ACADEMY OF SCIENCES OF MOLDOVA
BOTANICAL GARDEN (INSTITUTE)

JOURNAL OF BOTANY

VOL. VI **NR. 2(9)**

Chisinau, 2014

FOUNDER OF THE "JOURNAL OF BOTANY": BOTANICAL GARDEN (INSTITUTE) OF THE ASM

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

I. Structural and functional diversity of plant organisms

II. Conservation of biological diversity

III. Introduction of plants and sustainable use of plant resources

IV. Scientific chronic

I. STRUCTURAL AND FUNCTIONAL DIVERSITY OF PLANT ORGANISMS

CONTENT OF SOME NATURAL FRUITS COMPOUNDS OF CHOKEBERRY AND SEA- BUCKTHORN NEW FORMS

Calalb[1] T., Onica[2] E.

[1] *Public Institution of State Medicine and Pharmacy University „Nicolae Testemitanu"*

[2] *Botanical Garden (Institute) of Academy of Sciences of Moldova*

Summary: The new two forms (1-13 and 3-13) of Hippophäe rhamnoides L. and two (1 and 2) of Aronia melanocarpa (Michx.) Elliot, which were created in the Botanical Garden (Institute) of ASM, the bio-morphological and chemical characters of plants and fruits by following qualitative and quantitative analyses of ascorbic acid- titrimetric, flavonoids- spectrophotometric, tannins- titrimetric methods were analyzed. The new forms of sea-buckthorn and of chokeberry can serve as a good source of ascorbic acid, also of flavonoids and tannins, respectively.

Key words: fruits, biochemistry, flavonoids, ascorbinic acid.

INTRODUCTION

A. melanocarpa fruits, thanks to the polyphenolic component in vitamins, organic acids, minerals and carbohydrates are considered as a valuable source of biological active substances (BAV), possessing pharmaceutical and therapeutic properties: vasoprotective, hypotensive, antioxidant, antimutagenic, chemopreventive, gastroprotective, antiviral, hypoglycaemic, anti-inflammatory, and antimicrobial [2, 4]. Nowadays, chokeberry fruits are recognized on the world market as a quality and antioxidant product, which supplement daily food ration necessary to strengthen the health, being called super-fruits [2].

H. rhamnoides fruits are rich in fatty acids (palmitic (C16:0), palmitoleic (C16:1), caprylic (C8:0) linoleic, oleanolic, ursolic, 19-α-hydroxyursolic, dulcioic, octacosanoic acids), vitamins (A and C), free sugars (sucrose, xylose, glucose and mannitol) [6]. A wide spectrum of pharmacological effects of biological active substances have been recently reported, including antioxidant, immunomodulatory, anti-atherogenic, anti-stress, patoprotective, radioprotective and tissue repair [1]. *A. melanocarpa* (Michx.)

Elliot is a native plant of North America and, due to decorative and curative qualities of fruits, was grown on large areas in Asian and European countries, including the Republic of Moldova, where the forest plantations occupy an area of 157.8 ha.

Hippophäe rhamnoides L., originating from Türkistan, is one of the main plants, which is naturally distributed in the dry temperate and cold desert areas in regions of the Himalaya, China, Mongolia, India, Pakistan, Russia, Latvia, Romania and some countries from North Europe (Great Britain, Denmark, Netherlands, Germany, Finland and Sweden). There are some natural areas in the South of the Republic of Moldova, initially cultivated in the particular gardens, but during the last three decades had a great interest and at present is cultivated in large plantations [4, 5, 7]. The harvesting of qualitative chokeberry and sea-buckthorn fruits in large amounts is not always possible for various reasons, in recent decades were observed: frequent natural catastrophes (frosts and cold rains during flowering, drought, heat waves during the long summer ripening of fruit) pollution (acid rains, gas emissions, harmful elements), which reflect negatively on plants biology; lengthy and costly seasonal work management practices for prevention and protection; difficulties of gathering, transportation and storage. That is why the breeders create new varieties and forms with new peculiarities, such as: the different period of fruit maturity, quality of fruit (colour, size, weight), and biochemical composition. For this target, in the Dendrology Laboratory of Botanical Garden (Institute) of ASM, the new forms of *A. melanocarpa* and *H. rhamnoides* were and will be created. In our opinion, the new forms are promising and useful, due to their biochemical peculiarities.

MATERIAL AND METHODS

As the biological material for investigations, the fruits of 2 new forms (1-13 and 3-13) of sea-buckthorn and 2 new forms (1 and 2) were used, they were created in Botanical Garden of ASM where the qualitative and quantitative content, according ascorbic acid by titrimetric method with 2,6 diclofenolindofenolate); flavonoids by spectrophometric method and tannins by titrimetric with $KMnO_4$ solution were determined [3].

RESULTS AND DISCUSSIONS

The commercial use of aronia is mainly good for purple juice, because of anthocyan content and special sweet-astringent taste. The healing properties of aronia fruits are based on their very high levels of anthocyan and other flavonoids, polyphenols (phenolic acids and tannins), vitamins, minerals and sugars, that may include compounds with major effect as antioxidants and especially fight the cancer and heart disease [1,2,5,7]. For centuries, people used the sea-barckthorn fruits as a good regenerative remedy due to the high content of fatty acids, but nowadays it

is appreciated because it contains a large spectrum of vitamins and flavonoids with important antioxidant and anti-radiation role. That is why the target of the present article was to establish the content of ascorbic acid, flavonoids and tannins in the fruits of new created forms. This new forms of aronia and sea-barckthorn are characterized by the special biological peculiarities (Table 1).

Table 1

Biological characteristics of the new chokeberry and sea-burckthorn forms

Nr. d/o	Forms	Biological characteristics of plants	Biological characteristics of fruits
I	***Hippophäe rhamnoides***		
I.1.	1-13	• *height of tree – 4m* • *Annual growth -10-20 cm* • *Tree crown is medium compact* • *Начало формы2 years fruit twigs are practically without thorns*	• *Colour – gold -yellow* • *Size – long diameter -7,5 mm, short - 6,5 mm* • *Number of fruits on the twig (10 cm) – 30 units* • *Medium weight of 100 fruits – 19,0 g*
I.2.	3-13	• *height of tree – 5m* • *Annual growth – 20-25 cm* • *Tree crown – oval and medium compact* • *Начало формы2 years fruit twigs – practically without thorns*	• *Colour – orange* • *Size – long diameter -8,5 mm, short - 7,0 mm* • *Number of fruits on the twig (10 cm) – 75 units* • *Medium weight of 100 fruits – 22,0 g*
II	***Aronia melanocarpa***		
II.1.	2	• *height of shrub – 1.5 m.* • *Annual growth – 5-10 cm* • *Shrub crown – medium compact* • *Начало формыinflorescences – 3-5 on the steam*	• *Colour – violet-black* • *Size – long diameter -12.0 mm, short - 8,0 mm* • *Number of fruits on the twig (10 cm) – 15-75 units* • *Medium weight of 100 fruits – 113,0 g*
II.2.	3	• *height of shrub – 3.0 m* • *Annual growth -10- 12 cm* • *Shrub crown is radiate, medium compact* • *Начало форм inflorescences – 5-7 on the steam*	• *Colour – purplish-black* • *Size – long diameter -12.0 mm, short - 6,0 mm* • *Number of fruits on the twig (10 cm) – 9-60 units* • *Medium weight of 100 fruits – 99,0 g*

The chemical study of the fruits of the new chokeberry (1 and 2) and sea-buckthorn forms (1-13 and 3-13).

Qualitative analysis of ascorbic acid by the thin layer chromatography in the system with acetate ethyl and glacial acetic acid (80:20) was performed. In all analyzed fruit extracts of new forms, the ascorbic acid as a white spot on the pink fond after treatment with solution of 0.04% 2,6-diclorfenolindofenolate of sodium in the chokeberry extracts with Rf=0,65 and in the sea-buckthorn – Rf=0,57 was identified.

Quantitative analysis of ascorbic acid in the fruit extracts by titrimetric method

with solution of 0,001 n 2,6 – diclorfenolindofenolate of sodium was performed. The content of ascorbic acid is higher in two new forms of sea-buckthorn (respectively, form 1-13 – 93.2 mg/100g VD; form 3-13 – 99.0 mg/100g VD) than in another two new forms of chokeberry fruits (respectively, form 1 – 64.4 mg/100g VD; form 2 – 72.5 mg/100gVD). Priority among new forms had the sea-buckthorn 3-13 form, and that of chokeberry was the 2 form.

The chemical study of the flavonoids in the fruits from the new created forms.

Qualitative analysis of flavonoids. For determining flavonoid constituents' presence in the fruit extracts of new forms, 4 chemical special reactions were tested (table 2).

Table 2

Flavonoid constituents identified in the fruit extracts of new forms of chokeberry and sea- buckthorn by special chemical reactions

Chemical reaction	New forms of chokeberry		New forms of sea- buckthorn	
	1	2	1-13	3-13
Cyanidinic	Flavonol, flavonon, flavon	Flavonol, flavonon, flavon	Flavonol, flavonon, flavon	Flavonol, flavonon, flavon
Acetate of Pb	flavon anthocyan	flavon anthocyan	flavon	flavon
Ammoniac solution	anthocyan	anthocyan	-	-
Vanillin solution in HCl	Catechin	Catechin	Catechin	Catechin

The results of analysis denote that in the two new forms of chokeberry there are present 5 flavonoid constituents and they are in concordance with the results specific for chokeberry [2,4], but in the sea-buckthorn – only 4 constituents, in the last forms the anthocyan is absent.

Quantitative analysis of flavonoids. In the fruit extracts of analyzed 4 new forms of chokeberry and sea-burckthorn the flavonoids content by spectrophotometric method at a wave length 430 nm was established. The chokeberry fruits of new forms are the richest in flavonoids content and the better is the form 2 with 2,496 mg% that another form 1 – 2,228 mg%. In the new forms of sea-burckthorn the flavonoids content for 3 times is less than in the forms of chokeberry and respectively, form 1-13 – 0.862 mg% and form 3-13 – 0.685%.

Chemical analysis of tannins in the new forms.

Qualitative analysis. Applying 5 specific chemical reactions (with gelatin, Fe alaun and ammonia, acetic acid and Pb acetate, $FeCl_3$ and 1%HCl, $NaNO_3$ and HCl) in analyzed fruit extracts was determined the presence of tannin class. The forms of

chokeberry contain condensate and hydrolysable tannins, when those of sea-buckthorn – only hydrolysable one.

Quantitative analysis. The tannin content in the fruit extract by titrimetric method with potassium permanganate in presence of indigo-sulfonic acid was determinate. The obtained results attest that the tannin content is higher in the chokeberry form than in the sea-buckthorn forms (in decreasing): chokeberry form 2 – 4.157%, form 1 – 3.326%, sea-buckthorn form 1-13 – 2.070% and 3-13 – 1.650%.

The botanical and chemical study of chokeberry and sea-buckthorn new forms created in the Botanical Garden of ASM establish that all forms posses a good biological potential of plant and chemical fruit potential (in accordance with the content of ascorbic acid, flavonoids and tannins) and must be studied subsequently for propagation in culture on large areas.

CONCLUSIONS

1. The biological and chemical parameters correlate and the new forms of sea-buckthorn can be a good source of ascorbic acid, but the new forms of chokeberry – flavonoids and tannins.

2. The best sea-buckthorn is form 3-13, characterized with orange colour and large sizes of fruits, rich harvest and rich content of biological active substances.

3. Concerning chokeberry, the priority pertains to form 2, with high and compact crown, large and high number of fruits, and valuable chemical composition (ascorbic acid, flavonoids and tannins).

4. New created forms of chokeberry and sea-buckthorn represent a great interest to ameliorate the local gene pool with the value berry-producing plants.

BIBLIOGRAPHY

1. Brad I., Brad L., Radu F. *Cătina albă - o farmacie într-o plantă*. Ed. Tehnica, Bucureşti, 2002, 6-34.

2. Kokotkiewicz A., Jaremicz Z., Luczkiewicz M. *Aronia Plants: A review of traditional use, Biological Activities, and Perspectives for Modern Medicine*. In: J. of Med. Food. 2010; 13(2): 255-69.

3. Oniga I., Benedec D., Hanganu D. ş.a. *Analiza Produselor Naturale Medicinale*. Cluj-Napoca: Univ. Med. Farm. ,,Iuliu Haţieganu", 2004. 68 p.

4. Palancean A., Comanici I. Dendrologie (Asortimentul de arbori, arbuşti şi liane pentru împădurit şi spaţii verzi) Chişinău: ,,Tipogr. Centrală" 2009. 520 p.

5. Valcheva-Kuzmanova S., Belcheva A. Current knowledge of *Aronia melanocarpa* as a medicinal plant. In: Folia Med. (Plovdiv). 2006; 48(2): 11-7.

6. Zheng Rui-Xia, Xu-Dong Xu, Ze Tian. *Chemical constituents from the fruits of Hippophae rhamnoides.* In: Natural Product Research. 2009. Vol. 23.15. p. 34-39.

7. Чаховский А., Шапиро Д., Чекалинская И. и др. Черноплодная рябина, облепиха и другие перспективные плодово-ягодные растения. Минск: Ураджай.1976. 77 с.

ASSESSMENT OF SUNFLOWER RESISTANCE POTENTIAL TO DOWNY MILDEW

Maria Duca[1], Tatiana Şestacova[1], Angela Port[1], Aliona Cucereavîi[2], Ion Gîscă [2], Olesea Tabără[1]

[1] University of the Academy of Sciences of Moldova
[2] „AMG – Agroselect" SRL

Abstract: Downy mildew is a devastating disease that could be prevented in sunflower by growing of resistant hybrids. Molecular screening methods for the presence of downy mildew resistance genes are a useful and efficient tool in breeding programs of this culture. In conducted research was screened the presence of downy mildew resistance genes Pl_1, Pl_6 and Pl_5/Pl_8 in germplasm of 42 sunflower genotypes. The presence of all three investigated genes was detected in only two Rf lines – MS-2540C, MS-1995C, which can be useful for various breeding programs in quality of the original resistance source.

Key words: downy mildew, molecular markers, resistance, screening, sunflower.

INTRODUCTION

Plasmopara halstedii Berl. et de Toni in sunflower causes a fungal disease called downy mildew. The pathogen affects most vegetative organs of the host-plant and it is manifested by poorly developed root system with brown surface, discoloration and shortening of the stem internodes, leaf chlorosis around veins, deformation of the leaf lamina, reduced photosynthetic surface, upturned inflorescence and its deformation, reduction in growth and death [3,9,14,15].

Downy mildew induces morphological changes that reduce crop production and respectively causes significant economic losses [5]. In the case when 80-90% of plants are infected, the amount of collected sunflower seeds does not exceed 5-6 cwt/ha [14]. The pathogen is found throughout Republic of Moldova, especially in South regions [13,16].

Actually have been identified and described 18 downy mildew resistance genes [6]. The first gene was studied and referred as Pl_1 by Romanian scientist Al.V. Vrânceanu (1970) [12]. The presence of Pl_1 has been demonstrated in AD-66 inbred line derived from NARDI Fundulea [11]. Currently, for identification of Pl_1 gene are developed several molecular markers, including CAPS (*Cleaved Amplified*

Polymorphic Sequence) for Ha-4W2 locus linked with Pl_1 gene [4]. and SSR (*Simple Sequence Repeat*) markers ORS166 and ORS1043 at distance of 3.4 cM [10]. Pl_1 gene conferred resistance to race 100 of downy mildew.

Subsequently, have been developed SCAR (*Sequence Characterized Amplified Regions*) markers for Pl_2 gene [2] and CAPS markers for Pl_6 gene associated with resistance to race 730 [7]. For Pl_6 gene were identified 13 markers STS (*Sequence Tagged Sites*), which covers distance of 3cM and confers resistance to five races of downy mildew 100, 300, 700, 703 and 710 [1].

Radwan O. and coauthors (2004) [8] conducted research on cloning and mapping of two genes for RGA (*resistance gene analogue*) from CC-NBC-LRR class. Sequences of these genes were used to develop 14 STS markers for complex locus Pl_5/Pl_8, which provides resistance to the most known races of downy mildew. The authors recommend constructed markers for the use in marker assisted selection (MAS) programs.

Studies regarding resistance of sunflower germplasm will lead to improvement of breeding programs and will open the possibility for obtaining of commercial hybrids with high economic value. These considerations served as a background for investigation related to molecular screening of the presence of Pl_1, Pl_6 and Pl_5/Pl_8 downy mildew resistance genes among 42 sunflower genotypes used in the production and sale of seed material.

MATERIALS AND METHODS

Genetic material. For the study were used 42 sunflower genotypes offered from the breeding collection of company "AMG-Agroselect", Soroca. The set consisted of 12 lines with cytoplasmic male sterility - CMS (MS-2077A, MS-2067A, MS-2091A, MS-1589A, MS-2039A, MS-2098A, MS-2161A, MS-2073A, MS-2185A, MS-2075A, MS-2036A, MS-2026A), 22 Rf (restore of fertility) lines (MS-2440C, MS-2064C, MS-1924C, MS-1944C, MS-1950C, MS-2080C, MS-1985C, MS-1995C, MS-2570C, MS-2275C, MS-3470C, MS-1920C, MS-2555C, MS-2540C, MS-2203C, MS-2583C, MS-2400C, MS-2565C, MS-2005C, MS-2020C, MS-2090C, MS-2550C) and 8 commercial F_1 hybrids (Codru, Dacia, Nistru, Zimbru, Talmaz, Doina, Cezar, Oscar).

