae	Other species
Cortinarius torvus (Fr.) Fr.		+	+		+	
Cortinarius triumphans Fr.					+	
Cortinarius trivialis J.E. Lange	+	+				
Cortinarius variicolor (Pers.) Fr.		+			+	
Entoloma aprile (Britzelm.) Sacc.						+
Entoloma clypeatum (L.) P. Kumm.						+
Entoloma rhodopolium (Fr.) P. Kumm.	+	+	+			
Entoloma prunuloides (Fr.) Quél.						+
Entoloma sepium (Noulet & Dass.) Richon & Roze						+
Gomphidius glutinosus (Schaeff.) Fr.						+
Gyroporus castaneus (Bull.) Quél.	+	+				
Hebeloma birrus (Fr.) Gillet		+				
Hebeloma crustuliniforme (Bull.) Quél.	+	+				
Hebeloma pallidoluctuosum Gröger &Zschiesch.	+	+				
Hebeloma pusillum J.E. Lange	+				+	
Hebeloma quercetorum Quadr.	+					
Hebeloma radicosum **(**Bull.)Ricken		+				
Hebeloma sacchariolens Quél.	+				+	
Hebeloma sarcophyllum (Peck) Sacc						+
Hebeloma sinapizans (Fr.) Sacc.	+	+	+			
Hebeloma submelinoides (Kühner) Kühner	+				+	
Hydnum repandum L.	+	+				
Hygrophorus mesotephrus Berk. & Broome	+	+			+	
Hygrophorus arbustivus Fr.	+	+			+	
Hygrophorus chrysodon (Batsch) Fr	+	+	+			
Hygrophorus cossus (Sowerby) Fr.		+				
Hygrophorus discoxanthus (Fr.) Rea		+				
Hygrophorus eburneus (Bull.) Fr.		+				
Hygrophorus lindtneri M.M. Moser			+			
Hygrophorus nemoreus (Pers.) Fr.		+				
Hygrophorus penarius Fr.	+	+				
Hygrophorus persoonii Arnolds	+					
Hygrophorus russula (Schaeff.) Kauffman	+					
Hygrophorus unicolor Gröger	+	+				
Lactarius acerrimus Britzelm.	+			+		
Lactarius acris (Bolton) Fray		+				
Lactarius aurantiacus (Pers.) Gray	+					
Lactarius azonites (Bull.) Fr.	+		+			
Lactarius blennius (Fr.) Fr.		+				
Lactarius chrysorrheus Fr.	+					
Lactarius circellatus Fr.			+			
Lactarius citriolens Pouzar		+				
Lactarius controversus Pers.					+	
Lactarius decipiens Quel.	+		+			
Lactarius deliciosus (L.) Gray						+

Species	Oak	Beech	Horn-beam	Lime	Poplae	Other species
Lactarius deterrimus Gröger						+
Lactarius evosmus Kuhner & Romagn.					+	
Lactarius flavidus Boud.	+	+	+			
Lactarius flexuosus (Pers.) Gray	+	+				
Lactarius fluens Boud.		+	+			
Lactarius fulvissimus Romagn.					+	
Lactarius glyciosmus (Fr.) Fr.					+	
Lactarius illyricus Piltaver	+		+			
Lactarius lacunarum Romagn. ex Hora	+					
Lactarius mairei Malençon	+		+			
Lactarius pallidus Pers.		+				
Lactarius pergamenus (Sw.) Fr.	+		+			
Lactarius piperatus (L.) Pers.	+	+	+			
Lactarius pubescens Fr.					+	
Lactarius pyrogalus (Bull.) Fr.			+			
Lactarius quietus (Fr.) Fr.	+					
Lactarius romagnesii Bon		+	+			
Lactarius rubrocinctus Fr.	+	+				
Lactarius sanguifluus (Paulet) Fr.						+
Lactarius subdulcis (Pers.) Gray -		+				
Lactarius tabidus Fr.		+				
Lactarius trivialis (Fr.) Fr.					+	
Lactarius uvidus (Fr.) Fr.	+	+				
Lactarius vellereus (Fr.) Fr.	+	+	+			
Lactarius violascens(J. Otto) Fr.		+			+	
Lactarius volemus (Fr.) Fr.	+	+				
Lactarius zonarius (Bull.) Fr.	+					
Lactifluus rugatus (Kuhner & Romagn.) Verbeken		+				
Leccinellum crocipodium (Letell.) Watling	+		+		+	
Leccinellum griseum (Quél.) Bresinsky & Manfr.Binder			+			
Leccinum albostipitatum den Bakker & Noordel.					+	
Leccinum aurantiacum (Bull.) Gray					+	
Leccinum cyaneobasileucum Lannoy & Estadès					+	
Leccinum duriusculum (Schulzer ex Kalchbr.) Singer					+	
Leccinum holopus (Rostk.) Watling					+	
Leccinum molle (Bon) Bon					+	
Leccinum pseudoscabrum (Kallenb.) Šutara			+			
Leccinum scabrum (Bull.) Gray					+	
Leccinum variicolor Watling					+	
Leccinum versipelle (Fr. & Hök) Snell					+	
Paxillus involutus (Batsch) Fr.		+	+		+	
Paxillus rubicundulus P.D. Orton	+				+	
Phylloporus rhodoxanthus (Schwein.) Bres.	+	+				
Russula adusta (Pers.) Fr.					+	
Russula aeruginea Fr.						+

Species	Oak	Beech	Horn-beam	Lime	Poplae	Other species
Russula albonigra (Krombh.) Fr.		+				
Russula alutacea (Fr.) Fr.	+					
Russula amarissima Romagn. & E.-J. Gilbert -	+					
Russula amoenolens Romagn.	+					
Russula anatina Romagn.	+					
Russula atropurpurea (Krombh.) Britzem.	+	+				
Russula aurantiaca (Jul. Schaff.) Romagn.	+					
Russula aurea Pers.		+				
Russula aurora Bres.	+	+				
Russula azurea Bres.					+	
Russula brunneoviolacea Crawshay		+				
Russula camarophylla Romagn.		+				
Russula chloroides (Krombh.) Bres.		+				
Russula cuprea (Krombh.) J.E. Lange	+	+	+			
Russula curtipes F.H. Møller & Jul. Schäff		+				
Russula cyanoxantha (Schaeff.) Fr.	+	+	+	+	+	
Russula decipiens (Singer) Bon	+					
Russula delica Fr.	+	+			+	
Russula densifolia Secr. ex Gillet	+					
Russula faginea Romagn. ex Romagn.		+				
Russula farinipes Romell	+					
Russula fellea (Fr.) Fr.		+				
Russula foetens Pers.	+	+	+	+		
Russula fragilis Fr.		+				
Russula furcata Pers.	+		+			
Russula graveolens Romell	+					
Russula grisea Fr.	+		+			
Russula heterophylla (Fr.) Fr.	+		+		+	
Russula illota Romagn.					+	
Russula insignis Quél.	+					
Russula integra **(**L.) Fr.					+	
Russula laeta Jul. Schäff.		+				
Russula lepidicolor Romagn.	+	+				
Russula lilacea Quel.		+				
Russula luteotacta Rea	+					
Russula maculata Quél.	+	+				
Russula melitodes Romagn.		+				
Russula melliolens Quél.		+				
Russula minutila Velen.	+					
Russula nana Killerm	+					
Russula nigricans Fr.	+	+			+	
*Russula nitida (*Pers.) Fr.					+	
Russula nobilis Velen.		+				
Russula nuragica Sarnari	+					
Russula ochracea Fr.	+	+				

Species	Oak	Beech	Horn-beam	Lime	Poplae	Other species
Russula olivacea (Schaeff.) Fr.	+					
Russula parazurea Jul. Schäff.					+	
Russula pectinata (Bull.) Fr.	+					
Russula pectinatoides Peck	+					
Russula pelargonia Niolle		+				
Russula persicina Krombh.	+	+	+			
Russula praetervisa Sarnari	+					
Russula pseudointegra Arnould & Goris	+	+				
Russula puellula Ebbesen, F.H. Møller & Jul. Schäff	+	+				
Russula raoultii Quel.		+				
Russula risigallina (Batsch) Sacc.	+	+	+		+	
Russula romellii Maire		+				
Russula rosea Pers.	+					
Russula roseicolor J. Blum	+					
Russula rubra (Fr.) Fr.	+	+				
Russula rubroalba (Singer) Romagn.		+				
Russula rutila Romagn.	+					
Russula sanguinaria (Schumach.) Rauschert	+				+	
Russula solaris Ferd. & Winge		+				
Russula sororia Fr.	+				+	
Russula subfoetens W.G. Sm.	+					
Russula subrubens (J.E.Lange) Bon	+					
Russula subterfurcata Romagn	+					
Russula tinctipes J. Blum ex Bon		+				
Russula vesca Fr.	+					
Russula veternosa Fr.		+				
Russula vinosa Lindblad					+	
Russula violeipes Quél.		+				
Russula virescens (Schaeff.) Fr.	+	+			+	
Russula xerampelina (Schaeff.) Fr.					+	
Russula zvarae Velen.	+					
Strobilurus esculentus (Wulfen) Singer						+
Suillus collinitus (Fr.) Kuntze						+
Suillus granulatus (L.) Roussel						+
Suillus grevillei (Klotzsch)Sing.						+
Suillus luteus (L.) Roussel						+
Tricholoma albobrunneum (Pers.) P. Kumm.					+	
Tricholoma album (Schaeff.) P.Kumm.	+					
Tricholoma argyraceum (Bull.) Gillet	+					
Tricholoma atrosquamosum Sacc.	+	+				
Tricholoma basirubens (Bon) A. Riva & Bon	+	+				
Tricholoma columbetta (Fr.) P. Kumm.	+					
Tricholoma fracticum (Britzelm.) Kreisel	+					
Tricholoma gausapatum (Fr.) Quel.	+					
Tricholoma orirubens Quél.	+	+				

Species	Oak	Beech	Horn-beam	Lime	Poplae	Other species
Tricholoma portentosum (Fr.) Quél.					+	
Tricholoma saponaceum (Fr.) P. Kumm.	+					
Tricholoma scalpturatum (Fr.) Quél.	+	+				
Tricholoma sejunctum (Sowerby) Quél.	+					
Tricholoma sulphureum (Bull.) P. Kumm.	+	+	+			
Tricholoma terreum (Schaeff.) P. Kumm.					+	
Tricholoma tridentinum Singer	+					
Tricholoma ustale (Fr.) P. Kumm	+					
Tricholoma ustaloides Romagn.	+					
Tricholoma viridilutescens M.M. Moser	+					
Tricholosporum goniospermum (Bres.) Guzman ex T.J. Baroni	+					
Tuber aestivum Vittad.	+	+				
Tuber brumale Vittad.	+					
Tuber excavatum Vittad.		+				
Xerocomellus armeniacus (Quél.) Šutara					+	
Xerocomellus chrysenteron (Bull.) Šutara	+	+	+	+	+	
Xerocomellus pruinatus (Fr. & Hök) Šutara	+					
Xerocomellus rubellus Krombh.	+					
Total – **287 sp.**	183/84	138/34	48/5	6	63/33	16

$^{x}/_{y}$ - the numerator - the total number macromycete that form mycorrhiza with several species of trees and shrubs, the denominator - the number macromycetes which have symbiotic links with only one species of mycorrhiza tree.

As shown in the table above, the spectrum of macromycetes mycorrhiza from investigated forest fitocenoza reflects a numerical superiority of taxa associated with oak (183), followed by those which create mycorrhizae with beech (138), poplar (63), hornbeam (48), lime (6) and various other species (16).

The need for mushrooms symbiotic ties is selective as well as for the trees. There are species of mushrooms that form symbiotic links with both deciduous and conifers trees. The following species have been researched in the field: *Amanita pantherina, A. vaginal vellereus Lactarius, Russula delicate foetens R., R. nigricans*.

Another category of mycorrhiza mushrooms have symbiotic relationships only with certain species of deciduous or coniferous or even only with one of them [7].

In phytocoenosis of Moldova forests you may quite frequently meet the following species with oak: *Amanita solitaria, aereus Boletus, B. impolitus, B. edulis, Lactarius quietus, Hygrophorus mesotephrus, Russula sorority, R. verescens;* with beech: *Lactarius blennius, L. subdulcis, R. Fell, R. Illot, R. romellii;* with hornbeam: *Leccinum griseum;* with birch: *Lactarius pubescens, Russula aeruginea, Leccinum scabrum;* with poplars: *Leccinum duriusculum, L. albostipitatum, L. aurantiacum.*

Some mycorrhizal musgrooms have a pretty wide ecological amplitude. They behave sometimes like saprotrophic humic mushrooms. *Paxillus involutus* can be an example that is found in lawns the unforested field, while others, which usually have a saprotrophic mode of nutrition, have the ability to form mycorrhiza. For example, in the Moldova forest phytocoenosis, such species as *Calocybe gambosa, Entoloma aprile, E. prunuloides* can be always met around trees and shrubs of the *Rosaceae* family.

Taking into consideration the mushrooms ability to form mycorrhiza with certain species of trees and shrubs, and the need of woody species to have symbiotic links, one can explain the presence or absence of mycorrhizal musgrooms in certain forest phytocenosis.

CONCLUSIONS

From all ecological factors in the spatial distribution of macromycete species the trophic and topical connections a have a significant importance for all for mushrooms, as heterotrophic organisms. 287 species of mycorrhizal fungus were found in the forest fitocenoza of Republic of Moldova by way of nutrition.

Among the 287 species of mycorrhiza macromycete researched in the forest stand on the territory of Republic of Moldova, the spectre of species the researched forest fitocenoza reflects a numerical superiority of taxa associated with oak (183), followed by those which create mycorrhizae with beech (138), poplar (63), hornbeam (48), lime (6) and various other species (16).

Simbiotrofe macromycetes are important elements in the forest fitocenoza structure, where their spatial distribution is closely related to forest fitocenoza composition, which determines that the fungus-plant relationship is largely specific.

Mycorrhizal mushrooms not only fulfil the role of the provider, but also of the distributor of biogenic substances for the plants of the entire ecosystem. The mycelium is connecting the vascular system of plants into a single communicable system. In this way, in any plant association the radicular root system of plants of different species become associated together in the complicated network of hyphae of several species of mushrooms.

Mycorrhiza intervenes as an integration mechanism that determines the physiological integrity of the association. Through these symbiotic relationships trees increase their potential for absorption and thus become more resistant to droughts, which are quite frequent on the territory of Republic of Moldova.

BIBLIOGRAPHY

1. **Constantinescu O.** Metode şi tehnici în micologie. *Bucureşti:* Ceres, 1974. 215 p.
2. **Manic Ş. ş. a.** Conspectul diversităţii biologice a Rezervaţiei "Codrii". *Chişinău:* Ştiinţa, 2011. 328 p.
3. **Tănase C. ş. a.** Macromicete din România. *Iaşi:* Univ. „Al. I. Cuza". 2009. 563 p.
4. Бондарцев **А. С. и Зингер П. А.** Руководство по сбору высших базидиальных грибов для научного их изучения. В кн*: Тр. БИН АН СССР, сер. В, Споровые растения,* 1950, вып. 6, с. 499-543.
5. Бункина **И. А.** Микотрофность главнейших древесных и кустарниковых пород Приморского края. В кн.: Тр.Д.В. фил. СО АН СССР, сер. бот.*, 5,* 1962, с. 79-126.
6. Лобанов Н. В. Микотрофность древесных растений. М.,1971, 2-е изд. 216 с.
8. **Becker G.** Observations sur l´écologie des champignons supérieurs**.** *In: Annales Sci. de l´Univ. de Besançon,* 1956, 2 Sér., fasc. 7, Botanique, p. 15-128.
9. **Bon M.** Champignons de France et d´Europe occidentale. Paris: Arthaud, 1988. 368 p.
10. **Courtecuisse R., Duhem B.** Guide Des Champignons De France Et D'europe. *Paris:* Delachaux Et Niestlé Lausanne, 1994. 476 p.
11. **Candusso M.** Fungi Europaei 6. Hygrophorus s. 1. *Basso,* 1997. 784 p.
12. **Eyssartier G., Roux P.** Le guide des champignons France et Europe. *Paris:* Belin, 2011. 1119 p.
13. **Galli R.** Tricholomi. *Milano:* Edinatura, 2003. 271 p.
14. **Manic Ş.** Contributions to taxonomic diversity research of macromycobiota of Republic of Moldova. *In: Journal of Botani,Chi*şinău*,* 2014, vol.YI, nr.2 (9), p. 52-62.
15. **Moser M.** Guida alla determination dei funghi. Polyporales, Boletales, Agaricales, Russulales). *Trento:* Saturnia, 1993. 565 p.
16. **Neville D., Webster A. J.** Fungal Ecology. *London:* Chapman & Hall, 1995. 549 p.
17. **Neville P., Poumarat S.** Amaniteae, (Amanita. Limacella & Torrendia). *Alassio:* Candusso, 2004. 1120p.
18. **Romagnesi H.** Les Russules d´Europe et d´Afrique du Nord. *Paris:* Bordas, 1967b. 998 p

FLORA AND VEGETATION GRASSLAND AREA SEMI-DESERT "CÎȘLIȚA-PRUT"

Titica Ghenadie

Botanical Garden (Institute) of the Academy of Science of Moldova

email: ghena20@ymail.com

Abstract: Research results are presented grassland flora and vegetation of the area semi-desert "Cîșliţa-Prut" in southern Moldova. It was highlighted that this sector flora includes 237 species of vascular plants, 30 species of rare plants. Plant communities were assigned to nine plant associations. Semi-desert grassland sector "Cîșliţa-Prut" (surface 42,8 ha) which includes plant species and rare plant communities characteristic of grasslands, semi-desert is proposed to be established protected natural area.

Key words: flora, vegetation, protected area semi-desert steppe, plant communities, biodiversity conservation.

INTRODUCTION

Semi-desert grassland sector "Cîșliţa-Prut" (area of 42.8 ha) is located near the riverbed Prut and Prut village (r. Cahul). Located on the slopes of complex waves, sunny, west-facing of the lower Prut River. The slope of the slope is 25-40 ° slope very quickly in places with steep (Fig. 1).

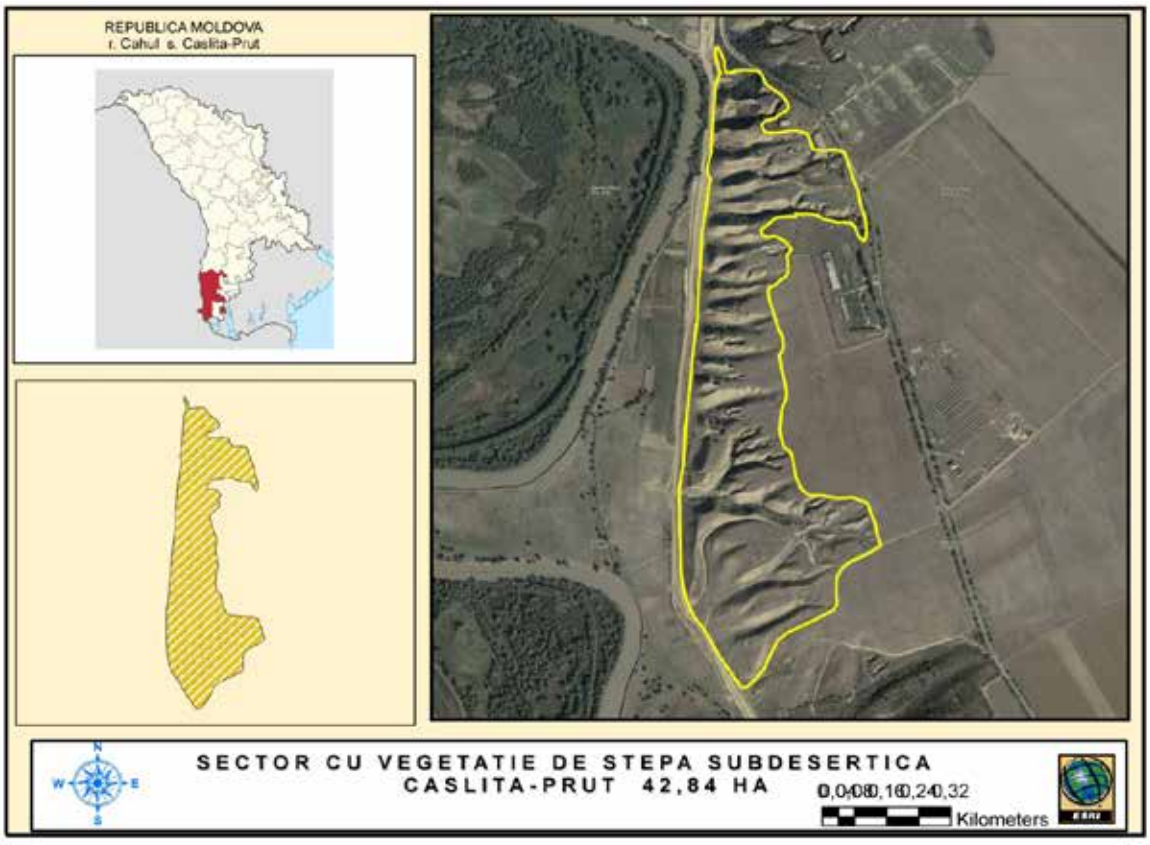


Fig. 1. Map steppe sector semi-desert "Cîșliţa-Prut"

Lithologic substrate is present with rocks and sandy clay loam loess from wind origin. Very shallow soils with moisture-dried (U). In forming plant communities of the area is analyzed, a special character to the local climate. On the slopes of the analyzed surface is formed particularly climate region. In summer exhibition southwest slopes of this area are very strong heat, with frequent extreme temperatures. Depending on these factors in this area has formed a very special vegetation zone of vegetation in this region.

MATERIAL AND METHOD

Field research was conducted during 2007-2015 growing season according to the method and route surveys phytocoenology. Floristic research was conducted during the growing season (March-September). There were collected 200 herbarium sheets. In determining consulted herbarium plants Botanical Garden (Institute) of the ASM, the Department of Botany of the State University of Moldova, Tiraspol State University and ierbarele various botanical centers in Europe. Rare plant species have been assigned to that category of rarity according to the International Classification of endangered species (IUCN, 1994), the Law on Protected Natural Areas by the State (1998).

Plant communities were investigated according to the principles Central European phytocoenology school-based surveys phytocoenology method, the summary table of analysis and determination of plant associations developed by J. Braun-Blanquet (1964); Al. Borza, Boşcaiu N. (1965) and. Name associations is given in accordance with the International Code of Nomenclature Phytosociology (Weber et al., 2000).

RESULTS AND DISCUSSIONS

Steppes semi-desert formed at the transition from the desert steppe and is characterized by alteration perennial herbaceous plant communities, xerophyte, with rich plant communities semi-shrub, xerophit unfinished (Postolache 1994, 1995). For steppe plant communities semi-desert is characteristic semi rest long summer (Keller, 1923). These and other features were recorded and grassland area semi-desert "Cîşliţa-Prut".

Based on research conducted floristic composition was determined and was developed epitome vascular flora, grasslands in the area "Cîşliţa-Prut". There have been rare plant species identified in the steppes semi-desert. Flora analysis (taxonomic bioforms, ecological, geoelementelor) shows us the following.

Taxonomic analysis. In sector "Cîşliţa-Prut" there were 237 species of vascular plants: *Ephedra distachya*, *Aristolochia clematitis*, *Ceratocephala testiculata*, *Consolida paniculata, Consolida regalis*, *Nigella arvensis*, *Ranunculus pedatus*, *Thalictrum minus, Glaucium corniculatum, Papaver dubium, Fumaria schleicheri, Dianthus leptopetalus, Gypsophila glomerata, Holosteum umbellatum, Kohlrauschia prolifera, Minuartia glomerata, Minuartia setacea, Pleconax conica, Scleranthus annuus, Silene longiflora, Amaranthus blitoides, Atriplex oblongifolia, Atriplex patula, Atriplex tatarica, Kochia prostrata, Salsola australis, Fallopia dumetorum, Polygonum aviculare, Polygonum patulum, Goniolimon besserianum, Anagallis arvensis, Viola ambigua, Viola suavis, Tamarix ramosissima, Alyssum calycinum*, *Alyssum desertorum*, *Berteroa incana*, *Cardaria draba, Descurainia sophia*, *Diplotaxis tenuifolia*, *Erysimum canescens, Erysimum repandum*, *Lepidium perfoliatum*, *Lepidium ruderale*, *Sisymbrium altissimum*, *Sisymbrium loeselii, Sisymbrium officinale*, *Reseda lutea*, *Althaea cannabina, Hibiscus trionum, Lavatera thuringiaca, Euphorbia agraria, Euphorbia esula, Euphorbia seguieriana, Thymelaea passerina*, *Sedum maximum, Agrimonia eupatoria, Amygdalus nana, Cerasus mahaleb, Crataegus monogyna, Filipendula vulgaris, Potentilla arenaria, Potentilla recta, Poterium sanguisorba, Prunus spinosa, Rosa canina, Rosa corymbifera, Rubus canescens, Oenothera biennis, Astragalus austriacus, Astragalus corniculatus, Astragalus dasyanthus, Astragalus onobrychis, Astragalus varius*, *Caragana frutex, Chamaecytisus austriacus, Coronilla varia, Lotus corniculatus*, *Medicago falcate, Medicago lupulina, Medicago minima, Melilotus albus, Melilotus officinalis, Onobrychis gracilis, Onobrychis viciifolia, Trifolium arvense, Trifolium diffusum, Vicia angustifolia, Vicia villosa, Haplophyllum suaveolens, Ailanthus altissima, Tribulus terrestris, Cotinus coggygria, Linum austriacum, Linum perenne, Linum tenuifolium, Erodium cicutarium, Geranium pusillum, Elaeagnus angustifolia, Hippophaë* ***rhamnoides,*** *Eryngium campestre, Falcaria vulgaris, Pimpinella saxifraga, Torilis arvensis, Valerianella coronata, Cephalaria uralensis, Knautia arvensis, Scabiosa ochroleuca, Scabiosa ucrainica, Asperula cynanchica, Asperula tenella, Galium verum, Galium volhynicum, Centaurium pulchellum,Vinca herbacea, Ligustrum vulgare, Hyoscyamus albus, Convolvulus arvensis, Convolvulus lineatus, Cuscuta lupuliformis, Anchusa italica, Buglossoides sibthorpiana, Echium russicum, Echium vulgare, Heliotropium europaeum, Lappula squarrosa, Lithospermum officinale, Nonea*

pulla, Linaria genistifolia, Verbascum phlomoides, Verbascum speciosum, Veronica arvensis, Veronica praecox, Veronica prostrata, Veronica verna, Plantago media, Plantago arenaria, Verbena officinalis, Acinos arvensis, Ajuga chia, Ballota nigra, Marrubium peregrinum, Marrubium praecox, Nepeta pannonica, Origanum vulgare, Phlomis pungens, Salvia austriaca, Salvia nemorosa, Salvia nutans, Sideritis montana, Teucrium polium, Thymus marschallianus, Campanula sibirica, Achillea coarctata, Achillea nobilis, Achillea pannonica, Achillea setacea, Anthemis ruthenica, Artemisia absinthium, Artemisia austriaca, Artemisia campestris, Artemisia santonica, Artemisia vulgaris, Carduus acanthoides, Carduus hamulosus, Carduus nutans, Carduus thoermeri, Carthamus lanatus, Centaurea arenaria, Centaurea besseriana, Centaurea biebersteinii, Centaurea diffusa, Centaurea orientalis, Centaurea pseudomaculosa, Centaurea solstitialis, Centaurea stereophylla, Centaurea trinervia, Chondrilla juncea, Cirsium arvense, Crepis pannonica, Crepis rhoeadifolia, Echinops ruthenicus, Echinops sphaerocephalus, Conyza canadensis, Helichrysum arenarium, Hieracium cymosum, Inula oculus-christi, Jurinea calcarea, Jurinea mollissima, Lactuca serriola, Lactuca tatarica, Matricaria perforata, Onopordum acanthium, Picris hieracioides, Scorzonera mollis, Senecio vernalis, Tanacetum millefolium, Taraxacum serotinum, Tragopogon dubius, Tussilago farfara, Xanthium spinosum, Xeranthemum annuum, Colchium triphyllum, Gagea taurica, Hyacinthella leucophaea, Ornithogalum amphibolum, Ornithogalum boucheanum, Ornithogalum kochii, Allium flavescens, Allium guttatum, Allium paniculatum, Allium podolicum, Allium sphaerocephalon, Asparagus officinalis, Asparagus tenuifolius, Carex supina, Aegilops cylindrica, Agropyron pectinatum, Bothriochloa ischaemum, Bromopsis riparia, Bromus arvensis, Bromus mollis, Bromus squarrosus, Calamagrostis epigeios, Cleistogenes bulgarica, Cynodon dactylon, Elytrigia repens, Festuca rupicola, Festuca valesiaca, Hordeum murinum, Melica ciliata, Phleum paniculatum, Phleum phleoides, Poa angustifolia, Poa bulbosa, Poa compressa, Stipa capillata belonging to 163 genera and 53 families. The most numerous families are Asteraeae -49 followed families Poaceae species-21 species and 20 species Fabaceae.

The spectrum of the bioformes: the therophytes are clearly dominant 41,1%, followed by the with hemicryptophytes 40%, geophytes 9,2%, fanerophytes 6,7% and chamaephytes 3,3%.

The analysis of the phytogeographic elements: euriasiatic element 45,1% and pontic species 28,2%, followed by the european 7,6%, central-european 5,9%, mediterranean 3,7%, adventiv and circumpolar with 2,5% each, cosmopolite 2,1%, submediterranean 1,2%, atlantic and pannonian with 0,4% each.

The analysis of the ecologic spectra: the xerophytes 65%, xeromesophytes species 33,3%, and amphitolerant 1,6%. **The thermic factor** is predominated moderat-thermophile and micromezotherm 44,7% each, amphytolerant 5%, thermophile 4,2% and microtherm 1,2%. According **soil reaction** the most of species are slightly acid-neutrophilious 57 %, amphytolerant 22,3%, acid-neutrophilious 15,1% each, neutrobasiphile 3,7% and acidophile is represented by 1,6%.

The economical plant importance. Analyses of plant from wild flora is represented by relevant categories of economical plant importance. The most numerous are the medicinal 41,1%, melliferous and industrial 19,1%, fodder 9,3%, alimentary 6%, decorative 3,5% and toxic 1,9%.