Growing and collection of biological material. Sunflower plants were grown in the laboratory in 200-ml containers on sandy substrate until the two cotyledon leaf stage after 7 days of cultivation. Growth was performed at 21°C average temperature and photoperiod of 10-12 hours.

DNA isolation. DNA extraction was performed using fresh vegetative material with GeneJET Plant Genomic DNA Purification Mini Kit (*Thermo Scientific*). DNA samples were quantified by electrophoresis on 1% agarose gel and using

spectrophotometric measurement at UV-VIS Spectrophotometer T60. Quality and quantity estimation for extracted DNA samples was performed at wavelengths of 260 and 280 nm.

Molecular screening of *Pl*$_1$ gene. CAPS analysis was realized in volume of 20 µl of reaction mixture, which includes 200 µM dNTP, 2,5 mM $MgCl_2$, 1,0 U DreamTaq DNA Polymerase (*Thermo Scientific*), 0,3 µM of each primer and 50 ng of DNA. Amplification reaction was run using following program: 95°C - 3 minutes; 40 cycles of 95°C - 30 sec, 53°C - 30 sec, 72°C - 45 sec; 72°C - 3 minutes in GeneAmp® PCR System 9700 (*Applied Biosystems*) thermocycler. Primer sequences for *Pl*$_1$:

forward ATGCGGAAATCTCTCACC, *reverse* GACAGCCTCGTCTTGTGA.

The amplified fragments were digested with the enzyme FastDigest Tsp509I (TasI) (*Thermo Scientific*) according to the manufacturer's recommendations for 5 min at 65° C. After digestion fragments were visualized in 8% polyacrylamide gel in TBE buffer in the presence of the GeneRuler 100 bp DNA ladder SM0241 (*Thermo Scientific*).

Molecular screening of *Pl*$_6$ and *Pl*$_5$/*Pl*$_8$ genes was performed by PCR with specific primers. Primer sequences:

Pl$_6$: *forward* GTTTGTGGATCATCTCTATGCG,
reverse TGCTTCTTCCTTCTATCTCACTC

Pl$_5$/*Pl*$_8$: *forward* GCCCAAAATTGAAAGAAAGGTGTG,
reverse GGCGAAATTGGTTCCCGTGAGTCG.

Amplification conditions:

- for *Pl*$_6$ gene - 95°C - 3 minutes, 35 cycles at 95°C - 30 sec, 60°C - 30 sec, 72°C - 2 minutes and the final elongation at 72°C - 2 minutes;
- for *Pl*$_5$/*Pl*$_8$ gene - 95°C - 3 minutes, 35 cycles at 95°C - 20 sec, 59°C - 30 sec, 72°C - 2 minutes and the final elongation at 72°C - 3 minutes.

Reaction was performed in volume of 15 µl containing: 0,2 mM dNTP, 2,0-2,5 mM $MgCl_2$, 1,0 U DreamTaq DNA Polymerase (*Thermo Scientific*), 0,4 µM of each primer and 50 ng of DNA.

The amplicons were visualized on 1% agarose gel using TAE buffer in the presence of the GeneRuler Express DNA Ladder SM1553 (*Thermo Scientific*).

RESULTS AND DISCUSSIONS

Assessment of resistance to downy mildew among sunflower genotypes grown in fields of AMG-Agroselect Company revealed the characteristic symptoms of infection: reduction in growth and shortening of internodes (figure 1a), leaf chlorosis around veins, deformation of the leaf lamina and reduction of photosynthetic surface (figure 1b), upturned head and its deformation (figure 1c), deformation of leaves and death of strongly affected plant (figure 1d).

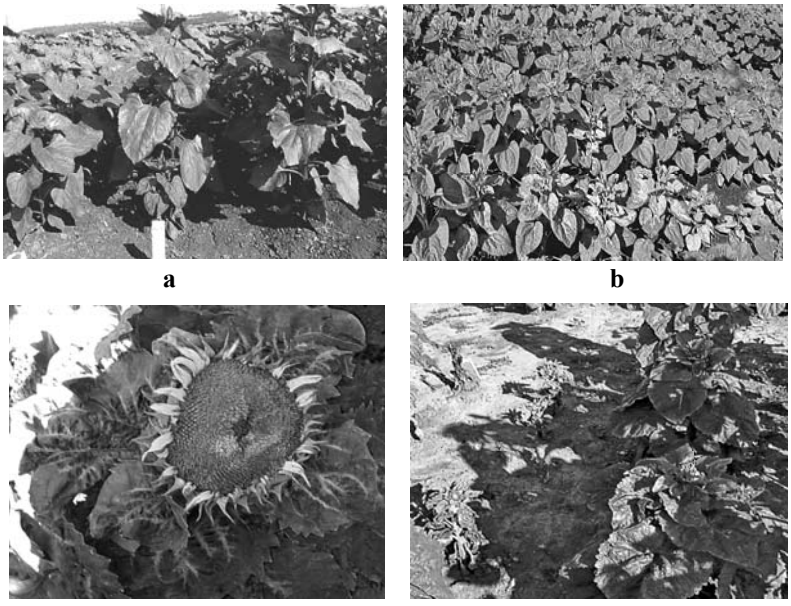


Figure 1. Field symptoms of *P. halstedii* on sunflower plants
a. Stunting
b. Leaf chlorosis
c. Upturned head and deformed leaves
d. Death of strongly infected plants

CAPS marker was used for determination of the Pl_1 gene presence [4], which revealed three fragments (88, 93 and 188 bp) in plants susceptible to race 100 of downy mildew and four fragments (88, 93, 188 and 276 bp) in those resistant.

The molecular screeening of resistance at 42 sunflower genotypes used in the study showed the presence of 363 bp amplicon after PCR, which generated after digestion with Tas509I four DNA fragments, thus indicating resistance to race 100 of downy mildew (figure 2).

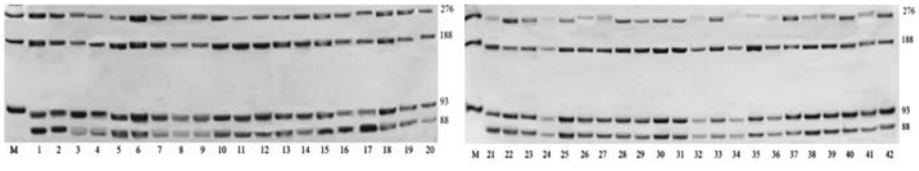


Figure 2. Molecular screening of Pl_1 gene

M – DNA ladder, 1 – MS-2440C, 2 – MS-2064C, 3 – MS-1924C, 4 – MS-1944C, 5 – MS-1950C, 6 – MS-2080C, 7 – MS-1985C, 8 – MS-1995C, 9 – MS-2570C, 10 – MS-2275C, 11 – MS-3470C, 12 – MS-1920C, 13 – MS-2555C, 14 – MS-2540C, 15 – MS-2203C, 16 – MS-2583C, 17 – MS-2400C, 18 – MS-2565C, 19 – MS-2005C, 20 – MS-2020C, 21 – MS-2090C, 22 – MS-2550C, 23 – MS-2077A, 24 – MS-2067A, 25 – MS-2091A, 26 – MS-1589A, 27 – MS-2039A, 28 – MS-2098A, 29 – MS-2161A, 30 – MS-2073A, 31 – MS-2185A, 32 – MS-2075A, 33 – MS-2036A, 34 – MS-2026A, 35 – Codru, 36 – Dacia, 37 – Nistru, 38 – Zimbru, 39 – Talmaz, 40 – Doina, 41 – Cezar, 42 – Oscar.

Identification of Pl_6 gene among sunflower genotypes was performed using HAP3 primer pair that generates amplicons: 1720, 1330, 1060 and 940 bp [7]. Realized study showed the presence of fragments associated with resistance in 22 from 42 analyzed genotypes.

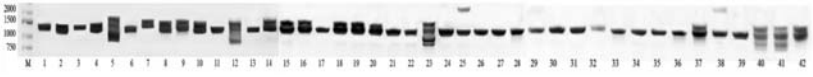


Figure 3. Molecular screening of Pl_6 gene

M – DNA ladder, 1 – MS-2440C, 2 – MS-2064C, 3 – MS-1924C, 4 – MS-1944C, 5 – MS-1950C, 6 – MS-2080C, 7 – MS-1985C, 8 – MS-1995C, 9 – MS-2570C, 10 – MS-2275C, 11 – MS-3470C, 12 – MS-1920C, 13 – MS-2555C, 14 – MS-2540C, 15 – MS-2203C, 16 – MS-2583C, 17 – MS-2400C, 18 – MS-2565C, 19 – MS-2005C, 20 – MS-2020C, 21 – MS-2090C, 22 – MS-2550C, 23 – MS-2077A, 24 – MS-2067A, 25 – MS-2091A, 26 – MS-1589A, 27 – MS-2039A, 28 – MS-2098A, 29 – MS-2161A, 30 – MS-2073A, 31 – MS-2185A, 32 – MS-2075A, 33 – MS-2036A, 34 – MS-2026A, 35 – Codru, 36 – Dacia, 37 – Nistru, 38 – Zimbru, 39 – Talmaz, 40 – Doina, 41 – Cezar, 42 – Oscar.

Amplicons, indicating presence of Pl_6 resistance gene were revealed in 15 paternal lines (MS-2064C, MS-1944C, MS-1950C, MS-2080C, MS-1985C, MS-1995C, MS-2570C, MS-2275C, MS-1920C, MS-2540C, MS-2203C, MS-2583C, MS-2565C, MS-2005C, MS-2020C) from 22 investigated and only two maternal lines with CMS (MS-2077A, MS-2091A) from 12 analyzed.

Three F_1 hybrids (Codru, Dacia, Talmaz) from eight included in the investigation were characterized by the presence of fragment associated with susceptibility (figure 3; table 1).

Table 1

The distribution of genotypes based on the presence/absence of markers associated with Pl_6 gene

Genotypes	Resistant	Susceptible
F_1 hybrids (5R/3S)	Nistru, Zimbru, Doina, Cezar, Oscar	Codru, Dacia, Talmaz
Rf lines (15R/7S)	MS-2064C, MS-1944C, MS-1950C, MS-2080C, MS-1985C, MS-1995C, MS-2570C, MS-2275C, MS-1920C, MS-2540C, MS-2203C, MS-2583C, MS-2565C, MS-2005C, MS-2020C	MS-2440C, MS-1924C, MS-3470C, MS-2555C, MS-2400C, MS-2090C, MS-2550C
CMS lines (2R/10S)	MS-2077A, MS-2091A	MS-2067A, MS-1589A, MS-2039A, MS-2098A, MS-2161A, MS-2073A, MS-2185A, MS-2075A, MS-2036A, MS-2026A
Total	**22 genotypes**	**20 genotypes**

Identification of genotypes with resistance to downy mildew caused by the presence of Pl_5/Pl_8 genes was revealed through analysis of amplicons combination:

1569, 2119 and 2237 bp or 2021 bp. Susceptible genotypes were characterized by the presence of fragments: 1153, 1610 bp or 1303 and 1424 bp [8].

Analysis of obtained amplicons revealed seven Rf lines (MS-1944C, MS-2080C, MS-1995C, MS-2555C, MS-2540C, MS-2400C and MS-2550C) and two CMS lines (MS-2067A and MS-2026A) containing markers associated with these resistance gene (figure 4, table 2).

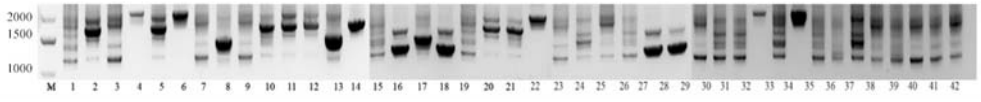


Figure 4. Molecular screening of Pl_5/Pl_8 locus

M – DNA ladder, 1 – MS-2440C, 2 – MS-2064C, 3 – MS-1924C, 4 – MS-1944C, 5 – MS-1950C, 6 – MS-2080C, 7 – MS-1985C, 8 – MS-1995C, 9 – MS-2570C, 10 – MS-2275C, 11 – MS-3470C, 12 – MS-1920C, 13 – MS-2555C, 14 – MS-2540C, 15 – MS-2203C, 16 – MS-2583C, 17 – MS-2400C, 18 – MS-2565C, 19 – MS-2005C, 20 – MS-2020C, 21 – MS-2090C, 22 – MS-2550C, 23 – MS-2077A, 24 – MS-2067A, 25 – MS-2091A, 26 – MS-1589A, 27 – MS-2039A, 28 – MS-2098A, 29 – MS-2161A, 30 – MS-2073A, 31 – MS-2185A, 32 – MS-2075A, 33 – MS-2036A, 34 – MS-2026A, 35 – Codru, 36 – Dacia, 37 – Nistru, 38 – Zimbru, 39 – Talmaz, 40 – Doina, 41 – Cezar, 42 – Oscar.

Table 2

The distribution of genotypes based on the presence/absence of markers associated with Pl_5/Pl_8 locus

Genotypes	Resistant	Susceptible	Contain both types of fragments R/S
F_1 hybrids (0R/0S)			Codru, Dacia, Nistru, Zimbru, Talmaz, Doina, Cezar, Oscar
Rf lines (7R/2S)	MS-1944C, MS-2080C, MS-1995C, MS-2555C, MS-2540C, MS-2400C, MS-2550C	MS-2064C, MS-2565C	MS-2440C, MS-1924C, MS-1950C, MS-1985C, MS-2570C, MS-2275C, MS-3470C, MS-1920C, MS-2203C, MS-2005C, MS-2020C, MS-2090C
CMS lines (2R/2S)	MS-2067A, MS-2026A	MS-2039A, MS-2098A	MS-2077A, MS-2091A, MS-1589A, MS-2161A, MS-2073A, MS-2185A, MS-2075A, MS-2036A
Total	**9 genotypes**	**4 genotypes**	**29 genotypes**

CONCLUSIONS

Evaluation of the downy mildew resistance potential on sunflower germplasm using molecular markers demonstrated the presence of all three investigated genes in only two Rf lines – MS-2540C, MS-1995C, which can be useful for various breeding programs in quality of the original resistance source. Obtained data could be applied at the initial stage of parental lines selection for production of elite sunflower germplasm, allowing the application of gene pyramiding to obtain hybrids resistant to different races of downy mildew.

BIBLIOGRAPHY

1. Bouzidi, M.F, Badaoui, S., Cambon, F., Vear, F., Tourvieille De Labrouhe, D., Nicolas Mouzeyar S. Molecular analysis of a major locus for resistance to downy mildew in sunflower with specific PCR-based markers. // Theor. Appl. Genet., 2002, 104, p. 592–600.

2. Brahm, L., Röcher, T., Friedt, W. PCR-based markers facilitating marker assisted selection in sunflower for resistance to downy mildew. // Crop. Sci., 2000, 40, p. 676–682.

3. Duca, M., Port, A., Şestacova, T. Particularităţi morfo-fiziologice şi genetico-moleculare ale interacţiunii Helianthus annuus L. – Plasmopara halstedii F. Berlet de Toni. // Buletinul Academiei de Ştiinţe a Moldovei. Ştiinţele Vieţii. 2012, 3 (317), p. 23-35.

4. Gedil, M.A., Slabaugh, M.B., Berry, S. Johnson, R., Michelmore, R., Miller J., Gulya, T., Knapp, S.J. Candidate disease resistance genes in sunflower cloned using conserved nucleotide binding site motifs: genetic mapping and linkage to downy mildew resistance gene Pl_1. // Genome, 2001, 44, p. 205–212.

5. Gulya, T.J. Distribution of Plasmopara halstedii races from sunflower around the world. // Advances in Downy Mildew Research, Palacky University and JOLA Publishers, 2007, 3, p. 121–134.

6. Mulpuri, S., Liu, Z., Feng, J., Gulya, T.J., Jan, C.C. Inheritance and molecular mapping of a downy mildew resistance gene, Pl_{13} in cultivated sunflower (Helianthus annuusL.). // TAG, 2009, vol. 119, p. 795–803.

7. Pankovic, D., Radovanovic, N., Jocic, S., Satovic, Z., Skoric, D. Development of co-dominant ampliied polymorphic sequence markers for resistance of sunlower to downy mildew race 730. // Plant. Breed., 2007, 126, p. 440–444.

8. Radwan, O., Bouzidi, M.F., Nicolas, P., Mouzeyar, S. Development of PCR markers for the Pl_5/Pl_8 locus for resistance to Plasmopara halstedii in sunflower Helianthus annuus L. from complete CC-NBS-LRR sequences. // Theor. Appl. Genet., 2004, 109, p. 176–185.

9. Şestacova, T. Utilizarea markerilor moleculari în evaluarea potenţialului de rezistenţă a florii-soarelui la mană. // Buletinul Academiei de Ştiinţe a Moldovei. Ştiinţele Vieţii, 2013, 1 (319), p. 96-101.

10. Slabaugh, M.B., Yu, J.K., Tang, S.X., Heesacker, A., Hu, X., Lu, G.H., Bidney, D., Han, F., Knapp, S.J. Haplotyping and mapping a large cluster of downy mildew resistance gene candidates in sunflower using multilocus intron fragment length polymorphisms. // Plant. Biotech. Jornal, 2003, 1, p. 167–185.

11. Vrânceanu, A. Floarea-soarelui hibridă. // Bucureşti, Ceres, 2000, 520 p.

12. Vranceanu, V., Stoenescu, F. Imunitate la mana florii-soarelui, condiţionată monogenic. // Probleme Agric., 1970, 22, p. 34-40.

13. Vronschih, M.D. Protecţia plantelor de cîmp (Culturile de cîmp). // Chişinău, 2011, 120 p.

14. Вронских М.Д., Петкович И. П. Болезни подсолнечника и меры борьбы с ними. // г. Кишинэу, 2007, с. 67.

15. Попушой И.С., Гринберг Ш.М. Ложная мучнистая роса подсолнечника в Молдавии и меры борьбы с ней. // Кишинев: РИОАНМССР, 1971. 16 с.

16. Попушой И.С., Гринберг Ш.М. Прогноз развития ЛМР подсолнечника (Plasmopara helianthi Novot. helianthi). // В: Известия Академии Наук Молдавской ССР, 1975, с. 83-84.

GENETIC VARIABILITY OF THE CONTENT OF THE CANNABINOID IN THE BREEDING PROCESS OF MONOECIOUS HEMP (*CANNABIS SATIVA* L.) VAR. MONOICA

Găucă Constantin, Popa Lorena-Diana, Druțu Adina Cătălina, Pomohaci Traian Ioan

Agricultural Research and Development Station of Secuieni

Abstract. The paper put forward a study on the introduction of monoecious hemp into the culture with implications concerning the variation in the THC content in breeding and selection processes. Extension of hemp cultivation is possible only by reducing the cannabinoid content under 0.3% in the European Union and under 0.2% in Romania. The reduction process of the THC content in improving and creating monoecious hemp varieties started by hybridization works, backcrossing, followed by repeated selection and multiplication in isolation conditions. Finally, the monoecious lines led to obtaining Dacia Secuieni varieties, for strains and fiber and Secuieni Jubileu for seed, whose THC content was below the detection limit (0,01%, 0.008% THC content, respectively). It resulted an annual genetic progress of 0.046% between Secuieni 1 variety (the first approved variety with 0,4 - 0,6% THC) and the last approved Secuieni Jubileu variety.

INTRODUCTION

Growing hemp (*Cannabis sativa* L.) is not possible anymore but by obtaining new cultivation with decreased cannabinoid content, below 0.3% in the EU and 0.2% in Romania.

In the cannabinoids group there are known more than 60 products, including THC (delta 9 tetrahydrocannabinol), in the forms -cis or –trans, which has psychogenic effects by crossing the blood-brain barrier (**Bodea C. and colab., 1965**). Cannabinoids accumulate themselves in different quantities in all the parts of the plant, secreted by the glandular and cystolithic brushes, concentrated on the female inflorescences, leaves, on the outer surface thereof or on the bracteoles that encase the fruit (**Clarke R.C., 1981; Hammond C.T., Mahlberg P.G., 1977**).

MATERIALS AND METHODS

The decrease of the cannabinoid content was successfully developed after applying the colorimetric method of highlighting the THC content. The method consists in determining a colorimetric scale with different intensities and shades of

colour, marked from 1 to 10, according to the THC content from 0,1 - 1,0% (**Găucă C., Berea N., 1997**).

The identification is made on the dried bracteoles of the fruits, in five repetitions on each selected elite plant or on a bigger lot of seeds; depending on the lot's size, the identification is performed on an appropriate number of 10 to 20 plants etc.

The breeding process and creating new hemp cultivation aimed at obtaining and introducing monoecious hemp into the culture. As initial genetic sources of monoecious hemp, the Fibrimon 24 and Fibrimon 21 cultivars of French origin were used. Although the THC content was varying between 0,1 - 0,3%, through individual analysis, forms with a lower content were identified, which could be introduced in the selection and improvement process of the new creations that comply with regulations in force.

RESULTS AND DISCUSSIONS

Obtaining monoecious hemp varieties involves a selection and breeding process, both for maternal genitor (dioecious), and the paternal genitor (monoecious) that has to meet the characters of productivity in stems, fiber content, seed productions, resistance to unfavorable environmental factors, pests and diseases.

In the first stage, the spontaneous forms of hemp, the local populations and also the Fibramulta 151 dioecious variety were studied.

Studies have shown that all the forms belong to the dioecious hemp, genetically well-established. Forms belonging to spontaneous subspecies are characterized by very small seeds, the MMB *(weight of 1000 grains)* being ranged between 6 -10 g, with a low germination rate of 10-12% due to the repose effect present in most spontaneous plants from the different ecological niches (table 1).

Table 1

Variability of some production characters and of the THC content on the wild forms, the local populations and the Fibramulta 151 variety

Crt. nr.		Subspecies	Variety	Productivity and quality characters					
				Stems (kg/ha)	Seed (kg/ha)	MMB (g)	Germination (%)	Fiber content (%)	THC Note
		Spontanea							
1.	Basarabi	spontanea	ramosa	2010	154	7,3	7,5	7,8	9
2.	Ciucurova	spontanea	intermedia	3040	215	8,2	9,0	8,4	8
		Local populations							
3.	Manea	culta	textilis	6200	710	14,2	81	12,5	8
4.	Arieş	culta	textilis	5300	680	12,5	83	14,5	7
5.	Unirea	culta	textilis	6700	720	15,6	86	14,6	7
6.	Văleni	culta	textilis	6300	710	14,8	72	12,1	8
7.	Fibramulta 151 (cultivar)	culta	textilis	7250	730	15,6	87	16,5	8

The THC content of the spontaneous varieties from the extreme southern area is being reduced while increasing the latitude, from grade 9 given to them, to the grades 6 and 7 for the local populations and also at the Fibramulta variety.

In stage II, through direct hybridization, backcross and selection, the variation in the THC content was studied, according to the hybridization generations and also to the parental forms studied. Thus, the first varieties of Secuieni 1, Irene, Alice monoecious hemp were obtained, which, however, in terms of cannabinoid content, were not satisfactory, being marked with 4-5, corresponding to a content greater than 0.3% (tables 2, 3, 4; fig. 1, 2, 3).

Table 2

The decrease of the cannabinoid content by hybridizing the dioecious maternal form with monoecious paternal form Fibramulta x Fibrimon 24 → Secuieni 1 (1984)

Generation	FM	F1	B1	B2	S1	S2
THC Note	8	8	7	5	3	3

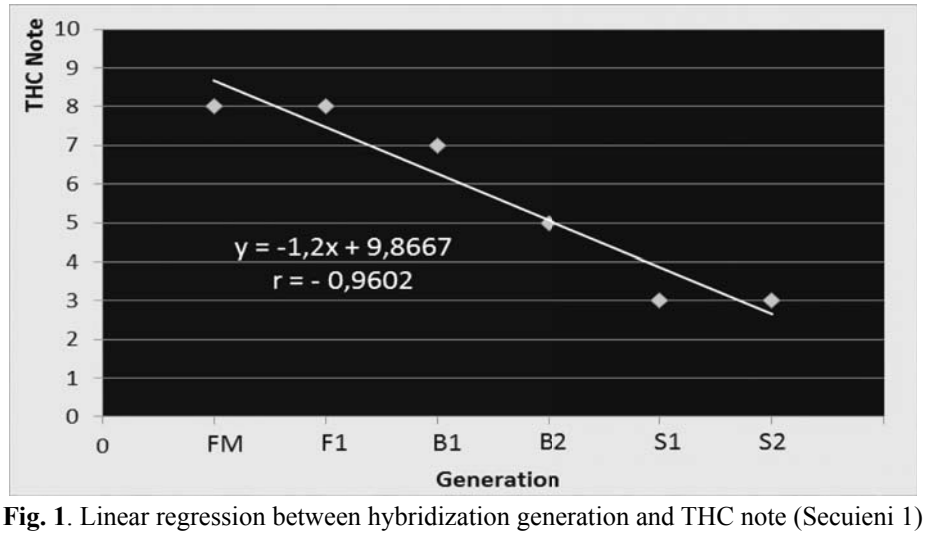


Fig. 1. Linear regression between hybridization generation and THC note (Secuieni 1)

Table 3

Dneprovskaia x Secuieni 1 → Irene (1995)

Generation	DN	F1	B1	B2	S1	S2
THC Note	9	9	8	7	5	4

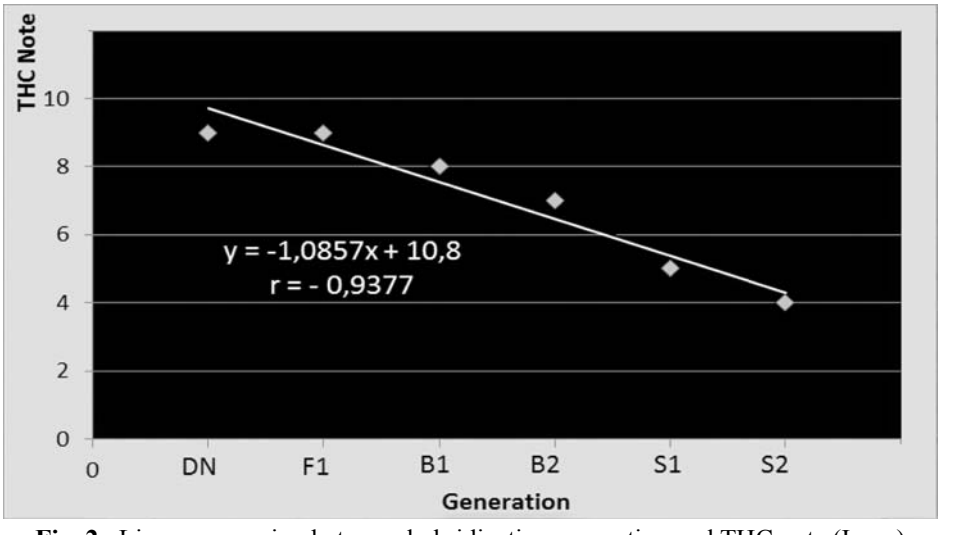


Fig. 2. Linear regression between hybridization generation and THC note (Irene)

Table 4

Kompolti x S211 → Alice (1992)

Generation	K	F1	B1	B2	S1	S2
THC Note	8	8	7	6	3	3

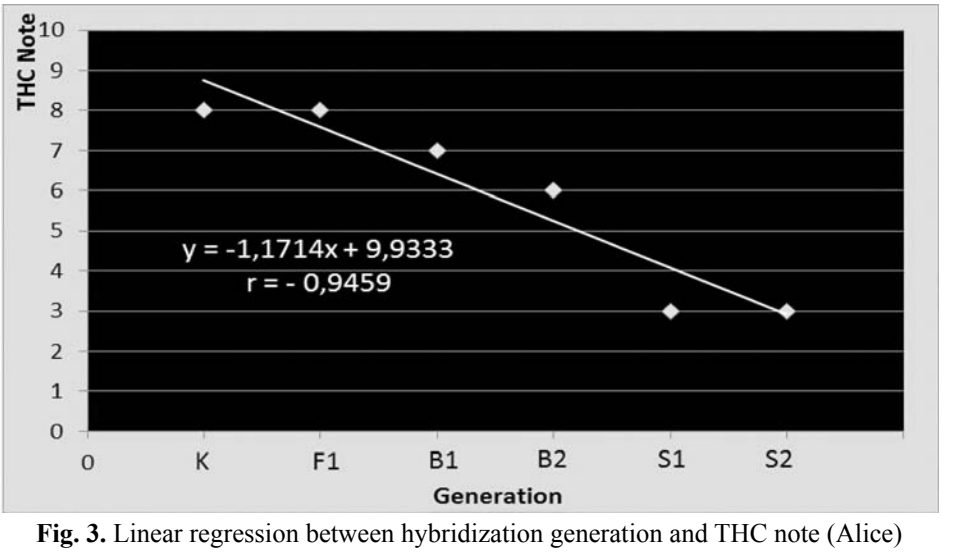


Fig. 3. Linear regression between hybridization generation and THC note (Alice)

In the next stage, through analysis and rigorous selection, valuable lines in terms of productivity and the THC content were obtained, S 211/95, S 237/95, SF 200, ZF 314 used as parental forms that were materialized through the creation of new varieties specific for the fiber production and seed (mixed use) the Denise variety, for seed - Zenit and the Diana cultivar – for strain and fiber. The new cultivars were characterized by an evident reduction in the THC content below 0.2% (fig. 4).

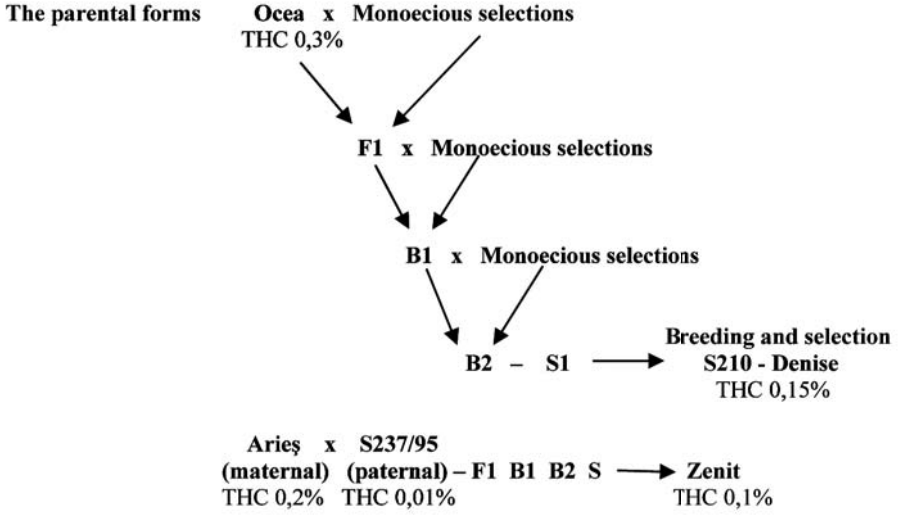


Fig. 4. The use in the improvement process of the dioecious and monoecious lines selected with a low THC content

Studies on genetic resources from the laboratory's collection, the purchase of new cultivars, the identification, the selection and the rigorous works aiming to reduce the THC content were conducted concurrently with the development of the researches on the production characteristics regarding the vegetative mass obtained per surface unit, the fiber content and also the increase of the seed yield. Thus, the new selections K8 x AR 1 have led to the Dacia cultivar, with a content below 0.01%, and from the F7-3 x Z114-SCM-44 combination it was performed the Jubileu - Secuieni cultivar with a non-detectable content through the chromatographic method used by the laboratory certified for this purpose. Based on the content of 0,5 - 0,6%, through the methods of breeding the monoecious hemp, an annual genetic progress of 0.046% in reducing the THC content has been made (fig. 5).

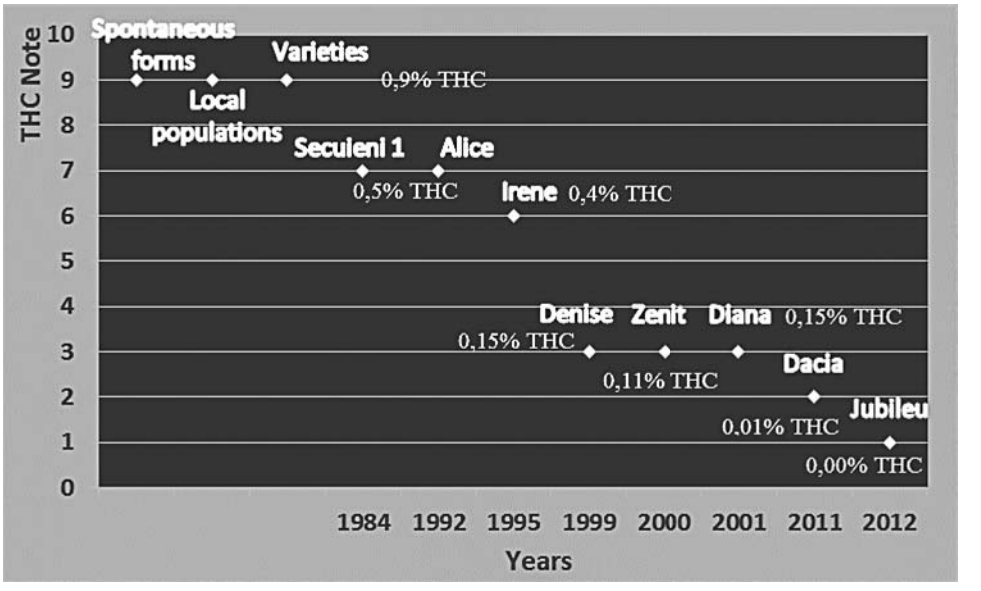


Fig. 5. Decrease of the cannabinoid content chart during 1984 – 2014

CONCLUSIONS

1. The study conducted on local populations and varieties empirically cultivated shows us a natural state of the THC content of 0,4 - 0,5%.

2. The THC content can be reduced until obtaining free forms, but maintaining low values is possible only through rigorous selection works and the multiplication of the valuable materials in isolation conditions.

3. The introduction of the monoecious varieties in the culture determined a rapid progress, whereas researches focus on the use of the plants that have both sexes on the same stem.