Rare plants. In the steppe "Cîşliţa-Prut" were identified 30 species of vascular plants with varying degrees of rarity. In accordance with the Law on Protected Natural Areas by the State (1998) and International Union for Conservation of Nature (IUCN, 1994), these are grouped into the following categories of rarity; The plants included in the Red Book of Moldova (second edition 2001 CRM) are 6 species. Rare plant species identified by category rarity: *Achillea coarctata* (R), *Allium guttatum* (R), *Amygdalus nana* (EN), *Asparagus officinalis* (VU), *Asparagus tenuifolius* (EN), *Asperula tenella* (I), *Astragalus corniculatus* (R), *Astragalus varius* (NT), *Astragalus dasyanthus* (VU, CRM), *Carex supina* (R), *Centaurea trinervia* (R), *Colchium triphyllum* (EN, CRM), *Convolvulus lineatus* (VU, CRM), *Dianthus leptopetalus* (NT), *Diplotaxis tenuifolia* (I), *Ephedra distachya* (VU, CRM), *Gagea taurica* (R), *Galium volhynicum* (R), *Gypsophila glomerata* (CR, CRM), *Haplophyllum suaveolens* (R), *Helichrysum arenarium* (EN), *Hyacinthella leucophaea* (Nt), *Minuartia glomerata* (R), *Ornithogalum boucheanum* (R), *Ornithogalum kochii* (R), *Ornithogalum amphibolum* (EN, CRM), *Pleconax conica* (R), *Scorzonera mollis* (R), *Tamarix ramosissima* (R), *Valerianella coronata* (R). *capillatae, Artemisio austriacae – Poëtum bulbosae, Aegilopsietum cylindricae, Bromo squarrosi – Xeranthemetum annui, Agropyro cristati –*

Kochietum prostratae, Artemisietum santonici.

Vegetation. Plant communities of the "Cîşliţa-Prut" were assigned to nine associations: as.*Taraxaco serotinae – Festucetum valesiacae, Poo angustifoliae – Festucetum valesiacae, Taraxaco serotinae – Bothriochloetum ischaemi, Agropyro pectinati–Stipetum*

Fig. 2 Steppe sector semi-desert "Cîşliţa-Prut"

Fig. 3 Steppe sector semi-desert "Cîşliţa-Prut"

Fig. 4 Steppe sector semi-desert "Cîşliţa-Prut"

CONCLUSIONS

1. Flora grassland sector semi-desert "Cîşliţa-Prut" includes 237 species of vascular plants belonging to 163 genera and 53 families. The most representative families are Asteraceae, Poaceae, Fabaceae, Brassicaceae. The most numerous genres are: Centaurea, Astragalus and Veronica.

2. In the grassland sector semi-desert "Cîşliţa-Prut" were found 30 species of rare plants, including 6 species of rare plants (*Astragalus dasyanthus, Colchium triphyllum, Convolvulus lineatus, Ephedra distachya, Gypsophila glomerata, Ornithogalum amphibolum*) are included in the Red Book of Moldova.

3. Analysis reveals bioforms domination and hemicryptophytes and terrophytes indicating the presence grassland degradation levels increased and influenced mainly by climatic conditions.

4. Phytogeographic elements analysis showed that most species of plants belonging of eurasiatic and pontic.

5. Flora grassland ecological spectrum semi-desert sector "Cîşliţa-Prut" is dominated by plant species xerophytes - 67.1% and xeromesophytes is much lower. This report shows that this surface properly award category semi-desert steppe.

6. Plant Communities of the "Cîşliţa-Prut" were assigned to nine plant associations.

7. Given the presence of rich gene pool (237 species of vascular plants), of which 30 rare plant species, plant communities assigned to the nine associations proposed that the grassland steppe semi-desert "Cîşliţa-Prut" with surface 42.8 ha of protected area established meadow titled "Cîşliţa-Prut".

BIBLIOGRAPHY

1. Borza A., Boscaiu N., 1965 – Introducere în studiul covorului vegetal, Edit. Acad. Române, București.
2. Chifu T., Minzu C., Zamfirescu O., 2006 – Flora și vegetația Moldovei (România). II. Vegetația, Edit. Universității „Alexandru Ioan Cuza", Iași.
3. Cristea V., 2004 – Fitosociologie, Edit. Presa Univ. Clujeană, Cluj-Napoca.
4. Negru A. Determinator de plante din flora Republicii Moldova, Chișinău, Universul, 2007.
5. Postolache Gh. Vegetaţia Republicii Moldova, Chişinău, Ştiinţa, 1995. 340 pag.
6. Tofan Burac T., Chifu T., 2002 – Flora și vegetația din valea Prutului, Edit. Corson, Iași.
7. Săvulescu Tr. Die Vegetation von Bessarabien mit Besonder Beruckcsichtigung der Steppe. Buc. 1927.
8. Doniţă N., Popescu A., Paucă Comănescu Mihaela, Mihăilescu Simona, Biriş I. – A., Habitatele din România, Editura Tehnică, Bucureşti, 2005.
9. Постолаке Г.Г. Растительность степей Республики Молдова. // Известия АН РМ. Серия биол. и хим. наук. 1993, № 4, с. 3-10.
10. Ciocârlan V., 2009 - Flora ilustrată a României. Pteridophyta et Spermatophyta (Illustrated Flora of Romania. Pteridophyta et Spermatophyta). 2nd Ed., Edit. Ceres, Bucureşti, 1141 pp.
11. Weber H.E., J. Moravec, J.P. Theurillat, 2000 - International Code of Phytosociological Nomenclature. 3rd Ed., J. Veg. Sci., 11: 739-768.

A NEW SPECIES OF GENUS *ROSA* (*ROSA TURCICA* ROUY) IN THE FLORA OF REPUBLIC OF MOLDOVA

Tofan-Dorofeev Elena

Botanical Garden (Institute) of ASM

Summary: The research results of the new record of Rosa turcica Rouy for the flora of Republic of Moldova is presented in the article. The synonymy, morphological description, ecology, habitat characteristics and corology of the species is given.

Key words: habitat taxonomy, morphology, bioecology, chorology, Rosa turcica, Rosaceae

INTRODUCTION

In the spontaneous flora of the Earth, the genus *Rosa* L. comprises about 300-500 species distributed exclusively in the Northern Hemisphere.

Shrubs, usually deciduous. Stems usually with prickles. Leaves pinnate; stipules usually adnate to the petiole. Flowers terminal, solitary or in (4)5-merous corymbs. Hypanthium urceolate, becoming coloured and fleshy in fruit; epicalyx absent; stamens and carpels numerous; styles protruding through the orifice of a disc, sometimes forming a short column. Fruit – pseudocarp of numerous achenes enclosed in the hypanthium.

As regards the flora of the Republic of Moldova, there are 30 species recorded, out of which 19 species are listed in the spontaneous flora [5, 9] and which are most commonly spread at the edge of the forest, in meadows, open steppe slopes or limestone ones.

MATERIALS AND METHODS

In the research of the genus *Rosa* L., we have used as materials both the collections of the Herbarium of Botanical Garden (Institute) of ASM, and the one of the Ecology, Botany and Forestry Chair of Moldova State University, as well as our own recently collected plant exsiccata. The critical analysis of *Rosa* L. species has been performed by the classical comparative-morphological method [10]. We have used a number of fundamental reference sources on determination, nomenclature and bioecology of taxa [1-4, 6-8, 11].

RESULTS AND DISCUSSIONS

Section *Caninae* DC. 1818, in Ser., Mus. Helv. 1: 3.
Subsection *Rubiginosae* Crép. 1892, Bull. Soc. Bot. Belg. 31, 2 : 81.

T y p e: *R. rubiginosa* L.

Erect shrubs up to 3-5 m prickles usually hooked or curved, sometimes mixed with acicles and glandular setae. Leaflets suborbicular, ovate, obovate or elliptical, rounded or cuneate at base, biserrate to compound-serrate, glabrous or somewhat pubescent, never tomentose, more or less densely glandular-viscid beneath, smelling of apples; teeth glandular. Pedicels glabrous or glandular-hispid. Flowers solitary or 2-3. Sepals pinnatifid, erect or deflexed after anthesis. Petals small, white or pink. Styles short or long, glabrous, villous or lanate. Fruit globose, ovoid or ellipsoid, glabrous or glandular-hispid.

Following the field expeditions conducted in the Area of Multifunctional Management – a typical area of steppe vegetation in the south of Bugeac, and in the north-eastern part of the country, on the limestone slopes of the Dniester river, there has been identified a new species of *Rosa* for the flora of Republic of Moldova (Fig. 1).

This species is very similar to other rare species – *R. micrantha* Borrer ex Smith, but has some distinguishing features:

- Prickles not mixed with setae and stipitate glands; stems up to 3-5 m . . . . . R. micrantha
- Prickles mixed with numerous setae and stipitate glands, strongly branched bush, stems not

more than 0,5 m tall. . . . . R. turcica

R. turcica Rouy, 1896, Ill. Pl. Europ. Rar. 6 : 45, tab. 134; Klášterský, 1968, Fl. Europ. 2 : 32; Бузунова, 2001, Фл. вост. Европы, 10 : 353; Ciocârlan, 2009, Fl. ilustr. a Rom. : 338. – R. ferox Bieb. 1810, Cent. Pl. Rar. 1 : tab. 37, non Lawrence, 1799. – R. horrida Bieb. ex Crép. 1872, Bull. Soc. Bot. Belg. 11 : 86, non Spreng. 1825; Юз. 1941, Фл. СССР, 10 : 498; Хржан. 1958, Розы: 279.

A. **B.**

Fig. 1. A. – *Rosa micrantha* **Borrer ex Smith. B. –** *R. turcica* **Rouy**

Up to 0,5-0,7 m tall. Prickles abundant, stout, curved, mixed with numerous setae and stalked glands. Leaflets 5-7, 8-12 mm long, broadly ovate to suborbicular, compound-serrate, usually glabrous and sparsely glandular above, densely glandular and glabrous or sparsely pubescent beneath. Pedicels 5-6 mm long often stipitate-glandular. Solitary flowers, rarely by 2. Sepals glandular on the back, deflexed and deciduous after anthesis. Petals 15-20 mm, white. Styles glabrous or somewhat villous. Fruit red, 8-10 mm in diameter, subglobose, usually sparsely stipitate-glandular,. It blossoms is June-July. Heliophilic and thermophilic species, it grows on dry, neutral soils.

Fig. 2. Distribution of the Rosa turcica Rouy

Spreading Area. In the Republic of Moldova it has been registered in the Area of Multifunctional Management – a typical area of steppe vegetation in the south of Bugeac (vill. Ciumai, Taraclia district), and in the Rezina district near the village of Pereprava. Outside the republic, it is spread in the South-Eastern Europe, South-Western region of Ukraine, Turkey. [8]

Habitat. The slopes transformed into a steppe. The abrupt and very eroded calcareous-stony slopes of the banks of the Dniester river and some of its tributaries.

Limitative Factors. Limit of the species spreading area; the destruction of the habitat.

CONCLUSIONS

Rosa turcica Rouy is a species whose distribution area is at risk, exhibiting high vulnerability to anthropogenic factors; further research and field assessment are required to establish the degree of rarity, and to elaborate the special conservation measures for example to be included in the list of spesies protected on the territory of the Republic of Moldova.

BIBLIOGRAPHY

1. Buia Al., Prodan I. Flora Republicii Populare Române. Bucureşti: Ed. Academiei Republicii Populare Române, 1956, vol. IV, p. 802.
2. Ciocârlan V. Flora ilustrată a României: *Pteridophyta et Spermatophyta*. Bucureşti: Ceres, 2009, p. 338.
3. Dihoru Gh., Negrean G. Cartea Roşie a plantelor vasculare din România. Bucuresti: Ed. Academiei Române, 2009. p. 454.
4. Klášterský I. *Rosa* L. In: Tutin T. G. et al. (Eds.) *Flora Europaea*. Cambridge University Press, 1968, vol. 2, p. 32.
5. Negru A. Determinator de plante din flora Republicii Moldova. Chișinău: Universul, 2007, 391 p.
6. Popescu A., Sanda V. Conspectul florei cormofitelor spontane din România / Lucrările Grădinii Botanice. Bucureşti: Ed. Universităţii din Bucureşti, 1998, 336 p.
7. Андреев В. Деревья и кустарники Молдавии, Кишинев: Картя молдовенеаскэ, 1964, вып. 2, с. 188.
8. Бузунова И. Род *Rosa* L. В: Флора Восточной Европы. Санкт-Петербург: Мир и Семья, 2001, с. 329-361.
9. Гейдеман Т.С. Определитель высших растений МССР. Кишинев: Штиинца, изд.3, 1986. 637 с.
10. Коровина О. Методические указания к систематике растений. Ленинград: изд. ВИР, 1986, 210 с.
11. Хржановский В. *Розы.* Москва: Советская наука, 1958, 497 с.

CONTRIBUTIONS TO THE STUDY OF *RUBUS* L. (*ROSACEAE* JUSS.) GENUS IN THE FLORA OF REPUBLIC OF MOLDOVA

Tofan-Dorofeev Elena

Botanical Garden (Institute) of the ASM, Chisinau

Abstract: The paper contains information on the study of Rubus L. in the flora of Republic of Moldova. Two species: R. constrictus Lef. et P. J. Mull. and R. ulmifolius Schott were recorded in the list of local flora for the first time. The synonymy, morphological description, ecology, habitat characteristics and chorology of the species is given.

Key words: habitat taxonomy, morphology, bioecology, chorology, Rubus, Rosaceae, Republic of Moldova.

INTRODUCTION

The genus *Rubus* L. in the world flora includes over 300 species, typically found in extra tropical areas of both hemispheres[11]. This genus is complicated taxonomically because of the abundance of fertile spontaneous hybrids, their stabilization and passing to apomictic reproduction, but also because of the lack of botanical material in herbaria collections required for determination: portions of vegetative shoots and upper part of generative shoots [10].

The flora of the Republic of Moldova includes 8 spontaneous species [3, 8]; most of them grow in forests, meadows, groves, hollows, rocky hills.

MATERIALS AND METHODS

The research on *Rubus* L. genus was carried out in the Herbarium of the Botanical Garden (I) of the ASM. The critical analysis of specific taxa was performed according to the classical comparative-morphological method [9]. Fundamental papers in this field were used to determine and establish morphological and bioecological peculiarities [1-5, 8, 11, 12].

RESULTS AND DISCUSSIONS

As a result of the critical study of the *Rubus* L. species, kept in the Herbarium of the Botanical Garden (I) of the ASM, among the exsiccatae of *R. candicans* Weihe ex Reichenb., 10 exsiccatae of *R. ulmifolius* Schott and 5 exsiccatae of *R. constrictus* Lef. et P. J. Mull. were identified; these species had not been previously indicated in the lists of vascular plants of Moldova [3, 8]. These two species were redetermined in 1993, by L. Krassovskaja, researcher at the Botanical Institute of the Russian Academy of Sciences, St. Petersburg, being later indicated in the monograph "Флора Восточной Европы" ("Flora of Eastern Europe") [11], for the territory under study. Further, we present the synonyms, biomorphological and chorological peculiarities of newly registered species.

R. constrictus Lef. et P. J. Mull. 1859, in P. J. Mull., Pollichia, 16-17 : 79; Nyárády, 1956, Fl. RPR, 4 : 339; H. E. Weber, 1995, in Hegi, Ill. Fl. Mitt.-Eur., ed. 3, 4, 2A : 352; Красовская, 2001, Фл. вост. Европы, 10 : 376; Ciocârlan, 2009, Fl. ilustr. a Rom. : 309. – *R. vestii* Focke, 1877, Syn. Rub. Germ. : 155; Hesl.-Harr. 1968, Fl. Europ. 2 : 16. – *R. thyrsoideus* Wimm. subsp. *constrictus* (Lef. et P. J. Mull.) Sudre, 1910, Rubi Eur. : 92.

Shrub up to 2 m tall. Stems arched, glabrous, canaliculated. Thorns are strong, horizontal or a little inclined, straight, flattened at the base. Linear stipels. Leaves have 5 leaflets, glabrescent petiole with slightly curved thorns. Leaflets are light green, on the upper side – glabrous, on the lower side – with short, uniform, velvety hairs and with a few longer hairs; the margin of leaf blade is unevenly toothed. The terminal leaflet is medium wide-ovate, cuneate at the base, long acuminate at the tip, the petiole is 3-4 times shorter than the leaf blade. The lateral leaflets are ovate, short (2-3 mm) petiolulate. Floriferous branches – edged, glabrescent, ternary-leaved or the lower ones – with 5 leaflets, with rare thorns. Flowers are gathered in panicle inflorescence, with ternary of simple bracts at the base, erect pedicels with curved thorns up to 3 mm long. Petals are elliptical or elongated-obovate, 10-12 mm long, pinkish. Sepals are gray-greenish, tomentous, reflected during the fruiting phase. Stamens longer than stigma. The upper

part of the ovary is pubescent. Fruits are purple-black, shiny. Blooms in June-July, seeds ripen in August-September.

This species is characteristic of Central European deciduous forests, grows in glades, groves and edge of forests. Xeromesophilic, mesothermal, amphitolerant species. In the spontaneous flora of Bessarabia, this species is mentioned by Săvulescu Tr. and Rayss T. [6] as *R. candicans* Weihe ex Reichenb. var. *vestii* (Focke) Hruby, for Mlynki village, Hotin district from the North of Bessarabia. The exsiccatae kept in the Herbarium of the Botanical Garden (I) of the ASM have been collected from the territory of Republic of Moldova by T. Gheideman and L. Nicolaeva, near Rădenii Vechi village, Ungheni district and Vălcineţ village, Călăraşi district (in the beech, oak and hornbeam forest).

R. ulmifolius Schott, 1818, Isis (Oken), 2 : 821; Hesl.-Harr. 1968, Fl. Europ. 2 : 15; H. E. Weber, 1995, in Hegi, Ill. Fl. Mitt.-Eur., ed 3, 4, 2A : 368; Красовская, 2001, Фл. вост. Европы, 10 : 378. – *R. discolor* Weihe et Nees, 1825, Rubi Germ. : 46, tab. 20; Мякушко, 1999, Опред. высш. раст. Укр. изд. 2 : 162. – *R. fruticosus* var. *ulmifolius* (Schott) Fiori, 1898, in Fiori et Paol., Fl. Ital. 1, 2 : 579. – **elmleaf blackberry.**

It is a shrub that grows up to 1.5 m tall, it is not glandulous. Stems arched-nutant, edged, canaliculated, glaucescent, glabrescent to tomentous, with semiadpressed hairs; thorns are strong, flattened at the base, falcate, pubescent in the lower half, 7-11 mm long. Leaves have (3)5 leaflets, are long petiolate, irregularly toothed, coriaceous, on the upper side, they are green, hairless, on the lower side adpressed, white-tomentous, with prominent veins. The terminal leaflet is obovate, sometimes ovate, short acuminate, long petiolulate, cordate or slightly rounded at the base. Lateral leaflets are elliptic, evidently petiolulate. The petiole and the petiolules are hairy, with scattered thorns. Stipels linear. Inflorescence paniculate, sometimes elongated, leafy toward the base, with pubescent, falcate thorns. Flowers 2.5-3 cm in diameter. Sepals with white-*tomentous indumentum*, deflected after flowering, provided with small needle-like thorns. Petals pink-violet to red, broad-elliptical to round. Stamens equal or longer than stigma. Ovary pubescent. Fruits purple-black. Blooms in June-July, seeds ripen in August-September.

This species is widespread in Central and Southern Europe, grows sporadically forming thickets in glades, groves and edge of forests [10]. Xeromesophilic, mesothermal species, without edaphic preferences. It was collected from the surroundings of Soroca town (Soroca forest, the upper part of the slope with eastern exposure, under the canopy) and near Călăraşi town (in the forest, on slope with southern exposure).

CONCLUSIONS

As a result of the critical study of the *Rubus* L. species in the Republic of Moldova, two new species, for the list of local flora, have been introduced: *R. constrictus* Lef. et P. J. Mull. and *R. ulmifolius* Schott. These taxa require further research in the field to accumulate new data on their chorological peculiarities and population al features in natural habitats.

BIBLIOGRAPHY

1. Ciocârlan V. Flora ilustrată a României: *Pteridophyta et Spermatophyta*. Bucureşti: Ceres, 2009, p. 309.
2. Heslop-Harrison Y. *Rubus* L. In: Tutin T. G. et al. (Eds.) *Flora Europaea*. Cambridge University Press, 1968, v. 2, p. 15.
3. Negru A. Determinator de plante din flora Republicii Moldova. Chişinău: Universul, 2007, 391 p.
4. Nyárády E. *Rubus* L. In: Flora Republicii Populare Române. Bucureşti: Ed. Academiei Republicii Populare Române, 1956, vol. IV, p. 276-580.
5. Popescu A., Sanda V. Conspectul florei cormofitelor spontane din România / Lucrările Grădinii Botanice. Bucureşti: Ed. Universităţii din Bucureşti, 1998, 336 p.
6. Săvulescu Tr., Rayss T. Materiale pentru flora Basarabiei. Bucureşti, 1934, p. 23-29.
7. Андреев В. Деревья и кустарники Молдавии, Кишинев: Картя молдовенеаскэ, 1964, вып. 2, с. 171-186.
8. Гейдеман Т.С. Определитель высших растений МССР, изд. 3, Кишинев: Штиинца, 1986, 637 с.

9. Коровина О. Методические указания к систематике растений. Ленинград: изд. ВИР, 1986, 210 с.

10. Красовская Л. О некоторых видах рода *Rubus* секции *Rubus* L. (*Rosaceae*) Восточной Европы. // Ботанический журнал. Том 82, 1997, Санкт-Петербург: Наука, с. 120-123.

11. Красовская Л. Род *Rubus* L. В: Флора Восточной Европы. Санкт-Петербург: Мир и Семья, 2001, с. 362-393.

12. Мякушко Т. Род *Rubus* L. / Определитель высших растений Украины. Киев: Фитосоциоцентр, 1999, с. 162-163.

TOTAL RESULTS OF STUDYING *CHRYSANTHEMUM MULTIFLORA* VARIETIES IN THE BOTANICAL GARDEN (INSTITUTE)OF THE MOLDOVA ACADEMY OF SCIENCES

Voiniac Inna

Botanical Garden (Institute) of the Academy of Sciences of Moldova

Chisinau, 18, Padurii str., MD-2002, Republic of Moldova

e-mail:inna0566@mail.ru

Abstract: One of the methods of enrichment assortment collection of genepool is the introduction of plants. The paper presents scientific research data concerning the investigations the adaptive abilities and biological peculiarities of the new varieties of chrysanthemums.

Key words: chrysanthemums diversity, variety, improvement, introduction.

INTRODUCTION

One of the main tasks of the botanical gardens consist in the introduction of plants, the target of which is the involving of plant resources from different regions of the world, their multilateral studying and discovering new plants, that are very convenient to be used in the national economy of our country [3]. The introduction of plants is one of the methods of enrichment the data collection assortment of the genepool.

The perennial chrysanthemums represent one of the leading cultures in ornamental floriculture. They belong to two species of the extensive genus – *Chrysanthemum morifolium* Ramat (*Chrysanthemum grandiflorum*) and *Chrysanthemum indicum* L., a small flowered chrysanthemum, the family of *Asteraceae*. The greatest diversity of modern varieties of these species appeared as a result a centuries-old culture, accompanied by the selection of species of the genus *Chrysanthemum*.

The chrysanthemum is the one of the ancient of flower cultures, which not only did not lose their significance in our days, but also takes the second place in the global production of flower production. Such a place in the chrysanthemums flower growing is determined not only by high decorative quality, but also the possibility of universal use. They are grown for cutting, for designing flower gardens of different destination, in the pots, in containerized culture, in the form of the trunk and the cascade, of bonsai. Thanks to many centuries of selection the chrysanthemums in the Eastern countries and more than a century of selection in Europe and America, the modern varieties are characterized by a huge number of varieties with different physiological and morphological properties. As a result of many centuries of breeding work were grown more than 10000 varieties of chrysanthemums, which are different by the shape of inflorescences, their coloring, in size and number, shape and height of the bush, the timing and duration of flowering.

A great diversity of chrysanthemums varieties, numbering tens of thousands denominations, gives us the opportunity to choose an interesting assortment from the ornamental point of view. However, the variety is not stable and might significantly change when moving in different geographical and environmental conditions. And the diversity of varieties, not only complicates the introduction, but also the agrotechniques of chrysanthemums, which is expressed in the various specific requirements to the light, temperature and the conditions of nutrition. Unstudied the biological characteristics of the variety, lack of knowledge of the adaptive abilities, its requirements to environmental factors of crop growing, often lead to lower quality and ornamentals plants.

In this connection, the introduction of chrysanthemums for the employees of floriculture laboratory, Botanical Garden (Institute) of Moldova Academy of Sciences, is of great interest not only from the standpoint of replenishment the collection genefund, but also the exploring new varieties, their adaptive abilities, the improvement and the use of the taxa, perspective for the national production.

MATERIALS AND METHODS

The investigations in the experimental plot, in the conservatory of the floriculture laboratory and in the conservatory of the Botanical Garden (Institute) of the ASM were carried out. The objects of cultivar investigation the 20 small flowering varieties of chrysanthemums from the group of multiflora were served. The investigations was carried out according to the methodics of the State Crop Variety Testing of the Republic of Moldova (issue 6, the division of ornamental plants, 1968), **by** Dvoryaninova, K.F., and based on the methodics referring the phenological observations in the botanical gardens (1975).

RESULTS AND DISCUSSIONS

From 1954 onwards, at the same time with the establishment of the basic collection, the scientific researchers of the Botanical Garden of the Academy of Sciences of Moldavian SSR began to the introduction of chrysanthemums. At that time, have been collected the varieties that were available in the country, were imported the varieties of national and foreign selection from Kiev, Yalta and Sukhumi.

Especially many varieties of chrysanthemums were introduced in 1963, mainly due to the extensive collection of the Main Botanical Garden of the Academy of Sciences of SSSR, of State Nikita Botanical Gardens, Central Botanical Gardens of the National Academy of Sciences of Ukraine and other botanical institutions. In 1973 it was delivered 220 large- and small-flowered varieties of chrysanthemums, and by 1977, the collection numbered over 300 varieties. The collection was consisted mainly of varieties of foreign selection: 92 of English and Dutch, 21 Sorts of Chinese and Japanese selection and 62 varieties of national breeding [1].

The climate of Moldova is moderate continental, with a short comparatively mild winter and the long, hot summer, it is favorable for the cultivation of chrysanthemums. For the spring is characteristic a rapid increase in the average daily air temperatures and the rapid warming of the soil. However, the freezing could be in the third decade of April, in the rare years, even in the third decade of May.

The peculiarity of the climate of Moldova is a dry summer, when there is no precipitations extended period of time under high temperature and of low relative humidity. From the end of 90th years has worsened the overall environmental conditions, the drought periods have increased, and has increased significantly the air temperature during the spring and summer months. The abnormal heat (from May to + 300 ° C, and in June and July to 400-450 ° C and higher), a small amount of, and, often also the lack of rainfall during the vegetative growth and reproductive development of chrysanthemums, could not but affect the state of the plants. Many varieties were lost, one of the part simply less developed.

Taking into account the environmental exigencies and in connection with the changes in the tendencies in floriculture, it became necessary to be renewed the collection and replenishing it with new varieties more ornamental and sustainable in the conditions of urbanization.

We were introduced a number of varieties from Romania and Poland. At a recent time, were increased the interest to the landscape industry, taking into consideration the demand for a specific assortment and following the popular trend, the taxonomic composition regularly has been renewed.

At the present time, the collection of chrysanthemums of Chisinau Botanical Garden (Institute) of Moldova Academy of Sciences includes about 100 varieties and 20th of selection forms. Our collection has represented varieties with different periods of flowering plants, so as from September till January. The colouring of inflorescences is quite diverse, beginning from white to the brownish-crimson color, so violet, yellow, pink, orange, and green-flowered by different reflexes and their combinations, often with a differently colored with the outer and inner bunch of flowers.

From the shape point of view the inflorescences there are representatives of the 9 classes, according to the classification elaborated by the Institute of Horticulture of the GDR (Clauss, 1966) and supplemented by Dvoryaninova [3].

By the origin, the varieties are distributed as follows: 55 varieties of foreign selection, including 24 - Polish, 8 - French and American, 10 - Romanian, 9 - Dutch, 6 - Moldovan selection, 15 - Ukrainian

varieties 5 - Russian, 7 varieties of unknown origin and 50 of selection forms, perspective for obtaining new autochthonous varieties.

Since 2010 year, in the taxonomic composition of the collection 26 of new the varieties of chrysanthemums from the group of *Multiflora* (*Chrysanthemum multiflora* Thunb.), an eastern Asian shrubby or climbing rose that bears clusters of small single pink or white flowers have been introduced. This is a new flower potted group, which distinguishes by ornamental spherical-shaped of the bush, abounding flowering, because sometimes the number of inflorescences on the bush is difficult to recount.

The new *Multiflora* group is predestinated first of all for the open ground and refers to the garden plants. With the selection of these chrysanthemums are involved in the Netherlands, England, Germany, and Poland. The varieties are different by the density of the petals from one flower, shape of inflorescences (ornamental, dahliashaped flowers, pompon form, needle-shaped (aciculate), chamomileform, anemoneform) also by coloration (white, yellow, salmon (a pale pinkish orange color), red, purple, lilac - of various reflexes, bicolor), as well as the habitus of the bush and flowering periods [2]. One part of them was brought from Poland and another part from Netherlands.

The scientific researchers of the Botanical Garden the work for the study of adaptive capacities and biological peculiarities of New Varieties of chrysanthemums has been carried out. According to the results of investigations, we have selected 10 of the most sustainable varieties, which are perfectly have adapted to the local agroclimatic conditions. There are such varieties, as *Axima white*, *Ajuga white*, *Camina*, *Comaco gold*, *Flamingo sanny*, *Galantino*, *Lariva Reg*, *Mino rose*, *Terano*, *Triki white*. On the basis of the data on phenological observations and biometric parameters, the characteristics of various sorts and varieties of investigated chrysanthemums were obtained:

Axima white is the variety of Dutch selection. Is a globular bush of 25-30 cm height, and up to 60 cm in diameter. The inflorescences are rounded, dahlia-shaped, and white with a little cream center at the beginning of the flower clusters has come out. On one flowering shoots there are 15-20 flower clusters, of 3-4 cm in diameter. The leaves are deep green, sharpened at the ends, small and dense. The sort is cold and drought resistant, in the conditions of the Republic of Moldova perfectly hibernates without shelter. Flowering is abundant and quite for a long time, about 40-50 days. It is recommended for flower borders, mixborders, alpine hills, may be cultivated in the pots, in containerized culture, vases and solitary.

Ajuga white is a Dutch variety. The bush is 25-30 cm height, globular, reaches 65 cm in diameter, per growing season from cuttings. White with cream nuances and the light yellow center, the flower clusters are dahlia-shaped, reaches of 4-6 cm in diameter, densely arranged along the entire perimeter of the crown. The leaves are dense; the average size, dark green in color, leaf lamina wide is cut up by one/third. It blooms from the middle of October during 45-55 days. Perfectly looks in pots and vases, flower gardens of different purposes (flower borders, mixborders, parterres and alpine hills).

Camina is a variety of Polish origin. The bush height reaches up to 30 cm, shaped like a sphere, with dense foliage, compacted bush, sustainable, reaches 70 cm in diameter. The leaves are small, of dark green color, leaf lamina wide is cut up by one/third, are sharpened edges, on the inner side we can observe a light pubescence. The flower clusters are dahlia-shaped, plane, of dark red color, in the full blooming from the outside are lighter, reaches 3-5 cm in diameter. On one flowering shoots forms an up to 20 flower clusters, but on a bush of up to 400. It blooms from the first decade of October until the end of November. The variety is drought- and cold-resistant, winters in the open ground. Some disease wasn't observed, is damaged by sucking and leaf-eating insects. It is recommended for use in open and protected ground.

Comaco gold is a Polish variety. The shrub has a compact and spherical shape, reaches a height of 20-25 cm and 35-65 cm in diameter, densely foliate-leaved. The leaves are light green and small the length of the leaf blade is of 4-5 cm, the width of 2,0-2,5 cm, on the interior side is lightly pubescent. The flower clusters are dahlia-shaped, flat and bright yellow, of 2,0 - 4,5 cm in diameter, uniformly arranged all over the perimeter of the crown. On one flowering shoots till 25 flower clusters, but on a bush of up to 350. It blooms from the middle of October until the end of November. Offers resistance to the high temperatures, but don't winters without protection. It is recommended for the flower beds of different destination and as a potted variety.

Flamingo sanny is a Dutch variety. Compacted and globe-shaped bush, reaches the height of 20-25 cm, densely leaved. The leaves are dark green of average size. The flower clusters are dahlia-shaped, flat and loose, of canary yellow color, achieves from 3 to 5 cm in diameter. On one bush up to 250 flower clusters. It blooms from early October during 50-60 days. The variety is drought- and cold-resistant, is damaged by sucking and leaf-eating insects. The variety is resistant to fungal diseases. It can be used in both open and closed ground.

Galantino is the variety of Dutch selection. The bush possesses a spherical form, reaches the height of 20-30 cm and 35-45 cm in diameter, possess the average foliage. The leaves are small, of dark green color, are sharpened at the ends. The flower clusters aren't large, of 2-3.5 cm in diameter, the flower clusters are dahlia-shaped, pompon, are distinguished by deep purple (beet) color. The abundant flowering, of up to 300 flower clusters on one bush. It blooms from the middle of October during 55-65 days. It is recommended for the flower beds, mixborders, alpine hills, perfectly looks in vases in combination with white and pink varieties.

Lariva Red is a Polish variety. The bush height reaches of 20-25 cm and spheroidal shape. The compact bush reaches a diameter of 40-60 cm, densely foliate leaves. The leaves are small, dark green; the leaf lamina is subintegrifolious, acuminate. The flower clusters are dahlia-shaped, planipetalus, of 2-4 cm diameter, orbicularifolius, of a brownish-crimson color, by the end of flowering turn pale and obtaining a reddish nuance. It blossoms from the second decade of October until early December. The variety supports the thermal variations and the freezing of short duration. It is recommended as decorative container, typically made of glass or china and used as an ornament or for displaying cut flowers.

Mino rose is a Polish variety. The bushes possess the height of 20-40 cm; in shaded areas in the 2nd year of cultivation can achieve a height of 50 cm. The bush is of globe-shaped form, which is formed by the plant and without removal of growth pointes, during each removal the bush increases twice in diameter. Is a compact bush, densely foliate leaves. The leaves are small, dark green; cut up by one/third, a little sharpened at the ends. Possess little flower clusters which reaches 2,0-2,5 см in diameter, pompon, are pale pink with a lilac reflexes, are numerous, On one bush up to 400 or more inflorescences. It blooms from the middle of October until first frosts. It is extremely cold- and drought-resistant, as well as the variety is resistant to diseases and pests. May be cultivated in pots, containers, vases, flower beds, mixborders, alpine hills, rockeries, perfectly is looked as a solitaire.

Terano is a Polish variety. The bush is of globe-shaped form; compacted, sustained, achieve a height of 30-40 cm, from 30 till 60 cm in diameter, densely foliate leaves. The leaves are dark green, elongated, shallow, a slightly pubescent, a little sharpened at the ends. The flower clusters are dahlia-shaped, rounded, pure-white with a bright yellow center, which is well-marked in their full blooming. It blossoms abundant and for quite a long up to 65 days, beginning with middle of October. Drought- and frost-resistant, winters in open ground without protection. It recommended for use in open and protected ground.

Triki white is a Polish variety. The bush is of the 20-25 cm height, up to 35-65 cm in diameter, is of globe-shaped form. The bushes are compacted, thick, and densely foliate leaves. The leaves are green-light, medium sized, nearly integers with slightly acuminated ends, a little pubescent the inner side. The flower clusters are dahlia-shaped, planipetalus, that is at the bottom involuted in a tubule and pubescent to the end. On one bush there are more than 200 flower clusters up to 3,0-5,5 cm in diameter. It blossoms from the end of September till the middle of November. Is drought resistant, but in open ground no winters without be protected. The variety is susceptible to fungal diseases. It is recommended for flower beds of various destinations, may be cultivated as a solitaire, for growing in pots, containers and vases.

CONCLUSIONS

As a result of our investigations it was established that the varieties of *Chrysanthemum multiflora* in the conditions of the Botanical Garden (Institute) of the Academy of Sciences of Moldova, pass through all the phases of development, abundantly and for a long period blossom, that leads to the conclusion about the successfulness of their adaptation to the new environment.

The most perspective for landscaping are such varieties as: *Axima white*, *Ajuga white*, *Camina*, *Comaco gold*, *Flamingo sanny*, *Galantino*, *Lariva Reg*, *Mino rose*, *Terano*, *Triki white*.

REFERENCES

1. Дворянинова К.Ф. Хризантемы. Кишинев: Штиинца, 1982. 157 с.

2. Черкашина В.П. Модная хризантема Мультифлора. In: Цветоводство, 2008, 5, с.7-8.

3. Шарова Н.Л., Дворянинова К.Ф. Промышленные сорта хризантем в Молдавии. Кишинев: Штиинца, 1972. 147 с.

III. INTRODUCTION OF PLANTS AND SUSTAINABLE USE OF PLANT RESOURCES

PHENOLOGICAL ASPECTS OF *GALEGA ORIENTALIS* LAM. IN THE CONDITIONS OF THE REPUBLIC OF MOLDOVA

Vitalie Ababii

Botanical Garden (Institute) of the ASM, MD 2002 Chisinau, Padurii str. 18

Abstract: The phenological observations of Galega orientalis Lam. under the conditions of the central part of the Republic of Moldova are reflected in this article. The research in question was carried out during the years 2010 - 2012 in the collection of fodder plants of the Botanical Garden (Institute) of the ASM. It was found that, beginning with the second year, the studied plants go through all stages of the life cycle.

Keywords: Galega orientalis, introduction, phenology, growing season.

INTRODUCTION

One of the main factors of livestock sector's degradation remains the acute shortage of fodder protein, which could be compensated by diversifying the range of fodder. The pedoclimatic conditions of the Republic of Moldova allow successfully the expansion of the assortment of fodder crops on account of introducing new plant species. It is important, however, to choose those crops that could give us the highest yield and quality per unit area, with low costs of labour and resources, besides, they should not be invasive and, if possible, allow improving the fertility of degraded soil. Plants that meet these parameters are perennial legumes. The energy efficiency resulted from fodder protein production in perennial legumes is 2-3 times higher than in cereals [1]. Among these plants, a new fodder crop - Galega orientalis Lam. can be found. This species has been introduced in our country by Alexandru Teleuţă, PhD.

In the process of introduction of new plant species, the phenological research plays a very important role. The earliest extant mentions of phenological observations are related by Theophrastus (371- 287 BC) in "The Calendar of Flora" and the by the Roman writer Pliny the Younger. [2]. In the Middle Ages, in monasteries, phenological observations of the most precious plants and animals, and also weather anomalies and their consequences were recorded systematically [3].

MATERIALS AND METHODS

The research was conducted within the laboratory "Medicinal, Aromatic, Spice and Fodder Plants" of the Botanical Garden (Institute) of the ASM, during the three years – 2010-2012. As the object of study, Galega orientalis L. from the collection of fodder plants was used, since the first until the third year of vegetation. Experiments were mounted on 3 m long plots and a width of 70 cm between rows. The plants were processed mechanically and fertilizers weren't used during the research.

The examination of phenological aspects has been carried out according to the method of phenological observations in botanical gardens („Методика фенологических наблюдений в ботанических садах СССР") [4]. Climate conditions during the research were taken from the website (meteo.md) of the State Hydrometeorological Service.

RESULTS AND DISCUSSIONS

The term "phenology" was introduced in literature in the middle of the nineteenth century by the botanist Ch. Morren. Etymologically speaking, the term "phenology" comes from the Greek words "phainestai" (appearance) + logos (science), i.e., phenology is the science of occurrence of events in the life of plants and animals. As a branch of biology, phenology studies the periodic phenomena of plant and animal life and their relation to environmental factors; these periodic phenomena are known in

phenology as phenological phases or phenophases [2].

The years 2010 - 2012, which proved to be different in terms of temperature and water regime, were examined in order to establish and characterize the phenological phases of the studied species. 2010 was a warm year with a lot of precipitation. The average annual air temperature was 8.9-11.2°C, exceeding the climatic norm with 0.8-1.3°C. The absolute maximum temperature was 39 ° C and the absolute minimum temperature was -31°C. Precipitations fell unevenly. Their amount throughout the year on most of the territory was 615-790 mm (110-150% of the norm), which is recorded on average once in 5-25 years. [5].

For the studied species, 2010 was the first year of research. The seeds were sown in the middle of April (Table 1). The first plantlets appeared after 15 days from sowing, it should be noted that in order to germinate, seeds require a minimum temperature of 5 - 6 ° C and the optimum temperature ranges between 10 and 12 ° C [6]. In the year when they are sown, the Galega orientalis Lam. plants grow slowly and rarely move on to the generative phase (Table 1).

***Table 1*. Phenological phases of Galega orientalis Lam in 2011 – 2012**

Year of research	Sowing of seeds	Initiation of vegetation	Budding	Flowering			Fructification			End of vegetation
				beginning	mass flowering	end	beginning	mass fructification	end	
2010	23.04	08.05	-	-	-	-	-	-	-	-
2011	-	05.04	10.05	22.05	07.06	28.06	12.07	04.08	17.08	November
2012	-	28.03	05.05	18.05	03.06	18.06	21.06	11.07	26.07	November

If we characterize briefly 2011, we can mention that it was warmer than normal and with large precipitation deficit on more than 60% of the country. The average annual air temperature was +9.1 .. + 10.7 ° C, exceeding the climatic norm with 0.5-1.3°C, at Weather Station of Chisinau, the average annual air temperature was 10.5 ° C (1 ° C higher than the norm). The absolute minimum temperature in 2011 was -19.2°C, which is recorded on average once in two years. The absolute maximum temperature was + 35.8°C, which is recorded on average once in two years. Precipitations fell unevenly. Large precipitation deficit occurred on more than 60% of the country. Their sum was 290-415 mm (50-75% of the annual norm). On 40% of the country, the amount of precipitation was almost normal - 430-545 mm (80-105% of the annual norm) [5]. 2012 on the territory of the Republic of Moldova was also mostly warmer than average and a large precipitation deficit was recorded from June to September. These conditions helped maintain during this period a strong atmospheric and soil drought. The average annual air temperature was +9.3 .. +11.7 ° C, exceeding the climatic norm with 1.1-1.8 ° C, such temperature is recorded on average once in 5-10 years. The absolute minimum air temperature in 2012 was -32.0°C. The absolute maximum air temperature for the first time during the whole period of observations in the Republic of Moldova reached + 42.4°C. The annual amount of precipitation was within the norm and constituted 444-704 mm (85-120% of the norm), but they fell very unevenly throughout the year [5]. Examining the phenological aspects of Galega orientalis Lam., it was determined that since the second year of vegetation (2011), plants underwent a whole vegetation cycle which was divided into five phenological phases: initiation of vegetation, budding, flowering, fructification, end of vegetation (Table. 1 and 2).

***Table 2 Galega orientalis* Lam. phenological spectrum in vegetation years 2011 - 2012**

Year	Month																	
	March,			April			May			June			July			August		
	ten-days' period																	
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
2011																		
2012																		

- Initiation of vegetation
- Budding
- Flowering
- Fructification

Initiation of vegetation at Galega begins when temperatures above 0 °C are established, namely in March and April. It was noted that the initiation of vegetation in the third year of vegetation (2012) took place earlier and the length of the vegetative phase (the period from the initiation of vegetation until budding) was approximately 37 days compared with the second year (2011) that lasted about 35 days, this gap can be attributed to the fact that plants are more mature and the spring was short, very warm and rainy in 2012 (Table 1 and 2).

The beginning of budding signals that the plant moves into the generative phase of development. The budding phase occurred at the beginning of May and lasted on average 12 days (2011) and 13 days (2012) (Table 1 and 2).

The beginning of the flowering phase is considered the opening of the first flower from an inflorescence on the plant under study. Due to the increased importance of this phenological phase, the following stages are recorded: beginning of flowering, mass flowering and end of flowering (Table 1 and 2). The first flowers of an inflorescence (raceme) start blooming on the bottom and then gradually go upwards, so the flowering is acropetal. The flowering phase of Galega orientalis Lam. starts in the middle of May and continues until the end of June. Depending on the year, the entire flowering phase lasted about 35 days (2011) and 30 days (2012). Cross pollination with the help of insects is specific to the studied plant. As a result of several studies, it has been established that at a temperature exceeding 30 ° C, the bees' activity decreases. The same process occurs when the weather is gloomy or there is prolonged rainfall in the flowering period [7].

As a result of pollination and wilting of the first flowers, the plant moves into fructification period which takes place in parallel with flowering. Like the flowering phase, the fructification phase is divided into three stages: beginning of fructification, mass fructification and end of fructification (Table 1). On average, the fructification phase lasted 35 days in 2011 and in 2012, but with some differences regarding the beginning of the phenophase. In 2012, the fructification phase began about 20 days earlier in comparison with 2011 and also ended earlier (Table 1 and 2) .. The end of fructification phase is considered when the fruit (pod) opens and is ready to disseminate.

The end of vegetation begins when temperatures below 0 °C are recorded (October-November), although Galega orientalis Lam. is more resistant to low temperatures than other traditional fodder crops. Concerning the whole life cycle, we mention that in 2011, during the initiation of vegetation and till the end of vegetation, about 214 days passed and in 2012 – 222 days.

In order to determine the length of growing season on a given territory (in the area of a weather station), the graphical method called - histophenogram (chart 1) can be used. It is an analysis of the sequence of monthly, annual or multi-annual average air temperature, which directly and indirectly influences the behaviour of plants and, therefore, the biodiversity of a territory [7].

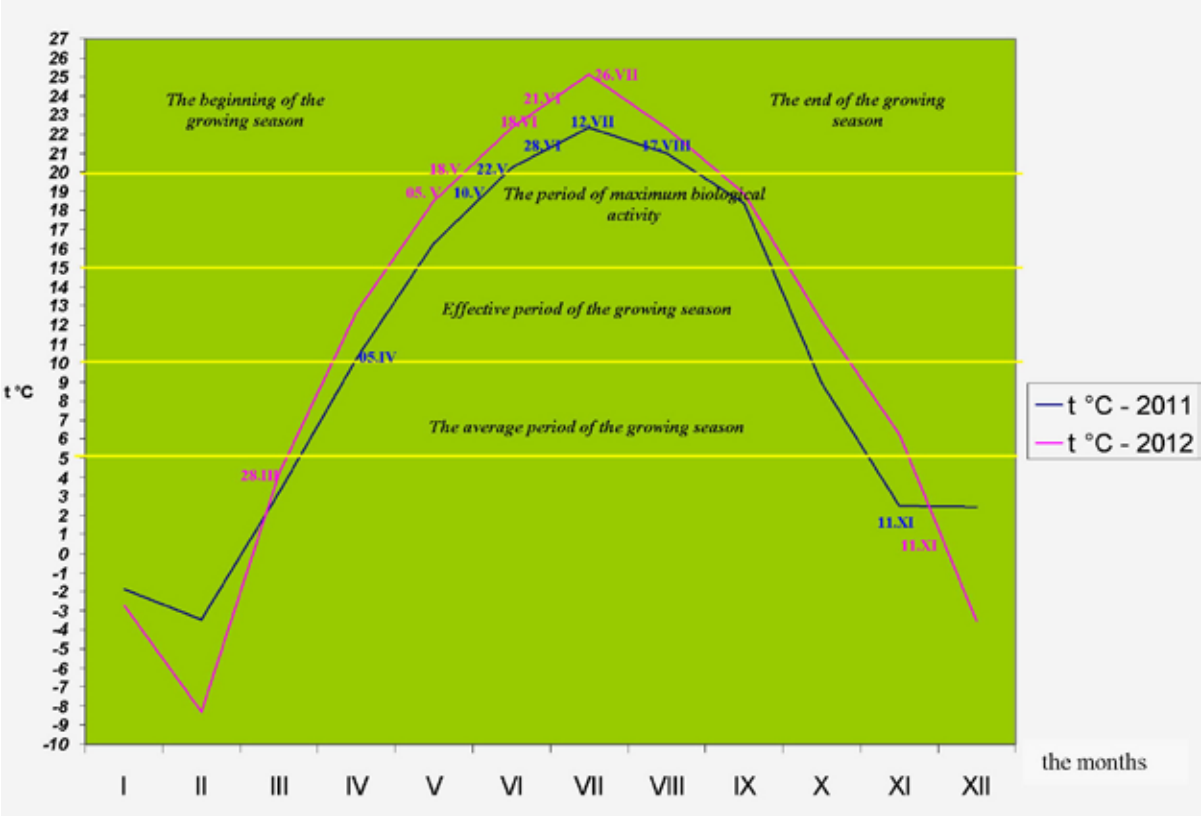


***Chart no.1*. Histophenogram (Galega orientalis Lam., 2011 – 2012) according to the data obtained from the Weather Station of Chisinau**

CONCLUSIONS

In the first year of vegetation, Galega orientalis Lam. plants grow slowly and rarely move into the generative phase. Since the second year of vegetation, the studied plants go through all phases of the life cycle. The generative period leads to fructification and viable seed formation, demonstrating their adaptability to local pedoclimatic conditions. The average length of the whole cycle of vegetation in the study years 2011 - 2013 in the Republic of Moldova was approximately 214-222 days, being observed an increasing tendency towards a longer growing season with age. Although it has a higher resistance to low temperatures than traditional crops, with the onset of frosts, the overground part of the plant dies.

BIBLIOGRAPHY:

1. *Teleuţă A. „Introducerea plantelor furajere noi în Republica Moldova”*// Conservarea diversităţii plantelor in situ şi ex situ: simpozionul ştiinţific internaţional, 27-29 oct.2011 – Iaşi 2011.
2. *Sparks T.H., Menzel A., Stenseth N.C. European cooperation in plant phenology* // Climate Research. 2009. Vol. 39, № 39. S. 175-177.
3. К.А. Крюкова, А.М. Данченко ,ФЕНОЛОГИЧЕСКИЕ НАБЛЮДЕНИЯ В РОССИИ: КРАТКАЯ ИСТОРИЯ РАЗВИТИЯ, Вестник Томского государственного университета. 2013. № 377. С. 192–195.
4. П.И. Лапина, Методика фенологических наблюдений в Ботанических садах СССР: Сб. стат./ :Изд-во Гл. бот. Сада АН СССР, 1972. - 135 с.
5. www.meteo.md
6. Надежкин,С.Н. „Галега восточная *(козлятник)*/С.Н.Надежкин,М.Х. Кираев. Уфа:БГАУ,2001.—106с
7. *Ababii V., TeleuţăA. THE FLOWERING AND POLLINATION TO GALEGA ORIENTALIS LAM. IN THE CONDITION OF REPUBLIC OF MOLDOVA*.....72 „Conservarea diversităţii plantelor”, Simp. şt. intern. (3; 2014; Chişinău).
8. *MANEA, G., [2008] 2011. Elemente de biogeografie*. Editura Universitară, Bucureşti.

CZU: 633.58:582.6 (478)

TAXONOMIC DIVERSITY OF MEDICINAL PLANT COLLECTION FROM BOTANICAL GARDEN (I) OF ASM

Nina Ciocarlan

Botanical Garden (Institute) of Academy of Sciences of Moldova

Foto 1. Collection of medicinal plants (June, 2013)

Abstract: The article presents data on the current state of the collection of medicinal plants from Botanical Garden (Institute) of ASM, as well as the dynamics of taxa increase over the last decade, ways to raise and maintain the gene pool. The taxonomic diversity of medicinal plant existing currently in the collection is given. Recent taxonomic inventory of medicinal plants collection led to identification of 309 taxa, belonging to 3 phylums, 4 classes, 62 botanical families and 194 genera. In the period 2004-2014 by means of international seed exchange the collection was enriched with 97 taxa and over 100 species were brought from the wild local flora.

Key words: medicinal plants, ex-situ collection, mobilization, taxonomic diversity.

INTRODUCTION

Currently, in more than 480 botanical gardens worldwide are recorded collections of medicinal plants [1]. The existence of these sectors in the botanical gardens is necessary, firstly, because of great scientific and economic importance of many medicinal plants, but also because every botanical garden always hosted such sectors as one of their primary tasks. In fact, the first botanical gardens were founded by the ancient Greek physicians that argued their existence through practical value they had, as primarily to be medicinal plant gardens.

The Collection of medicinal plants of the Botanical Garden, with a long and rich history, in the last decade has seen a real activation. The major activities in this subdivision are focused on continuous accumulation and maintenance of genetic resources of medicinal plants, plant biology research, ontogenetic features, obtaining scientific outcome and practical requirements for introduction into the culture, as well as setting the optimal strategy for their protection. The entire gene pool of the plant Collection serves primarily as a basis for introduction and breeding research to improve assortment of medicinal plants used in the national economy. Growing plants under controlled conditions allows undertaking a complex research, which helps to highlight their multiple features, which then become useful in their introduction into the culture. The research regarding plant biology features, ontogenetic cycle, growth and development during the vegetative period in new conditions, etc. is very important. Thus, in recent years the research on biomorphological and ontogenetic peculiarities of the good number of new medicinal species has been conducted.

MATERIALS AND METHODS

The research was carried out during the years 2004-2014. As the base of this study, the collection of medicinal plants from the Botanical Garden (I) of ASM has served. The genetic resource mobilization of medicinal plants was achieved through international exchange of seeds (*Delectus Seminum*) and by collecting seeds and plant material from the wild (indigenous) flora during expeditions. Phenologic observations and biometric measurements were performed annually during the entire vegetation period according to widely used methodological guidelines [6, 10-12]. Taxa nomenclature was performed according to contemporary floristic works [3-5].

RESULTS AND DISCUSSIONS

Over many years of research in the collection has been accumulated an impressive gene pool of medicinal plants. Certainly, as a base of the collection served the gene pool of already existing medicinal and aromatic plants [7-9]. At the beginning the collection included 92 species, forms and varieties. During the last decade the collection gradually enhances reaching now 308 taxa incorporated in 62 families and 193 genera. In the period 2004-2014 through the international exchange of seeds the number of plants boosted by 96 taxa. Nine species were purchased from medicinal plant exhibitions. At the same time more than 100 spontaneous species valuable in terms of their therapeutic and scientific value were added to the collection.

In total 96 taxa of medicinal plants introduced in the collection were obtained from the seeds received by *Delectus Seminum* from 34 Botanical Gardens and other specialized scientific institutions, nearly all being from European countries.

Further is presented the taxonomic diversity of medicinal plants collection.

Phylum *Polypodiophyta*

Classis Polypodiopsida

1. ***Aspidiaceae*** **Mett. ex Frank** (1 genus, 1 species): *Dryopteris* – 1.

Phylum *Pinophyta*

Classis Gnetopsida

2. ***Ephedraceae*** **Dumort.** ***(1 genus, 2 species):*** *Ephedra* – ***2.***

Phylum *Magnoliophyta*

Classis Magnoliopsida (Dicotiledones)

3. ***Actinidiaceae*** **Tiegh.** ***(1 genus, 1 species):*** *Actinidia* – ***1.***

4. ***Acanthaceae*** **Juss.** ***(1 genus, 1 species):*** *Acanthus* – ***1.***

5. ***Apiaceae*** **Lindl.** ***(10 genera, 15 species):*** *Anethum* – ***1,*** *Apium* – ***1,*** *Carum* – ***1,*** *Coriandrum* – ***1,*** *Foeniculum* – ***4,*** *Levisticum* – ***1,*** *Pastinaca* – ***1,*** *Petroselinum* – ***1,*** *Pimpinella* – ***3,*** *Ammi* – ***1.***

6. ***Apocynaceae*** **Juss.** ***(1 genus, 1 species):*** *Vinca* – ***1.***

7. ***Araliaceae*** **Vent.** ***(2 genera, 2 species):*** *Aralia* – ***1,*** *Eleuterococcus* – ***1.***

8. ***Aristolochiaceae*** **Juss.** ***(1 genus, 1 species):*** *Asarum* – ***1.***

9. ***Asclepiadaceae*** **R. Br.** ***(1 genus, 2 species):*** *Asclepias* – ***2.***

10. ***Asteraceae*** **Dumort.** ***(29 genera, 40 species):*** *Achillea* – ***2,*** *Arctium* – ***1,*** *Artemisia* – ***4,*** *Bidens* – ***1,*** *Calendula* – ***1,*** *Carthamus* – ***1,*** *Centaurea* – ***1,*** *Chrysanthemum* – ***1,*** *Cichorium* – ***1,*** *Cnicus* – ***1,*** *Coreopsis* – ***1,*** *Cynara* – ***1,*** *Echinacea* – ***4,*** *Echinops* – ***2,*** *Eclipta* – ***1,*** *Grindelia* – ***1,*** *Helianthus* – ***1,*** *Helychrisum* – ***2,*** *Inula* – ***2,*** *Jurinea* – ***1,*** *Matricaria* – ***1,*** *Polymnia* – ***1,*** *Pyrethrum* – ***1,*** *Santolina* – ***1,*** *Scorzonera* – ***1,*** *Solidago* – ***2,*** *Tagetes* – ***1,*** *Tanacetum* – ***1,*** *Taraxacum* – ***1.***

11. ***Basellaceae*** **Raf.** ***(1 genus, 2 species):*** *Basella* – ***2.***

12. ***Berberidaceae*** **Juss.** ***(1 genus, 1 species):*** *Berberis* – ***1.***

13. ***Boraginaceae*** **Juss.** ***(5 genera, 5 species):*** *Borago* – ***1,*** *Cynoglossum* – ***1,*** *Pulmonaria* – ***1,*** *Symphytum* – ***1,*** *Lithospermum* – ***1.***

14. ***Brassicaceae*** **Burnet** ***(6 genera, 6 species):*** *Armoracia* – ***1,*** *Crambe* – ***1,*** *Isatis* – ***1,*** *Lepidium* – ***1,*** *Sinapis* – ***1,*** *Erysimum* – ***1.***

15. ***Caryophyllaceae*** **Juss.** ***(2 genera, 2 species):*** *Gypsophila* – ***1,*** *Saponaria* – ***1.***

16. ***Convolvulaceae*** **Horan.** ***(1 genus, 2 species):*** *Convolvulus* – ***2.***

17. ***Cornaceae*** **Dumort.** ***(1 genus, 1 species):*** *Cornus* – ***1.***

18. ***Chenopodiaceae*** **Ventenat** ***(2 genera, 3 species):*** *Beta* – ***2,*** *Chenopodium* – ***1.***

19. ***Clusiaceae*** **Lindl.** ***(1 genus, 4 species):*** *Hypericum* – ***4.***

20. ***Cucurbitaceae*** **Juss.** ***(2 genera, 2 species):*** *Bryonia* – ***1,*** *Momordica* – ***1.***

21. ***Dioscoreaceae*** **Lindl.** ***(1 genus, 1 species):*** *Dioscorea* – ***1.***

22. ***Dipsacaceae*** **Juss.** ***(1 genus, 2 species):*** *Cephalaria* – ***2.***

23. ***Elaeagnaceae*** **Juss.** ***(1 genus, 1 species):*** *Hippophaë* – ***1.***

24. ***Euphorbiaceae*** **Juss.** ***(2 genera, 2 species):*** *Ricinus* – ***1,*** *Securinega* – ***1.***

25. ***Fabaceae*** **Lindl.** ***(10 genera, 16 species):*** *Astragalus* – ***4,*** *Cassia* – ***1,*** *Desmodium* – ***2,*** *Galega* – ***1,*** *Genista* – ***1,*** *Glycyrrhiza* – ***3,*** *Ononis* – ***1,*** *Indigofera* – ***1,*** *Lablab* – ***1.***

26. ***Illecebraceae*** **R. Br.** ***(1 genus, 1 species):*** *Herniaria* – ***1.***

27. ***Lamiaceae*** **Lindl.** ***(33 genera, 93 taxa):*** *Agastache* – ***3,*** *Ajuga* – ***1,*** *Betonica* – ***1,*** *Calamintha* – ***2,*** *Clinopodium* – ***1,*** *Dracocephalum* – ***1,*** *Elscholtzia* – ***1,*** *Hyssopus* – ***6,*** *Lamium* – ***1,*** *Lavandula* – ***3,*** *Leonotis* – ***1,*** *Leonurus* – ***2,*** *Majorana* – ***1,*** *Marrubium* – ***1,*** *Melissa* – ***2,*** *Mentha* – ***6,*** *Monarda* – ***1,*** *Mosla* – ***1,*** *Nepeta* – ***5,*** *Ocimum* – ***7,*** *Origanum* – ***5,*** *Perilla* – ***1,*** *Phlomis* – ***2,*** *Prasium* – ***1,*** *Prunella* – ***1,*** *Rosmarinus* – ***2,*** *Salvia* – ***13,*** *Satureja* – ***7,*** *Scutellaria* – ***3,*** *Sphacelae* – ***1,*** *Stachys* – ***1,*** *Teucrium* – ***2,*** *Thymus* – ***7.***

28. ***Linaceae*** **S. F. Gray** ***(1 genus, 2 species):*** *Linum* – ***2.***

29. ***Malvaceae*** **Juss.** ***(4 genera, 5 species):*** *Althaea* – ***2,*** *Alcea* – ***1,*** *Malva* – ***1,*** *Lavatera* – ***1.***

30. ***Onagraceae*** **Juss.** ***(1 genus, 1 species):*** *Epilobium* – ***1.***

31. ***Oxalidaceae*** **R. Br.** ***(1 genus, 1 species):*** *Oxalis* – ***1.***

32. ***Paeoniaceae*** **Rudolphi** ***(1 genus, 2 species):*** *Paeonia* – ***2.***

33. ***Papaveraceae*** **Juss.** ***(3 genera, 3 species):*** *Chelidonium* – ***1,*** *Glaucium* – ***1,*** *Macleya* – ***1.***

34. ***Pedaliaceae*** **R. Br.** ***(1 genus, 1 species):*** *Sesamum* – ***1.***

35. ***Peganaceae*** **Tiegh. ex Takht.** ***(1 genus, 1 species):*** *Peganum* – ***1.***

36. ***Phytolaccaceae*** **R. Br.** ***(2 genera, 4 species):*** *Phytolacca* – ***3,*** *Rivina* – ***1.***

37. ***Plantaginaceae*** **Juss.** ***(1 genus, 4 species):*** *Plantago* – ***4.***

38. ***Polemoniaceae*** **Juss.** ***(1 genus, 1 species):*** *Polemonium* – ***1.***

39. ***Polygonaceae*** **Juss.** ***(3 genera, 7 species):*** *Polygonum* – ***3,*** *Rheum* – ***2,*** *Rumex* – ***2.***

40. ***Primulaceae*** **Vent.** ***(2 genera, 2 species):*** *Primula* – ***1,*** *Lyzimachia* – ***1.***

41. ***Ranunculaceae*** **Juss.** ***(9 genera, 10 species):*** *Aconitum* – ***1,*** *Aquilegia* – ***1,*** *Adonis* – ***2,*** *Clematis* – ***1,*** *Helleborus* – ***1,*** *Hepatica* – ***1,*** *Pulsatilla* – ***1,*** *Thalictrum* – ***1,*** *Trollius* – ***1.***

42. ***Rhamnaceae*** **Juss.** ***(1 genus, 1 species):*** *Zizyphus* – ***1.***

43. ***Rosaceae*** **Juss.** ***(11 genera, 18 species):*** *Agrimonia* – ***1,*** *Alchemilla* – ***1,*** *Chaenomeles* – ***1,*** *Coluria* – ***1,*** *Filipendula* – ***1,*** *Fragaria* – ***1,*** *Geum* – ***2,*** *Potentilla* – ***5,*** *Rosa* – ***1,*** *Rubus* – ***1,*** *Sanguisorba* – ***3.***

44. ***Rubiaceae*** **Juss.** ***(2 genera, 2 species):*** *Galium* – ***1,*** *Rubia* – ***1.***

45. ***Rutaceae*** **Juss.** ***(1 genus, 2 species):*** *Ruta* – ***2.***

46. ***Saxifragaceae*** **Juss.** ***(1 genus, 1 species):*** *Bergenia* – ***1.***

47. ***Schizandraceae*** ***(1 genus, 1 species):*** *Schizandra* – ***1.***

48. ***Scrophulariaceae*** **Juss.** ***(3 genera, 6 species):*** *Digitalis* – ***4,*** *Veronica* – ***1,*** *Linaria* – ***1.***

49. ***Solanaceae*** **Juss.** ***(5 genera, 5 species):*** *Atropa* – ***1,*** *Scopolia* – ***1,*** *Physalis* – ***1,*** *Withania* – ***1,*** *Lycium* – ***1.***

50. ***Urticaceae*** **Juss.** ***(2 genera, 2 species):*** *Urtica* – ***1,*** *Parietaria* – ***1.***

51. ***Valerianaceae*** **Batsch** ***(1 genus, 1 species):*** *Valeriana* – ***1.***

52. ***Verbenaceae*** **St.-Hil.** ***(3 genera, 5 species):*** *Lantana* – ***1,*** *Verbena* – ***1,*** *Vitex* – ***3.***

53. ***Viburnaceae*** **Rafin.** ***(1 genus, 1 species):*** *Viburnum* – ***1.***

54. ***Violaceae*** **Batsch** ***(1 genus, 1 species):*** *Viola* – ***1.***

55. ***Zigophyllaceae*** **Lindl.** ***(1 genus, 1 species):*** *Tribulus* – ***1.***

Classis Liliopsida (Monocotyledones)

56. ***Alliaceae*** **J. G. Agardh.** ***(1 genus, 4 species):*** *Allium* – ***4.***

57. ***Amaryllidaceae*** **Juame** ***(2 genera, 3 species):*** *Sternbergia* – ***1,*** *Galanthus* – ***2.***

58. ***Asparagaceae*** **Juss.** ***(1 genus, 1 species):*** *Asparagus* – ***1.***

59. ***Araceae*** **Juss.** ***(1 genus, 1 species):*** *Acorus* – ***1.***

60. ***Convallariaceae*** **Horaninow** ***(2 genera, 2 species):*** *Convallaria* – ***1,*** *Polygonatum* – ***1.***

61. ***Liliaceae*** **Juss.** ***(1 genus, 1 species):*** *Lilium* – ***1.***

62. ***Cyperaceae*** **Juss.** ***(1 genus, 1 species):*** *Cyperus* – ***1.***

Recent taxonomic inventory of medicinal plants collection led to identification 308 taxa, belonging to 3 phylum, 4 classes, 62 botanical families and 193 genera.