BIBLIOGRAPHY

1. Bodea C. and colab. – *Tratat de biochimie vegetală.* Partea I. Fitotehnie, vol. II, Editura Academiei RSR, 1965.

2. Clarke R. C. – *Marijuana Botany. An Advanced Study: The Propagation and Breeding of Distinctive Cannabis*. Ronin Publishing, Berkeley, 1981.

3. Găucă C., Berea N. – *Variația conținutului în cannabinoide la soiurile şi populațiile de cânepă din România.* Lucrări ştiințifice, vol. 40. Seria Agronomie – supliment, USAMV Iaşi, 1997.

4. Hammond C.T., Mahlberg P.G. – *Morphology of glandular hairs of Cannabis sativa from Scanning Electron Microscopy.* American Journal of Botany, pages 524 – 528.

RAPD MOLECULAR MARKER STUDY OF THE INTRASPECIFIC VARIABILITY OF *Origanum vulgare* subsp. *vulgare* NATURALLY OCCURRING IN MOLDOVA

[1]Ana Mutu, [1]Oleg Budeanu, [1]Rodica Martea, [1]Steliana Clapco, [2]Elvira Gille

[1]*The University of the Academy of Sciences of Moldova*
[2]*,,Stejarul" Biological Research Centre Piatra Neamt, Romania*

Abstract: The objective of this study was to evaluate, by using Random Amplified Polymorphic DNA markers, the genetic relationship among a wild population of O. vulgare subsp. vulgare (one of the most variable species of the genus) from the spontaneous flora of Moldova. Seven genotypes of O. vulgare subsp. vulgare, collected from a natural site in Orheiul Vechi, were used for this study. Tested primers generated a total of 257 RAPD fragments, ranging in size from 250 to 5000 base pairs. The studied genotypes of O. vulgare subsp. vulgare are characterized by a high genetic variability, a number of 14 specific, 40 polymorphic and only 13 common bands have been revealed. The high degree of genetic polymorphism was established in the analysis with primer OPA19, in the presence of which 4 specific, 9 polymorphic and no common bands were detected, followed by OPG05, which generated 14 bands, including 3 - common, 6 - specific and 5 - polymorphic. According to the electrophoretic profiles in the case of genotypes O. vulgare subsp. vulgare 1 and O. vulgare subsp. vulgare 5 a number of 13 common and 40 polymorphic bands were revealed. One specific band for genotypes 2 and 4 and two specific bands for genotype O. vulgare subsp. vulgare 3 have been observed. The high degree of genetic diversity was observed for genotypes 6 and 7, which are distinguished by the presence of 4 and, respectively, 6 specific bands. This study showed that with the help of the RAPD technique one can easily discriminate closely related individual members and even different populations of medicinal plants.

INTRODUCTION

The studies of genetic diversity and relationship among and between individuals, populations and species are very important for the medicinal and crop plants improvement programs, management and conservation of germplasm, studying the evolutionary ecology of populations [8, 13].

It is known that a large amount of diversity of a species may be found within individual populations. Genetically distinct groups of individuals within a plant populations or/and subpopulations can be developed as a result of gene flow, drift, and/or selection. Fine genetic structure of populations not only impacts the evolutionary potential of a species, but it also indicates the role of evolutionary and ecological factors that shape plant populations [5, 6, 17].

Various types of markers such as morphological, biochemical and molecular markers are used to evaluate polymorphism. DNA-based molecular markers, which are not affected by environmental conditions, have become increasingly important for genetic diversity and genotype identification of many plant species [12].

Among several other molecular markers, Polymerase Chain Reaction based Randomly Amplified Polymorphic DNA (RAPD) has been largely used for genetic diversity investigation, due to their simplicity, relative low cost and lower amount of genomic DNA needed for analysis [1].

RAPD markers have been widely applied for genetic studies of various medical and aromatic plants, including *Origanum* [1, 2, 7, 10, 13]. The genus *Origanum* is a member of the *Lamiaceae* family and has a complex taxonomy. *O. vulgare* plays a primary role among culinary herbs in world trade and, due to biological properties of p-cymene and carvacrol, can be used as medicinal plant [11].

The objective of this study was to evaluate, by using random amplified polymorphic DNA markers, the genetic relationship among a wild population of *O. vulgare* subsp. *vulgare* (one of the most variable species of the genus) from the spontaneous flora of Moldova.

MATERIALS AND METHODS

Seven genotypes of *O. vulgare* subsp. *vulgare*, marked conventionally with numbers from one to seven, collected from a natural site in Orheiul Vechi (60 kilometers to the north-east of Chisinau), were used for this study.

Total genomic DNA was isolated from young leaves using CTAB [16]. The purity and yield was monitored by 1% agarose gel electrophoresis and by UV absorbance (A260/A280) using PG instruments UV VIS T60U spectrophotometer. PCR amplification was performed in the following mixture: 50-60 ng DNA, dNTP 200μM of each type, 1,0 U per reaction of Taq DNA-polymerase, 2,5 mM $MgCl_2$ and 0,4-0,6 μM of decamere primers: OPA2 (5'-TGCCGAGCTG-3'); OPA9 (5'-GGGTAACGCC-3'); OPA19 (5'-CAAACGTCGG-3'); OPB01 (5'-GTTTCGCTCC-3'); OPG05 (5'-CTGAGACGGA-3'); OPK17 (5'-CCCAGCTGTG-3') and UBC250 (5'-CGACAGTCCC-3') in the Applied Biosystem GeneAmp PCR System 9700 (Singapore) thermocycler, programmed with the cycling profile: initial denaturation at 95°C for 5 min followed by 35 cycles: 95°C - 1 min, 34– 36°C – 1,0 min, 72°C - 1 min and a final extension at 72° C for 3 min.

The amplification products were separated by electrophoresis in agarose gel (1.4%). The gel was visualized by UV transilluminator and photographed with gel documentation system DOC – PRINT-VX2.

RESULTS AND DISCUSSIONS

RAPD markers have been used to characterize genetic diversity in a number of medicinal and aromatic plants including *Origanum.* Thus, Katsiotis et al. have carried out a study to clarify phylogenetic relationships and variations of Greek *O. vulgare subsp. hirtum* by RAPD markers and rDNA sequences. On the basis of RAPD markers the Turkish oregano (*Origanum onites* L.) clones were divided into three main groups. Using randomly amplified polymorphic DNA primers the genetic variation between and among 14 populations of wild *Origanum syriacum* L., four accessions of cultivated *Origanum syriacum* and two accessions *of Origanum majorana* L. collected from various wild habitats and agricultural companies from Jordan were analyzed [2, 9, 14].

The selected primers generated a total of 257 fragments, ranging in size from 250 to 5000 base pairs. The maximum number of amplicons was found at *Origanum vulgare* subsp. *vulgare* 6 (46 amplicons), followed by genotype 3 (41 amplicons) and 5 (with 38 amplicons) (Table).

The studied genotypes of *O. vulgare* subsp. *vulgare* are characterized by a high genetic variability, a number of 14 specific, 40 polymorphic and only 13 common bands have been revealed. The high degree of genetic polymorphism was established in the analysis with primer OPA19, in the presence of which 4 specific, 9 polymorphic and no common bands were detected, followed by OPG05, which generated 14 bands, including 3 – common, 6 – specific and 5 – polymorphic. The observed DNA polymorphism did not only consist of the presence or absence of fragments with a particular length in the RAPD patterns, but also of a change in the intensity of amplification of fragments with the same length.

The present findings are correlated with those of Brzosko et al. (2002), Manners et al. (2013) showed in *Cypripedium calceolus* and, respectively, *Vanda coerulea* a significant intrapopulation genetic variability [4, 15]. The AFLP and SAMPL primers revealed a high value of polymorphism of 19 accessions from *O. vulgare subsp. vulgare* [3].

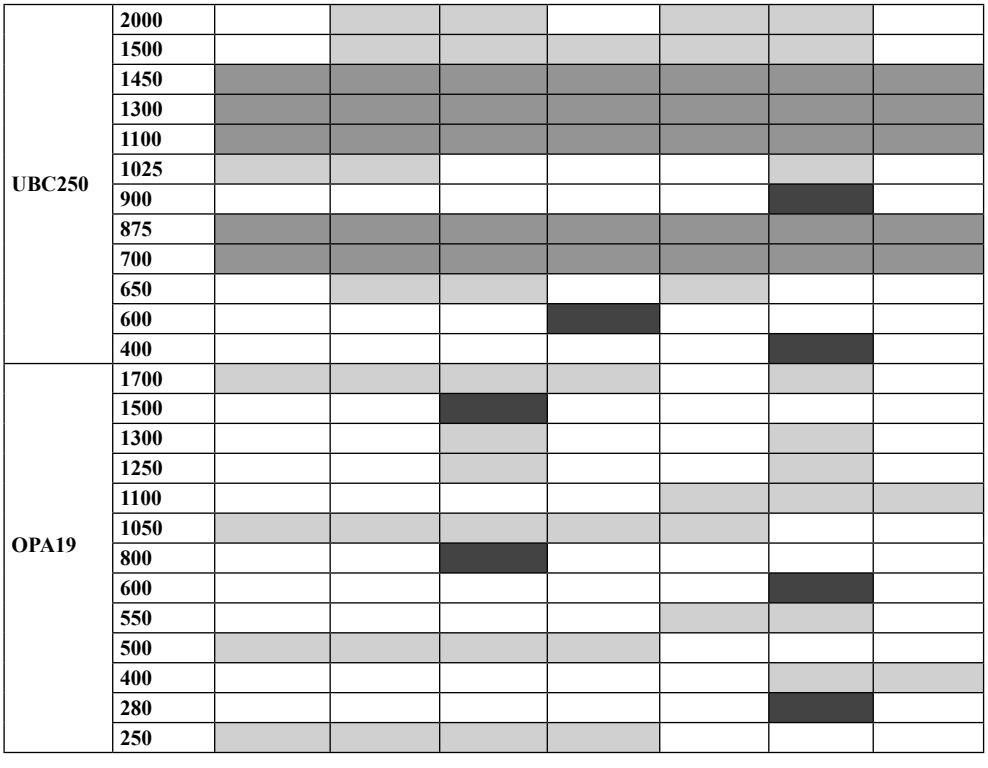
A number of thirteen bands, including five generated by primer UBC250 ($UBC250_{700,}$ $UBC250_{875,}$ $UBC250_{1100,}$ $UBC250_{1300,}$ $UBC250_{1450}$), three by primer OPG05 ($OPG05_{450,}$ $OPG05_{600,}$ $OPG05_{950}$) two revealed by each of primers OPA02 ($OPA02_{600}$, $OPA09_{450}$) and OPK17 ($OPK17_{350,}$ $OPK17_{450}$) and finally, one generated by primer OPB01 ($OPB01_{1500}$) were common for all tested genotypes.

According to the electrophoretic profiles in the case of genotypes *O. vulgare* subsp. *vulgare* 1 and *O. vulgare* subsp. *vulgare* 5 a number of 13 common and 40 polymorphic bands were revealed. One specific band was for genotypes 2 ($OPB01_{2300}$) and 4 ($UBC250_{600}$) and two specific bands for genotype *O. vulgare* subsp. *vulgare* 3 ($UBC250_{600,}$ $UBC250_{400,}$ $UBC250_{900}$) have been observed.

Table

Polymorphism exhibited by RAPD primers in *Origanum vulgare* subsp. v*ulgare* genotypes

Primers	Mr., b.p.	Genotype 1	Genotype 2	Genotype 3	Genotype 4	Genotype 5	Genotype 6	Genotype 7
OPA2	2800							
	1500							
	1200							
	1000							
	850							
	600							
	500							
OPA9	1500							
	1300							
	750							
	500							
	450							
OPB01	2300							
	1500							
	1400							
	1050							
	1000							
	850							
	700							
	600							
	500							
	300							
OPK17	1000							
	875							
	750							
	600							
	450							
	350							
OPG05	5000							
	2800							
	2000							
	1700							
	1400							
	1100							
	1000							
	950							
	800							
	750							
	600							
	500							
	450							
	300							



The most polymorphic genotypes were *O. vulgare* subsp. *vulgare* 6 and 7, which are distinguished by the presence of 4 and, respectively, 6 specific bands. In the case *O. vulgare* subsp. *vulgare* 6 the RAPD primer UBC250 and OPA19 generated each for two monomorphic bands ($UBC250_{400}$, $UBC250_{900}$; $OPA19_{280}$, $OPA19_{600}$). For *O. vulgare* subsp. *vulgare* 7 were characteristic six specific bands, ranged between 1000-5000 base pairs. These fragments will be isolated, reamplified and utilized as a probe in next step analysis.

Thus, we have demonstrated the reliability of RAPD analysis to detect DNA polymorphisms within *Origanum vulgare* subsp. *vulgare* population. The presence of genetic variation among individuals from *O. vulgare* population indicated that Moldova had a wide genetic diversity for those and that there was a promising future for the breeding and oregano cultivation/utilization.

CONCLUSIONS

This study showed that with the help of the RAPD technique one can easily discriminate closely related individual members and even different populations of medicinal plants. The technique provides sufficient evidence in the form of numbers of polymorphic markers for identification of varieties.

BIBLIOGRAPHY

1. Ahmed Yahya Al-Maskri, Muhammad Mumtaz Khan, Sultan Habibullah Khan, Genetic diversity among Omani Basil (Ocimum basilicum L.) landraces using RAPD markers, Journal of Agricultural Research and Development Vol. 3(6) , August, 2013, p. 094-097.

2. Akeel R.N., Rawashdeh I. et al. Genetic variation between and among Origanum syriacum L.and Origanum majorana L. populations collected from different locations in Jordan using RAPD markers. Journal Crop Res, Volume 38(1,2,&3), 2009.

3. Ali Azizi, Carola Wagner, Bernd Honermeier, Wolfgang Friedt, Intraspecific diversity and relationship between subspecies of Origanum vulgare revealed by comparative AFLP and SAMPL marker analysis, Plant Syst Evol, 2009, 281, p. 151–160.

4. Brzosko E. et Wróblewska A., Genetic variation and clonal dive rsity in island Cephalanthera rubra populations from the Biebrza National Park, Poland. Botanical Journal of the Linnean Society, 2003, 143(1), p. 99–108.

5. Campbell DR, Dooley J.L, The spatial scale of genetic differentiation in a hummingbird-pollinated plant: comparison with models of isolation by distance. Am Nat. 1992.139:706-734.

6. Cruse-Sanders J. M. and J. L. Hamrick, Spatial and Genetic Structure within Populations of Wild American Ginseng (Panax quinquefolius L., Araliaceae), Oxford Journals Life Sciences Journal of Heredity, Volume 95, Issue 4, p. 309-321.

7. Duca Maria, Port Angela, Homenco Tatiana, Polimorfismul RAPD-PCR la plantele de Cucumis sativus, Buletinul ASM, 2008, nr. 1(304), p. 81-88.

8. Duran Chris, Nikki Appleby, David Edwards, and Jacqueline Batley, Molecular Genetic Marker: Discovery, Applications, Data storage and visulaisation, Current Bioinformatics, 2009, 4, p. 16-27.

9. Fatma Aykut Tonk et al. Chemical and genetic variability of selected Turkish oregano (Origanum onites L.) clones, Plant Syst Evol (2010) 288: p. 157–165.

10. Fenwick A.L. and S.M. Ward, Use of Random Amplified Polymorphic DNA Markers for Cultivar Identification in Mint, Hortscience 2001, 36(4), p.761–764.

11. Fetah Elezi, Fatbardh Plaku, Alban Ibraliu, Gose Stefkov, Marija Karapandzova et al. Genetic variation of oregano (Origanum vulgare L.) for etheric oil in Albania, Agricultural Sciences, 2013, Vol.4, No.9, p. 449-454.

12. Gounaris Y., Skoula M., Fournaraki C., Drakakaki G., Makris A., Comparison of essential oils and genetic relationship of Origanum intercedens to its parental taxa in the island of Crete. Biochem Syst Ecol, 2002, nr. 30, p. 249–258.

13. Joshi K., Chavan P., Warude D., Patwardhan B., Molecular markers in herbal drug technology, Curr. Sci. 2004, 87, p. 159–165.

14. Katsiotis A., Nikoloudakis N., Linos A., Drossou A., Constantinidis T., Phylogenetic relationships in Origanum spp. based on rDNA sequences and intragenetic variation of Greek O. vulgare subsp. Hirtum revealed by RAPD. 2009, Sci Hortic 121, p. 103-108.

15. Manners V., Kumaria S., Tandon P., SPAR methods revealed high genetic diversity within populations and high gene flow of Vanda coerulea Griff ex Lindl (Blue Vanda), an endangered orchid species. Gene, 2013 Apr 25, 519(1).

16. Murray M.G., Thompson W.F., Rapid isolation of high molecular weight plant DNA. Nucleic Acids Res. 1980 Oct 10, 8(19), p. 4321-4326.

17. Ramanatha V. Rao, Toby Hodgkin, Genetic diversity and conservation and utilization of plant genetic resources, Plant Cell, Tissue and Organ Culture, 2002, n. 68, p. 1–19.

18. These studies are the part of Modova - Romanian project “Genetic intraspecific polymorphism analysis for the elaboration of molecular markers of some medicinal and aromatic plants chemotypes”.