Polipodiofites (Phylum *Polypodiophyta*) are represented by 1 species belonging to *Dryopteris* genus, *Aspidiaceae* family and *Polypodiopsida* classis.

Gymnosperms (Phylum *Pinophyta*) are represented by 2 species belonging to 1 genus (*Ephedra*), *Ephedraceae* family, *Gnetopsida* classis.

It is obvious preponderance of angiosperms (Phylum *Magnoliophyta*) with 305 species belonging to 192 genera, 60 families – 53 belonging to Classis *Magnoliopsida* and the remaining 7 to Classis *Liliopsida*. Among angiosperms, *Magnoliopsida* classis regroups the largest number of taxa (293 species, forms and varieties) compared with *Liliopsida* classis with 13 species. Reported to the entire number of medicinal plant cultivated in the collection polipodiofites and gymnosperms represent 0,3% and 0,6% respectively. The remaining 99,1% are angiosperms.

The most numerous families are: *Lamiaceae* (93 taxa belonging to 33 genera), *Asteraceae* (40 taxa belonging to 29 genera), *Rosaceae* (18 taxa belonging to 12 genera), *Fabaceae* (15 species belonging to 9 genera), *Apiaceae* (15 taxa belonging to 10 genera), *Ranunculaceae* (10 taxa belonging to 9 genera), *Polygonaceae* (7 species belonging to 3 genera) (Fig. 1).

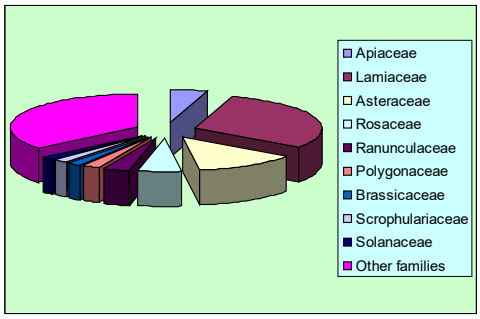


Fig. 1. The most representative families

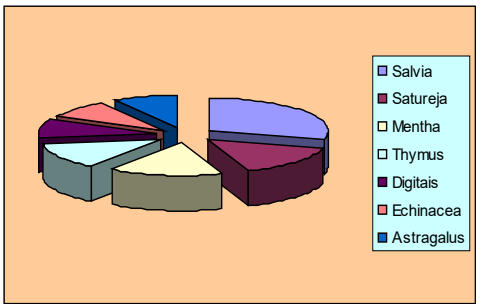


Fig. 2. The most frequent genera

Follow *Brassicaceae* and *Scrophulariaceae* families with 6 species, and families *Solanaceae*, *Verbenaceae*, *Boraginaceae* and *Malvaceae* are represented in the collection by 5 taxa each. Twenty seven botanical families are represented only by one species.

Genera with the largest number of species in descending order, are following: *Salvia* L. (with 13 species), *Satureja* L. (7), *Thymus* L. (7), *Mentha* L. (6), *Digitalis* L., *Echinacea* Moench and *Astragalus* L. (with 4 species) (Fig.2).

A number of new species included in the collection in the last years *Leonurus japonicus* Houtte., *Leonurus sibiricus* L., *Lavatera arborea* L., *Salvia verbascifolia* Bieb., *S. canariensis* L., *S. kopetdaghensis* Kudr., *Basella rubra* L., *Echinacea angustifolia* L., *Hyssopus officinalis* ssp. *aristatus* (Godr) Briq., *Ocimum gratissimum* L., *Grindelia robusta* Nutt., *Trollius altaicus* C.A. Mey., *Prasium majus* L., *Pimpinella rhodantha* Boiss., *Eclipta prostrata* L., *Sphacele salviae* (Lindl.) Briq., *Hypericum pulchrum* L., *Lantana viburnoides* (Forssk.) Vahl., *Mosla japonica* (Oliv.) Maxim.), *Rivina tinctoria* Hamillt., *Prunella vulgaris* var. *lilacina, Ocimum basilicum var. piperitum* underwent first introduction and acclimatization research in the conditions of botanical garden [2].

During the field expeditions a large number of medicinal species were collected from different natural habitats and transplanted in the collection. Only in 2009 -2010 period more than twenty native medicinal plants were included in the experimental field of the collection. Good adaptation showed *Salvia nemorosa* L., *S. verticilata* L., *Astragalus ponticus* Pall., *Phlomis pungens* Willd., *Ph. tuberosa* L., *Teucrium chamaedrys* L., *Thymus marshalianus* Willd., *Adonis wolgensis* Stev., *Veronica chamaedrys* L., *Physalis alkekengi* L., *Aconitum lasiostomum* Reich. etc. Some spontaneous species (*Epilobium parviflorum* Schreb., *Solidago virgaurea* L., *Pimpinella saxifraga* L.) proved as difficult species for cultivation.

CONCLUSIONS

1. Recent taxonomic inventory of medicinal plants collection led to identification of 309 taxa, belonging to 3 phylums, 4 classes, 62 families and 194 genera.

2. The most representative families are: *Lamiaceae* (with 93 taxa), *Asteraceae* (40), *Rosaceae* (18), *Apiaceae* (15), *Ranunculaceae* (10), *Polygonaceae* (7). The most frequent genera are: *Salvia* L. (with 13 species), *Satureja* L. (7), *Thymus* L. (7), *Mentha* L. (6), *Digitalis* L., *Echinacea* Moench and *Astragalus* L. (4 species).

3. In the period 2004-2014 by means of international seed exchange the collection was enriched with 96 taxa received by *Delectus Seminum* from 34 Botanical Gardens and other specialized scientific institutions. Over 100 species were brought from the wild local flora.

REFERENCES

1. Hawkins B. Plants for Life: Medicinal plant conservation and Botanic Gardens**.** 2008, Botanic Gardens Conservation International: Richmond U. K. p. 1- 48.

2. Ciocârlan Nina. Some aspects of introduction of new medicinal plants in the Botanical Garden of ASM. In: International Scientific Symposium „Conservation of plant diversity", 2012, Chişinău, p. 283-290.

3. Ciocârlan V. Flora ilustrată a României. Pteridophyta et Spermatophyta. Bucureşti: Edit. Ceres, 2009, 1141 pp.

4. Negru A. Determinator de plante din flora Republicii Moldova. Chişinău: Edit. Universul. 2007, 391 pp.

5. Tutin T. G. et al., Flora Europaea. Vols. 1-5. Cambridge: Cambridge University Press. 1964-1980.

6. Бейдеман И.Н. Методика изучения фенологии растений и растительных сообществ. Методические указания, Н., Изд-во «Наука», 1974, 155 стр.

7. Бодруг М. В. Дикорастущие эфиромасличные растения Молдавии. Кишинев «Штиинца», 1981, 142 стр.

8. Бодруг М. В. Интродукция новых эфирномасличных растений в Молдове. Кишинев «Штиинца», 1993, 258 стр.

9. Флоря В.Н. Интродукция и акклиматизация растений в Молдове. Кишинев «Штиинца», 1987, 296 стр.

10. Лакин Г.Ф. Биометрия / Г.Ф. Лакин. М.: Высшая школа, 1980, 246 стр.

11. Майсурадзе Н.И., Черкасов О.А., Тихонова В.Л. Методика исследований при интродукции лекарственных растений // ЦБНТИ. Сер. Лекарственное растениеводство. М., 1984, N 3, 33 стр.

12. Методика фенологических наблюдений в ботанических садах СССР //Бюл. ГБС АН СССР, 1972, вып. 113, стр. 3-8.

THE DYNAMIC DEVELOPMENT OF THE SHOOTS OF *POLYGONUM SACHALINENSE* FR. SCHMIDT AT THE BEGINNING OF THE GROWING SEASON

Cîrlig Natalia

Botanical Garden (Institute)

of the Academy of Sciences of Moldova

E-mail: naty000@mail.ru

Abstract. Polygonum sachalinense it is new plant introduced in Republic of Moldova, which belongs to the family Polygonaceae, with a high growth potential and high content of green mass. The beginning of the growing season early, with record temperatures both night and day positive. Intensive growth of aerial parts of the plant, occurs in the first 60 days of vegetation, reaching a height of 4.5-5 m, growth slows next period. It is considered for fodder, energy and a good mielifer

Keywords: Polygonum sachalinense, shoot, leaf, node, internode, growth potential.

INTRODUCTION

Polygonum sachalinense Fr. Schmidt – perennial, herbaceous plant in the family *Polygonaceae*, called *giant knotweed* or *Sakhalin knotweed*, *Fallopia sachalinense* (F. Schmidt ex Maxim) Ronse Decr., *Reynoutria sachalinense* (F.Schmidt ex Maxim) Nakai [10,11] – it was first introduced from Japan to Europe, in the second half of the 19th century, subsequently introduced in North America in the end of the 19th century as forage and ornamental plant. The taxonomy of this plant has been the subject of discussion for many authors, placing it in genres as *Reynoutria, Polygonum* or *Fallopia*. [7]

Polygonum genus contains over 200 species herbaceous, annual and perennial species of which 40 are used in natural conditions, as food for animals and birds. [11] *Fallopia* sect. *Reynoutria* (Houtt) Ronse Decr. is a morphologically distinct unit and is characterized by its herbaceous perennial habit, erect robust stems, well-developed thick rhizomes. Some authors (Horaldson 1978, Holub 1971, Nakai 1926), have maintained the group as a distinct genus, but more recent authors (Bailey 1992, Ronse Decraene & Akeroyd 1988), have recognized it as a section of the genus *Fallopia* Adans. This sections includes as many as 12 species, which were distinguished mainly on the basis of differences in leaf size and shape. [1, 2, 3, 5,6, 8]

Sakhalin knotweed is unpretentious plant and can be cultivated in different climatic conditions. It combines winter hardiness, drought, being able to harvest large green mass dee when unfavorable environmental conditions. For this reason it is considered prospective due to plant tolerance pedoclimatic factors and stable production. [4]

One of the major issues is the creation and development of livestock fodder production diversification, who can provide quality food throughout the year, according to the physiological requirements of animals. *Polygonum sachalinense* is one of non-traditional crops, with a high content of fresh meal, about 124.2 t / ha. [12,13]

MATERIAL AND METHODS

As the material for the research served plants *Polygonum sachalinense*, the variety *Gigant.* The research was conducted on the experimental plots of the Botanical Garden (Institute) ASM. Sakhalin knotweed was registered as a forage crop in the catalog of varieties of plants for the year 2013 with registration number 1492625. In the collection of the Botanical Gardens this species was introduced about 30 years ago. The research was conducted with the start of the growing season, as indicated methodical -Бейдеман 1974 1985 Доспехов Методика полевого опыта. [14,16]

RESULTS AND DISCUSSIONS

Polygonum sachalinense is a perennial and herbaceous plant that could be mowed down 2-4 times per year. The most important advantage is its high productivity and longevity of living [15, 17], it can grow up on the same surface during 10-15 years long. Pivoting root system consists of one main root and some lateral roots which are immune to winter frost. In 2015 on march 30 started the vegetation when the air temperature was during the day not more than +8; +12 ^{0}C, but during the night +3;+6^{0}C. During that period the air relative humidity was 60-80%. The starting of the growth is seen through buds developing from the base of the stem. (Fig.1)

As a result of phenological prosecution it was noticed that the first leaves begin to appear after 4-8 days of vegetation, but the root formation after 12-15 days. The morphological analysis of the twigs of *Polygonum sachalinense* crop during the period of vegetation showed that this species has an intense growth of green mass what makes it more favorable than other species of traditional fodder plants.

a) *Beginning of vegetation*

b) *4 days of growth*

c) 6 days of growth

d) *15 days of growth*

Fig.1. (a,b,c,d) Vegetative buds of *Polygonum sachalinense* during the growing season

As a result of study and evidence of 35 plants during 20 days of growth it was noticed that on one *Polygonum sachalinense* shrub can grow from 4 to 14 twigs with a height varying from 6 to 65 cm. In this period the leaves have the width approximately equal to the length and their number on the twig can be up to 9. The maximal diameter of the twig on the base can be up to 2 cm (tab.1). Each lump has a leaf and their position on the twig is alternate. The length of internodes it is 6-8cm.

Fig. 2 The twig in a transversal section at internode level.

Typical for *Polygonum sachalinense* stem are the empty internodes (Fig.2), but the nodes are full with texture. This kind of stem is called culm [9]. The first type branches begin to appear when the plant has a height of 2.5 – 3 m from the nodes 10, 11, 12.

As a result of the analysis of the *Polygonum sachainense* twig (tab.1) were identified such developing indices of the plant as the height, the diameter of the twig, the leaves width and length, the number and the length of the internodes, and the number of branches. During the period of growth 30.03-15.06. 2015 it was noticed a positive growth of these indices. The most emphatic indices is the height, the plant had a growth speed of 200 cm during 15 days.

Table 1 Analysis of a shoot during the growing season.

Nr.	The index characterizing plant development.	Period				
		21.04 2015	30.04 2015	15.05 2015	22.05 2015	15.06 2015
1	Height (cm)	43	93	293	342,5	406,8
2	Diameter (cm)	0,8	1,1	1,8	2,0	2,8
3	The number of leaves	5	8	10	24	20
4	*Width of the leaf (cm)*	8	13,5	18,3	25	29
5	*Length leaves (cm)*	8,5	13,0	21,8	32	40
6	Number of internodes	4	7	14	20	31
7	The length of internodes	5-8	8-12	11-19	15-23	17-26
8	The number of branches.	-	-	1	2	4

The leaves length and the width are also important indicators in formation of the vegetal mass and the determination of the growth dynamics of the plant. The new leaves of the *Polygonum sachalinense* have 4-5 cm in size and their number are approximately 4 on each twig, but in short time they grow considerably in number and in size. During 15 days the leaves length grow with 8-10 cm but their width with 5-7 cm. (Fig.3)

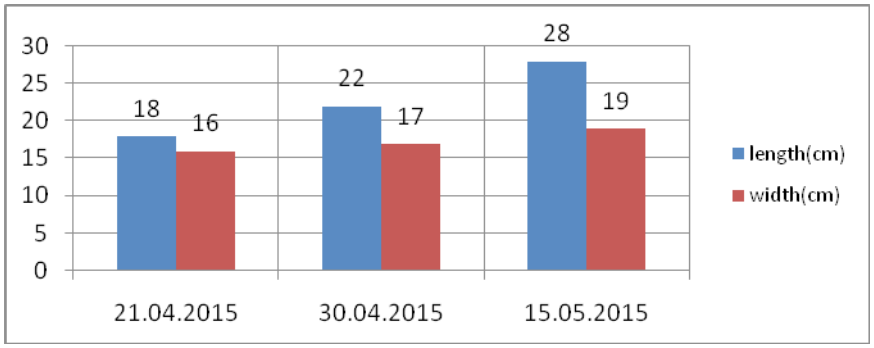


Fig.3Dynamics change of *Polygonum sachalinense* leaves length and width of during the growing season

The first mowing was made at the 53rd day from the beginning of the growth (may, 2015) when the plant has a height of 280-350 cm. The bush weight is approximately of 9.74 kg from which the stem is of 5.48 kg and the leaves are of 4.26 kg. After mowing the plant quickly restores its power and grows up during 21 days and the number of the twigs on a bush can be of 17-23 with a maximal height of 85 cm but its width at the base is less than at the beginning of the growth. Also at these examples of twigs that grow after mowing the branches of the 1st order begin to grow faster at the nodes level 5, 6. (Tab.2).

The plants that appear after mowing, as at the beginning of the growth, are distinguished with their height – as an index that characterizes the plants growth that during 13 days this index increases up to 100 cm. All analyzed clues show the high growth speed with an impressive potential of the formation of the vegetal mass.

Table 2 Analysis occurred shoot after the first stitch

Nr.	*The index characterizing plant development.*	*Period*		
		12.06.2015	**25.06.2015**	**30.06.2015**
1	Height (cm)	52,5	150	165,3
2	Diameter (cm)	0,7	0,9	1,1
3	The number of leaves	5	8	10
4	Width of the leaf (cm)	16	17	19
5	Length leaves (cm)	18	22	28
6	Number of internodes	4	7	9
7	The length of internodes	6-8	7-15	9-17
8	The number of branches.	-	*1*	*2*

When we know the *Polygonum sachalinense* leaves dynamic of growth in length and width, it gives us the possibility to point out the periods of a more intense growth and obtain a vegetal mass rich in vitamins and macro and microelements.

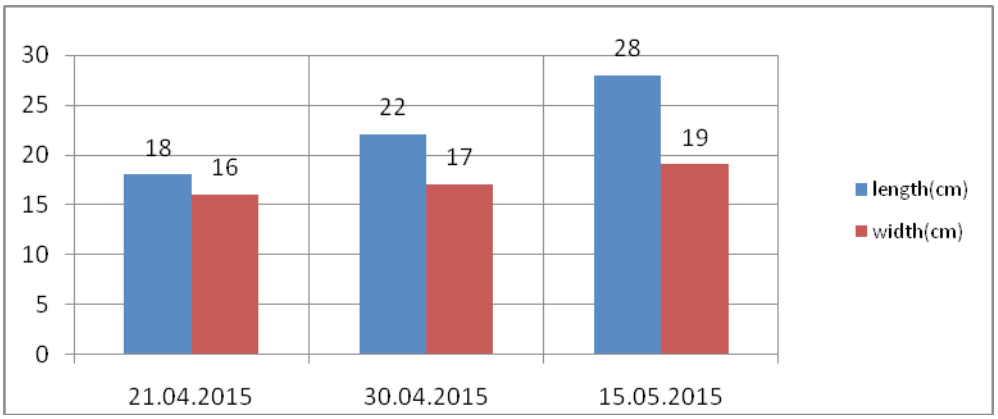


Fig.4 Dynamics change of *Polygonum sachalinense* leaves length and width occurred after the first stitch

CONCLUSIONS

A) Polygonum sachalinense –is a perspective plant for the Republic of Moldova if taking the climate condition having a high productivity of green mass that can be used as fresh fodder, as silos, and also as a mixed crops mass.

B) As a result of the research it was studied the growth dynamic of *Polygonum sachalinense, Giant* type during 90 days from the beginning of the growth period. There were obtained new facts about the plant growth dynamic and also important facts for the further study of this species.

C) After the first mowing the plant grows fast the aerial parts that during 22 days from mowing

grows with 130 cm and easily adapts to the environmental conditions from the Republic of Moldova.

REFERENCES

1. Bailey J.P & Stace C.A Chromosome number, morphology, pairing, and DNA values of species and hybrids in the genus *Fallopia* (Polygonaceae).Pl.Syst.Evol. 1992, 180: 29-51.
2. Haraldson H.F. Anatomy and taxonomy in *Polygonanaceae* subfam. *Polygonoideae*. Meisn.emend. Jaretzky. Symb. Bot. Upsal 22(2) 1978, p. 95.
3. Holub J., *Fallopia* Adans. 1763 instead of Bilderdykia Dum. 1827. Folia Geobot. Phytotax. 1971 6:171-177.
4. Ivanova Raisa, Țiței V., Studiul acumulării substanțelor polifenoloce cu activitate antioxidanță în rizomii de *Polygonum sachalinense.* Materialele Conferinței științifice internaționale (Ediția a V-a) "Genetuca, fiziologia și ameliorarea plantelor", Chișinău, 2014, p 105-108.
5. Jeong Yeon Kim & Chong-Wook Park. Morphological and chromosomal variation in Fallopia section Reynoutria (Polygonaceae) in Korea. USA 2000., Brittonia 52(1), p. 34-48.
6. Nakai T., A new classification of Linnaean *Polygonum.* Sci. World (Japan) 1926, 24:189-301.
7. Laurean S., Sarah Reichard, Charls Halpern, Community and ecosystem consequences of giant knotweed (*P. sachalinense*) invasion into riparian forest of western Washington, USA, Journal Biological Conservation, 2009, p-6.
8. Ronse Secraene L.P.& Akeroyd J.R. Generic limits in Polygonum and related genera (Polygonaceae) on the basis of floral characters. Bot. J. Linn. Soc, 1988, 98: 321-371.
9. Săvulescu Elena, Botanică Morfologia plantelor, USAMVB-București, 2009, p-129.
10. Teleuță A., Țiței V., Tehnologii inovative în fondarea plantațiilor energetice și valorificara biomasei pentru termoficarea Grădinii Botanice a AȘM, Materialele Conferinței internaționale: "Rolul inovațiilor pentru sporirea competivității economiei naționale" Chișinău 2013.
11. Teleuță A., Țiței V.,Coșman S, Biological Chatacteristics and fodder value of some species of plants of the genus *Polygonum* L. under the conditions of the Republic of Moldova. Bulletin UASMV serie Agriculture 70(1)2013, p. 258-264.
12. Țiței V., Teleuță A., Coșman S., Fodder value of silage of the giant knotweed plants under the conditionsof the Republic of Moldova. Simpozionul științific internațional:"Conservation of plant diversity", Chișinău 2014, p.125-126.
13. Țiței V., Teleuță A., Agrobiological peculiarities of giant knotweed and cup plant after fertilization with sewage sludge. Scientific Paper.Series A. Agronomy, Vol.LVII, 2014.p 350-356.
14. Бейдеман И.Н. 1974 Методика изучения фегологии растений в растительных сообществ. М.100с
15. Вавилов Н.Г., Кондратьев А.А Новые кормовые культуры. М. Россельхозиздат 1975. С-19
16. Доспехов Б.А. Методика полевого опыта. Москва агропромиздот 1985.с-350.
17. Черняева А.М. Многолетние кормово-силосные растения Сахалина и Курильских островов. Новые и малораспространенные кормово-силосные растения. Изд. «Наукова Думка»,Киев,1969 с.189-195.

GOJI BERRIES GENERAL CHARACTERISTICS

dr. Adelina Dodon, prof. Galina Dicusar, drd. Livia Bolohan

Academy of Sciences of Moldova, Technical University of Moldova

Abstract: The paper represents a study of the biological and nutritional potentials of Goji fruits. In our country, Goji fruits aren't as well-known as sea buckthorns and rose hip cultures, that's why there should be performed a better study of them. The reason of such highlighted attention for these berries is well-known by 6000 years of exploitation by Chinese, Tibetan and Indian phytotherapists, though there wasn't made any scientific researches. This work contains bibliographic studies of Goji berries composition and nutritional effect. Those are consumed in row and dry form and are highly requested in our country and are imported from foreign ones. Although for a better understanding of the effect of these fruits there must be performed a detailed study of the composition and the quality of this product in relation to the national and international standards.

CARACTERISTICI GENERALE A POMUŞOARELOR GOJI

dr. Adelina Dodon, prof. Galina Dicusar, drd. Livia Bolohan

Academia de Ştiinţe a Moldovei, Universitatea Tehnică a Moldovei

Rezumat: Se argumentează studiul privind valorificarea potenţialului biologic şi nutritiv a fructelor Goji. Deşi la nivel naţional nu are aceeaşi pondere precum cătina sau măcieşul, cultura Goji necesită un studiu mai profund pentru a fi cultivată şi prelucrată la noi în ţară. Această necesitate este argumentată prin beneficiile apreciate timp de 6000 de ani de către fitoterapeuţi în China, Tibet şi India însă ne fiind cercetate ştiinţific. În lucrare sunt expuse rezultatele studiului bibliografic a compoziţiei şi efectului nutriţional a fructelor Goji, care se consumă atât proaspete cât şi uscate, produs solicitat pe piaţa internă dar exportat din străinătate. Totuşi pentru valorificarea potenţialului biologic a fructelor Goji se impune necesitatea studierii amănunţite a compoziţiei şi calităţii acestui produs în concordanţă cu standardele naţionale şi internaţionale.

Goji is known for over 2000 years in Tibet and used in traditional medicine because of the many benefits to curative. Locals who drink different forms - as dried fruit, juice, tea or as an ingredient in dishes - live longer, healthier more energetic and even over 100 years.

It has been statistically proven that in this region the number of people older than 100 years is 16 times higher than in other regions of the world !

Although so many years was known properties of goji berries have been recognized only recently modern medicine.

Scientific research confirms the truth known 2000 years. Introduced to the US market in 2007 only very briefly becomes super fruit of consumption Madonna, Elizabeth Hurley, Mischa Barton and other stars.

Goji fruit is the red berry obtained from two closely related plants, *Lycium chinense* and *Lycium barbarum*, naturally occurring in Asia, primarily in northwest China. The fruits from these species are considered interchangeable, though larger fruits are preferred and are more often found on plants of *L. barbarum*. *Lycium* is in the Solanaceae family that yields numerous foods, including some that are yellow to red fruits, such as peppers, tomatoes, and the cape gooseberry (a Peruvian species of *Physalis*).

The Chinese name for the lycium plant is *gouqi* and for the fruits is *gouqizi* (*zi* is used to describe small fruits); the common name "wolfberry" comes about because the character *gou* is related to the one that means dog or wolf. The spiny shrub has also been called matrimony vine, for reasons long lost. Carl Linnaeus provided the genus name *Lycium* in 1753. He is responsible for the species name *barbarum*, while botanist Philip Miller described *Lycium chinense* just 15 years later. Lycium is extensively cultivated, especially in Ningxia Province, a small autonomous region formerly part of Gansu, with

several production projects initiated since 1987. China now produces over 5 million kilograms of dried lycium fruit each year, most of it for domestic use. The fruits are dried with or without sulfur to yield the market herb, or the fresh fruits may be squeezed for their juice that is then concentrated to preserve it for future use in making various beverages.

Traditional and modern uses

Lycium fruit is depicted by Chinese doctors as having the properties of nourishing the blood, enriching the yin, tonifying the kidney and liver, and moistening the lungs, but its action of nourishing the yin of the kidney, and thereby enriching the yin of the liver, is the dominant presentation. It is applied in the treatment of such conditions as consumptive disease accompanied by thirst (includes early-onset diabetes and tuberculosis), dizziness, diminished visual acuity, and chronic cough. As a folk remedy, lycium fruit is best known as an aid to vision, a longevity aid, and a remedy for diabetes. With the intensive research work done in recent years, reliance on descriptions of centuries-old use of the herb is less important than for many other Chinese herbs, since much is now known about the chemical constituents and their potential health benefits.

Constituents and Actions

The secret of longevity that gives goji fruit consists of its high content of vitamins and minerals. Among the vitamins that are found in goji berries include:vitamin C, in very large quantities; vitamin A, is an excellent source of vitamin A; Vitamin E, which is found rarely in fruits, with a strong antioxidant effect; vitamins B1 (thiamine), B2 (riboflavin) and B6 are vital metabolic processes and help convert food into energy.