STUDIES OF SOME INTRODUCED APRICOT VARIETIES IN THE REP. OF MOLDOVA

Pintea Maria

Research Institute for Horticulture and Alimentary Technologies, Chisinau, Republic of Moldova

Abstract. No significant differences have been observed between introduced (American and European) and Moldavian ones according to the time of initiation and characteristics of the differentiation of flower buds. American varieties Rival, Robada, Lorna, Katy, do not have an acceptable resistance of flower buds to the winter low (-15 - -20 °C during 7-10 days) temperatures. Only some studied American genotypes have the earliest beginning of blooming (1-2 days) in comparison to the Moldavian ones. There have been found some Romanian varieties with late blooming period. The period of flowering of CR-263, NJA-42, Paterson, Tilton coincide with the principal Moldavian varieties (Bucuria, Krasnoshciokii, Nadejda, Detskii), serving as good pollinators for them. The most of American varieties are more susceptible to the attack of Monillinia laxa than Moldavian ones.

INTRODUCTION

In the Republic of Moldova, the cultivation of apricot has secular traditions. But apricot production has many risks, mainly manifested during the post-dormancy and flowering periods. For the improvement of the yield stability it is necessary to develop (breeding and promotion) new varieties [1, 3, 4] with high adaptability to variable local micro climatic conditions. Apricot fruits are distinguished by valuable qualities, being considered as an important and primordial source of nutritional and therapeutic primordial substances for maintenance and fortification the human health. Actually there are sophisticate apricot varieties which are characterized by small and medium compact crown but strong fruiting shoots, form of crown appropriate for high density of orchard, root system of rootstock which is adaptable to different kind of soils, especially for "heavy" soil, which is specific for majority of terrains, attributed to apricot in the case of Republic of Moldova; genetic resistance to frost, fluctuations of winter and spring unfavorable temperatures; physiologic potential of equilibration of growth and fructification, especially high excitability of vegetative buds with the possibility of rehabilitation of crown after drastic manifestation of moniliosis [4]. For fresh consumption apricot fruits should be big, very attractive colored, with firm but juicy flesh, fine texture, equilibrate taste and pretty apricot aroma, with relatively

small stone, detachable from flesh. Fruits obtained for industrial processing should have constant form and largeness, uniformly colored flesh after boiling or dehydration, with high content of dry substances, sugar, pectin, macro and microelements, etc. Therefore in the programs of varieties amelioration regarding enlargement of fruit varietal conveyer there are indispensable multilateral experimental researches for evaluation of important genitors, including comparative studies of introduced perspective varieties from international assortment.

MATERIALS AND METHODS

Experimental researches where effectuated in the national collections of apricot (Experimental Station „Codrul", Research and Practical Institute for Horticulture and Alimentary Technologies). Biologic material is represented by 50 introduced (American and European) varieties and selections being compared with the main ones created in Rep. Moldova. (Bucuria, Kişinevskii rannii, Moldavskii olimpieț, Detskii, Kostiujenskii). Apricot biotype MVA served as a rootstock. Distances of plantation: 5 x 4 m, in the absence of irrigation. During the investigations there were employed methodical and methodological principles which were approved for breeding and genetics of fruit trees species [1, 4]. The frequency and the level of attack to *Monilinia laxa* where appreciated in percents.

RESULTS AND DISCUSSIONS

As a result of microscopic investigations of floral buds initiation and embryonic development of floral parts of experimented genotypes in the summer-autumn period there are no distinguished principled differences between introduced (American and European) varieties and Moldavian ones. Practically within all varieties there are noticed the same morphogenetical dynamic of initiation and development of whole perianth, commencement of the development of stamens, ovarian loge. Detailed observations concerning outgoing of floral buds from deep biological rest demonstrate the following results.

Table 1

Comportment of some introduced and Moldavian apricot varieties against the attack of *Monilinia laxa* in the conditions of the Rep. Moldova

Genotype	Attack frequency (%)		Class of resistance
	Flowers	Juvenile shoots	
Introduced varieties			
Traian	75	70	HA-AFÎ
Selena	65	68	HA
Olimp	45	75	MA-HA
Krimskii amur	40	24	MA

Cream ridge	50	24	MA-LA
CR 24-17	65	21	HA-LA
Early orange	45	18	MA-LA
Early blush	70	20	HA-MA
Goldrich	72	70	HA
Katy	85	45	VHA -MA
Kettleman	90	72	VHA -HA
K-106-2	92	70	VHA -HA
K-604-19	96	58	VHA -HA
K-611-150	95	65	VHA -HA
Lorna	65	70	HA-AFÎ
NJA-19	67	58	HA
NJA-21	35	65	MA-HA
NJA-38	40	24	MA
NJA-42	70	70	HA
NJA-44	68	42	HA-MA
Patterson	30	20	MA-LA
P72-155	49	65	MA-HA
P74-74	41	48	MA
P301-105	30	80	LA- VHA
Robada	77	25	VHA -LA
Stark Early Orange	50	24	MA-LA
Tomcot	41	70	MA-HA
Y103-253	70	76	HA- VHA
Y604-75	81	45	VHA -MA
Wesley	77	47	VHA -MA
Created in Rep. Moldova			
Bucuria	25	20	LA
Kishinevskii rannii	38	24	MA-LA
3-2-17	60	52	HA
Raduga	27	26	MA

Legend: Attack degree: 0% - resistance (R); 0-25% - low attack (LA); 26-50% - medium attack VHA (MA); 51-75% - high attack HA)-100% - very high attack (VHA).

American varieties and selections Lorna, Katy, Kettleman, Modesto, Helena, Nicole, Robada, P301-105, Y 103-253, Y604-75, K-106-2, K-604-19, Wesley, K-611-150, Y103-253, Y604-75, Rival (mains – from California) finished the profound biological rest already at December 20-25. In the same time, another part of American varieties (for example: Stark Early Orange, Creame ridge, CR 24-17, Early orange, Henderson, Goldrich, Early blush, Tomcot, NJA-19, NJA-21, NJA-38, NJA-42, NJA-44 and others) continued to be in profound rest another 4-5 weeks, that is coming to

second decade of January. During the same period get out of the rest period the flower buds of local varieties (Bucuria, Kishinevskii rannii, Detskii, Moldavskii olimpieț, Nadejda, Raduga, Kosrtiujenskii). The effectuated researches demonstrate that at the group of American varieties, which get out from the rest period earlier, there is continued development of reproductive organs and structures during the "windows" of 1-2 weeks which have relatively high temperatures (higher than 10^0C). Thereby, during these periods, at genotypes with relatively short rest period, the process of microsporogenesis is running rapidly. After the main parts of flowers are affected by frost of about 17^0C just in the first 4-6 days, we notice that the dynamic of floral development in buds of the majority of registered apricot varieties in the Republic of Moldova is comparatively slow. The beginning of flowering of American genotypes, with earliest outgoing from biological rest of flower buds (during December), was earlier comparatively with other Moldavian and American varieties (average terms –the third decade of Mars – second decade of April) maximum with 1- 2 days. Thereupon terms of flowering-pollination of the majority of Moldavian varieties overlaps the same of main studied American varieties at least for 2 days. Only some American genotypes have the earliest beginning of blooming (1-2 days) in comparison to the Moldavian ones. In the conditions of Rep. Moldova, the American variety Cream ridge is distinguished from the majority of studied varieties by longer periods of flowering (with 1-2 days) and by delayed maturation of fruits (more than one weak). This variety was registered in Rep. Moldova for cultivation in the frame of domestic production.

The manifestation of the attack of *Monilinia laxa* (flowers and juvenile shoots) of both American and Moldavian varieties is demonstrated in tab. 1. The received data shows that both open flowers and juvenile shoots of the American genotypes are more susceptible to this pathogen. The most susceptible varieties are Helena, Katy, Nicole, Wenatchee, Kettleman, Lorna, K-106-2, K 604-19, K 611-150, P 72-155, Y 103-255, Y 604-75 Wesley, Robada. The varieties Early orange, Cream ridge, Stark Early Orange, CR 24-17, Henderson, Goldrich, Early blush, Tomcot, NJA-21, NJA-38 also are relatively highly attacked, but usually in epiphytotic years conserve a weak yield. Moldavian varieties (Bucuria, Kişinevskii rannii, Costiujenskii, Raduga, 3-2-17) are less attacked. In our opinion this phenomenon could be explained by the presence of various fruiting shoots, which have a different dynamic of flower structures differentiation in buds. In such cases one part of flowers and vegetal buds are developed later, when the opportune microclimatic conditions for intensive development of pathogen already passed.

The general analysis of the manifestation of the most important agronomical and biological features during the period of studies in relation with the frequency and intensity of the development of moniliozis and introduced in the specific conditions of the rep. Moldova varieties permit to ascertain the following. The varieties

Patterson, Cream ridge, Goldrich, Tomcot and Early orange are characterized in the Republic of Moldova by high productivity of qualitative fruits for processing, having good resistance to unfavorable local factors. Extra early ripening of fruits of NJA-42, medium vigor and high capacity of regeneration of trees represent the features for its promotion as a promising variety. Within the conveyer of early varieties with high quality of fruits there is tested the variety Orange red. A stable fruit production of evaluated American varieties depends on appropriate management of moniliosis during flowering and initial development of juvenile shoots.

Table 2

General characteristics of some American apricot varieties.

Genotype	Vigor	Productivity	Profile/ Flavor	Primary fruits purpose	Recovery capacity of trees	Important features (as donors)
Introduced varieties						
Traian	+++	++	+++	FC, PR	++	Productivity, fruit quality. Good resistance to unfavorable abiotic local factors
Selena	+++	+++	++	FC, PR	+++	Productivity, good fruit quality for processing
Olimp	++	+++	++	FC, PR	++	Productivity, late fruit maturity.
Krimskii amur	++	+++	++	FC, PR	+++	Productivity, good fruit quality for processing
Cream ridge	+++	+++	+++	FC, PR	++	Productivity, fruit quality. Good resistance to unfavorable abiotic local factors
Early orange	+++	+++	+++	FC, PR	+++	Productivity, good fruit quality, especially for processing
Goldrich	+++	+++	++	FC, PR	++	Productivity, fruit quality.
Tom cot	++	++	+++	PR	++	Early fruit maturation, fruit quality.
NJA 42	++	++	+++	FC, PR	++	Extra early fruit maturation
Orange red	+++	+++	+++	PR, FC	++	Early fruit maturation, fruit quality.
Paterson	+++	+++	++	PR	++	Stable productivity, fruit quality. Good resistance to unfavorable abiotic local factors

Varieties created in rep. Moldova						
Kostiujenskii	++	+++	+++	PR, FC	++	Productivity, fruit quality for processing. Good resistance to unfavorable abiotic local factors
Nadejda	++	++	++	FC	+	Productivity, fruit quality. Resistance to unfavorable abiotic local factors

Legend: +++ -high, ++ - medium, + - low, FC -=fresh consumption, PR - processing

CONCLUSIONS

1. No significant differences have been observed between introduced (American and European) and Moldavian genotypes according to the time of initiation and differentiation of flower organs in flower buds.

2. The most of studied American varieties are more susceptible to the attack of *Monillinia laxa* than Moldavian ones.

3. The introduced varieties Cream ridge, Stark Early Orange, Goldrich, NJA-42, Patterson, Selena, Olimp, Krimskii amur are interesting for utilization in intraspecific hybridizations because of the complex of valuable features which are favorably manifested in the conditions of the Republic of Moldova.

BIBLIOGRAPHY

1. Cociu V., Oprea Şt., 1989 - *Metode de cercetare în ameliorarea plantelor pomicole.* Ed. Dacia, Cluj, p. 124-129.

2. Nicotra A., Conte.L., Moser L., Fantechi P. et all. 2006. - *Breeding programme for Monilinia laxa (Aderh. Et Ruhl.) Resistance on Apricot.* Proc. XIIth Symposium on apricot. Acta. Hort.701. ISHS. P. 307-311.

3. Pîntea M. 2002. - *Sortimentul de cais omologat şi de perspectivă*. Cercetări în Pomicultură. Vol. I.(Institutul de Cercetări pentru Pomicultură). Ed. AŞM, Chişinău. P.59-65.

4. Pîntea M. 2003 - *Cultivarea caisului.* Chişinău. *2003.* 56 p.

II. CONSERVATION OF BIOLOGICAL DIVERSITY

DIVERSITY AND ECOLOGICAL DETERMINANTS OF DEAD WOOD FUNGI IN NATURAL RESERVES OF BROAD LEAVED FORESTS OF SUCEAVA DISTRICT

Bîrsan C., Tănase C., Mardari C., Cojocariu Ana, Balaes T.

„Anastasie Fătu" Botanical Garden - „Alexandru Ioan Cuza" University from Iasi

Summary: Climatic conditions, host tree species, length and diameter of woody debris, decomposition degree of wood have a major influence on species diversity of lignicolous fungi. This study has been realized in Crujana, Dragomirna and Zamostea forest reserves. Determinant elements for dead wood fungi were been investigated using statistical analysis with DCA and RDA methods.

INTRODUCTION

Dead wood have a main role in the maintaining of ecosystems health, life cycles, and consequently a major importance for biodiversity. Lignicolous fungi are, together with insects, the main agents of wood degradation in forest habitats [11]. Dead wood quantities are lower in forests where the intensive silvicultural interventions are made by humans than in old growth forests and natural reserves where human interventions are minimized [8]. The main aim of this study was to investigate dead wood fungi of deciduous forest types. Secular beech-trees from Dragomirna natural reserve area are situated in low hills region with main host tree species *Fagus sylvatica*. Crujana forest (Quercetum) is constituted of deciduous species, with oak species (*Quercus robur*) as dominant. Zamostea Forest is a natural reserve represented by mixed communities of *Quercus robur*, *Fraxinus* sp., *Salix* sp. and *Populus* sp. It represents an area of riverine forest with more lignicolous species comparing to the above mentioned natural reserves (Tab. 1) [2].

Host-tree species, wood debris size, microclimate conditions, decomposition degree and initial position of dead wood from tree are the variable keys which influencing fungi species composition [5, 9].

Table 1

Important geographical features of the three natural reserves of broad leaved forests

Crt. No.	Name	Area (ha)	Altitude (m)	Main forest types	Geographical coordinates
1.	Crujana Reserve (Quercetum)	39,4	370-393	*Quercus robur* dominant	47^0 45' N 26^0 11' E
2.	Dragomirna Reserve (Beech-trees)	134,8	380-450	*Fagus sylvatica* dominant	47^0 45' N 26^0 12' E
3.	Zamostea Reserve	107,6	290	*Quercus robur*, *Fraxinus excelsior*, *Populus* sp., *Salix* sp.	47^0 52' N 26^0 15' E

MATERIALS AND METHODS

Diversity of lignicolous fungi was analyzed in three reserves of broad leaved forests Crujana, Dragomirna and Zamostea (Fig. 1). Samples were collected from 63 relevees randomly chosen (100 m^2 each). Investigations were made from April to October 2013. For each sample, geographical coordinates and altitude were recorded using a geographic positioning device (GPS II Plus Garmin Ltd.). All remnants of dead wood which had at least one sporocarps have been registered. For all we noticed: diameter, length, decomposition degree and host-species. Sporocarps of unidentified species were investigated through laboratory specific methods based on micromorphological and macromorphological characters according to keys and reference guides [1, 3, 6, 7, 12, 13]. Measuring of wood decomposition degree was semiquantitatively done. The analysis of similarities between lignicolous fungi species was realized using lignicolous Sorensen index. The UPGMA, DCA and RDA methods were used to characterize them from ecological point of view (both relevees and lignicolous fungi species). The hierarchical agglomerative clustering has been realized using the GINKGO software [4].

Detrended Correspondence Analysis (DCA) has been realized in order to distinguish the main gradients in lignicolous species composition and to characterize them from an ecological perspective. Detrending by segments and non weighted average values of altitudes, heat load and potential annual incidence radiation [10] for each relevés were used (as passive projected variables). DCA and RDA have been realized in CANOCO 4.5 [14].

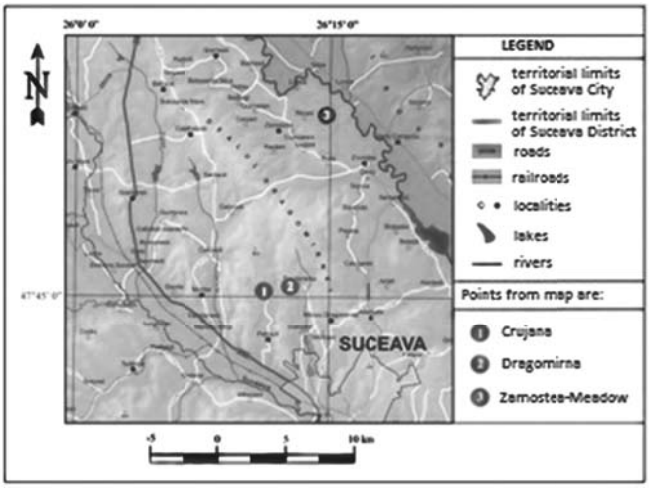


Fig. 1. Geographical positions of investigated Forests Reservations

RESULTS AND DISCUSSIONS

Investigations have been realized in the mentioned areas where we collect 486 samples belonging to 44 lignicolous fungi species (Tab. 2). The amount of dead wood is one of the important features of the maintaining of a high diversity of lignicolous macrofungi communities. The more dead wood is present, the greater diversity of species was registered, because of higher colonization probability.