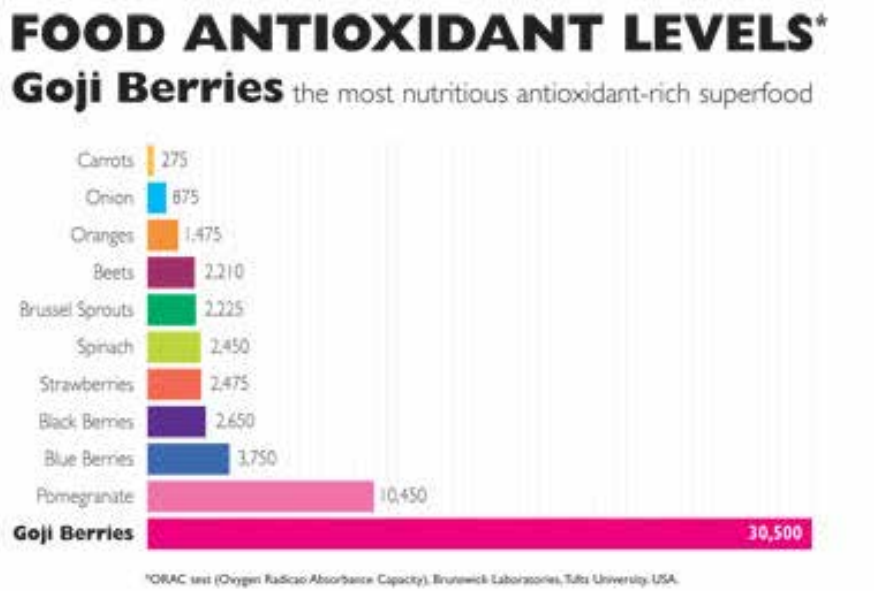
Goji fruits contain high amounts of carotenoids, which have a strong antioxidant effect and solar photoprotection. The most important carotenoids that are found in goji berries are: beta carotene which form vitamin A carotene content is higher than any other food known to date zeaxanthin that protects the retina; lutein important for the regeneration of DNA and all cells;

Goji berries have in their composition important micronutrients such as iron, calcium, potassium, copper, magnesium, phosphorus and germanium. They are rich in selenium, a mineral element that reduces the toxicity of the drug and has antioxidant. Clinical studies have shown that goji berries, selenium and germanium by content are particularly useful in cancers.

Goji berries contain amino acids and proteins, including 8 essential amino acids that can not be synthesized by the body when food prosecutors.

What effect goji berries?Antioxidant - Goji berry is the most powerful antioxidant of all existing food in the world. Antioxidants are substances that protect the body from the damaging effects of molecules called “free radicals” that accumulates in the body. Free radicals are true “enemies” of the organization, are unstable molecules derived either from metabolic processes essential, normal occurring in body or body from exposure to X-rays, smoke, toxic gases resulting from combustion. Due to the unstable free radical attack on healthy cells of the body. The chemicals capable of neutralizing free radicals called antioxidants.

Level of Goji berry antioxidants measured ORAC scale (ability to absorb oxygen free radicals) is 30,500 units, almost 20 times more than the oranges. Antioxidants reduce the aging process.



The color components of lycium fruit are a group of carotenoids, which make up only 0.03–0.5% of the dried fruit (1). The predominant carotenoid is zeaxanthin (see structure below), which is present mainly as zeaxanthin dipalmitate (also called physalien or physalin), comprising about one-third to one-half of the total carotenoids. Lycium fruit is considered one of the best food sources of zeaxanthin.

Zeaxanthin is a yellow pigment (an isomer of lutein and a derivative of β-carotene) produced in plants. It contributes to the color of corn, oranges, mangoes, and egg yolks (from dietary carotenoids), and it is also the main pigment of another medicinal fruit recently popularized in China: sea buckthorn (hippophae). When ingested, zeaxanthin accumulates in fatty tissues, but especially in the macula, a region of the retina. It is believed that by having a good supply of this compound, the macula is protected from degeneration, which can be induced by excessive sun exposure (UV light) and by other "oxidative" processes (2–4). Lutein, another yellow carotenoid that accumulates in the macula and provides similar protection, is an ingredient of yellow chrysanthemum flowers (*juhua*) that are often combined with lycium fruits in traditional Chinese herb formulas to benefit the eyes, including deteriorating vision that occurs with aging and may, in some cases, correspond to macular degeneration. The effective daily dose of these two carotenoids, from food and supplements, has been estimated to be about 10 mg.

The red carotenoids of lycium have not been fully analyzed. It is believed that part is due to lycopene, the major red pigment in tomatoes and capsicum fruits. The red portion of lycium has been designated as renieratene; the red color overwhelms the yellow of zeaxanthin and the small amount of β-carotene, though the fruits often display an orange tinge due to the yellow components.

Benefits of carotenoid intake are thought to mainly arise from prolonged use. Therefore, lycium fruit, as a source of zeaxanthin and other carotenoids, would be consumed regularly to complement dietary sources, boosting the amount of these components available from fruits and vegetables and egg yolks.

Another component of lycium is polysaccharides, chains of sugar molecules with high molecular weight (several hundred sugar molecules per chain). It is estimated that 5-8% of the dried fruits are these polysaccharides (5), though measures of the active polysaccharides are difficult to undertake, since differentiating functional long chains versus non-functional short chains is challenging; this figure for polysaccharide content is likely on the high side. Studies of the polysaccharides have indicated that there are four groups of them, each group having slightly different structures and molecular weights (6). Although referred to as polysaccharides, the functional immune-regulating substance is actually a polysaccharide-peptide mixture; the amino acid chains maintain a critical structure for the polysaccharide.

The immunological impacts of polysaccharides have been the primary focus of study (10). One

of the primary mechanisms of action for these large molecules may be that they appear to the immune system as though they were cell surface components of microorganisms, promoting activation of a response cascade involving interleukins (such as IL-2) that impact immune cells (such as T-cells). Since the plant polysaccharides are not the same as the structures on particular pathogens, but have a more poorly defined quality, the response is non-specific. It is possible that repeated exposure to large amounts of polysaccharides might result in a lessened response, so that this method of therapy is probably best suited to relatively short duration (e.g., a few weeks). Low dosage exposure may result in no immunological responses, since these polysaccharides are present in several foods in small amounts, and the immune system would be protected from reacting to ordinary exposure levels.

Extraction and isolation of polysaccharides in low concentration is simple, as they are soluble in hot water that is used as an extracting agent. Getting a high concentration of polysaccharides is a more significant task. The easiest method is to first produce a hot water extract of the herb (using more than one extraction to get most of the polysaccharides into solution), and then force the polysaccharides out of solution by adding alcohol, in which they are not soluble; then, the liquid is separated off and the residue is dried to produce the finished polysaccharide product. This method will also condense other large molecules. Although small amounts of highly purified polysaccharides can be produced for laboratory and clinical studies, at this time, commercial extracts containing 40% polysaccharides represent the highest concentration available, while 10–15% polysaccharide content from simple hot water extraction is more common.

A third constituent of interest is the amino-acid like substance betaine, which is related to the nutrient choline (betaine is an oxidized form of choline and is converted back to choline by the liver when it is ingested). Betaine was shown to protect the livers of laboratory animals from the impact of toxic chemicals; other pharmacologic studies have shown that it is an anticonvulsant, sedative, and vasodilator. It has been suggested that betaine could aid the treatment of various chronic liver diseases, such as non-alcoholic fatty liver disease. Betaine is found also in capsicum, silybum (the source of the liver-protective flavonoid silymarin), and beets (*Beta vulgaris*, from which betaine gets its name). The amount of betaine in lycium fruit, is about 1% (10), so to get a significant amount, a large dose of lycium fruit would need to be consumed (e.g., 20–30 grams).

The mild fragrance of the fruits is attributed to a small amount of volatile oils, mainly two sesquiterpenes: cyperone and solavetivone (6). The amount present does not have significant pharmacological functions when lycium is consumed in ordinary amounts. The fruit also contains about 0.15% flavonoids, including rutin and chlorogenic acid.

Typical Dosing of Lycium Fruit

Lycium fruit is most often incorporated into complex herb formulas, in which its dose is in the range of 6–18 grams. Since other herbs in the formula could contribute significant amounts of compounds such as carotenoids and polysaccharides, this dose may be insufficient if lycium is used as a single herb remedy instead. There have been a few reports of using lycium fruit as a single herb or as a major component in a small recipe. For example, in the treatment of atrophic gastritis, one of the recommended therapies is to consume lycium fruits, 10 grams each time, twice daily. In folk medicine, for diabetes it is recommended to consume 10 grams each time, two or three times daily (3). As a food therapy for strengthening the elderly or debilitated, it is cooked with lean pork, bamboo shoots, and typical Chinese flavorings, and the daily dose would be 15–30 grams (6). As a dietary supplement for eye health (2), a dose of 15 grams per day was deemed beneficial in supplying adequate zeaxanthin (estimated at 3 mg/day). A simple tea for decreased visual perception is made from 20 grams lycium fruit as a daily dose. Thus, the dose in complex formulas of 6–18 grams shifts to a dose of 15–30 grams when it is the main herb, or about a 2.5-fold increase in the dose.

Comparing this juice to the lycium fruit described in traditional Chinese medicine is somewhat difficult. The manufacturer indicates: “One liter of Himalayan Goji Juice contains the polysaccharides equivalent of 2.2 pounds [1 kg] of fresh goji berries.” Typically, a dried berry is about one-sixth the

weight of a fresh berry (that is, the moisture content of the fresh fruit is about 83%), so a dose of 2–4 ounces of the juice would correspond to 10–20 grams of the dried fruit, which is in the correct dosage range in accordance with traditional recommendations, though higher doses have been used in some applications. Dried lycium fruit can be eaten whole (sold most in one pound bags, about 23–46 doses of 10–20 grams), and can be obtained at a lower cost because it is in crude form. The makers of this juice, and other similar products, proclaim unique benefits to the juice, mainly because of specific selection of berries, compared to the dried lycium fruits readily available from Chinese herb and grocery stores. The juice is a convenient form of administration and also provides other juices (that yield a more acceptable flavor), so the extra expense may be considered worthwhile, while there is little evidence that would support a contention of differing therapeutic effect if similar amounts of the lycium fruit are obtained from drinking the juice or from eating the dried fruits or taking supplements made from lycium extracts.

REFERENCES

1. Yong Peng, et.al., *Quantification of zeaxanthin dipalmitate and total carotenoids in Lycium fruits*, 2006 Plant Foods for Human Nutrition, 60(4): 161–164
2. Cheng CY, et.al., *Fasting plasma zeaxanthin response to Fructus barbarum in a food-based human supplementation trial*, British Journal of Nutrition 2005; 93(1): 123–130
3. Rosenthal JM, et.al., *Dose-ranging study of lutein supplementation in persons aged 60 years or older*, Investigative Ophthalmology and Visual Science 2006; 47(12): 5227–5233
4. Dharmananda S, A Bag of Pearls, 2004 Institute for Traditional Medicine, Portland, OR
5. Haru Amagase, personal communication, July 2007
6. Lam AY, Elmer GW, and Mohutsky MA, *Possible interaction between warfarin and Lycium barbarum*, The Annals of Pharmacotherapy: 2001; 35 (10): 1199-1201.

NOTES ON *ALLIUM PANICULATUM* L. s. l. (*ALLIACEAE* JUSS.) IN THE FLORA OF REPUBLIC OF MOLDOVA

Veaceslav Ghendov

Botanical Garden (Institute) of the Academy of Sciences of Moldova

Abstract: This article presents data on Allium paniculatum L. s. l. species, and data on a new species for the flora of Republic of Moldova – A. fuscum Waldst. et Kit. is presented. A brief habitat description and the Red List status of threatened species is given.

Keywords: Flora, Allium fuscum, Allium paniculatum, Alliaceae, Republic of Moldova

INTRODUCTION

The vegetation of Republic of Moldova is under permanent transformations by human impact. In the last three decades plant diversity in the Republic of Moldova has been facing increasing anthropogenic pressure, which causes deterioration and loss of habitats and direct destruction of species populations by trampling, grazing, infrastructural development, stone-pitting, etc. Adaptation processes as well as the conservation efforts could not keep up with swiftly changing external environments induced by humans which gave way to the processes of extinction.

The flora of the Republic of Moldova comprises over 1820 species inhabiting one of the most fragmented landscape in Eastern Europe with only a tiny fraction of its land surface that can be considered as wilderness. The genus *Allium* L. is probably one of the most diverse and taxonomically difficult groups of the petaloid monocotyledons and comprises a major taxonomic portion of the monocot family *Alliaceae* and consists of a diverse group of perennial herbs characterized by rhizomatous or, more commonly, bulbous stems, narrow basal leaves, flowers with six free tepals and superior ovaries with 0–6 crests, inflorescences of scapose umbels, mucilaginous latex, and a distinctive onion-like odor and taste due to the presence of cystine sulfoxides. *Allium* is an important genus of economic and medicinal value [14].

In the past taxonomic information of this genus was based largely on morphological markers, which leads to certain taxonomic confusion. Anatomical studies could be an important tool to resolve taxonomic problems of this genus. In early classification of angiosperm *Allium* was placed in *Liliaceae* family. Recently molecular data have favored a division of *Liliaceae* into large number of small monofiletic families [21]. Although some authors, on the basis of inflorescence structure include the genus into *Amaryllidaceae* family [3, 16], in the most recent and reliable taxonomic treatments of *Monocotyledons*, *Allium* and its close relatives were recognized as distinct family *Alliaceae* comprising about 750-850 species [1, 5, 13, 17, 19]. Most species occur naturally in the northern hemisphere, with a main centre of diversity in the mountains of Southwest to Central Asia and second centre is in western North America [15, 18, 19, 20]. The genus *Allium* in the flora of Republic of Moldova is represented by 15 species [6, 7, 12].

MATERIALS AND METHODS

The collected material of plant species is deposited in the Herbarium of the Botanical Garden (Institute) of the Academy of Sciences of Moldova. Descriptions of plants are based on the morphological features of the checked out herbarium specimens as well as on the floristic sources [18, 20, 22].

The designation of Habitat types were made according to NATURA 2000 (Interpretation Manual of EU Habitats, 2007, Directive 92/43/EEC) on the basis of scientific criteria defined in Annex III of the Directive [8].

The estimation of the threat status of the species for the territory of R. Moldova is made according to the IUCN Red List Categories and Criteria (2001, 2003) [9, 10].

RESULTS AND DISCUSSIONS

Following our taxonomic studies in the garlic flora of the Republic of Moldova [7], and within the framework of the project of the *Allium* treatment for the Flora of Bessarabia (vol. VI, in prep.), we compared the material with the plants deposited in the existing herbaria and samples collected from the wild during 2011-2014. A new species of garlic for the flora of Republic of Moldova – ***Allium fuscum*** Waldst. et Kit. was registered in the central (Zloti village, district Cimislia, Landscape reservation "Carbuna" – N 46° 42' 02", E 28° 54' 41") and southern parts of the country (Vadul lui Isac village, district Cahul, Flamanda natural forest reservation – N 45° 44› 46», E 28° 15› 53»).

The taxonomy of *Allium* is complicated with a great number of synonyms and intrageneric groupings [11]. During the history of *Allium paniculatum* L. *s. l.* (sect. *Codonoprasum* Koch) investigations, there were different considerations about the volume of the taxa and its number of *sensu stricto* species. The taxonomic position of *Allium podolicum* (Aschers.et Graebn.)Blocki ex Racib. and *A. fuscum* Waldst. et Kit. has long been the matter of controversy. Although in early classification some authors consider them belonging to the complex species of the south-European *Allium paniculatum* L. [20], but most recent views consider these three species as being related and independent [3, 4, 15, 18, 22].

Like most species sect. *Codonoprasum* with main distribution in southern and eastern Europe these three species grow in arid habitats, but each of them having their own preferences. *Allium paniculatum* prefers dry steppic habitat and commonly met in the southern parts of the country in so called Bugeac steppe in a habitat – Ponto-Sarmatic steppes (62C0). Similar to its relative, *Allium podolicum* grows on arid limestown gravelly slopes in the northern parts of the country, in a habitat – Sub-pannonic steppic grasslands (6240), in fact it is known from two localities in Rashcani district. *Allium fuscum* was collected from the azonal white-oak dominated woods with a submediterranean flora – Eastern white oak woods (91AA).

The key to the species of *A. paniculatum* L. group and nomenclatural citation are given below:

1a. Perianth segments 4,4-5,5 mm long. Ovary at anthesis ellipsoid, rounded-truncate at apex . . . . . *2.A. podolicum*

1b. Perianth segments 6-7 mm long. Ovary at anthesis cylindrical, narrowed at baseand apex2

2a. Perianth segments lilac-pink or whitish. Ovary glabrescent . . . . . 1. ***A. paniculatum***

2b. Perianth segments brownish, yellowish, sometimes tinged with pink or with reddish *streaks. Ovary papillose-scabrid above*. . . . . *3.A. fuscum*

1. *A. paniculatum* L. 1759, Syst. Nat., ed. 10, 2: 978; Введ. 1935, Фл. СССР, 4: 205, p.p.; Бордз. 1950, Фл. УРСР, 3: 140; Zahar. 1966, Fl. RSR, 11: 213; Омельчук-Мякушко, 1979, Фл. евр. ч. СССР, 4: 269; Stearn, 1980, Fl. Europ., 5: 60, p.p.; Гейдеман, 1986, Опред. высш. раст. Молд. ССР, изд. 3: 120; Negru, 2007, Determ. pl. fl. R.Mold.: 286. – Ceapă paniculată. – Лук метельчатый. (Fig.1,B).

A. – habitat **B. – inflorescence in blossom**

Fig. 1. Allium paniculatum L. (Steppic grassland, vill. Bugeac, ATU Gagauzia)

Species met sporadically. In Republic of Moldova grows in the southern half of the country, in so called Bugeac steppe region (ATU Gagauzia; Cimishlia, Leova, Cantemir, Causeni and Cahul districts). Outside the country is spread throughout central Europe and Mediterranean region [15, 18]. Species grows on cernoziomic arid plateau and hills with steppic grassland vegetation, in groups of 20-50 specimens. Populations sometimes cover up to 1,5-2 hectars; the density is up to 10 plants per one square meter.

The Allium paniculatum can be met in a Habitat 62C0 – Ponto-Sarmatic steppes (Fig.1,A), these are Steppes of the plains, plateau and hills of the western Black Sea, west of the Dniester and the basins, including those of the lower Danube, of the southern edge and valleys of the Podolian plateau, of the Central Russian plateau, dominated by tussock-grasses, chamaephytes and perennials of the alliance Festucion valesiacae and related syntaxa [8]. These xerotherme communities are developed on southern exposed slopes with alkaline soils and on clay-sandy sedimentation layers, sometimes enriched with gravels, with grasses such as: *Stipa capillata L., Stipa lessingiana Trin. et Rupr., Kochia prostrata (L.) Schrad., Koeleria cristata (L.) Pers., Bothriochloa ischaemum (L.) Keng, Festuca valesiaca Gaudin, Fragaria viridis (Duch.) Weston, Achillea ochroleuca Ehrh., Achillea collina J.Beck. ex Reichenb., Achillea nobilis L., Ajuga chia Schreb., Allium sphaerocephalon L., A. albidum Fisch., Allium waldsteinii G.Don fil., Inula britannica L., Inula germanica L., Inula oculus-christi L., Iris halophila Pall., Iris variegata L., Artemisia austriaca Jacq., Artemisia marschalliana Spreng., Artemisia pontica L., Astragalus dasyanthus Pall., Astragalus exscapus L., Astragalus austriacus Jacq., Astragalus subuliformis DC., Dianthus leptopetalus Willd., Limonium hypanicum Klok., Linum austriacum L., Linum hirsutum L., Linum tenuifolium L., Euphorbia cyparissias L., Euphorbia stepposa Zoz, Gagea pusilla (F.W.Schmidt) Schult. et Schult.fil., Gagea villosa (Bieb.) Duby, Galium humifusum Bieb., Galium campanulatum Vill., Gypsophila paniculata L., Herniaria besseri Fisch. et Horenem., Jurinea mollissima Klok., Jurinea multiflora (L.) B.Fedtsch., Marrubium peregrinum L., Melica transsilvanica Schur, Nepeta parviflora Bieb., Origanum vulgare L., Ornithogalum kochii Parl., Plantago urvillei Opiz, Poa bulbosa L., Polygala major Jacq., Potentilla arenaria Borkh., Potentilla erecta (L.) Raeusch., Rumex thyrsiflorus Fingerh. etc.*

2. *A. podolicum* (Aschers. et Graebn.) Błocki ex Racib. 1919, Fl. Polska, 1: 124; Бордз. 1950, Фл. УРСР, 3: 142; Омельчук-Мякушко, 1979, Фл. евр. ч. СССР, 4: 269; Stearn, 1980, Fl. Europ., 5: 61; Гейдеман, Опред. высш. раст. Молд. ССР, изд. 3: 120; Negru, 2007, Determ. pl. fl. R.Mold.: 286. – *A. paniculatum* L. var. *paniculatum* f. *podolicum* (Błocki) Aschers. et Graebn. 1905, Syn. Mitteleurop. Fl. 3: 142; Zahar. 1966, Fl. RSR, 11: 214. – *A. paniculatum* auct., non L.: Введ. 1935, Фл. СССР, 4: 205, p.p. – Ceapă podoleană. – Лук подольский. (Fig.2,B).

A. – habitat **B. – inflorescence in blossom**

Fig. 2. Allium podolicum (Aschers. et Graebn.) Błocki ex Racib. (Steppic grassland on limestone substrate, vill. Horodiste, Rascani district)

Critically Endangered species **CR B2ab(ii,iii,iv).** In Republic of Moldova can be met in the northern part of the country near communes of Varatic and Horodiste (Rascani district). Outside the country is spread in Romania, in the east of Hungary and in the west of Ukraine [15, 18]. Species grows on calcareous arid slopes with petrofilous vegetation, solitarily or in groups of 3-10 specimens, rarely it forms clusters. The population is stable, represented by specimens of different ages; the density amounts

up to 10 plants per one square meter [7].

The code of the Habitat for *Allium podolicum* is **6240 – Sub-pannonic steppic grasslands** (Fig.2,A). These are grasslands, dominated by tussock-grasses, chamaephytes and perennials of the alliance *Festucion vallesiacae* and related syntaxa [8]. These xerotherme communities are developed on southern exposed slopes with AC-soils on rocky substrate and on clay-sandy sedimentation layers enriched with gravels. They are partially of natural, partially of anthropogenic origin, with plants such as: *Festuca valesiaca* Gaudin, *Iris pumila* L., *Ranunculus illyricus* L., *Teucrium chamaedrys* L., *Medicago minima* (L.) Bartalini, *Potentilla arenaria* Borkh., *Artemisia austriaca* Jacq., *Astragalus austriacus* Jacq., *Astragalus exscapus* L., *Astragalus onobrychis* L., *Oxytropis pilosa* (L.) DC., *Stipa capillata* L., *Bothriochloa ischaemum* (L.) Keng etc. [8].

3. *A. fuscum* Waldst. et Kit. 1812, Pl. rar. Hung, 3, tab. 241; Zahar. 1966, Fl. RSR, 11: 215; Ciocârlan, 2009, Fl. ilustr. a Rom.: 921. – *A. paniculatum* L. subsp. *fuscum* (Waldst. et Kit.) Arcangeli. 1894, Comp. Fl. Ital. ed. 2: 136; Stearn, 1980, Fl. Europ., 5: 60. – *A. fuscum* auct. fl. Ross.: in Введ. 1935, Фл. СССР, 4: 205. – Ceapă brună. – Лук бурый. (Fig.3,B).

Critically Endangered species **CR B2ab(ii,iii).** In Republic of Moldova grows in the southern half of the country near commune Vadul lui Isac (Valul lui Traian rampart), Cahul district and Zloti, Cimishlia district. Outside the country is spread from Romania to Greece [18]. Species grows on cernoziomic arid slopes, forest glades with steppic grassland vegetation, in groups of 10-20 specimens. The population is also represented by specimens of different ages; the density is 5 to 10 plants per one square meter.

A. – habitat **B. – inflorescence in blossom**

Fig. 3. Allium fuscum Waldst. et Kit. (Landscape reservation "Carbuna", vill. Zloti, Cimislia district)

This critically endangered species was registered in a Habitat of Eastern white oak woods – 91AA (Fig.3,A). The Azonal white-oak dominated woods with a submediterranean flora, occupying thermic oases within the sub-continental Quercion and Carpinion zones [8]. They are characterized by Quercus pubescens Willd. woods of the Black Sea plains. The oaks are accompanied by Carpinus orientalis Mill., Fraxinus excelsior L., Acer campestre L. or Tilia tomentosa Moench and by sub-Mediterranean floral elements, such as: Chrysopogon gryllus (L.) Trin. Chrysaspis aurea (Poll.) Greene, Ferulago galbanifera *(Mill.) Koch, Gagea paczoskii (Zapal.) Ghrossh., Gagea villosa (Bieb.) Duby, Coronaria coriacea (Moench) Schischk. et Gorschk., Galium mollugo L., Galium octonarium (Klok.) Soo, Cotinus coggygria Scop., Crataegus monogyna Jacq., Scorzonera cana (C.A.Mey.) O.Hoffm., Silene bupleuroides L., Cruciata laevipes Opiz, Dianthus armeria L., Dianthus carthusianorum L., Erysimum cuspidatum (Bieb.) DC., Falcaria vulgaris Bernh., Galatella linosyris (L.) Reichenb. fil., Hieracium pilosella L., Inula conyza DC., Leopoldia comosa (L.) Parl., Ranunculus illyricus L., Salvia nemorosa L., Salvia verticillata L., Stachys recta L., Teucrium chamaedrys L. etc.*

CONCLUSIONS

Data on the occurrence of *A. fuscum* Waldst. et Kit., *A. podolicum* (Aschers. et Graebn.) Błocki ex Racib. and *A. paniculatum* L. contribute to better understanding of their distribution in the flora of Republic of Moldova. A newly recorded species of *Allium* L. – *A. fuscum* and the first herbarium records for the *A. podolicum,* as well as their corological characteristics in the flora of the Republic of Moldova are presented.

On the basis of estimated conservation status according to IUCN Red List Categories and Criteria [9, 10] we propose *A. fuscum* [CR B2ab(ii,iii)] and *A. podolicum* [CR B2ab(ii,iii,iv)] to be included in the next edition of Red Book of the Republic of Moldova and in the List of vascular plants protected

by national law. All three species are met in the Priority habitat types: 62C0 (Ponto-Sarmatic steppes), 6240 (Sub-pannonic steppic grasslands) and 91AA (Eastern white oak woods) which are in danger of disappearance and whose natural range mainly falls within the territory of the European Union.

REFERENCES

1. Angiosperm Phylogeny Group. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. Bot. J. Linn. Soc. 2003, vol. 141, p. 399-436.
2. Bordzilovski E.I. Gen. *Allium* L. In Flora U.R.S.R., in Kotov, Barbaricz (eds.), Ed. Akad. Nauk URSR, Kiev, 1950, t. 3, p. 91-146.
3. Chase M.W., Reveal J.L., Fay M.F. A subfamilial classification for the expanded asparagalean families *Amaryllidaceae*, *Asparagaceae* and *Xanthorrhoeaceae*. Botanical Journal of the Linnean Society, 2009, vol. 161, p. 132-136.
4. Ciocârlan V. Flora ilustrată a României – *Pteridophyta et Spermatophyta*. București: Edit. Ceres. 2009, 1138 p.
5. Friesen N., Fritsch R. M., Blattner F. R. Phylogeny and new intrageneric classification of *Allium* L. (*Alliaceae*) based on nuclear ribosomal DNA ITS sequences. *Aliso,* 2006, vol. 22, p.372-395.
6. Gheideman T. S. Opredelitel'vysših rastenij MSSR. Izd. 3-e, Kišinev, «Štiintsa», 1986, p. 1-636.
7. Ghendov V. Rare species of *Allium* L. (*Alliaceae*) in the flora of Republic of Moldova /Botaničeskie čtenija. Išim. Izd. IGPI im. P.P. Eršova, 2012, cc. 6-7.
8. Interpretation Manual of European Union Habitats – EUR 27. European Commission DG Environment. Nature and biodiversity. July 2007, 142 pp.
9. IUCN. IUCN Red List Categories and Criteria: Version 3.1. IUCN Species Survival Commission. IUCN, Gland, Switzerland, 2001.
10. IUCN. Guidelines for application of IUCN Red List Criteria at Regional Levels: Version 3.0. IUCN Species Survival Commission. IUCN, Gland, Switzerland, 2003.
11. Klaas, M. Applications and impact of molecular markers on evolutionary and diversity studies in the genus *Allium*. Plant Breeding, 1998, vol. 117, p. 297–308.
12. Negru A. Determinator de plante din flora Republicii Moldova. Chișinău: Edit. Universul, 2007, 391 p.
13. Neriman Özhatay, Mine Kocyigit. Pollen morphology of *Allium* species (*Alliaceae*) in European Turkey and around Istanbul. Phytologia Balcanica, 2009, vol. 15(2), p. 199-208.
14. Nguyen N. H., Driscoll H.E., Specht C.D. A molecular phylogeny of the wild onions (*Allium*; *Alliaceae*) with a focus on the western North American center of diversity. Mol. Phylogenet. Evol. 2008, p. 69-87.
15. Omelczuk-Mjakushko T.Ja. *Alliaceae* J.G. Agardh. In Flora partis europaeae URSS, in An. A. Fedorov (eds.), Ed. Nauka, Leningrad, 1979, t. 4, p. 261-276.
16. Pînzaru P., Sîrbu T. Flora vasculară din Republica Moldova (lista speciilor și bioecologia). Chișinău: Garomond-Studio, 2014, p. 49-50.
17. Robert C. *Common families of flowering plants*. Cambridge University Press, Cambridge, 1992, 240 p.
18. Stearn W.T. Gen. *Allium* L. In Tutin T. G. et al. (Eds.) *Flora Europaea.* Cambridge: Cambridge University Press, 1980, vol. 5, p. 49-69.
19. Stearn W.T. How many species of *Allium* are known? *Kew Mag.* 1992, vol. 9, p. 180–182.
20. Vvedensky A. Gen. *Allium* L. In Flora U.R.S.S., in V.L. Komarov (eds.), Ed. Akad. Nauk SSSR, Leningrad, 1935, t. 4, p. 112-280.
21. Yousaf, Z., Z.K. Shinwari, R.A. Qureshi, R. Asghar, A. Parveen. Leaf epidermal anatomy of selected *Allium* species, family *Alliaceae* from Pakistan. *Pak. J. Bot*., 2008, vol. 40(1), p. 77-90.
22. Zahariadi C. Gen. *Allium* L. in Flora RSR. Ed. Acad. RSR, 1966, Vol. 11, p. 187-267.

SALICACEAE MIRBEL. FAMILY REPRESENTATIVES' INVASION WITHMISTLETOE (*VISCUM ALBUM* L.*)*

Ishchuk L.P.

Bila Tserkva national agrarian university

Abstract. Nowadays Viscum album is one the most dangerous factors which influence viability, longevity and ornamentality of Salicaceae representatives at green planting in Bila Tserkva town. Damage degree of Salicaceae Mirbel. representatives with white mistletoe (Viscum album L.) in the conditions of urbanized environment is determined. High level of damage, of 8-12 points, was caused to Populus alba L., Populus nigra L., Populus balsamifera L., Salix alba L., Salix alba L. 'Viteline Pendula'. Low level of damage of crown and skeletal branches 1-2 points is characteristic of Populus italica (Du Roi Moench.), Salix caprea L., Salix fragilis L., Salix pentandra L., Salix matsudana Koidz. The species with middle and low degree of damage caused by Viscum alba are promising for use in landscaping and planting in settlements in Ukraine. Promising species for landscaping and gardening of settlements in Ukraine: Populus italica (Du Roi Moench.), Salix caprea L., Salix fragilis L, Salix pentandra L., Salix matsudana Koidz.

Key words: Salix, Populus, Viscum album, damage evaluation, evaluation index, Bila Tserkva.

INTRODUCTION

Expansion speed of white mistletoe (*Viscum album* L.) and damage degree caused by this semi parasite of green plantings, afforestation belts and age-old trees in the gardens, parks and public parks becomes more noticeable in Ukraine. White mistletoe appeared on the branches of different plant species is more aggressive among other semi parasite plants. White mistletoe leads to reduction of the growth energy of host trees and of their longevity, ornamentality and to productivity loss, and at the end it can cause drying and gradual dying-off of the whole tree (Kosenko, Hrabovyi, 2005). White mistletoe as a semi parasite plant with a wide selective ability parasitizes many autochthonous species of willow and poplar.

It takes water and nutrients from the tree and produces independently the organic matter. In addition, mistletoe-affected tree trunks are depreciated from a technical point of view. Mistletoe invasion causes the decrease in growth energy of host trees and their macrobiosis, decorative qualities and productivity, and ultimately results in drying and gradual dying-off of the whole tree.

Mistletoe-affected trees become very brittle at the points where roots enter the branches and break easily during wind gusts, so, they are especially dangerous in parks and gardens pedestrian areas as well as for traffic. It should be noted that the appearance of mistletoe affected trees is quite original. The branches are covered with small hemiparasitic bushes of spherical shape. Mistletoe leaves are evergreen, and thus in winter they even decorate the park landscape or trees growing on both sides of roads. However, mistletoe is quite harmful; it affects particularly orchards and causes fir forests to shrink, though it can be used as a decorative element of park landscape.

It is also worth mentioning that mistletoe parasitizes the majority of old trees, while the young plantations are seldom infected by it. The author has also observed that mistletoe is less spread in forests and forest belts growing far from highways. In my opinion, the gases emitted by cars influence positively its distribution.

The problem seems topical since the mistletoe invasion is rather extended and is almost extreme, and Ukraine may face an ecological disaster. If all the trees in the state are not cleared from this hemiparasite in two or three years, the invasion will go on a new circle and in 10-15 years it will practically be too late to control mistletoe.

The aim of the research is to analyze the damage degree of *Salicaceae* Mirbel. representatives affected by white mistletoe (*Viscum album* L.) and to make complex evaluation of their damage in the conditions of urbanized environment. Another task is to identify species of the family *Salicaceae* Mirbel. resistant to damage caused by *Viscum album*, promising for use in landscaping and planted settlements.

MATERIALS AND METHODS

Mistletoe efficient control began only a few years ago. However, little is known on the mistletoe control techniques at the moment. The simplest and most common one is cutting the affected branches or even the whole trees with chainsaws as well as with special axes – so-called cutters and special tractors for cutting mistletoed branches.

Sanitary health-improvement works for prevention of the development of pathological processes in planting, for diminishing the harm inflicted by pathogenic organisms and elemental natural phenomena or technotronic catastrophe are made intensively in city planting during the last years. It's necessary to have methodological instructive regulations for professional implementation of such actions. These regulations must help to estimate sanitary state of the trees in urban ecosystems and develop the project of measures for its improvement. 5-rating estimation of woody plants' state (offered by A.I. Kuznetsov and others) (Kuznetsov, Levon, Klymenko, Pylypchuk, Shumyk, 2000) at street planting affected with white mistletoe deserves attention in this situation (Kosenko, Hrabovyi, 2005). However this methodology for city planting does not take into account all influence factors. That's why we used a rating estimation by V.P. Shlapak and others (Shlapak, Muzyka, Sobchenko, Marno, Tysiachnyi, 2010) which estimates the damages of woody plants affected by white mistletoe after two 7-rating estimation and index of complex estimation of damaged plants with mistletoe (CEDM). Researches were conducted in Bila Tserkva town.

The analysis of mistletoe control methods in Bila Tserkva was carried by I.D. Vaselenko et al. (Vasylenko, Filipova, Fuchylo 2013). A.V. Tsylyuryk et al (Tsylyuryk, Drozda, Bodyaka, 2005) have patented a method of mistletoe control with a tree trunk injection of 12% "Roundup" solution, but in a few years after the injection the tree shrinks completely.

RESULTS AND DISCUSSION

White mistletoe is an obligate semi parasite with a life cycle of 4-6 years. Timber system of mistletoe together with cortical striae is an endophytic system. Endophytic system can often get to the apical meristem forming new parasite branches. Such phenomenon is called systemic infection. White mistletoe has chlorophyll-bearing system that gives it opportunity to be partly independent from a host it settled on. White mistletoe is propagated by seed germination.

Mistletoe is spread by birds that like its fruit very much. Mistletoe fruit – a white, rarely yellow juicy drupe – has a peculiar feature: its rich content is a very sticky substance that does not dry for long. Having eaten the fruit, a bird often clears its beak from the pasted-in seed. This seed sticks to the trees' bark. But the bulk of the seed is stuck to the branches along with droppings. Thrushes and waxwings eat mistletoe fruits eagerly. These birds fly from branch to branch, so the seeds of mistletoe extend far beyond the neighboring trees. The birds' droppings with mistletoe seeds do not just fall somewhere. These adhesive droppings with mistletoe fruit hang from the birds' cloaca for a long time and finally it clings to a twig the bird jumped on and tears off. Thus, all the seed falls directly on the destination area and remains there. Mistletoe seeds germinate quickly. Seedlings' root penetrates into the tree bark and grows into a wide plate-haustorium. The latter gradually penetrates into the wood tissue which nourishes mistletoe. A shoot develops next year. It is green with opposite leathery and green leaves as well. Mistletoe photosynthesises, i.e. it creates the organic mass itself though water and mineral salts that are taken from the tree. Later on long cylindrical strands grow from haustorium under the bark of trees. In the short run, new haustoriums grow on the shoots which give growth to new mistletoe shoots and soon after they cover tree quite densely. This results in a decrease in the number and size of leaves by 18%, and a decrease in annual growth of shoots of affected trees by 40-60%. Moreover, mistletoe as an evergreen plant continues to evaporate water when the host tree has dropped its leaves in winter. The tree eventually dies prematurely.

The first stages of development run very slow. Stem and shoots begin to develop only in several years.

As soon as they appear, the development becomes faster. During the first year after seed germination, mistletoe shoot runs to 7 cm in length. Next year, the shoot thrives and runs to 20 cm forming spherical shape, in three years it becomes an ordinary spherical bush of 30 cm in diameter. Having sufficient content of nutrients, it forms branchy bushes. Soon additional buds appear on root system and they germinate outside and develop into new mistletoe bushes. An infected tree starts shrinking after several years (fig. 1).

During our planting survey in Bila Tserkva town we noticed different infection degrees of willow and poplar: partial, average, mass crown affection; partial average and mass trunk and skeletal branches affection; those affections which significantly degrade the ornamentality of separate trees and alley plantations (Table 1).

Fig. 1. Vcyhannya branches of *Populus nigra* infected with *Viscum alba*

Table 1 Degree of damage caused by *Viscum album* to *Salicaceae* representatives in Bila Tserkva

N.	Genus name	Damage of different parts, degree			Index of complex estimation of the damage of plants infected with mistletoe, degree
		Crown damage	Trunk damage	Skeletal branches damage	
1.	*Populus alba* L.	6	2	4	12
2.	*Populus balsamifera* L.	5	-	3	8
3.	*Populus italica* (Du Roi Moench.)	3	-	-	3
4.	*Populus nigra* L.	5	3	4	12
5.	*Populus tremula* L.	4	2	3	9
6.	*Salix alba* L.	5	2	4	11
7.	*Salix alba* L. 'Viteline Pendula'	4	1	3	8
8.	*Salix caprea* L.	1	-	1	2
9.	*Salix fragilis* L.	1	-	1	2
10.	*Salix pentandra* L.	1	-	1	2
11.	*Salix matsudana* Koidz.	1	-	1	2

Thus, damage degree of *Salicaceae* representatives with white mistletoe isn't the same. High level of damage has *Populus alba* L., *Populus nigra* L., *Populus balsamifera* L., *Salix alba* L., *Salix alba* L. 'Viteline Pendula'. Low damage level of crown is characteristic of *Populus italica* (Du Roi Moench.), *Salix caprea*

L., *Salix fragilis* L., *Salix pentandra* L., *Salix matsudana* Koidz. As usual, crown suffers the most damage (16-25 "bushes") on one tree and the trunks of affected trees suffer the least damage. We noted very intense damage of 11-12 degree at roadside plantings with *Populus alba* L., *Populus nigra* L., *Salix alba* L. The varieties with middle and low level of lesion caused by *Viscum album* are promising for use in landscaping and planting settlements in Ukraine.

Nowadays the most effective method of controlling mistletoe is cutting affected branches or even the whole tree. It doesn't allow this tree to yield and propagate. According to the sanitary principles, if 50% of the crown is damaged by mistletoe such a tree must be pruned away. These controlling methods are executed episodically in Bila Tserkva and don't give proper effect because of lack of financing. Trees infected with mistletoe in the phase of fruiting are noticed in the parks, public gardens, roadside forest belt, private plots of land and they are the source of spreading of this hemiparasite to other trees planted in the city. According to our survey, a damaged tree can wither in 7-12 years after infection or in 2-4 years after the beginning of fruiting.

Fig. 2. Roadside plantation of *Populus nigra* affected by *Viscum alba*

Fig. 3. Roadside plantation of *Salix alba* affected by *Viscum alba*

The mechanism of resistance isn't studied enough, it's not only adaptation of anatomical character but physiological adaptations which restrain and prevent germination of haustorial roots into woody plant tissue (for example, inhibitory substances outflux). A necessary factor for tree colonization with mistletoe and its development is light. That is the reason why park plantings are affected more often.

Fig. 4. Roadside plantation *Populus nigra* affected by *Viscum alba* around the city Bila Tserkva

CONCLUSIONS

Nowadays *Viscum album* is one the most dangerous factors which influence viability, longevity and ornamentality of *Salicaceae* representatives from green plantings in Bila Tserkva town. There is a great amount of trees affected by mistletoe, whose fruits promote its propagation and birds that eat its fruits promote its expansion. It's necessary to cut trees systematically for avoiding its fruiting in order to destroy mistletoe. The most affected trees must be chopped off. To solve this problem, we need to embrace municipal and state course of controlling actions concerning white mistletoe. Besides, authorities must allocate funds for carrying out these actions. Some promising species for landscaping and gardening of settlements in Ukraine are *Populus italica* (Du Roi Moench.), *Salix caprea* L., *Salix fragilis* L, *Salix pentandra* L., *Salix matsudana* Koidz.

BIBLIOGRAPHY

1. Kosenko I.S. White mistletoe in green plantings of Uman town and National dendrological park "Sophiivka" of Ukrainian National Academy of Sciences / I.S.Kosenko, V.M.Hrabovyi // Problems of conservation, restoration and enrichment of biological diversity in anthropogenic changed environment. Materials of international scientific conference. – Kryvyi Rig, 2005. – P. 225–228.
2. Kuznetsov S.I. Modern state and optimization ways of green planting in Kyiv / S.I.Kuznetsov, F.M.Levon, Yu.A.Klymenko, V.F.Pylypchuk, M.I.Shumyk // Plant introduction and amenity planting. – Bila Tserkva, 2000. – P. 90-104.

3. Patent (21) u200506717 Ukraine / (19) UA (11) 11413 (13) U (51) Method of clearing deciduous woody plants from flowering parasites / Tsylyuryk A., Drozda V., Bodyaka V.D.; applicant and patentee is National Agrarian University. – №7 AD1M21 / 04; applic. 08/07/2005; publ. 15.12.2005, Bull. № 12, 2005.

4. Shlapak V.P. Definition peculiarities of damage degree of arboreal plantings with *Viscum album* L. in historical part of National dendrological park "Sophiivka" of Ukrainian National Academy of Sciences / V.P.Shlapak, H.I.Muzyka, V.F.Sobchenko, L.I.Marno, O.P.Tysiachnyi // Scientific announcer of NLTU of Ukraine. – 2010. – Edition 20.7. – P. 8–14.

5. Vasylenko I.D. Mistletoe control on poplar trees in the green belt of Bila Tserkva / I.D. Vasylenko, L.M. Filipova, Ya.D. Fuchylo. – Scientific papers in Volume NLTU of Ukraine. - 2013. - Vol. 23.13. – P. 30–38.

THE INFLUENCE OF TEMPERATURE ON GRAINS GERMINATION AT *SORGHUM BICOLOR* L.

Simona – Florina Pochișcanu[1], Teodor Robu[1], Cătălina Druțu[2], Diana Popa[2], Elena Trotuș[2]

[1] *University of Agricultural Sciences and Veterinary Medicine, Iași, Romania*

[2] *Agricultural Research and Development Station Secuieni, Neamț, Romania*

Abstract: Sorghum is a very demanding species to heat, it prefer at sowing minimum germination temperatures higher than 10°C. For this reason, at the Agricultural Research – Development Station Secuieni, we have experienced a number of 16 samples of sorghum with 100 grains each under different temperatures in order to determine the effect of temperature on the germination of Sorghum bicolor L. Following the results, sit was observed that, in laboratory conditions, at temperatures ≤ with 10 °C is obtained a very slow germination and with a huge percentage of grains which do not germinate. Thus, at a temperature of 7 °C, the number of days necessary for seeds germination was of 21 days and the percentage of germinated seeds was only of 41.6 %. By increasing the temperature provided at germination until 10 °C, the number of days necessary for germination decreased to 18 days, and the percentage of germinated seeds was increased up to 67.5 %. Once we assured the germination temperatures higher than 14 °C and respectively 18 °C, it was observed an improvement of the seeds germination capacity at Sorghum bicolor L. The sorghum grains have germinated in only 9 days and the percentage of germinated seeds was of 81.2 % when it was subjected to temperatures of 14 °C, but at the ensuring of a temperature of 18 °C, the sorghum grains have germinated in 6 days and the percentage of germinated seeds was of 93.5 %.

INTRODUCTION

Sorghum bicolor L. has a great development because it's use in the alimentation especially in the semi-arid areas of the world where the climatic conditions gives limited conditions for agriculture. Such situations predominantly in Africa, Asia and Latin America, which are frequently drought-prone. India grows the largest acreage of sorghum in the world followed by Nigeria and Sudan, and produces the second largest tonnage after the US (FAO, 1995; ICRISAT, 2004; Nadia et al., 2009).

Sorghum can be an excellent source of starch, protein, sugar, fiber, being cheaper than corn, because the cost/ha are lower than the corn (Claver et al., 2010; Shinde, 2005; Singh and Sandhu, 2007).

In the present paper we followed under laboratory conditions, the influence of the temperature on seed germination of sorghum. The temperatures traced were comprised between 7°C and 18°C.

MATERIAL AND METHOD

In the laboratory, we have performed tests which consist in determining the percentage of germination of pure seeds capable to producing normal germs and which placed under favorable conditions they produce normal plants developed.

From the pure seed, well stirred, were counted by chance four samples with 100 seeds for each examined temperature. The seeds were placed on the vegetation cover in Petri dishes. The vegetation cover had sufficient moisture throughout the germination, of which was laid continuously available of the seeds and of the germs. In the moment when we obtained a maximum germination of the sample, the test was ended.

The samples of sorghum were placed in a germination room at the temperatures comprised between 7° C and 18° C, and the test results of germination was calculated as an average of four tests, every of 100 seeds.

RESULTS AND DISCUSSIONS

The sorghum is a very pretentious species from heat, and he prefer at sowing a minimum germination temperature higher of 10°C. From the table 1 we can see that in the laboratory conditions, at the temperatures ≤ 10° C whe obtain a very slow emergence and a very high percentage of goals.

Tabelul 1. Influenţa temperaturii asupra germinaţiei boabelor de *Sorghum bicolor* (L.) Moench.

Variant	Room temperature °C	Number of days until seed germination	Germination %
1	7	21	41.6
3	10	18	67.5
4	14	9	81.2
5	18	6	93.5

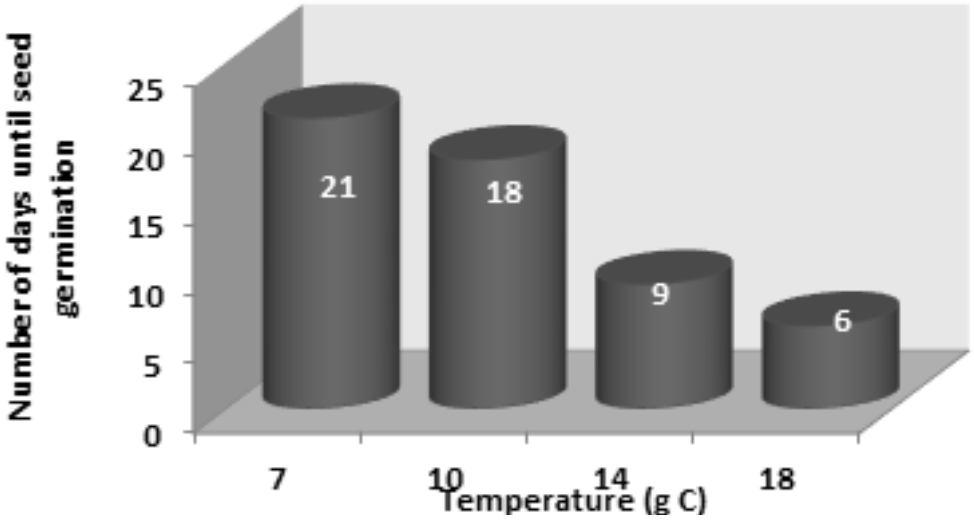


Figure 1. The influence of temperature of number of days required for seed germination at Sorghum bicolor (L.) Moench.

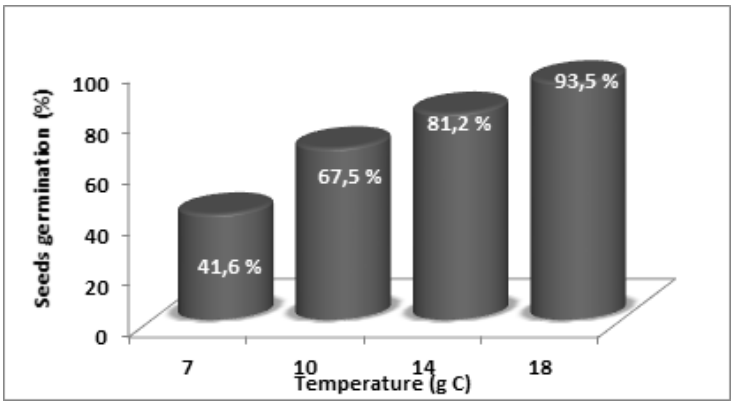


Figure 2. Influence of temperature on seeds germination at Sorghum bicolor (L.) Moench.

When the seeds were germinated at the temperatures > 10 °C was realized a much faster germination of grains. Thus, at a temperature of 14 °C to achieve a 81.2% percentage of seeds germinated, it took 9 days. The increasing the temperature of germination by an additional 4 °C above to this temperature (18°C), made sorghum germinating in 6 days, uniform with a very small percentage of seeds which do not germinate (table 1). The importance of the temperature ensured of the grain sorghum germination can be seen in Figures 1 and 2.

From the results, it is clearly observed that between the temperature insured and the number of days needed for seed germination there is an indirect correlation, and between temperature ensured and the percentage of grains germinated there is a direct correlation, correlation coefficients calculated were statistically assured and they are interpreted as very significant negative (the number of days) and very

significant (the percentage of grain) (figure 3.).

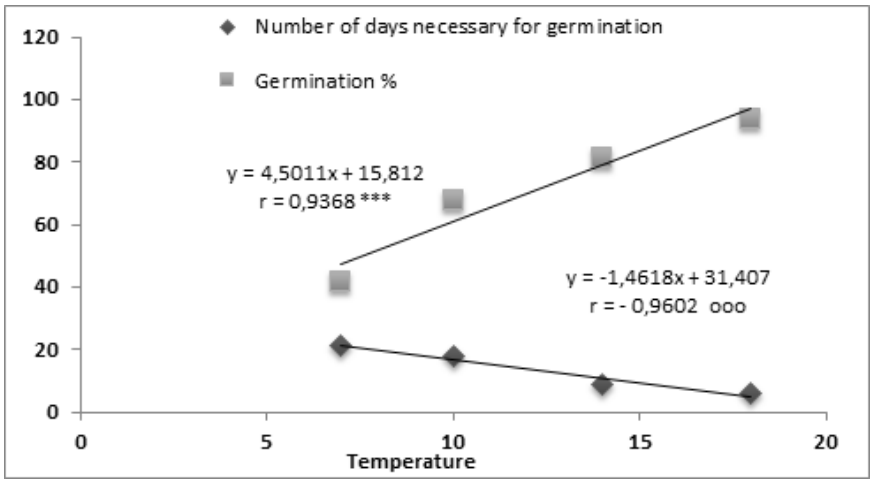


Figure 3. The correlation between room temperature and the number of days required for seed germination, percentage of grain germinated from *Sorghum bicolor* **L.**

CONCLUSIONS

The results obtained have revealed that the sorghum sowed at temperatures ≤ 10 ° C has a very slow emergence and a very high percentage of goals. To avoid losses caused by gaps of the emergence on the crop sorghum must ensure a seeding temperature a minimum of 14 °C.

BIBLIOGRAPHY

1. Claver I.P., Zhang H., Li Q. Zhu, K. and Zhou H. (2010). *Impact of the Soak and the Malt on the Physicochemical Properties of the Sorghum Starches*. International Journal of Molecular, Sciences 11, pp. 3002-3015.

FAO. (1995). *Sorghum and Millets in Human Nutrition*. FAO Food and Nutrition Series; No. 27, ISBN 92-5-103381-1.

2. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) (2004). *Sorghum, a crop of substance. (In En.) Patancheru 502 324, Andhra Pradesh,* India: International Crops Research Institute for the Semi-Arid Tropics, ISBN-92-9066-473-8

3. Nadia B., Naïma B., Boubekeur N., Claude D., Mohamed M., Barbara R. and Marianne S. (2009). *Physicochemical and functional properties of starches from sorghum cultivated in the Sahara of Algeria*. Carbohydrate Polymers 78, pp. 475-480.

4. Shinde V.V. (2005). *Production kinetics and functional properties of carboxymethyl sorghum starch*. Natural Product Radiance, 4(6), pp. 466-470.

5. Singh H., Singh Sodhi N. and Singh N. (2009). *Structure and Functional Properties of Acid Thinned Sorghum Starch*. International Journal of Food Properties, 12, pp. 713–725,

6. Singh N. and Sandhu K.S. (2007). *Some properties of corn starches II: Physicochemical, gelatinization, retrogradation, pasting and gel textural properties*. Food Chemistry, 101, pp. 1499-1507.

CZU 633.81: 633.812 (478)

TO THE MORPHOLOGICAL ELEMENTS SHARE OF HARVESTIN PRODUCTION ESSENTIAL OIL AT HYSSOP

Roshca Nina, Musteata G., Baranova Natalia, Vornicu Zinaida, Jelezneac Tamara, Timciuc C.

Institute of Genetics, Physiology and Plant Protection of A.S.M.

e-mail: ninaroshca@mail.ru

Abstract: In hyssop feedstock structure the most important component are the flowers which are 36,0% in the production of row material and assures 56,2% of volatile oil production.

In pharmaceutical herba production at the beginning of flowering leaves constitute 35,8%, 32,3% at full flowering stage, and drops to 26,9% when hyssop is harvested for obtaining essential oil.

Annual semi-lignified hyssop shoots contain very less quantity of volatile oil and therefore their share in the production of essential oil is insignificant. In inflorescences volatile oil content is 0,468% against 0,211% in the leaves, production of volatile oil from leaves and inflorescences being 10,2 and 32,9 kg/ha respectively.

Inflorescences have, as in raw material production as in volatile oil production, the highest share.

Key words: hyssop, pharmaceutical herba production, aromatic row material, volatile oil content, morphological elements share.

PONDEREA ELEMENTELOR MORFOLOGICE A RECOLTEI ÎN PRODUCŢIA ULEIULUI VOLATIL LA ISOP

Roşca Nina, Musteaţă G., Baranova Natalia, Vornicu Zinaida, Jelezneac Tamara, Timciuc C.

Institutul de Genetică, Fiziologie şi Protecţie a Plantelor al AŞM

e-mail: ninaroshca@mail.ru

Rezumat: În structura materiei prime la isop cea mai importantă componentă sunt inflorescenţele care constituie 36,0% în producţia de materie primă şi asigură obţinerea a 56,2% în producţia de ulei volatil.

În producţia de herba farmaceutică la început de înflorire frunzele alcătuiesc 35,8%, în faza înfloririi depline 32,3%, scăzând până la 26,9% când isopul se recoltează pentru obţinerea uleiului volatil.

Lăstarii anuali semi-lignificaţi la isop conţin numai urme de ulei volatil şi deci ponderea lor în producerea uleiului volatil este nesemnificativă. La inflorescenţe conţinutul de ulei volatil este de 0,468% contra 0,211% în frunze, producţia de ulei volatil din frunze şi inflorescenţe fiind 10,2 şi 32,9 kg/ha respectiv.

Ponderea cea mai mare atât în producţia de materie primă, cât şi de ulei volatil o au inflorescenţele.

Cuvinte cheie: isop, producţie herba farmaceutică, materie primă aromatică, conţinut ulei volatil, pondere elemente morfologice.

Introduction

The hyssop – a Biblical herb from the Psalms of David is used as an ornamental plant, for medicinal targets in diseases of respiratory channels treatment, has antiseptic influence, and regulates the digestive functions etc. The studied plant is originating from the eastern Mediterranean region of Europe to central Asia. It is spreading natively on the calcareous and arid of Central Europe and North Africa lands. In the Republic of Moldova and Roumania countries the hyssop in wild flora is not spread that is why it must be cultivated [1, 2]. During the 70-80 years of twentieth century the hyssop was introduced as an industrial culture of Republic of Moldova. Presently the surfaces occupied with hyssop constitute about 200 ha and continues to be increased [3].

Due to the fact that the volatile oil of hyssop is increasingly solicited, many producers increase the surfaces occupied with hyssop which has created the necessity to study the structure of the harvest in different stages of vegetation, the morphological elements share of in the harvest and of total volatile oil production, in order to specify procedures for collecting, also the cutting depth of the raw material.

Materials and Methods

The investigations were performed during four years in the in the Institute of Genetics, Physiology and Plant Protection of A.S.M. The samples for determination was carried out, in dynamics, the accumulation of biological mass manually within 4-6 repetitions. The determinations were done by weighing the total sample and the organs in particular: leaves, inflorescences, annual shoots, pedunculate, semi-lignified. The volatile oil content of the raw material was determined after Ginsberg micromethod [4]. The researches were carried out on 3-4 years plantations.

Results and Discussions

Phenological and biometrical researches that hyssop forms 350-410 of annual shoots/ m^2, meantime the plants reaching a height of 47 cm in complet flowering stage were established. Beginning with the budding stage and until the harvest on the annual shoots persist 13-14 pairs of active leaves and from the armpit of which are formed the lateral shoots, but on the one third of apical there are the verticils with flowers which generally form the inflorescence. Such of morphological structure of the plants creates the premise of obtaining high yields of raw materials.

Toward budding stage, the total masses of plants constitute 1232 g/m^2 that it was established. The total mass increases as becoming the development phases. Therefore, at the beginning of flowering, the mass is equal to1546 g/m^2 to full flowering - 1594 g/m^2, while at the seed formation stage – 1914 g/m^2. During budding stage the harvest is compound of leaves, but annual pedunculate shoots form by 44,6% and 47,6% respectively, the inflorescences at this stage constituting only 7,8% of the total mass. Naturally, in the posterior developmental stages the ratio of organs in annual biomass is changing: the rate of inflorescences increases from 7,8% to 36,0% during budding full flowering stage, remaining at this level in the phase of seed formation. The rate of leaves, contrarily, in this period is decreasing: 44,6% during budding stage, 35,8% at the begining of flowering, and 32,3% – in full flowering, but in the phase of seed formation the rate of leaves constitutes only 26,9% of the total mass [figure].

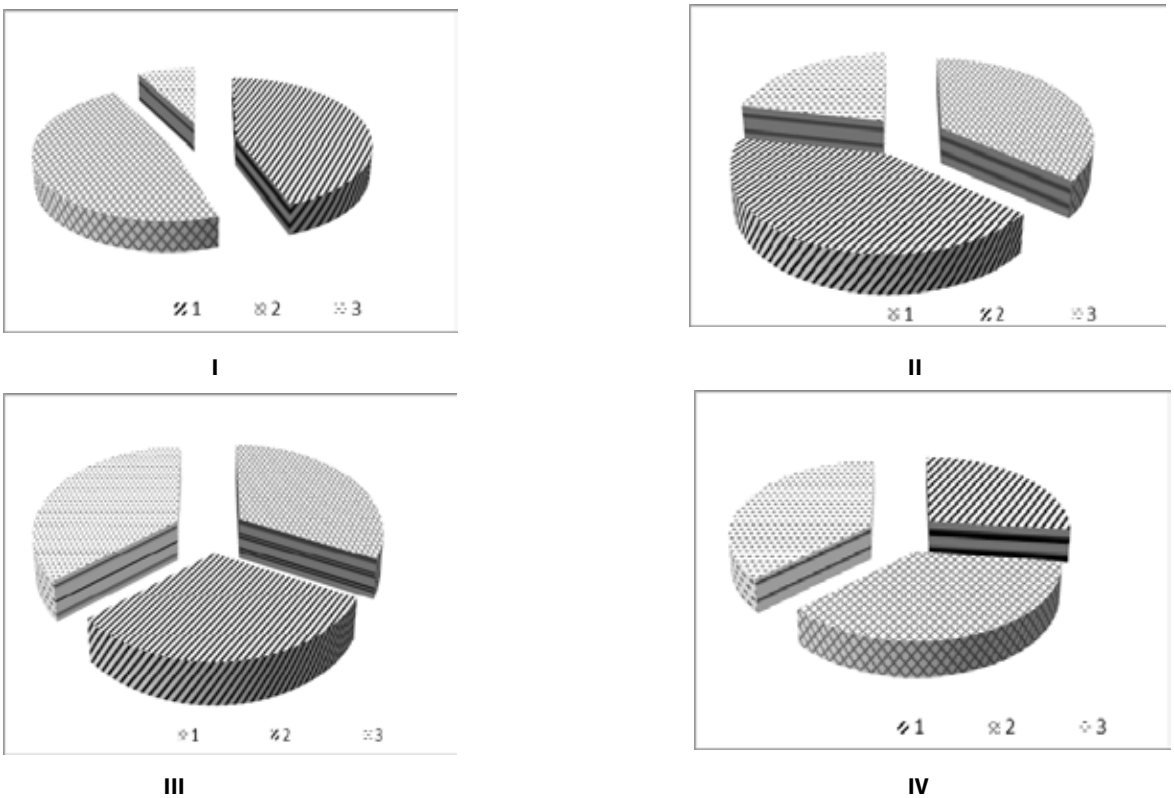


Figure. Rate of morphological elements at hyssop in ontogenesis.
Legend: I – budding stage; II – begining of flowering stage; III – full flowering stage; IV – seed formation phase.
1 – leaves mass, g/m^2; 2 – mass of annual semi-lignified shoots, g/m^2; 3 – inflorescences mass, g/m^2.