Table 2

The species and main characteristics of lignicolous fungi recorded in the research plots

Species	Occurence	Host-tree	Species	Occurence	Host-tree
1. Armillaria mellea	IX XI	Deciduous	*23. Peniophora quercina*	I XII	Oak
2. Armillaria ostoyae	IX XI	Deciduous	*24. Phellinus ferruginosus*	I XII	Beech-tree
3. Auricularia auricula-judae	I XII	Elder, Beech-tree, Acacia	*25. Phellinus igniarus*	I XII	Deciduous, Willow
4. Bjerkandera adusta	I XII	Deciduous, Beech-tree	*26. Phlebia radiata*	IX XII	Deciduous
5. Bulgaria inquinans	IX XI	Deciduous	*27. Pleurotus ostreatus*	X XII	Beech-tree, Poplar, Willow
6. Chondrostereum purpureum	I XII	Deciduous, Beech-tree, Birch-tree, Poplar	*28.Plicaturopsis crispa*	IX XII	Beech-tree

7. Daedalea quercina	I XII	Oak	*29. Pluteus salicinus*	VIII X	Willow, Alder, Beech-tree
8. Daedaleopsis confragosa	VII X	Deciduous	*30. Polyporus arcularius*	I XII	Deciduous
9. Daldinia concentrica	V X	Deciduous, Birch-tree, Beech-tree, Oak	*31. Pycnoporus cinnabarinus*	I XII	Deciduous, Beech-tree, Cherry
10. Exidia glandulosa	I XII	Oak	*32. Sarcoschypa coccinea*	II IV	Deciduous, Hornbeam
11. Fistulina hepatica	VIII X	Deciduous, Oak	*33. Schizophyllum commune*	I XII	Deciduous
12. Fomes fomentarius	I XII	Beech-tree, Birch-tree	*34. Stereum hirsutum*	I XII	Deciduous
13. Ganoderma applanatum	I XII	Deciduous	*35. Tramestes pubescens*	VII X	Deciduous
14. Ganoderma lucidum	I XII	Oak	*36. Trametes hirsuta*	I XII	Beech-tree, Oak
15. Hyphodontia sambuci	I XII	Deciduous	*37. Trametes versicolor*	I XII	Deciduous
16. Hypholoma fasciculare	V XI	Deciduous	*38. Tremella foliacea*	I XII	Birch-tree, Beech-tree
17. Hypholoma sublateritium	VIII XI	Deciduous	*39. Tremella mesenterica*	I XII	Beech-tree, Oak, Ash
18. Hypoxylon fragiforme	I XII	Deciduous, Beech-tree	*40. Vuilleminia comedens*	I XII	Beech-tree
19. Laetiporus sulphureus	I XII	Deciduous, Willow	*41. Xylaria hypoxylon*	I XII	Deciduous
20. Lenzites betulina	IV XII	Deciduous, Beech-tree, Oak	*42. Xylaria longipes*	I XII	Maple
21. Meripilus giganteus	VII X	Beech-tree, Oak	*43. Xylaria polymorpha*	I XII	Beech-tree, Oak
22. Merulius tremellosus	IX XII	Beech-tree, Poplar	*44. Xylobolus frustulatus*	I XII	Deciduous, Oak

Analysis of similarities between lingnicolous fungi species from these three investigated reserves show a separation of three fungi groups as follows: a group with *Quercus*, another group with *Fagus* and another group with *Populus* and *Salix*. This suggests that the installation of lignicolous fungi species depends on the host-trees (e.g. *Populus* and *Salix* forests prefer places with higher humidity and presents a different fungi community comparing to *Fagus* stands).

A generalized linear model (Fig. 2) suggests that diversity of dead wood fungi species increases proportionally with diversity of woody plant species from investigated areas.

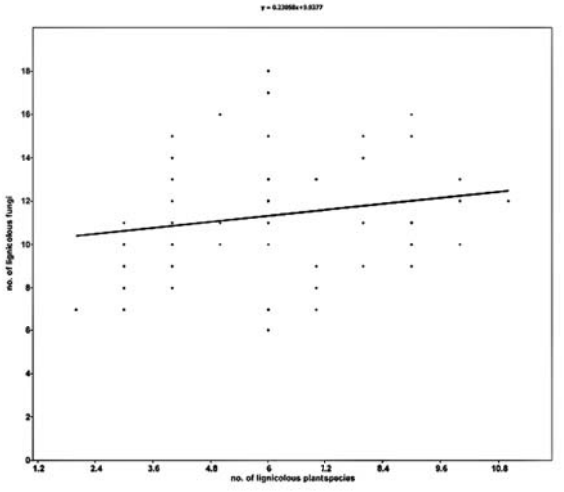


Fig. 2. GLM of the variation of fungi species as function of tree species diversity

Detrended Correspondence Analysis (Fig. 3) also separated three groups: the first group located at the right, in the lower region of the ordinogram includes the dead wood fungi from the *Fagus sylvatica* forest (Dragomirna), the second one also from the right part but in the upper part of the ordinogram include the dead wood fungi from the mixed forest of *Quercus robur* and other more hygrophilous species (Zamostea) and the third one includes dead wood fungi from the *Quercus robur* forest (Crujana). The first DCA axis is weakly negative correlated with heat load and PADI and explains only 5.9% of species-environment relation. The second axis is more strongly correlated with altitude and explains 37.6% of species-environment relation, indicating that the second axis is the most important one and the existence of a altitudinal gradient, from relatively low altitudes forests to higher altitude forests, suggesting that altitude represent the

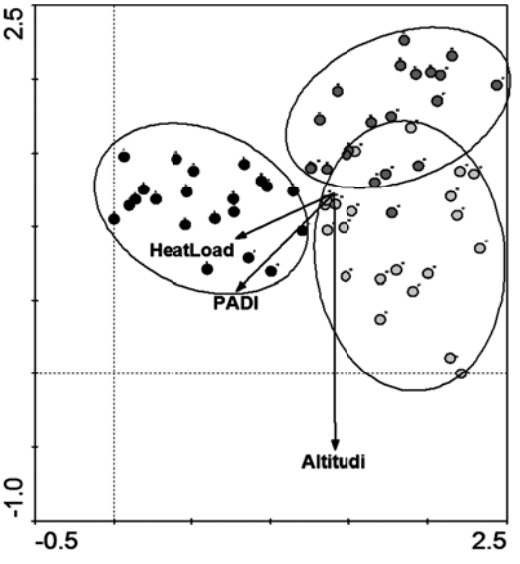


Fig. 3. DCA ordination diagram of the 63 samples using heat load index, potential anual direct radiation index and altitude as passive variables first two axes presented. Eigenvalues: 1st axis: 0.350, 2nd axis: 0.201, total inertia: 2.750.

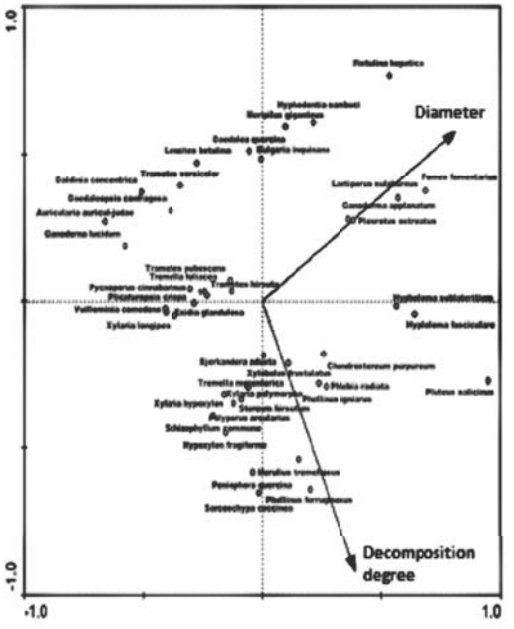


Fig. 4. RDA biplot of axes 1 and 2 with fungal species (44 species) constrained by two explanatory variables (diameter and decomposition degree)

main factor with significant influence on the dead wood fungi composition in the investigated vegetal communities. Only secondarily, the dead wood fungi composition is influenced by the heat and incidence solar radiation. DCA could be also interpreted in terms of dead wood fungi affinity for host-trees. Thus, left group include species preferring oak wood (*Quercus robur*-dominant tree in Crujana forest): *Daedalea quercina, Ganoderma lucidum, Exidia glandulosa* and *Peniophora quercina*. The second group includes species showing a high affinity for beech wood (*Fagus sylvatica*-dominant tree in Dragomirna forest): *Pleurotus ostreatus, Fomes fomentarius, Plicaturopsis crispa* and *Vuilleminia comedens*. The third group includes species besides oak, also willow and poplar wood: *Pluteus salicinus, Phellinus igniarus* and *Laetiporus sulphureus*.

RDA analysis (Fig. 4) suggests that diameter and decomposition degree of fallen trunks and branches have a significant importance for lignicolous fungi species. Thus, wood debris with large surfaces are more easily colonized by the fungi species (interspecific competition is avoided) developing large sporocarps (*Fomes fomentarius*, *Laetiporus sulphureus*, *Ganoderma applanatum* etc.), as compared to small branches with low diameters, which allow only few or a single fungus species to colonize during a particular time (*Picnoporus cynnabarinus*, *Exidia glandulosa*, *Plicaturopsis crispa* etc.). From another perspective, the monocentric species (which have only one starting point in growth) typically requires more substrate relative to their size than polycentric species. Thus, polycentric species have a physiological and competition advantage on monocentric species. Therefore, presence of these species can be determined not only by the diameter and volume of the substrate itself, but also by the great ability to grow on such a substrate. Besides diameter, the decomposition degree is a determinant factor for the fungus species which can be observed at a certain stage of wood decomposition. Thus, for the incipient stages of wood decomposition *Bjerkandera adusta*, *Chondrostereum purpureum* can be observed; for increased decomposition degrees *Hypoxylon fragiforme* and *Peniophora quercina* are more frequent in the investigated forests.

CONCLUSIONS

The diversity of lignicolous plant species (linear relationship between their diversity and dead wood fungi species diversity) and the host tree species have significant influence on the dead wood fungi species composition in the investigated areas. Also, the decomposition degree and dimensions of wood debris make clear distinctions among the fungal species which colonize the dead wood of different sizes and different decomposition stages.

REFERENCES

1. Bernicchia A. 2005. *Polyporaceae s.l.* Fungi Europaei 10. Edizioni Candusso, Alassio

2. Bleahu M., Done A. & Done T. 2006. *Arii naturale protejate din Bucovina. Ed. Terra Design Gura Humorului*

3. Breitenbach J. & Kränzlin F. 1986. T. **2**. *Heterobasidiomycetes, Aphyllophorales, Gasteromycetes*. Lucerne: Ed. Mykologia, Suisse, 412 pp.

4. De Cáceres M., Font X., Garcia R. & Oliva F. 2003. *vegana, un paquette des programas para la gestión y análisis de datos ecológicos*. VII Congreso Nacional de la Asociación Española de Ecologia Terrestre: 1484-1497.

5. Jacob H. & Morten C. 2004. Wood-inhabiting macrofungi in Danish beech-forests – conflicting diversity patterns and their implications in a conservation perspective. *Biological Conservation.* 122(2005): 633–642.

6. Jülich W. & Stalpers J.A. 1980. *The resupinate non-poroide Aphyllophorales of the temperate northern hemisphere*, North-Holland Publishing Company, Amsterdam, Oxford, New York, 335 pp.

7. Jülich W. 1989. *Guida alla determinazione dei funghi*. *Aphyllophorales, Heterobasidiomycetes, Gasteromycetes*, Vol. 2, Saturnia, Italy, 597 pp.

8. Kirby K.J., Reid C.M., Thomas R.C. & Goldsmith F.B. 1998. Preliminary estimates of fallen dead wood and standing dead trees in managed and unmanaged forests in Britain. *J. Appl. Ecol.* **35**: 148–155.

9. Küffer N. & Senn-Irlet B. 2005. Diversity and ecology of wood-inhabiting aphyllophoroid basidiomycetes on fallen woody debris in various forest types in Switzerland. *Mycological Progress*. **4**(1): 77–86.

10. McCune B. & Keon D. 2002. Equations for potential annual direct incident radiation and heat load. *Journal of vegetation science*. **13**: 603-606.

11. Müller J., Hothorn T. & Pretzsch H. 2007. Long-term effects of logging intensity on structures, birds, saproxylic beetles and wood-inhabiting fungi in stands of European beech *Fagus sylvatica* L., *Forest Ecology and Management.* **242**(2–3): 297–305.

12. Sălăgeanu G. & Sălăgeanu A. 1985. *Determinator pentru recunoaşterea ciupercilor comestibile şi otrăvitoare din România*. Bucureşti: Edit. Ceres, 330 pp.

13. Tanase C., Birsan C., Chinan V. & Cojocariu A. 2009. *Macromicete din Romania*, Ed. Univ. Al. I. Cuza Iasi, 537 pp.

14. Ter Braak C. J. F. & Љmilauer P. 2002. CANOCO reference manual and CanoDraw for Windows user's guide. Software for Canonical Community Ordination (version 4.5). – Microcomputer Power, Ithaca.

CONSERVATION OF WOODY PLANTS BIODIVERSITY IN THE O.V.FOMIN BOTANICAL GARDEN

Z.G. Bonyuk, O.O. Tkachuk, A.I.Girin, A.T. Grevtsova

O. V. Fomin Botanical Garden
of Taras Shevchenko National University of Kyiv;
1 Symon Petlyura Str., Kyiv, 01032 Ukraine, botsad_fomin@ukr.net.

Abstract. The article presents the results of studies of introduction of woody plants collection in the O. V. Fomin Botanical Garden, which has 1091 species and 1035 intraspecific taxa belonging to 217 genera, 69 families, 33 orders, 5 classes and 2 sections. The most widely are represented the generic complexes: Cotoneaster Medik., Crataegus L., Rhododendron L., Spiraea L., Magnolia L., Rosa L. etc.

INTRODUCTION

In modern conditions of the negative anthropogenic impact on the environment, climatic changes in the world, quick conversion of natural vegetation, disappearance of many species, the problem of conservation of plant diversity becomes especially urgent one. The botanical gardens play an important role in solving this problem with their rich collections of living plants all over the world. They are the sources of the gene pool of local and world flora and perform an important task of replenishment of plant resources. The O. V. Fomin Botanical Garden of Taras Shevchenko National University of Kyiv, founded in 1839, is one of the centers of conservation and enrichment of plant diversity in Ukraine. It occupies 22.5 hectares in the center of Kyiv. Low subzero temperatures in winter period in the absence of snow cover and frequent thaws are essential obstacles of successful acclimatization of plants in this region. The researches of phenotypic diversity of woody plants, their resistance in new conditions of growth for a long period of time are both a theoretical and practical interest.

MATERIALS AND METHODS

The object of research is the collection fund of woody plants of outdoor ground, numbering 2126 species and intraspecific taxa of which 1091 species, 10 subspecies, 871 cultivars, 33 forms, 62 variations, 59 hybrids that belong to 217 genera, 69 families, 33 orders, 5 classes and two sections [1]. The conventional methods [8–10],

archive documents, publications, materials of inventor are used in the researches with the dendrological fund.

RESULTS AND DISCUSSIONS

In the Botanical Garden Arboretum such genera are the most widely represented: *Cotoneaster* Medik. – about 200 taxa, *Crataegus* L. – 59, *Rhododendron* L. – 170, *Spiraea* L. – 127, *Pinus* L. – 51, *Magnolia* L. – 61, *Chamaecyparis* Spach – 28, *Juniperus* L. – 56, *Rosa* L. – 174 etc. [2–7]. More than a half of the taxa collection (54%) comes from Asia, 23% – from the North America, 17% – from Europe and the rest are widely distributed in Eurasia and North America. The trees make up 43%, including evergreen – 18%; shrubs – 52%, 11% of them are evergreen; subshrubs – about 2% and vines – 3% of the collection fund. As a result of the research of introduction perspective, from 70 to 98% of the tested species are estimated as promising for use in the forest-steppe and woodland of Ukraine.

The particular attention is paid to the conservation of the collection plants which age is hundred years or more, namely: *Carya glabra* (Mill.) Sweet., *C. ovata* (Mill.) K. Koch, *Cladrastis lutea* K. Koch, *Juglans nigra* L., *Pinus strobus* L, *Pseudotsuga menziesii* (Mirb.) Franco, *Quercus bicolor* Willd., *Q. rubra* L., *Tsuga canadensis* (L.) Carr. from the North America; *Fraxinus syriaca* Boiss. from the Asia Minor and the Central Asia; *Phellodendron amurense* Rupr. from the Far East; *Ginkgo biloba* L. from China; *Quercus macranthera* Fisch. et C. A. Mey. ex Hohen from the Caucasus; *Pinus pallasiana* D. Don - from countries of the Asia Minor and Crimea, *P. nigra* Arn. from the Balkans; powerful specimens of *Quercus robur* L. of local flora and *Larix decidua* Mill. from the mountains of Europe.

The arboretum plant collection has been formed by generations of botanists for over 170 years. Through the efforts of the scientific staff of the Botanical Garden in Ukraine such exotic plants are widespread: *Ailanthus altissima* (Mill.) Swingle, *Cercis canadensis* L., *Celtis occidentals* L., *Gleditsia triacanthos* L., *Gymnocladus dioicus* (L.) K. Koch, *Juglans nigra* L., *Morus alba* L., *Phellodendron amurense* Rupr., *Pinus strobus* L., *Robinia pseudoacacia* L., *Thuja occidentalis* L. and others.

Due to the large polymorphism, hybridization and apomixis of the representatives of the genus *Cotoneaster,* their source material is collected as far as possible in natural habitats. Some species dominate in the collection by geographical origin: Cotoneasters from the Southeast (18%) and Southwest (17%) China, then Himalayan (14%) and Chinese species (8%) of the mountainous areas of the Pamir-Alai and Tien-Shan and the Central Kopet Dagh – 10%; Europe – 9%; Iran, Afghanistan, Pakistan – 7%; Caucasus – 7%; Altai, Eastern Siberia – 5%; Mongolia – 2%; Crimea – 2%; North Africa – 1%. The collection of *Cotoneaster* Medik. in the O. V. Fomin Botanical Garden is replenished with 9 species, new for botanical science, which are named in honor of scientists: C. *bilokonii* Grevtsova, *C. daralagesicus* Grevtsova,

C. grevtsovae Bonyuk, *C. kazankinii* Grevtsova, *C. kirgizicus* Grevtsova, *C. logginovii* Grevtsova, *C. russanovii* Grevtsova, *C. tkatschenkoii* Grevtsova, *C. uzbezicus* Grevtsova [3].

According to the duration of the vegetation period, the studied species are distributed in groups: 171–180, 181–190, 191–200, 201–210, 211–220, 221–230, 231–240 days. It is found that there is a dependence between the duration of the growing season and winter hardiness of *Cotoneaster*. In the group with the duration of the growing season 171–180 days, a number of winter-hardy species makes up 100%. With an increase in the growing season, the number of winter-hardy species decreases from 94% (181–190 days) to 33% (221–230 days). In the group of species with the duration of the growing season 231–240 days the winter-hardy species are absent. According to the results of the overwintering of representatives of the genus *Cotoneaster* the extreme winters of 2005–2006 years in Kyiv, 65% of taxa are persistent and can be recommended for introduction in ornamental gardening, 25% – are subject to acclimatization, 10% – for the valuable collection of the Botanical Garden as a priority in Ukraine and neighboring countries. As a result of the long-term researches, the representatives of the genus *Cotoneaster* 160 perspective taxa are determined and recommended to use: in ornamental horticulture – 140, to secure the eroded slopes, ravines – 80; landscaping for suburban recreation areas, trails, local roads – 60; plantations – 50; interior phytodesign – 40; apiculture – 70; horticulture – 15, as medicinal plants with high adaptogenic properties – 88.

Since 1983, in the Botanical Garden, more than 100 species and intraspecific taxa of *Spiraea* have been studied. Most of the species of *Spiraea* are from 10–30 years or more and they are presented with 340 samples, more than 3 thousand specimens. The plants are represented in different landscape compositions: in borders, flowerbeds, stone hills, clumps of 5–7, 20–30 and more specimens, solitaires, as ground cover, in accordance with the environmental requirements of the species. The polymorphic genus *Spiraea* is represented in the Botanical Garden both as arrow local endemics and species of widespread habitat, extended in conditions of tropical, subtropical to temperate climate (eg, *S. japonica* L. fil.), which is a manifestation of stability or variability of morphological characteristics of plants in conditions of introduction. There were the most variable features in conditions of the Botanical Garden: size of leaves, pubescence, color of leaves and flowers. We carried out the identification of the species diversity of the collection of *Spiraea* by chemotaxonomy method. We investigated more than 300 samples of *Spiraea* and analyzed spectra of peroxidases. Each species of *Spiraea* has the characteristic spectrum of isoperoxidase. A form and two new cultivars are identified and described: *S. trilobata* L. f. *crataegifolia* hort., f. nova, *S. nipponica* Maxim. f. *tosaensis* (Vatabe) Mak. `Nana`, cv. nov., *S. fritschiana* Schneid. `Rosea` cv. nov. [2].

The present collection of the genus *Rosa* L. in the Botanical Garden consists of

52 species and taxa of subspecies rank belonging to 9 sections, as well as 122 varieties of roses of 10 garden groups. Some sections are the most widely represented in the collection: *Caninae* Crép., *Cinnamomeae* DC., *Pimpinellifoliae* DC., *Rugosae* Chrshan. and *Synstylae* DC. There are majority of varieties in the expositions of the Botanical Garden: tea-hybrid, floribunda and winding garden roses groups. The most part of the present collection fund of wild roses in the Botanical Garden is introduced in the 1970-s from the Central Asia, Baltic States and Western Europe through the exchange of seeds by delectus. About 20% of species are collected in their natural habitats.

The investigations of introduction in the conditions of the Botanical Garden were done using more than 80 species of wild rose and 320 varieties of 10 garden roses groups. As a result of the researches, 35 species of wild rose and 50 varieties of roses were selected from the collection for wide use in gardening design in the conditions of the north-west of Ukraine. The study of environmental sustainability of introduced plants allowed to select 25 tolerant varieties that can successfully grow and develop, blossom abundantly and continuously in the conditions of high gas content of the air.

According to the results of breeding work currently being undertaken with a collection of *Rosa*, the author O. O. Tkachuk created two new high-decorative, winter-hardy and resistant to fungal disease pathogens of the grade tea-hybrid groups – 'Pervistok' and 'Kelych Aromatu'. The last one has a deep tea aroma inherent in some representatives of the ancient tea roses [11, 12].

The hawthorn *Crataegus* L., growing in the Botanical Garden of the University of Kyiv, is first mentioned in the list of seed exchange in 1842. On the summary list of inventory for 1884 the collection consisted of 9 species. Currently, the collection numbers 59 species and forms, 56 of them entered into the generative phase. The greatest number of species of the genus *Crataegus* researched in the Botanical Garden makes up the North American hawthorns (87%). The introduced hawthorns by systematic basis belong to 15 sections. The most part of species are grown from seed samples obtained in the botanical gardens of Tashkent, Frunze and Minsk. The native species are grown from seeds collected in the areas of natural habitat. The collection of *Crataegus* is located on the separate plot. The plants are in clumps of 3–5 (7) specimens. In addition, a part of the collection plants is located on lighted spots across the Botanical Garden. All investigated species are winter-hardy, blossom and fruit.

CONCLUSIONS

The collection of trees and shrubs in the Botanical Garden has more than 2000 species and intraspecific taxa and serves as a source of enrichment of the Ukrainian flora with new species and cultivars as well as a base for researches on the biology of plants, and is used for the educational process of students of biological faculties and specialists of green building, for educational activity.

The phenotypic diversity of forms of polymorphic genera *Cotoneaster, Crataegus, Magnolia*, *Spiraea*, *Rhododendron*, *Rosa* and many others allows conserving the vegetable biodiversity and serves as a basis for the further studies of their genetic potential and microevolutionary processes.

REFERENCES

1. APG III. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants : APG III // Bot. J. Linnean Soc. – 2009. – 161. – P. 105–121.

2. Бонюк З. Г. Таволги (SpiraeaL.) : монографія / З. Г. Бонюк. –К. : ВПЦ "Київський університет", 2008. – 248 с.

3. Гревцова Г. Т. Атлас – Кизильники Cotoneaster (Medic.) Bauhin. / Г. Т. Гревцова. – К.: Дім, сад, город, 1999. – 372 с. ISBN 966-95428-4-7.

4. Зарубенко А. У. Культура рододендронів в Україні : Монографія / А.У. Зарубенко – К.: ВПЦ "Київський університет", 2006. – 175 с.

5. Інтродукція деревних рослин у Ботанічному саду ім. акад. О. В. Фоміна (1839-2009) : монографія / О. М. Колісніченко, З. Г. Бонюк, Г. Т. Гревцова та ін.; за ред. Г. Т. Гревцової. – К.: ВПЦ «Київський університет», 2011. – 175 с. ISBN 978-966-439-465-6.

6. Колісніченко О.М. Сезонні біоритми та зимостійкість деревних рослин. – Київ: Фітосоціоцентр, 2004. – 178 с.

7. Коршук Т. П., Палагеча Р. М. Магнолії (Magnolia L.): Монографія / Т. П. Коршук, Р. М. Палагеча – К.: ВПЦ "Київський університет", 2007. – 207 с.

8. Лапин П.И., Сиднева С.В. Оценка перспективности интродукции древесных растений по данным визуальных наблюдений // Опыт интродукции древесных растений. – М.: Наука. – 1973. С. 7–67.

9. Русанов Ф.Н. Метод родовых комплексов в интродукции растений и его дальнейшее развитие // Бюл. ГБС АН СССР. – 1971. – Вып. 81. – С. 15–20.

10. Соколов С. Я. Современное состояние теории интродукции и акклиматизации растений. – М.-Л., 1953. – С. 10–18.

11. Ткачук О.О. Свідоцтво №10365 про авторство на сорт троянди 'Первісток'. Заявка №09246004 // Державний реєстр сортів рослин придатних для поширення в Україні у 2011 р. – К., 2011. – С. 270.

12. Ткачук О.О. Свідоцтво №10366 про авторство на сорт троянди 'Келих аромату'. Заявка №09246003 // Державний реєстр сортів рослин придатних для поширення в Україні у 2011 р. – К., 2011. – С. 269.

ENVIRONMENTAL EDUCATION MODEL ON PLANT SPECIES OF MOLDOVA, included in THE Appendix OF CITES (WASHINGTON, 1973)

PhD., Ala Donica

Institute of Ecology and Geography

Summary: One of the 18 international environmental conventions ratified by the Republic of Moldova, which directly promotes natural heritage conservation is the Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington, 1973),known under the abbreviation CITES. Plant species of the Republic of Moldova, are found exclusively on Appendix II lists, i.e. species that may become threatened with extinction, being in number of 25 species and require appropriate environmental management (in this sense we propose an ecological model of education regarding knowledge and protection of these species). Environmental education regarding these species achieved by model aimed:

a) Geobotanical peculiarities of species, geographic distribution at international and local level, factors impacting on them, measures of conservation and protection of species;

b) variety of teaching, applied methods, depending on individual age of children, the stages of educational model and objectives (in our case being invented a teaching game - the "CITES shop", include the role of seller (played by professor) and buyers (pupils), who will only have to buy flowers that are not included in Annexes of the convention, arguing their choice).

INTRODUCTION

The main reason for the extinction of a species is habitat destruction (deforestation, construction etc.). Commercial collection of species is the second decisive factor in endangering species. Recognizing the damage of trade and diminishing wild populations, seeking a common solution to international problems, in 1973, the Washington Convention was declared (briefly CITES - "Convention on International Trade in Endangered Species of Wild Fauna and Flora"). Of the 192 countries, 173 have signed the Convention. Moldova acceded to the Convention in 2000 (Law no.1246-XIV ...., 2000). Because in international trade appear animals, live plants and parts thereof, or objects made from them (elephant ivory, caviar, reptile leather purses, rare plant roots etc.), CITES has extended the area of action on all parts and objects produced, that can be recognized. The Convention contains 35000 species of plants and animals, and, depending on the degree of endangerment, they can be divided into the following three categories:

Appendix I includes species that because of international trade are disappearing.

They are the most protected, the convention banning trade of these species. Capture and collection of living species or parts thereof is permitted only for the purpose of survival of the species. There are special cases when the import, export and re-export of these species are allowed. In the cases above (and if they were artificially propagated or from breeders) in their introducing into the country is need of import and export CITES documents.

Appendix II includes species endangered due to intense trade, but populations are not at a critical level. As these species do not suffer a decline in population size, convention controls severely the trade with them. Specimens from the wild are sold based on annual quotas established from scientific studies, with all right notices.

Appendix III includes species that in a given country represent endangered populations, but the laws of nature protection in that country are not strong enough to protect the species from trade damage. Thus, that country requires international aid. For sale species is needed an export permit from that country and from other countries - Certificate of Origin (CITIES Convention, 1973).

Parties of Convention discuss framing of a species in one of the annexes, again from four to four years. Therefore, the Convention does not prohibit mandatory, but rather wants to control trade in some species in favor of nature. Scientific argument that led to the signing of CITES Convention by our country are also 25 species of Moldova's Flora, found in Appendix II of the Convention (Begu, 2012).

Besides the basic normative documents, an important role in the protection and conservation of biodiversity of our country, have the editions and the awareness activities of the broad masses, namely the environmental education, which in view of sustainable development are essential in a community. Contemporary activities include education actions based on *pedagogy of sustainability* methods. The essence of teaching is to create and understand the linkages, the connections between the three complex systems (Environment-Economy-Society), along the pedagogical process. The transition from teaching of concrete materials, well differentiated, to an integrated approach of systems represent a problem in pedagogical skills. The most obvious connections between different elements of sustainability are:

- *Thinking, Mentality about future and the influencing of future* - the key concept of sustainability is the future. Let us think about the future when we act today.

- *Planning, designing sustainable communities* - focusing on communities, which are the highest form of organization, in which people can engage to the utmost in formation of sustainability, training the feeling of local belonging, "I live here".

- *Globalization* - we have to think that all the facts, our actions are influencing our lives entirely on the one hand, and the lives of those outside the community, on the other hand

- *Rational management of natural resources* - knowledge of environment and of

nature, every child learns to love the nature and we must use this enthusiasm to make the child understand the links between the different systems around us.

Therefore, there is a close relationship between the pedagogy of sustainability and environmental education. Environmental education deals with the present, investigating the natural, built and the social environment. Pedagogy of sustainability, but dealing with future, includes global education, ethics education, integration into the community, preserving the traditions, development, peace keeping, management of natural resources (Natura, 2012).

MATERIALS AND METHODS

Materials: CITES Appendix (1973); botanical, ecological particularities of species and distribution (Negru et al., 2002); list of plant species from Republic of Moldova, found in the appendix of CITES Convention, 1973 (Begu, 2012);

Metods: teaching methods (description, observation, didactic game, critical thinking, etc.); teaching materials (physical map of Moldova, distribution maps of rare species in the world, images of rare plants); applied didactic game - the "CITES shop", include the role of seller (played by teacher/pupil) and buyers (pupils).

RESULTS AND DISCUSSIONS

Environmental education of children on the plant species of the flora of Moldova, found in the Appendix of the CITES Convention, 1973, through the presented model, aims to:

- identify and describe the given species and explain to children their role in environment and economy, also the factors affecting the species existing in nature and to deduce the damage caused to nature through trade of these plants and their derivatives, preparations and some aspects of the law that controls this trade;

- setting the basis for global thinking and giving up of their interests for a bigger purpose.

The recommended period for these activities can be always, elements of this presentation can be intra- and interdisciplinary.

To achieve the given goal the teacher will follow the following **steps in the educational model**:

1. Overview of content and the need to develop CITES Convention, the legal procedure and documents required to export / import the species included in the CITES Appendix (www.mediu.gov.md).

2. Identification of plant species included in the CITES Appendix (1973). For Moldova these are (Begu, 2012): *Adonis vernalis, Cephalanthera alba, C. damasonium, C. rubra, Cypripedium calceolus, Dactylorhiza majalis, Epipactis atrorubens, E. helleborine, E. palustris, E. purpurata, Euphorbia virgata, Galanthus*

elwesii, G. nivalis, G. plicatus, Listera ovata, Neottia nidus-avis, Orchis mascula, O. morio, O. palustris, O. purpurea, O. ustulata, Planthatera bifolia, P. chlorantha, Sternbergia colchiciflora (fig.1).

Adonis venalis *Cypripedium calceolus* *Orchis mascula* *Galanthus nivalis*

Fig. 1. Some plant species from Moldova found in Appendix II of the CITES Convention (1973)

3. Description of species according to the algorithm:

- picture of described species;
- species status (according to international and national treaties of environmental conservation);
- map of spreading/distribution (in Eurasia, in the Republic of Moldova);
- description of the species (biological and ecological particularities);
- habitats populated by species;
- limiting and impact factors;
- role in nature and economy.

4. Didactic game „CITES Shop": will be prepared or imitated pictures of various plant species (from the world, from spontaneous native flora or from flower shops), flowers, natural teas, jars with natural jams, bathroom sweeps (made of trees branches or decorative) and other objects at the discretion of the teacher. The role of seller will be played by an active pupil or by teacher. The seller's task, is to convince each pupil to buy plants or their derivatives, included in the CITES Appendix. Pupils – clients come by one at shopping and should be very careful what they choose, arguments for and cons of their choices. If they buy a "forbidden" flower / plant or a derivate thereof, others will argue them, explain then that would be a good choice. If they are undecided or cannot decide on what is produced the object, from where it came, need to learn to ask the seller: Where is this flower from? Of what is produced jewelry, decorative objects, medicinal product or tea?

When the child decided to buy a right item, he really needs to ask him the reason for choosing the object, thus repeating the correct criteria of choice, buying.

5. Formulate opinions on our contribution to the reduction of this trade (in terms of the four sides of the pedagogy of sustainability).

Example: Increasingly more people in our country spend their annual leave abroad in exotic countries, where lack of information, or buy souvenirs collected

from nature that are derived from endangered species, thus contributing themselves to death of next specimen. Species in our country, which are included in the Annexes of the Convention, we can meet either in nature or in the market. Will be presented and pictures of ambulant, illegal vendors, of spring plant (on the streets of the capital, on the outskirts of highways).