The rate of annual semi-lignified shoots in the total mass as the leaves is in decreasing, but remains essential in the seed formation phase and constitutes 36,4%. The hyssop can be harvested to obtain herba pharmaceutical and essential oil. For the pharmaceutical herba volatile oil content according to pharmacopoeia should be no less than 0,2% [5]. In the budding phase herba pharmaceutical mass is equal to 4, 19 t / ha, but the essential oil content constitutes just 0,160%. After the volatile oil content for obtaining the pharmaceutical herba the supra-terrestrial herbaceous part will be reap during the begining of flowering and those of full flowering. The herba pharmaceutical mass is changing from 7,26 to 6,30 t/ha, but the essential oil content is 0,234 and 0,246%, respectively [table 1].

During seed formation stage the pharmaceutical herba mass is higher (8,22 t per ha), but the ratio of organs is not acceptable, because for the pharmaceutical herba it is important the ratio of leaves. In seed formation phase the ratio of the leaves from total mass is decreasing, but the ratio of annual semi-lignified shoots is increasing. For obtaining essential oil hyssop is harvested during the seed formation stage. In this phase the aromatic raw material and essential oil productions is the highest and constitutes 19, 14 t per ha and 44,0 kg per ha, respectively.

Table 1. ***Production of herba pharmaceutical raw material at hyssop*** *2010-2011*

Developmental stage	Production of herba pharmaceutical, t/ha (12% humidity)	Producţia de materie primă aromatică, t/ha	Conţinutul în ulei volatil, %	Production of volatile oil, kg/ha
Budding	4,19	12,32	0,160	19,7
Begining of flowering	7,26	15,46	0,234	36,2
Full flowering	6,30	15,94	0,246	39,2
Seed formation	8,22	19,14	0,230	44,0

The organs ratio in the herba pharmaceutical production is approximately the same and is 515 g/m^2 – the leaves, 505 g/m^2 – the annual semi-lignified shoots, 574 g/m^2 – the inflorescences or their ratio is approx. 1:1:1.

In the production of pharmaceutical raw materials rate of the leaves is decreasing and is equal to 27% of the total mass, while the ratio of annual semi-lignified shoots is increasing up to 36% from the total mass of harvest; the inflorescences remains at the same level as in the seed formation stage. For establish the useful value of the raw material component organs was determined the essential oil content in the average sample and in the organs which constitutes the harvest at hyssop [table 2].

Table 2 Raw material production values of the components at hyssop

Indices	Total, average sample	Including the organs		
		leaves	annual semi-lignified shoots	inflorescences
Harvest, t/ha	19,14	5,14	6,97	7,03
Volatile oil content, %	0,304	0,211	traces	0,468
Essential oil production, kg/ha	58,2	10,8	traces	32,9

It has been established that the volatile oil content in the average sample is of 0,304%, 0,211% in the leaves, in inflorescences 0,468%, while annual shoots contain only traces of volatile oil. The essential oil production from the leaves is equal to 10,8 kg/ha, from inflorescences – 32,9 kg/ha. Thus, for produce the essential oil of hyssop optimal harvest term will be that when the share of inflorescences in the total mass is larger, because also the volatile oil content is highest in inflorescences.

Conclusions

1. The most important component of hyssop raw material are inflorescences which are 36,0% in production of raw material and 56,25% in volatile oil production.

2. In production of pharmaceutical herba at the beginning of flowering leaves constitute 35,8%, at full flowering stage – 32,3%, and drops to 26,9% when hyssop is harvested for obtaining essential oil.

3. The optimum period for hyssop harvesting for pharmaceutical herba is the full flowering, and for aromatic raw material and volatile oil production is seed formation stage.

4. Annual semi-lignified hyssop shoots contain very less quantity of volatile oil and therefore their share in the production of essential oil is insignificant.

5. In inflorescences volatile oil content is 0,468% against 0,211% in the leaves, production of volatile oil from leaves and inflorescences being 10,2 and 32,9 kg/ha respectively.

BIBLIOGRAPHY

1. Мустяцэ Г.И. Возделывание ароматических растений. Кишинев: Штиинца, 1988. 197 с.

2. Păun E. Sănătatea Carpaţilor (farmacia din cămara). Bucureşti, 1995, p. 40.

3. Мустяцэ Г.И. Рошка Н.Д., Баранова Н., Михэлуцэ О. Методы создания противоэрозионных посадок иссопа лекарственного. In: Проблемы биоэкологии и пути их решения (II Ржавитинские чтения): Междунар. научн. конф. Саранск: Изд-во Мордовского Университета, 2008, с. 412-413.

4. Гинзберг А.С. Упрощенный способ определения количества эфирного масла в эфироносах. In: Хим-фарм. пром-ть, 1932, 8-9, с. 326-329.

5. Muntean L. S. Cultura plantelor medicinale şi aromatice. Cluj-Napoca: Dacia, 1996. 262 p.

BIOLOGICAL PECULIARITIES AND FORAGE VALUE OF THE SOME PERENNIAL SPECIES OF THE GENUS *LATHYRUS* L. IN MOLDOVA

Teleuţă Alexandru

Botanical Garden (Institute) of the Academy of Sciences of Moldova,

18 Pădurii str., MD 2002 Chişinău

e-mail: director@gb.asm.md

Abstract: We investigated the biological peculiarities, biochemical composition and nutritional value of the natural fodder of 3 perennial species of the genus Lathyrus L.: Lathyrus latifolius L., Lathyrus pisiformis L, Lathyrus sylvestris L. from Botanical Garden (Institute) of the Academy of Sciences of Moldova. Onobrychis viciifolia Scop. was used as control. It was found out that the species Lathyrus latifolius, Lathyrus sylvestris have a productivity of 4.58-4.71 kg/m^2 natural fodder exceeding by 16-19 % the control, with a nutritional value of the natural fodder – 0.21-0.23 n.u./kg and a content of digestible protein – 190.0-197.0 g/n.u.Key words: amino acids, biochemical composition, biological peculiarities, forage value, Lathyrus latifolius, Lathyrus pisiformis, Lathyrus sylvestris, yield

INTRODUCTION

Animal husbandry plays an important role in a modern and sustainable agriculture since it provides much of the food that is necessary for people as well as raw material for various industrial sectors. The development of this branch of agriculture depends on the production of fodder which is necessary for animal nutrition. The acute lack of fodder, its mediocre quality and the losses in quantity and quality that occur because of improper harvesting technologies, conservation and storage is the primary cause of the low breeding indices, the productive performance that is well below the breed's genetic potential and the high specific consumption of fodder per unit of product. A higher fodder production can be achieved by increasing the diversity of cultivated species, by expanding the areas where fodder crops are grown and by creating new varieties with increased genetic potential for productivity, quality and increased resistance to harmful biotic and abiotic factors.

During 65 years of scientific research on mobilization and acclimatization of plant resources, in the Botanical Garden (Institute) of the ASM, it was founded the fodder plant collection, which currently includes more than 300 taxa native to different floristic regions (Europe, Asia and America). Particular attention is paid to mobilization and study of species of the family *Fabaceae* Lindl., which can contribute to the production of nutritionally balanced forage, while providing a part of the protein, carbohydrate and mineral requirements [8, 13, 14, 15, 21, 26, 27].

An important advantage of legume crop production is the ability of these species to form symbiotic associations with nitrogen (N)-fixing *Rhizobium* bacteria, reducing their dependence on inorganic N fertilizers [4, 18].

The genus *Lathyrus* L. is the largest genus in the economically important tribe *Fabeae* (Adans.) DC., family *Fabaceae* Lindl. Most researchers divide *Lathyrus* into 12 or 13 sections which include about 160 species, it is distributed throughout temperate regions of the northern hemisphere and extends into tropical East Africa and South America. Its main centre of diversity is in the Mediterranean and Irano-Turanian regions, with smaller centres in North and South America. Most *Lathyrus* species are diploid ($2n = 14$), with a few natural autopolyploids or allopolyploids, or contain both diploid and autopolyploid forms. Members of the *Lathyrus* genus include food and fodder crops, ornamental plants, are used in medicine, as soil nitrifiers, dune stabilizers, important agricultural weeds and model organisms for genetic and ecological research [2,3,4,7,18,24]. Larin et. al. [22] listed about 22 species grown as fodder. *Lathyrus sylvestris* has a number of characteristics that potentially make it valuable as a forage plant, such as superior plant vigor, high seed production, and its ability to spread rapidly. It is a high yielding, acceptable legume that is high in protein [4, 5, 6, 18, 21, 22]. Some authors have highlighted more promising perennial species [1, 4, 17, 18, 22, 24, 25], which need to be studied in detail in order to be implemented in the conditions of Moldova.

Negru [10] considered 14 species of *Lathyrus* in Flora of the Republic of Moldova, including *Lathyrus sylvestris* and *Lathyrus latifolius.*

Lathyrus latifolius L., synonyms *Lathyrus megalanthus* Steud., common names: Everlasting peavine, Everlasting-pea, Perennial pea, Perennial sweet pea. Romanian: Mănerei de pădure. It is a perennial plant, 1-2 m tall with prostrate or climbing stem, clutching by means of leaf tendrils. Its stem is biangular, with two broad wings. Stipules – broadly lanceolate, semisagittate, 2-4 cm long, about 1 cm wide, with well distinct longitudinal veins. Petioles – broadly winged. Leaf rachis ends in a branched tendril. Leaves consist of 1 pair of oblong-oval leaflets 5.5-9 cm long, 1-3(5) cm wide, with 3-5 very distinct veins. Leaf blade ends in a cusp. Peduncles are thick, angular, longer than leaves. Inflorescence is a rather lax raceme of 3-10 flowers. Pedicel is as long as calyx. Flowers are large, 2-2.5 cm long, bright red. Calyx is broadly campanulate, its upper teeth triangular-lanceolate, as long as tube, lower tooth lanceolate-subulate, longer than tube and the other calyx teeth. Standard gradually narrowed toward its base into short unguis, wings distinctly shorter than standard, on narrow short unguis, keel half-round, on short unguis. Pods are oblong-linear, horizontally patent, narrower toward base, 5-6 cm long, about 1 cm wide, compressed, with acuminate end, with 3 longitudinal scabrous ribs at upper suture. Pod valves with longitudinal-reticular venation. Seeds are globose or oblong, weakly tuberculate [25].

Lathyrus sylvestris L. common names: Flat Pea-vine, Narrow-leaved, Everlasting-pea. Romanian: Bob de ţarină, Linte silvicolă. It is a perennial plant up to 2 m tall. Stems are winged, costate, ascending or climbing by means of branched tendrils. Stipules are semi-sagittate, up to 2 cm long. Petioles and leaf rachis winged. Rachis ends with branched tendril. Leaf consists of one pair of lanceolate acuminate leaflets, 5-15 cm long, 6-25 (40) mm wide, with distinct longitudinal veins. Peduncles are slightly angular, long. Inflorescence is a raceme of 3-10 flowers. Pedicels are thick, longer than calyx. Flowers are 1-2 cm long, pink. Calyx is broadly campanulate. Calyx teeth are acuminate, triangular-lanceolate, lowest one is the longest and as long as the calyx tube; uppermost are the shortest. Standard gradually narrowed into a short claw. Wings are pink, shorter than standard, on narrow short claws. Keel is as long as wings, broadening on narrow claw. Pods are oblong-linear, laterally compressed, narrowed toward both ends, 6-7 cm long and about 1 cm wide, yellowish. Pod valves with longitudinal-reticulate venation, with three convex scabrous longitudinal ribs along upper suture. Seeds are globose or oblong, slightly tuberculate. Hilum makes about a half of the seed circuit. Flowers in June-August, fruits in August-September. Entomophilous. Zoochore. 2n=14[25].

Lathyrus pisiformis L. common names: Pisiform grass pea. Perennial plant, 50-100 cm in height, with a long, branchy root. Stems slightly cling with the help of short cirri; stems are almost upright. Stipules are large, 20-50 mm in length, 8-18 mm in width, ovate, with lengthened top and denticles at the base. Leaves are bluish green below, usually consisting of 4-6 pairs of ovate or oval leaflets, 25-50 mm in length, 10-30 mm in width. The leaf axis culminates in a short cirrus. Racemes are shorter than leaves, with 8-15 flowers. Flowers are medium-sized, 10-15 mm in length, red-lilac. Pedicels are shorter than the calyx. Calyx is short and tubular, thickening slightly at the base; its denticles are triangular. Flag is round-elliptical with dark mesh veins and dredging on top, on wide stem. Wings are oblong-lanceolate. Keel is bent almost at a right angle to the bottom edge. Pods are linear, slightly compressed from the sides, 40-50 mm in length, 4-5 mm in width. Valves of pods are dark brown. Seeds are almost spherical, brown; there are 10-12 seeds in a pod. Hilum length is equal to 1/6 the circumference of the seed. Chromosome number: 2n=14. Distribution: Central Europe, Russia [25]. This species is registered in the Red list of vascular plants of the Carpathians [16].

This research was aimed to evaluate the biological peculiarities, biochemical composition and nutritional value of the natural fodder of the perennial species of the genus *Lathyrus* L. (*L. latifolius, L. pisiformis, L. sylvestris)* in conditions of Moldova.

MATERIALS AND METHODS

The perennial species of the genus *Lathyrus: L. latifolius, L. pisiformis, L. sylvestris* maintained

Photo 1. Lathyrus*pisiformis L.*

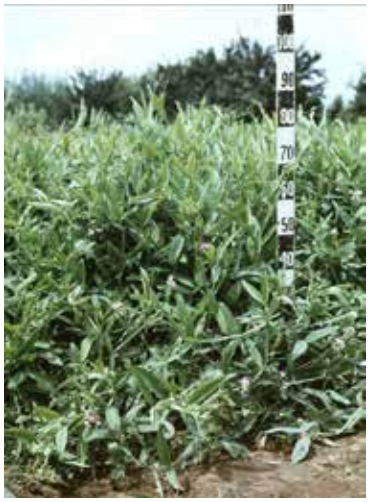


Photo 2. Lathyrus sylvestris L.

Photo 3. Lathyrus *latifolius L.*

Photo. 4. Onobrychis viciifolia Scop.

in monoculture, served as object of study. *Onobrychis viciifolia Scop.* served as control variant. The experiments were performed on non irrigated experimental land in the Botanical Garden (Institute) of the ASM with previously scarified seeds of Lathyrus species, they started in spring, when the soil had reached the physical readiness. The experimental design was a randomised complete block design with four replications, and the experimental plots measured 10 m^2.

The seeds were sown at a depth of 2.0-3.0 cm with soil compaction before and after sowing. The scientific researches on growth and development, yield and nutritional value of the plants were carried out according to the methodical indications [19, 20, 23].

RESULTS AND DISCUSSIONS

As a result of the conducted research, it has been established that the studied species of the genus *Lathyrus* need a moist seedbed for seed germination. In spite of the fact that seeds had been previously scarified mechanically, the emergence of seedlings at the soil surface was uneven and occurred 18-22 days later in comparison with *Onobrychis viciifolia*. In the first year of vegetation, the studied species have a rather slow growth and development rate. Thus, *L. latifolius* and *L. sylvestris* plants reach the flowering stage and grow 43-54 cm tall, and *L. pisiformis* develops a rosette which can grow up to 23 cm tall.

We might mention that, the next year, the vegetation period of the species of the genus *Lathyrus* starts 2-5 days later in comparison with *Onobrychis viciifolia*, the most delayed start of vegetation period is characteristic of the species *Lathyrus latifolius*. Analyzing the results shown in Table 1, it has been found that the studied species of the genus *Lathyrus* need a 17-28 day longer period to reach budding stage, a 8-33 day longer period – to reach flowering stage and a 30-51 day longer period – to reach seed maturation in comparison with *Onobrychis viciifolia* plants. A more delayed development during the growing season is characteristic of *Lathyrus sylvestris* plants; we could also mention that *Lathyrus latifolius* plants have a more rapid pace of development and are distinguished by a short flowering period.

Table 1. Biological peculiarities of the studied species of the family *Fabaceae*

Indicators	*Onobrychis viciifolia* (control)	*Lathyrus sylvestris*	*Lathyrus latifolius*	*Lathyrus pisiformis*
Days from the beginning of vegetation up to:				
- budding	75	103	92	103
- flowering	99	132	107	128
- seed ripening	133	184	165	163
Plant height, cm				
- at 20 April	23.30	26.40	22.00	19.60
- at flowering	85.50	187.78	165.60	124.40
The yield:				
- fresh mass, kg/m^2	3.95	4.58	4.71	2.33
- dry matter, kg/m^2	1.03	1.16	1.03	0.63
The leaf share of the fodder, %	35	54	55	48

From the resumption of growth till the end of April, a more rapid growth rate is observed in *Lathyrus sylvestris* plants (26.4 cm) and a slower one – in the *Lathyrus pisiformis* plants (19.6 cm), this tendency is maintained in the flowering phase. During this period, *Lathyrus sylvestris* plants reach 187.78 cm high, *Lathyrus latifolius* – 165.60 cm and *Lathyrus pisiformis* – 124.40 cm while the control: *Onobrychis viciifolia* plants reach 85.50 cm high. In other studies, it is mentioned that *Lathyrus sylvestris* plants can reach 3 m high [21], *Lathyrus pisiformis*- 0.7 m [17].

Total forage yield, quality and seasonal distribution of forage production may be of great importance to the livestock producers. It is known that about 65-80% of the yield is obtained at the first harvest [8]. We might mention that, in the second vegetation year, *Lathyrus sylvestris* and *Lathyrus latifolius* provide a natural fodder yield of 4.58-4.71 kg/m^2 exceeding the control with 16-18 %. *Lathyrus pisiformis* plants provide a poorer yield; this can be explained by the fact that this species, as claimed by some authors [17, 18, 24], achieves full yield potential in the 4th vegetation year. The harvested fodder of the species of the genus *Lathyrus* is richer in leaves, but poorer in dry matter. In some papers, it is mentioned that the fresh mass of *Lathyrus sylvestris* harvested in the 4th vegetation year reaches 92-125 t/ha [6, 21], *Lathyrus latifolius* – 95.5 t/ha [1].

Forages are a major source of nutrients for herbivores around the world. Sometimes the balance of nutrients or the presence of some constituent in the forage will have positive or negative effects on animal health. Biochemical composition of the species of the genus *Lathyrus* is reported in Table 2. It has been found that the studied species of the genus *Lathyrus* are characterized by relatively high content of protein in dry matter, ranging from 20.31% at *Lathyrus pisiformis* to 22.62% at *Lathyrus latifolius*, and minerals, ranging from 7.40% at *Lathyrus pisiformis* to 10.60% at *Lathyrus sylvestris*, probably due to the report leaves/stems of harvested fodder, as previously mentioned, but they are also characterised by lower fat content in comparison with *Onobrychis viciifolia.*

Table 2. Biochemical composition and nutritional value of the natural fodder

Indicators	Onobrychis viciifolia (control)	*Lathyrus sylvestris*	Lathyrus latifolius.	Lathyrus pisiformis
dry matter contains:				
raw protein, %	17.44	22.19	22.62	20.31
raw fats, %	3.39	2.50	2.90	3.06
raw cellulose, %	33.50	34.20	29.00	29.61
nitrogen free extractive substances, %	39.43	30.51	36.58	39.62
mineral substances,%	6.24	10.60	8.90	7.40
1 kg of natural fodder contains:				
nutritive units	0.23	0.23	0.21	0.27
metabolizable energy for cattle, MJ/kg	2.86	2.48	2.25	2.32
dry matter, g	274.00	253.28	218.68	270.71
raw protein, g	47.80	56.20	49.47	54.98
digestible protein, g	35.87	45.52	40.06	44.53
raw fats, g	9.30	6.33	6.34	8.28
raw cellulose, g	86.30	86.62	63.42	80.16
nitrogen free extractive substances, g	113.50	77.28	79.99	107.26
mineral substances, g	17.10	26.85	19.46	20.03
carotene, g	30.50	9.50	29.50	29.50
vitamin C, mg/%	41.21	35.71	19.96	39.73
digestible protein, g/ nutritive unit	156.00	197.06	189.95	166.68

Analyzing each species, we could mention that *Lathyrus sylvestris* has high content of cellulose and minerals and low content of fat and nitrogen free extractive substances, and *Lathyrus latifolius* and *Lathyrus pisiformis* – inversely proportional.

The dry matter content and its biochemical composition influence the nutritional value of natural fodder. It was found that the harvested fodder of *Lathyrus pisiformis* has high dry matter content, but not as high as the control's. We might also mention that the harvested fodder of the studied species of the genus *Lathyrus* has higher content of digestible protein: 40-45 g/kg or 166.68-197.06 g/ nutritive unit.

Vitamins have multiple functions, they act as *potentiators* or co-factors in certain enzymatic reactions, they play an important role in DNA synthesis, in cell membrane integrity, bone development, coagulation, in protein and amino acid metabolism, in nerve impulse transmission etc. The species *Lathyrus latifolius* and *Lathyrus pisiformis* have about the same carotene content in the fodder as the control, while the fodder of *Lathyrus sylvestris* is very poor in carotene. Vitamin C plays an important role in the body due to its strong antioxidant character. The fodder of *Lathyrus latifolius* contains 19.96 mg/%, *Lathyrus sylvestris* – 35.71 mg/% and *Lathyrus pisiformis* – 39.73 mg/% versus 41.21 mg/% in *Onobrychis viciifolia*.

An essential component of protein characteristics is its amino acid composition, which is its main structural characteristic, irrespective of the kind, origin and physiological function [9, 11]. Determining the amino acid composition of vegetal fodder of the different species and the proportions between respective amino acids facilitates the evaluation of its potential nutritive value, especially creating the possibility of not applying synthetic amino acids to enhance the nutritive value of animal feed mixtures.

Analyzing the results on the amino acid content in the fodder, Table 3, it has been found that species of the genus *Lathyrus* are distinguished by a high content of both essential and nonessential amino acids. Comparing each amino acid separately, we could mention that the content varies from species to species.

Table 3. The content of amino acids in the fodder (mg/100mg dry matter)

Amino acids	*Onobrychis viciifolia* (control)	*Lathyrus sylvestris*	*Lathyrus latifolius*	*Lathyrus pisiformis*
asparagine	1.891	3.008	3.014	1.883
threonine	0.669	1.221	1.174	1.066
serine	0.971	1.343	1.123	0.853
glutamine	2.340	3.674	2.945	3.377
proline	1.493	1.819	0.700	0.797
glycine	0.711	1.271	1.072	0.948
alanine	1.210	1.165	0.946	0.879
valine	0.309	1.229	1.277	1.096
methionine	0.132	0.227	0.310	0.250
isoleucine	0.432	0.864	0.827	0.741
leucine	1.561	1.934	1.877	1.752
tyrosine	1.082	0.672	0.669	0.660
phenylalanine	0.635	1.163	1.138	1.001
histidine	0.431	0.723	1.750	0.417
lysine	1.018	1.438	1.467	1.282
arginine	0.875	1.034	0.835	1.059

The role of the first deficit essential amino acid, limiting the nutritive value of protein, was played by methionine. After the methionine content in fodder, the species of the genus *Lathyrus* exceed the control 1.7-2.3 times, reaching values of 0.227-0.350 mg/100 mg.

The second amino acid limiting protein biosynthesis is lysine. The studied species are rich in lysine in comparison with *Onobrychis viciifolia* (1.282-1.467 mg/100 mg), very rich in threonine (1.066-1.221 mg/100 mg), valine (1.096-1.229 mg/100 mg), isoleucine (0.741-0.864 mg/100 mg), phenylalanine (0.741-0.864 mg/100 mg) and rich in leucine (1.752-1.934 mg/100mg). Regarding the semi-essential amino acid content, *Lathyrus latifolius* and *Lathyrus sylvestris* have a rather high content of histidine, and *Lathyrus pisiformis* and *Lathyrus sylvestris* – of arginine. The studied species have lower tyrosine content. It was found that *Lathyrus sylvestris* and *Lathyrus pisiformis* are poor in proline, alanine.

CONCLUSIONS

1. In the first year of vegetation, the studied *Lathyrus* species have a rather slow growth and development rate, in the second year *of* vegetation *Lathyrus sylvestris* plants reach 187.78 cm high, *Lathyrus latifolius* – 165.60 cm and *Lathyrus pisiformis* – 124.40 cm while the control: *Onobrychis viciifolia* plants reach 85.50 cm.

2. *Lathyrus sylvestris* and *Lathyrus latifolius* provide a natural fodder yield of 4.58-4.71 kg/m^2 exceeding the control with 16-18 %, report leaves/stems 1:1.

3. The studied species the genus *Lathyrus* are characterized by relatively high content of protein in dry matter, ranging from 20.31% at *Lathyrus pisiformis* to 22.62% at *Lathyrus latifolius,* higher content of digestible protein: 40-45 g/kg or 166.68-197.06 g/ nutritive unit, but lower fat content.

4. The studied species of the genus *Lathyrus* are distinguished by a high content of both essential

and nonessential amino acids, methionine content in fodder exceeds the control 1.7-2.3 times, reaching values of 0.227-0.350 mg/100 mg; they are also rich in lysine, threonine, valine, isoleucine, phenylalanine, leucine.

The obtained results are a good reason for further research on selection of valuable materials for future breeding programs.

REFERENCES

1. Aleman R., Wotto R.D. 2003. Experiences with *Lathyrus latifolius* in agriculture of high elevationzones of Central America. *Lathyrus Lathyrism Newsletter*, 3: 5-7.
2. Belaid Y, Chtourou-Ghorbel N, Marrakchi M, Trifi-Farah N. 2006. Genetic diversity within and between populations of *Lathyrus* genus (Fabaceae) revealed by ISSR markers. *Genetic Resources and Crop Evolution*, 53: 1413–1418.
3. Chtourou-Ghorbel N., Lauga B., Combes D., Marrakchi M. 2001.Comparative genetic diversity studies in the genus *Lathyrus* using RFLP and RAPD markers. *Lathyrus Lathyrism Newsletter*, 2: 62–68.
4. Duke J.A. 1981. Handbook of Legumes of World Economic Importance. Plenum Press, New York and London. 345p.
5. Flachowsky G., Bähr H., Anke M., Gruhn K., Löhnert H.J.,Wolf I. 1982. Untersuchungen zu Inhaltsstoffen und zum Futterwert der Waldplatterbse (Lathyrus sylvestris L.). *Archiv für Tierernährung*, 32:5-6, 393-399. [Composition and food value of the flat pea (Lathyrus sylvestris L.)].
6. Foster J.G. 1990. Flatpea (*Lathyrus sylvestris* L.): a new forage species? A comprehensive review. *Advances in agronomy, 43*:241–313.
7. Kupicha F.K. 1983.The infrageneric structure of *Lathyrus*. *Notes Royal Botanic Garden*, 41: 209–244.
8. Lupaşcu M. F. 1960. Agrotehnica culturilor conveerului verde în Moldova. Cartea Moldovenească. Chişinau. 118 p.
9. Mitchell H. H., Block R. J. 1946. The corelation of the amino acid composition of proteins wit their nutrive value. *Nutrient Review* (F), 16: 249-259.
10. Negru A. 2007. Determinator de plante din flora Republicii Moldova. Universul. Chişinău. 391 p.
11. Oser B. L. 1951. Metod for integrating essential amino acid content in the nutritional evaluation of protein. *Journal American Dietetic Association*, 27: 396-411.
12. Pavelka R. W. 1985.Flat pea *(Lathyrus sylvestris L.)* as a potential forage crop for ruminant livestock. *Cornell University-Technology & Engineering* . 58 p.
13. Teleuță A., Țîței V. 2011. Particularitățile biologice și calitatea furajului la ciumărea orientală în condițiile Republicii Moldova. In. Realizari și perspective în zootehnie, biotehnologii și medicină veterinară. Chișinău, p. 253-257
14. Teleuță A., Țîței V. 2014. Biological peculiarities and forage value of the species of the genus *Astragalus* L. in the Republic of Moldova. Scientific Papers. Series A. Agronomy, Vol. LVII, ISSN 2285-5845, 344-349. http://agronomyjournal.usamv.ro/pdf/2014/art61.pdf
15. Teleuță A., Țîței V. 2014. Biological and nutritional value of the genus *Medicago* L. in the conditions of the Republic of Moldova. *Lucrări Științifice, seria Agronomie.* (Universitatea de Științe Agricole și Medicină Veterinară Iași), 57 (1) : 119-124.
16. Witkowski Z.J., Król W., Solarz W. (eds.). 2003. Carpathian list of endangered species. Vienna-Krakow.
17. Абрамчук А. В. 2013. Интродукция чины гороховидной (Lathyrus pisiformis L.) Аграрное образование и наука. http://aon.urgau.ru/uploads/article/pdf_attachment/57/1 Абрамчук_интродукция_чины гороховидной__
18. Вишнякова М. А., Бурляева М.О. 2006. Потенциал хозяйственной ценности и перспективы использования российских видов чины. Сельскохозяйственная биология, 6: 85–97.
19. Ермаков А. И., Арасимович В. В., Ярош Н. Б.1987. Методы биохимического исследования растений. Агропромиздат. Ленинград. 430 с.
20. Иванов А.И. 1985. Изучение коллекций многолетних кормовых растений (методические указания). Л. 48 с.
21. Купорицкая Т.А. 1978. Новое высокобелковое кормовое растение -чина лесная Lathyrus sylvestris L. *Известия Академии наук Молдавской ССР*. Сер. Биол. и хим., 4:83-85.
22. Ларин И.В., Агабабян Ш.М., Работнов Т.А. и др. 1951. Кормовые растения сенокосов и пастбищ СССР. Т. 2. Двудольные (хлорантовые - бобовые). Сельхозгиз. Москва ; Ленинград. 948 с.

23. Новоселов Ю. К., Харьков Г. Д., Шеховцова Н. С. 1983. Методические указания по проведению полевых опытов с кормовыми культурами. ВНИИК. М. 197 с.

24. Поваляева И.А. 1992. Многолетние виды чины как перспективный исходный материал для селекции. Научн.-техн. бюлл. ВИР, 220: 20-24.

25. Смекалова Т.Н. Агроэкологический атлас России и сопредельных стран: экономически значимые растения, их болезни, вредители и сорные растения» http://www.agroatlas.ru/ru/content/related/Lathyrus_pisiformis/

26. Телеуцэ А.С., Цыцей В.Г. 2012. Химический состав и питательность зеленой массы малораспостраненных кормовых культур сем. Бобовых. **Проблеми експеримента-льної ботаніки** та біотехнології. Випуск 1. Київ . Фітосоціоцентр. с. 206-211.

27. Телеуцэ А.С., Цыцей В.Г. 2012. Нетрадиционные растения семейство бобовых - кормовые достойнство и продуктивность в условиях Республики Молдова. Матеріали доповідей Міжародної наукової конференції " Онтогенез – стан, проблеми та перспективи вивчения рослин в культурних та природних ценозах. м. Херсон. с. 293-298

PROMISING PERENNIAL PLANT SPECIES FOR BIOENERGY PRODUCTION IN THE REPUBLIC OF MOLDOVA

Victor Ţîţei

[1]*Botanical Garden (Institute) of the Academy of Sciences of Moldova, Chişinău, 18 Padurii str., MD 2002 Republic Moldova. Phone: + 373.22.55.04.43 Fax: + 373.22.55.04.43*

Corresponding author email: vtitei@ mail.ru

Abstract: Energy crops offer ecological advantages over fossil fuels by contributing to the reduction of greenhouse gases and acidifying emissions. The investigation of local as well as introduced tall perennial species for biofuel production is an important object in Botanical Garden (Institute) of ASM.

We investigated some agro-biological peculiarities and energy characteristics of biomass of the perennial species: Astragalus galegiformis L., Festuca arundinacea Schreb., Glycyrrhiza glabra L., Miscanthus sinensis Anderss. It has been found that the studied species grow and develop rapidly, that allows obtaining 0.59-1.41 kg/m^2 dry matter with heating value of 16.92-18.82 MJ/kg and moderate content of ash, and can be used to create energy plantations.

Keywords: agro-biological peculiarities, energy crops, energy characteristics of biomass, Astragalus galegiformis, Festuca arundinacea, Glycyrrhiza glabra, Miscanthus sinensis

INTRODUCTION

Food and energy supply remains the central topic of the XXI century. Economic growth and social development of society leads to increased consumption of energy resources, the cost of fossil types of fuels is constantly rising and soon we may run short of reserves in general. According to the forecast developed by World Energy Council, consumption of energy in 2050 will double, which, in turn, will lead to increased CO_2 content in the atmosphere and to strengthening of greenhouse effect. In this regard, searches for new renewable sources of energy are actively conducted, including the development of bioenergy, which gets increasing social demand and now it ranks among the main priorities of innovative development of world economy. The substitution of fossil fuels or of raw materials based on fossil fuels by biomass is an important contribution to reduce anthropogenic CO_2 emissions [2, 4, 11].

The Republic of Moldova imports 95% of energy resources and energy costs per unit of production are three times higher, than on average across Europe. According to Energy Strategy of the Republic of Moldova (2013), the total amount of energy produced from renewable sources should be increased to 20% by the year 2020 and ¾ of this amount will make energy from biomass. Taking into account that forests in Moldova cover less than 13% of the area, it becomes relevant to explore the suitability of using various types of phytoenergy plants (energy crops) as renewable energy sources, and also to develop technologies of their cultivation in order to obtain the maximum yield of technological raw materials for further processing into new types of fuels. Energy crops offer ecological advantages over fossil fuels by contributing to the reduction of greenhouse gases and acidifying emissions. There are many ecological benefits expected from the production and use of perennial species [2, 4, 5]. However, there could be ecological shortcomings related to the intensity of agricultural production.

In the last 65 years, as a result of the introduction and acclimatization researches done in the Botanical Garden (Institute) of the ASM, collections and exhibitions of plants with multiple uses, necessary for the development of the national economy, were founded. The investigation of local as well as introduced tall perennial species for biofuel production is an important object [9, 17]. Currently, about 100 species of plants from the Botanical Garden can be used to produce different types of biofuels.

The aim of the present study was to evaluate some agro-biological peculiarities and energy characteristics of biomass of the perennial species: *Astragalus galegiformis*, *Festuca arundinacea, Glycyrrhiza glabra*, *Miscanthus sinensis*

MATERIALS AND METHODS

The plant species from the collections of the Botanical Garden (Institute) of the ASM were used as material for research: *Astragalus galegiformis* L. and *Glycyrrhiza glabra* L. from family *Fabaceae* Lindl., *Festuca arundinacea* Schreb. and *Miscanthus sinensis* Andersson from family *Poaceae* Barnhar. The plant growth and development, their productivity were assessed according to methodical indication [14]. The moisture content of biomass (chopped material) was determined by CEN/TS 15414 in an automatic hot air oven MEMMERT100-800. Content of ash was determined at 550°C in a muffle furnace HT40AL according to CEN/TS 15403. Automatic calorimeter LAGET MS-10A with accessories was used for determination of heating value, according to CEN/TS 15400. The cylindrical containers were used for determination of bulk density, calculated by dividing the mass over the container volume. The briquetting was carried out by hydraulic piston briquetting press BrikStar model 50-12 (Briklis). The mean compressed (specific) density of the briquettes was determined immediately after removal from the mould as a ratio of measured mass over calculated volume.

The scientific research was performed during the years 2010-2014.

RESULTS AND DISCUSSIONS

Astragalus galegiformis L., (syn. *Astragalus galegifolius*, *Tragacantha galegiformis*), family *Fabaceae* Lindl., native to Caucasus, is an herbaceous perennial, up to 1.2-2.5 m in height. Leaves grow up to 20 cm long, with 13-16 pairs of leaflets, oblong-ovate, 12-25 mm long, rounded. The pea-shaped flowers are arranged in racemes up to 30 cm long. Calyx – 5-6 mm long, weak and short with linear-subulate teeth. Corolla – yellow or yellowish-white flag, 14 to 15 mm in length. Pods – 12-15 mm long, plano-convex, laterally compressed, glabrous, long-stipitate, mucronate, with 4-6 seeds. 2n = 16. *Astragalus galegiformis* is a fodder plant and an excellent source of nectar and pollen for honeybees [8, 10, 13, 15,16]. In the conditions of Moldova, the species *Astragalus galegiformis* is characterized by a longer period of germination due to the high content of hard seeds that require a greater amount of moisture and higher temperatures of the soil (16 °C). The seedlings emerge at the soil surface after 33 days, the growth and development of the aerial part of is slow, at the end of the growing season, the shoots reach 35-43 cm tall, but the development of root system is intense. In the following years, the aerial part has a faster growth and development rate. Thus, by the flowering period (middle of May), plants reach a height of 190.6 cm and shoots reach 9-14 mm in diameter. The plants need a shorter period until the formation and ripening of seeds.

It is known that the growth and development rate of plants reflects productivity and accumulation of dry matter. At the beginning of July, when seeds are completely mature, leaves turn yellow and fall, the moisture content of stems constitutes 55-65%, being mowed, over 3-5 days, the moisture content of stems is reduced below 15%, this fact allows chopping and transporting them for further processing. The productivity of the harvested biomass constitutes 0.97-1.41 kg/m^2 dry matter. The bulk density of the chopped stems is 176-187 kg/m^3. *The ash content is 1.5-2.3 %.* The heating value of absolutely dry matter reaches 18.12-18.82 MJ/kg. The density of the briquettes made from biomass is 840-860 kg/m^3.

Tall fescue *Festuca arundinacea* Schreb. (syn. *Schedonorus arundinaceus* (Schreb.) Dumort., *Schedonorus phoenix* (Scop.) Holub, *Festuca fenas* L., *Festuca uechtritziana* Schreb., *Lolium arundinaceum* (Schreb.) Darbysh), family *Poaceae* Barnhar., native to Europe is a densely cespitose to short-rhizomatous, cool-season, long-lived, important perennial forage grass. It is also an ornamental grass in gardens, and a plant used for phytoremediation. It reproduces by seed and spreads vegetatively, forming dense, solid stands. A tuft produces 10-30 flowering stalks with the inflorescence – an open to narrow branched panicle. Seeds are somewhat dark in colour and, as in all grasses, the fruit is a caryopsis. *Festuca arundinacea* roots are tough and coarse and penetrate to a depth of 150 cm in moist soils; culms are hollow and grow 0.5-2 m tall, from basal tufts. Leaf blades are coarse and thick and prominently ridge-veined above. Blades are

5-70 cm long and 4-10 mm wide with ciliate auricles. The first node of the panicle has 2-3 branches, each with 5-15 spikelets, 3-6-flowered. The first glume is 4-6 mm long, the second 5-9 mm long. Lemmas are 7-8.5 mm (or more) long, scabrous distally. The awn is 0.3-2 mm long . As a result of the study of the biological peculiarities in the first year of vegetation, it was determined that *Festuca arundinacea* grows and develops slowly, does not develop shoots. In the second year and the following years of vegetation, in spring, when the air temperature exceeds 4-6°C, starts plant development from generative buds, which go through all stages of ontogenetic development finishing with seed formation, the plant height reaches 118 -149 cm.

For the production of solid biofuel, in seed maturation phase, the biomass was mown using equipment for harvesting grassy fodder, laid in swath for drying, baled and transported for further processing. The productivity (at the 1st harvest) of the harvested biomass constitutes 0.59-1.21 kg/m^2 dry matter. The primary preparation of biomass for briquetting was done with the fodder chopper. The bulk density of the chopped biomass was 91-113 kg/m^3. *The ash content was 2.3-3.6 %.* The heating value reached 16.82-17.34 MJ/kg dry matter. The density of the briquettes made from biomass was 600-660 kg/ m^3.

The yield of dry matter of *Festuca arundinacea*, in the Czech Republic, reached 3999 kg/ ha in the first year, the heating value – 16.97 MJ/kg [3], in Germany 114000 -131000kg/ha and approximately 17.00 MJ/kg [2].

Licorice, *Glycyrrhiza glabra* L., family *Fabaceae* Lindl.*, is a* perennial herbaceous plant native to the Mediterranean region and central and south-western Asia, it is cultivated for its edible root which is widely used in medicine and for flavouring. Potential uses of *Glycyrrhiza glabra* in agriculture as forage, medicinal crop and phytomeliorant, the dry yield of shoot reached 8-12 t/ha and that of root -10-14 t/ ha [6].

The root system, as in so many leguminous plants, is double, one part consisting of a vertical or tap root, often with several branches penetrating to a depth of three or four feet, the other of horizontal rhizomes or stolons thrown off from the root below the surface of the ground, which attain a length of many feet. These runners are furnished with leaf buds and throw up stems in their second year. The perennial downward-running roots as well as the long horizontal stolons are equally preserved for use. Each root, if unrestricted, can reach a depth of 90 to 120 cm and can extend to 10 m. The plants grows 90-180 cm tall, with pinnate leaves about 7-15 cm long, with 9-17 leaflets. They flower in June-July; the flowers are 0.8-1.2 cm long, purple to pale whitish blue, produced in a loose inflorescence. The fruit is an oblong pod, 3-5 cm long, containing several seeds. Propagation – by seed and vegetative (cutting, division of the plants in spring or autumn). *Glycyrrhiza glabra is sown* in spring; seed germination is low and irregular, scarification of seeds is recommended.

This plant has the capacity, as the others in its family, to fix nitrogen in the soil, decrease the soil bulk density, land desalinization, lowering the groundwater levels, increase the humus and nutrient content of the soil, improve soil structure and its biological activity, it has potential for use in animal husbandry and beekeeping, has valuable medicinal properties and multi-purpose use in various industries. It has been found that, in autumn, when temperatures below 0 °C are established, leaves are falling and stems are drying fast, in November, the stems are already dry and can be harvested and chopped directly in the field. The yield of chopped biomass reaches 0.65-1.07 kg/m^2, while the bulk density is of 153 kg/m^3. *The ash content is of 1.7 %.* The heating value reaches 18.7 MJ/kg dry matter. The density of the briquettes made from biomass is 873 kg/m^3.

Miscanthus sinensis Andersson, section *Triarrhena* , family *Poaceae* Barnhar., tetraploid plant group C4, the genetic origin is in East-Asia, it is cultivated as an ornamental plant. It is an herbaceous perennial grass, growing up to 0.8–2 m tall, forming dense clumps from an underground rhizome. The leaves are 18-75 cm tall and 0.3-2.0 cm broad. The flowers are purplish, fan-like panicle with a long axis and many racemes; it is a wind pollinated species. Seeds are very small (1000 seeds weigh about 250–1000 mg), have low nutrient reserves, and require high temperature and moisture for germination. This species is highly persistent, more winter hardy and quite undemanding in terms of soil as compared with other

species of this genus [7, 12]. Under the conditions of the Republic of Moldova, *Miscanthus sinensis* is propagated vegetative, and a plantation could be exploited more than 15 years. When temperatures below 0 °C are established, dehydration is accelerated, the shoots are very thin and have poor resistance to flattening, and therefore it is necessary to harvest biomass as soon as possible. Harvesting is carried out directly by chopping or mowing and bale formation depends on the equipment. The harvested biomass (0.73-1.18 kg/m^2) has a high leaf content, which leads to a decrease in bulk density (79-87 kg/m^3) and to an increase in the ash content (2.9-3.8%). The heating value reaches 18.27 MJ/kg dry matter. The density of the briquettes made from biomass is 712 kg/m^3.

It has been reported that in Portugal *Miscanthus sinensis* produced 40.9 t/ha dry matter after the third year of growth [1, 2].

CONCLUSIONS

The studied perennial species can be used for the creation of energy plantations and recovery of degraded land. Starting with the second year, these plants are characterised by intensive growth and development that allow obtaining 5.9-14.1 t/ha dry matter with a heating value of 16.92-18.82 MJ/kg and moderate ash content. The maintenance of the plantation and harvesting of biomass do not require sophisticated equipment, agricultural machinery suitable for other fodder crops can be used for the cultivation and harvesting of these species.

BIBLIOGRAPHY

1. Clifton-Brown J.C., Lewandowski I., Andersson B., Basch G., Christian D.G., Kjeldsen J.B., Jorgensen U., Mortensen J.V., Riche A.B.,Sshwarz K.U., Tatebe K., Teixeira F. (2001). Performance of 15 Miscanthus genotypes at five sites in Europe. *Agron. J. 93*: *1013–1019*.

2. El Bassam N. (2010). Handbook of bioenergy crops a complete reference to species, development and applications. Earthscan. London – Washington. 545p.

3. Kocourkova D., Hakl J., Fuksa P., Mrkvicka J. (2004). *Festuca arundinacea* Schr. and *Bromus marginatus* Ness et Stend. as possible energy crops in the Czech Republic. In.Land use systems in grassland dominated regions. Proceedings of the 20th General Meeting of the European Grassland Federation. Luzern. pp. 852-854

4. Lewandowski I., Scurlock J.M.O., Lindvall E., Cristou M. (2003). The development and current status of perennial rhizomatous grasses as energy crops in the US and Europe. *Biomass and Bioenergy, 25*: *335–361*.

5. Sanderson M.A., Adler P.R. (2008). Perennial forages as second generation bioenergy crops. *Int. J. Mol. Sci., 9(5): 768–788.*

6.Shamsutdinov N. Z. (2002). Cropping of *Glycyrrhiza glabra* on the secondary salinity soils. *Prospects for saline agriculture*, 37: 411-414.

7. Stewart R, Toma Y, Fernández FG, Nishiwaki A, Yamada T, Bollero G. (2009). The ecology and agronomy of "Miscanthus sinensis", a species important to bioenergy crop development, in its native range in Japan: a review. *Global Change Biology Bioenergy, 1-2:126-153.*

8. Teleuţă A., **Ţîţei** V**.** (2014).Biological peculiarities and forage value of the species of the genus *Astragalus* L. in the Republic of Moldova. *Scientific Papers. Series A. Agronomy* (Universitatea de Ştiinţe Agricole şi Medicină Veterinară Bucureşti), Vol. LVII. pp. 344-349

9. Teleuta A., Titei V**.,** Muntean A. (2012). Species of new plants for producing biofuels in Moldova. "Conservation of plant diversity", intern. sc. symposium (2012; Chişinău). Ed. a 2-a. Chişinău 2012. pp. 396-402.

10. Ţîţei V., Teleuţă A. (2014). Introducerea speciei Astragalus galegiformis L. şi valoarea furajeră în condiţiile Republicii Moldova. Universitatea Agrară de Stat din Moldova. Lucrări ştiinţifice. Vol..41 : Agronomie. Chişinău, 2014. pp.310-313.

11. World Energy Scenarios: Composing energy futures to 2050. World Energy Council 2013. London. 288 p.

12. Zub H.W., Brancourt-Hulmel M.(2010). Agronomic and physiological performances of different species of *Miscanthus*, a major energy crop. *Agron. Sustain. Dev. 30 : 201–214.*

13. *Белоус В.Н.* (2005).*Виды рода Astragalus* L. и их роль в растительном покрове *Предкавказья*. *Автореф*. канд. биол. наук. Ставрополь. 20 с.

14.Иванов А.И. 1985. Изучение коллекций многолетних кормовых растений (методические указания). Л. 48 с.

15. Сытин А. К. (2009). Астрагалы (*Astragalus*L., Fabaceae) Восточной Европы и Кавказа: (систематика, география, эволюция). Автореф. док. *биол. наук*. Санкт-Петербург. 48 с.

16. Чибис С. П., Степанов А. Ф., Чибис В. В. 2011. Питательная ценность астрагала галеговидного. *Вестник Алтайского государственного аграрного университета 1 (75):65-68.*

17. Цыцей В.Г. (2013). Интродукция новых и нетрадиционных видов растений для производства биоэнергии в Республике Молдова. Материалы I Международной научной конференции**.** *Нетрадиционные, новые и забытые виды растений: научные и практические аспекты культивирования.* 10- 12 сентября 2013 года. Киев . с.151-153.

IV. LANDSCAPE ARCHITECTURE

THE APPEARANCE OF SOIL DEGRADATION IN THE RECEPTION BASIN "NEGREA"

Olesea Cojocaru

Institute of Pedology, Agrochemistry and Soil Protection "Nicolae Dimo"

Abstract: Most agricultural land in the Republic of Moldova (about 80%) is located on slopes with different inclination. The purpose of this paper is appreciation soil losses for ordinary chernozems with different degrees of erosion which leads to their degradation in the reception basin "Negrea". From the data analysis concerning soil losses washed it notes that they are in close contact with degree of erosion. In this way in the eroded ordinary chernozem soil losses constituted: poorly eroded - 9.3 t/ha, at the moderately eroded - 12.8 t/ha, increasing to 22.2 t/ha in the soil with strong degree of erosion. The effect to degrading of soil erosion it is not limited only to the removal of fertile layers but also the deterioration physical, chemical, hydric and biological its properties. The indirect impact of erosion process on environmental components it refers to training in the cycle of mineral and organic compounds from outside the agricultural lands.

Keywords: degradation, ordinary chernozem, soil losses, reception basin, Republic of Moldova.

INTRODUCTION

In the Republic of Moldova about 80 percent of agricultural land is located on the slopes and exposed to erosion or erosion danger. The presence of large areas with poorly eroded soils indicates potential possibility of increased erosion on agricultural lands as a result of their irrational management. Soil degradation processes, including through erosion, are conditioned both the natural factors as well as anthropogenic activity (Cerbari V.V, 1996).

Natural conditions only create the manifestation prerequisites of the geological erosion processes and landslides. Currently erosion processes has accelerated due to anthropogenic activities. Deforestation, deep tilling steppes, capitalization of over the allowable limits of the land fund has contributed to activating various forms of erosion and landslides. An example of anthropogenic intervention in result of which the intensity of the erosion processes has considerably increased, is agrarian reform carried out without scientific argumentation.

The character concentrated of leakages on the slopes also brings a colossal damage. Leakages formed by abundant atmospheric precipitations destroying soil, divestment the root system of plants. Rill erosion comprises 40-50 percent of the surface of demonstration fields. Soil washing from the surface is associated with the laminar course of water down the slope. In this sense has a transfer of soil particles and their resubmission in the bottom of the slope as deluvial deposits. The intensity soil washing varies on different surfaces (Cerbari V.V, 1996; Nour D., Balteanschi D., 2004).

The basin is located on the plain Middle Prut within the limits of the estate village Negrea, district of Hancesti, being part of the accumulation basin of rivulet Lapusnita, the left side tributary of the river Prut. The study aimed at the north-east and middle of the agricultural land of the village New Negrea.

The relief the basin framework consists of two primary surface heights denudation, with altitude 226 - 227 m, who starts from two elongated ridges ending in the valley rivulet Lapusnita. The inclination of relicts of denudation surface is about 1^0 (Andries al., 2003).

MATERIALS AND METHODS

The research was performed on sloppy clay-loam ordinary chernozems in the reception basin "Negrea", Hincesti district. Reception basin "Negrea" is located in the middle of the hydrographic basin of the rivulet Lapusnita and is typical for the reception basins formed as a result of fragmentation by erosion high terraces of the Prut river and their tributaries left. High terraces of the tributaries of the Prut river and the itself Prut river synchronous were formed in the Pleistocene and represents a unique relief in terms of genesis and lithology rock surface, characteristic of the Middle Prut Plain (Andries al., 2003). Mapping the soil cover of the reception basin was performed at the scale the detailed research 1:5000.

The natural factors which favor soil erosion are: highly fragmented relief, the character of torrential atmospheric precipitation in the warm seasons of the year and ability to resist low against erosion of soils (Cerbari V.V, 1996). Erosion in the territory of reception basin "Negrea" became the main factor of unrecoverable destruction agricultural soil profile and diminishes their production capacity. Potential erosion of soils located on different segments of the slope of the reception basin "Negrea" was determined under standard conditions on the plots of leakage control with area of 3 m^2 in 2014.

Artificial rain was simulated using a portable aspersion device. For water supply it has been used tankers with the volume 3,000 liters. The quantity of water elapsing from the plots was determined by volumetric method.

RESULTS AND DISCUSSIONS

The research aim consists of the prominence influence of the degree of soil erosion on runoff and soil loss from rural area in the village Negrea, the central part of the country. Duration of artificial rain has made 30 minutes; it had an intensity of 2 *mm/min*. Order to maintain the stable over time the flow rate of 6 *l/min* to the aspersion device has been connected to the water control. Value of washing soil was estimated by determining the turbidity of the samples taken over the every 5 minutes into flasks with a volume of 500 cm^3.

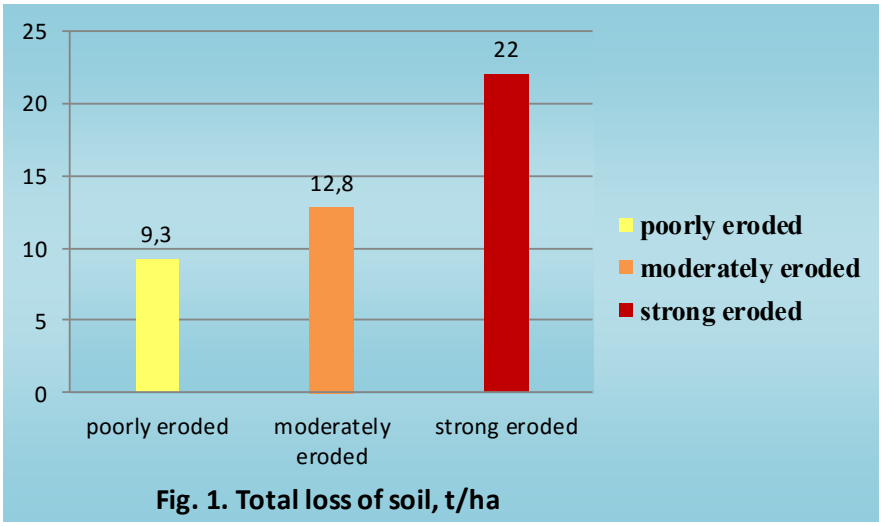


Fig. 1. Total loss of soil, t/ha

\s

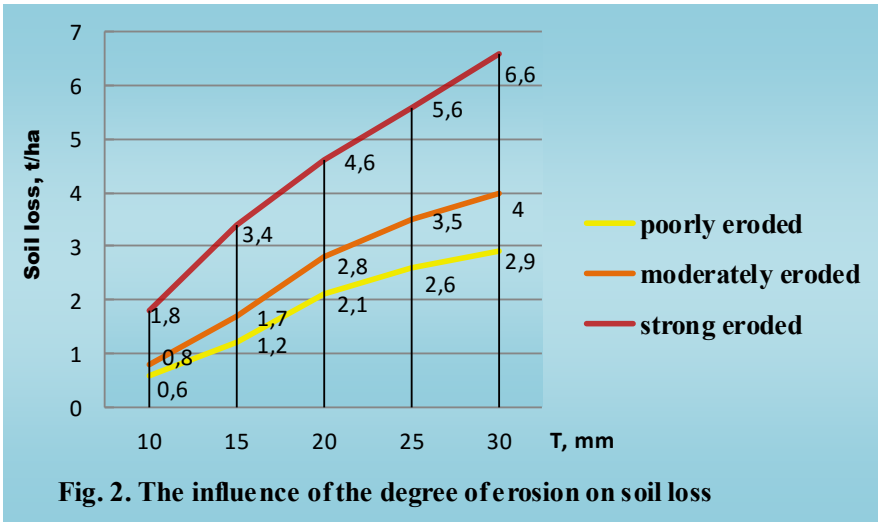


Fig. 2. The influence of the degree of erosion on soil loss

\s

The results (Figures 1 and 2) show that from amount of water applied to 60 mm, the volume of liquid leakage of poorly eroded soil constituted 41 %, moderately eroded soil from 46% and at strong degree of erosion with 52%.

Increase in the volume liquids leaks from poorly eroded at the strong eroded is explained by the decrease hidrostability of structure, increasing the degree of compaction and reduce lacunar space (Boaghe Lilea, 2010).

According to some estimates slopes with inclination of 1-5 degrees are located over 60% of arable soils, on the slope size between 5 and 8 degrees locates about 15% of this category of soils and about 5% are located on the slopes with a slope greater than 8 degrees. Therefore, on the slope lands sizes less than 1 ° and without risk of erosion of arable soils occupy not less than 20 percent (Constantinov I.S., 1987; Krupenikov I.A al., 2006).

Fig. 3 and 4. Determining the volume and turbidity leaks under the influence of artificial rain of certain intensity

The intensity of surface runoff registers sensitive changes during artificial rain. Accordance with data obtained, depending on the degree of soil erosion, the runoff coefficient increased from 0.06 to 0.12 at the beginning of observations to 0.39 to 0.52 at the end thereof. Between values of discharge coefficient and rate of infiltration of rainwater exists is an inverse correlation. Thus, the rate of infiltration decreases from 1.77 to 1.88 mm/min at the beginning of rain to 1.18 to 0.97 mm/min at the end of it (Figures 3 and 4). Reception basin soils with different degrees of erosion differ essentially after turbidity leakage.

Ordinary chernozems with different degrees of erosion registered on the essential differences relating to the turbidity of leakage.

The soil cover of the reception basin „Negrea" is an exemplification of indestructible unit between the interaction of soil, vegetation (life), environment and human in a hilly region.

Soils on the slopes are affected by denudation and evolve through a denudation-compensation of the pedogenesis. The soils on slopes are affected by denudation and evolve through a denudation-compensation pedogenesis, it means that there is a certain development of the soil in depth during the relatively long period of slow denudation.

From the results determinations observed medium values of turbidity at the poorly eroded soil up to 41.22 g/l; from soil to moderate erosion 48.47 g/l and strongly eroded at the 79.29 g/l. It noted that turbidity values leakage decreases in/or during rain, regardless of the degree of soil erosion.

It was established that the highest loading of leakages with washing earth material is recorded at an early stage immediately after the start leakages. Towards the end of the observations of turbidity value of

leakages is reduced by about 24 % in the middle, regardless of the degree of soil erosion. This regularity has been demonstrated also for ordinary chernozems in the south of the republic (Boaghe Lilea, 2010; Constantinov I.S., 1987).

The biggest loading leakages with washing earth material are recorded at the initial stage.

From the data analysis concerning soil losses washed it notes that they are in close contact with degree of erosion. Thus at poorly eroded soil losses constituted 9.3 t/ha, at the moderately eroded 12.8 t/ha and increasing to 22.2 t/ha in the soil with strong degree of erosion. Therefore, the allowable limit of the soil losses is exceeded by 1.6 to 3.7 times.

The effect of degrading the soil erosion is not limited only the removal fertile layers and worsening physical, chemical, hydric and biological of these properties. The indirect impact of erosion on the environmental components, especially that aquatic refers to training cycle of large quantities of mineral and organic compounds. In most cases, the final points of migration of these compounds are ponds and accumulation lakes located in places depressionary or river courses inland.

According to statistics the level of silting aquatic basins as a result of soil erosion varies from 11-54 % (Nour D., Balteanschi D., 2004).

At present there is a risk as gullies to evolve in trenches and gullies destroying agricultural lands and contributing to their degradation and desertification with consequences serious social for local people.

CONCLUSIONS

1. Sloppy soils included in the arable after grubbing vine plantations on the slopes, is characterized by low erosion resistance due to the appearance of the surface of horizons with low humus content, the structural hidrostability and low water permeability.

2. The diversity of relief forms, rocks and agricultural use conditional existence on the territory reception basin «Negrea» with complex cover of soils, in which the predominant component ordinary chernozems with varying degrees of erosion (83%).

3. Technological processes to prevent and / or combat soil erosion in the Reception basin "Negrea" should be differentiated and correlated with the intensity of erosion processes.

4. Values leakage and soil losses are determined by the degree of erosion. The volume of leakages decreased from 24.6 mm at poorly eroded soil to 31.0 mm at the soil with strong degree of erosion. Such regularity is also valid for soil losses which constituted 9.3 t/ha and respectively 22.0 t/ha.

5. The problem degradation and combating soil erosion in rural area in Moldova require particular attention.

6. Measures of diminishing soils degradation on the slopes in the reception basin "Negrea" is necessary to be planned by taking into consideration the degree of soil erosion, inclination of lands, agricultural use category.

BIBLIOGRAPHY

1. Andrieș S. și al. *Programul de conservare a solului din bazinul hidrografic al râului Lăpușna pentru reducerea poluării cu nutrienți a resurselor de apă*. Chișinău, 2003. p. 60.

2. Boaghe Lilea. **Însușirile și regimurile cernoziomurilor obișnuite din zona de sud a Moldovei și măsuri de prevenire a degradării accelerate**. – Autoreferatul tezei de doctor în biologie. Chișinău, 2010. 29 p.

3. Cerbari V.V. *Buletin de monitorizare ecopedologic (pedoerozional).* Ediția a treia. Chișinău, 1996. 84 p.

4. Nour D., Balteanschi D. *Eroziunea solului.* Chișinău "Pontos", 2004. 473 p.

5. Константинов И.С. Защита почв от эрозии при интенсивном земледелии. Кишинёв, «Штиинца», 1987. 239 с.

6. Крупеников И.А и др. Экологический аспект консолидации земель. / Agricultura Moldovei, nr. 7-8, 2006. с. 14-16.