It is very important that at an early age children learn that it is enough to admire the natural values in their place in environment, and should not break or destroy them. Do not buy such species taken from nature and does not contribute to a further illegal collection. Responsiveness of children to these problems it manifested by forgoing the purchase and collection of endangered species, the development of responsibility and forming a critical thinking.

CONCLUSIONS

The proposed educational model, aims to create connections between pedagogy and ecology through the sustainable development of both the environment and society as a whole; form positive feelings toward nature; know the economic, social, environmental problems existing in systems around us; and identify methods, ways and means of preventing and combating biodiversity loss at the global, national and local level.

BIBLIOGRAPHY

1. Begu A. *Biogeografia organismelor unicate şi ameninţate*. Chişinău, 2012, 268 p.

2. *Cheklist of CITIES species and Annotated CITIES appendices and reservations.* Washington, 1973, 417 p.

3. *Legea nr.1246-XIV din 28 septembrie 2000 pentru aderarea Republicii Moldova la Convenţia privind comerţul internaţional cu specii sălbatice de faună şi floră pe cale de dispariţie CITES* (2000). Monitorul Oficial al Republicii Moldova, nr. 133-136, art. 949.

4. *Natura - dascăl pentru dascăli. Metode educative pentru promovarea reţelei Natura 2000*. Asociatia Grupul Milvus.Târgu Mureş, 2012, 159 p.

5. Negru, A., Şabanov, G., Cantemir, V., Gînju, Gh., Ghendov, V., Bacalov, V. *Plante rare din flora spontană a Republicii Moldova*. Chişinău. 2002, 198 p.

6. www.mediu.gov.md, accesat 27.03.2014.

CONTRIBUTIONS TO TAXONOMIC DIVERSITY RESEARCH OF MACROMYCOBIOTA OF REPUBLIC OF MOLDOVA

Manic Ştefan

Botanical Garden (Institute) of the Academy of Sciences of Moldova Chişinau, 18, Padurii, str., MD-2002, Republic of Moldova

Abstract: Research aiming macromycetes' taxonomic diversity in mycobiota of Moldova revealed 836 taxa belonging to 227 genres, 81 families, 26 orders, 8 classes, falling into 3 phyla from 2 kingdoms of Fungi and Protozoa in the last four decades (1976-2013). From 836 species inventoried to date in Moldova, 263 are listed in premiere. This paper provides the taxonomic conspectus of the new species of macromycobiota of Moldova with recorded frequency and phenophases.

***Key words**:* taxonomy, macromycetes, variety.

INTRODUCTION

An important role in the evolution of Mycology played the development of agriculture (research of diseases caused by fungi), medicine (mycoses, antibiotics) and food industry (wine, bread, dairy products). In Moldova, where agriculture is an important branch of the national economy, the mycological investigations were initially focused on systematic groups of phytopathogenic fungi [9,15, 22, 23, 24].

For a long time, the macromycetes, that possess a strong indicator value of the environment in which they grow, remained outside the attention of specialists in our country. Several papers published the information about some representatives of this group of fungi, but they did not have a systematic approach [8, 11, 12, 21].

The systematic research of macromycetes started in the Botanical Garden of the Academy of Sciences in 1976 as a research theme of the "Flora and Phytogeography" laboratory. Based on this research 251 new species of mycobiota in Moldova have been identified and published [16, 17, 18].

The research of macromycetes continued during 1980-1990 in the same laboratory with state theme "Inventory of flora and vegetation in the natural reservation 'Plaiul Fagului'". As a result, an inventory of 241 species identified in the reservation was published [19].

Starting with 1990 and to the present, the research was extended to all macromycetes from all taxonomic groups of Protozoa and Fungi kingdoms. Extending

macromycetes research was made possible by our collaboration with highly qualified specialists from Romania (M. Thomas, G. Negrean, C. Tanase) and with the group of mycologists from Sainte-Ségolène - France (P. Roux, V. Dumas). Several papers were published as a result of this collaboration [1, 3, 4, 5, 6, 7, 30].

During the years 1990-2011 the frequency and abundance of macromycetes was researched and monitored in the natural scientific reservation "Codrii" within the "Annals of Nature" program. Based on this research a vast scientific material on macromycetes was accumulated and used in preparing of the macromycobiota conspectus of this territory that includes more than 500 fungal taxa published in the paper "Conspectus of biological diversity of the natural Reserve „Codrii" [5].

As a result of recent systematic inventory (2011-2014) and critical processing of macromycetes collections of Botanical Garden and natural reservation "Codrii", 263 species unpublished to present were highlighted (Tab. Nr.2).

RESEARCH METHODS

Sampling of biological material for taxonomic investigation was conducted by following guidance "Руководство по сбору высших базидиальных грибов для научного их изучения" (Guidance for collecting the highest basidiomycetes for their scientific study) [13].

In conformity with this guidance the macromycetes were collected from first appearance of mushrooms until late autumn, from various biotopes from Moldova, in various stages of development, in all seasons. This was preceded by macroscopic analysis of carpophores at spot, with registration of all phenotypic characters: the place of species growing, size, shape, color, the cap surface, sporogram and himenofor type, the type of veil - general and partial, stem shape and color, presence or absence of the ring, meat and its consistency, color and the change while exposed to air, taste, smell, presence / absence of latex etc.

With particular attention were researched the macro-chemical reactions of various structural and functional components of carpophores, especially the cuticle and the outside part of the stem, himenofor, spores, latex. The changes occurred as a result of the chemicals' action have been proved as undeniable taxonomic characteristics [2].

The macroscopic analyses were completed with the microscopic-photonic ones that focused on the structure of hymenium, with particular emphasis on characteristics of *ascus* and *ascospores*, respectively *basidii* and *basidiospores*, especially color, size, ornamentation and the amyloid reaction of the spores, phenotypic characters of great taxonomic value. Particular attention was given to biometrics that was very useful in determining many species, especially those of the *Cortinarius* genus [2].

The identification of taxa was done by using the well-known method - consulting some papers, which provided keys for determination and diagnosis of species [10, 14, 20, 26, 27, 28, 31, 32, 33].

To verify the determinations, some personal samples were analyzed against existing herbarium collections of the Botanical Institute in St. Petersburg and the Herbarium of the Institute of Biology from Bucharest. With the same purpose were consulted highly qualified mycologists (A. Kovalenko, T. Chifu, C. Tanase, M. Pārvu, P. Roux) with whom we cooperate for a long time.

The preparation and preservation of the samples was done following the conventional methodology [2, 13]. *Carpophores*, taxonomically identified, were dried and processed through the microwave oven in order to destroy the eggs of insects, and then pressed with iron and packed in plastic bags, and placed in labeled paper envelopes. Envelopes with fungal specimens were systematically organized and inserted into the herbarium of the Botanical Garden of Academy of Sciences and Scientific Natural Reserve "Codrii".

Mushroom samples collected in Moldova during the years 1976-2013 served as main material for this paper. Additionally, in the synthetic analysis of data, were used the publications of authors who contributed to the research of this group of fungi [8, 11, 21, 22].

RESULTS AND DISCUSSIONS

Currently, taxonomic analysis of specimens inventoried during 1976-2013 in Moldova shows the presence of 836 taxa belonging to 227 genres 81 families, 26 orders, 8 classes, falling into 3 phyla from 2 kingdoms - *Fungi* and *Protozoa*. (Table No. 1).

Micetozoa phylum is represented by 16 species belonging to 10 genera, falling within 8 families, 4 orders from *Myxogastria* class. The order *Trichiales Mixogastria* with 6 species is the most representative of the phylum followed by the order *Physarales* with 5 species. The *Liciales* and *Protosteliales* orders are on the opposite side with 3 and 2 species respectively. Most genera are represented only by a single species, with the exception of *Fuligo* and *Arcyria* genera with 3 and 2 species accordingly.

Phylum *Ascomycota* is represented by 55 macromycetes species belonging to 29 genera falling into 15 families, 5 orders and 3 classes. The most representative of the phylum *Ascomycota* is the order *Pezizales* with 38 species of 18 genera from 8 families, followed by the order *Xylariales* with 7 species of 3 genera from the family *Xylariaceae.*

The *Bazidiomycota* phylum is the most representative of studied macromycobiota. This phylum includes 765 species of 188 genera from 58 families, 17 orders and 4 classes. The order *Agaricales* with 475 species is the most representative of the phylum *Bazidiomycota*, followed by orders *Russulales* with 133 species and *Boletales* with 54 species. The families with the largest number of species in this order are *Russulaceae* and *Agaricaceae* with 117 and 63 species, followed by *Tricholomataceae* and *Cortinariaceae* with 63 and 49 species accordingly. A high diversity in the phylum

is presented in the genera *Russula* with 78 taxa, *Cortinarius* with 47 taxa, *Lactarius* with 39 taxa, *Boletus* and *Mycena* with 23 taxa each.

Table 1

Numerical share of the taxonomic categories of macromycetes

Phylum	Classes	Orders	No.fam	No.gen.	No.spec.
Mycetozoa	Myxogastria	Liceales	1	3	3
		Physarales	3	3	5
		Protosteliales	1	1	2
		Trichiales	2	3	6
Ascomycota	Leotiomycetes	Helotiales	2	4	5
		Leotiales	2	2	2
	Pezizomycetes	Pezizales	8	19	38
	Sordariomycetes	Hypocreales	2	2	3
		Xylariales	1	3	7
Basidiomycota	Agaricomycetes	Agaricales	24	105	475
		Auriculariales	1	2	5
		Boletales	7	14	54
		Cantharellales	3	4	6
		Corticiales	1	2	3
		Geastrales	1	1	5
		Gloeophyllales	1	1	1
		Gomphales	2	3	6
		Hymenochaetales	2	11	19
		Phallales	1	2	3
		Polyporales	6	29	49
		Russulales	5	9	132
		Sebacinales	1	1	2
		Thelephorales	1	1	2
	Atractielomyces	Atractiellales	1	1	1
	Dacrymycetes	Dacrymycetales	1	1	1
	Tremellomycetes	Tremellales	1	1	1
3	8	26	81	227	836

According to A.I. Tolmaceov [25], the first 10 families numeric number that have a dominant position among the other taxa, can determine the «face» of a flora. The first 10 families of macromycete (*Russulaceae* - 117, *Agaricaceae* - 63, *Tricholomataceae* - 62, *Cortinariaceae* - 49, *Strophariaceae* – 45, *Boletaceae* - 39, *Psathyrellaceae* - 31, *Inocybaceae* -29, *Pluteaceae* - 29, *Polyporaceae* - 26) include 491 species, or more than half (58.7%) of the total number of species recorded in the studied territory.

For certain reason, we cannot compare in detail the researched macromycobiota to our neighboring regions (Ukraine and Romania) that differ significantly from our country, both by area and by phytogeography and climatic conditions. However, even if we compare the general mycobiota of these countries it is evident the dominance of

Tricholomataceae, *Russulaceae* and *Cortinariaceae* families, which is characteristic for Moldova, in the macromycobiota of the entire Holarctic zone and characterized so as *Holarctic*. Taking in consideration the first places occupied by *Agaricaceae*, *Boletaceae* and *Pluteaceae* families, whose representatives are widely scattered deciduous forests, it can be concluded that macromycobiota of Moldova is of a nemoral character.

Table 2

Taxonomic conspectus of new macromycetes on territory of Moldova with record of the frequency and phenophases[x]

Families	Genera	Species	Frequency	Pheno phases
1	2	3	4	5
Tubiferaceae	Tubifera	T. ferruginosa	Rare	IX-XI
Physaraceae	Fuligo	F. rufa	Rare	III-V
Didymiaceae	Mucilago	M. crustacea	Rare	IX-XI
Stemonitidae	Stemonitis	S. fusca	Rare	IX-XI
Ceratiomyxaceae	Ceratiomyxa	C. porioides	Rare	IX-XI
Helotiaceae	Ascocoryne	A. sarcoides	Rare	VI-XI
Discinaceae	Discina	D. fastigiata	V. rare	III-V
	Gyromitra	G. leucoxantha	Rare	III-V
Helvellacea	Helvella	H. elastica	Rare	III-V
		H. maculata	Rare	V-XI
Morchellaceae	Morchella	M. deliciosa	Rare	III-V
	Verpa	V. digitaliformis	Rare	III-V
Pezizaceae	Peziza	P. varia	Com.	VI-VIII
Pyronemataceae	Tarzetta	T. catinus	Rare	VI-VIII
Sarcoscyphaceae	Sarcoscypha	S. austriaca	Com.	XI-III
Hypocreaceae	Hypocrea	H. sulphurea	Com.	IX-XI
Agaricaceae	Agaricus	A. abruptibulbus	Com.	VI-XI
		A. benesii	Rare	IX-XI
		A. koelerionis	Rare	IX-XI
		A. langei	V. rare	VI-XI
		A. urinascens	Com.	VI-XI
	Calvatia	C. candida	Rare	IX-XI
	Chlorophyllum	Ch. agaricoides	V. rare	VI-VIII
	Cyathus	C. olla	Com.	VI-VIII
	Echinoderma	E. carinii	Rare	IX-XI
	Lepiota	L. forquignonii	Rare	IX-XI
		L. ignivolvata	Rare	VI-XI
		L. severiana	Com.	VI-XI
	Leucoagaricus	L. leucothites	Rare	VI-XI
		L. pilatianus	Rare	VI-XI
		L. sericifer	Rare	VI-XI
	Leucocoprinus	L. birnbaumii	Rare	VI-XI
	Macrolepiota	M. gracilenta	Rare	IX-XI

Amanitaceae	Amanita	A. fulvoides	Rare	VI-VIII
		A. nivalis	Rare	VI-XI
		A. oblongospora	Rare	VI-XI
		A. ovoidea	V. rare	VI-VIII
Bolbitiaceae	Conocybe	C. pilosella	Rare	IX-XI
		C. percincta	Rare	VI-XI
	Panaeolus	P. acuminatus	Com.	III-XI
		P. papilionaceus	Com	IX-XI
		P. rickenii	V. rare	IX-XI
Clavariaceae	Clavulinopsis	C. umbrinella	Rare	VI-XI
Cortinariaceae	Cortinarius	C. aleuriosmus	Rare	IX-XI
		C. amoenolens	Rare	IX-XI
		C. arcuatorum	Rare	IX-XI
		C. balteatocumatilis	Rare	IX-XI
		C. bergeronii	Rare	IX-XI
		C. boudieri	Rare	IX-XI
		C. brunneofulvus	Rare	IX-XI
		C. cinnabarinus	Rare	IX-XI
		C. cyaneus	Rare	IX-XI
		C. decipiens	Rare	IX-XI
		C. dibaphus	Rare	IX-XI
		C. elatior	Rare	IX-XI
		C. flexipes	Rare	IX-XI
		C. fulmineus	Rare	IX-XI
		C. galeobdolon	Rare	IX-XI
		C. glaucopus	Rare	IX-XI
		C. hinnuleus	Rare	IX-XI
		C. largus	Com.	IX-XI
		C. meinhardii	Com.	IX-XI
		C. platypus	Rare	IX-XI
		C. pseudoprivignus	Com.	IX-XI
		C. sodagnitus	Rare	IX-XI
		C. sordescentipes	Com.	IX-XI
		C. subgracilior	Rare	IX-XI
		C. suillus	Com.	IX-XI
		C. talus	Rare	IX-XI
		C. triumphans	Rare	IX-XI
		C. tabularis	Rare	IX-XI
Entolomataceae	Entoloma	E. byssisedum	V. rare	IX-XI
		E. excentricum	Rare	IX-XI
		E. politum	Rare	IX-XI
		E. sepium	Rare	VI-VIII
		E. saussetiense	Rare	IX-XI
	Rhodocybe	Rh. gemina	Rare	IX-XI
		Rh. popinalis	Rare	IX-XI
Hydnangiaceae	Laccaria	L. bicolor	Rare	IX-XI
		L. fraterna	Rare	IX-XI

Hygrophoraceae	Cuphophyllus	C. pratensis	Com.	IX-XI
	Hygrocybe	H. acutoconica	Rare	IX-XI
		H. quieta	Rare	IX-XI
	Hygrophorus	H. arbustivus	Rare	IX-XI
		H. chrysodon	Com.	IX-XI
		H. discoxanthus	Rare	VI-XI
		H. nemoreus	Com.	VI-XI
Inocybaceae	Crepidotus	C. applanatus	Com.	IX-XI
		C. autochthonus	Com.	IX-XI
		C. ehrendorferi	Rare	IX-XI
	Inocybe	I. erubescens	Com.	IX-XI
		I. flocculosa	Com.	IX-XI
		I. hirtella	Rare	IX-XI
		I. paludinella	Rare	IX-XI
Lyophyllaceae	Lyophyllum	L. rhopalopodium	Com.	VI-XI
	Tephrocybe	T. rancida	V. rare	IX-XI
Marasmiaceae	Atheniella	A. flavoalba	Rare	IX-XI
	Gerronema	G. strombodes	Com	VI-XI
Mycenaceae	Hemimycena	H. delectabilis	Rare	IX-XI
		H. lactea	Com.	IX-XI
		H. rickenii	Rare	IX-XI
	Mycena	M. abramsii	Rare	III-XI
		M. aetites	Rare	IX-XI
		M. alba	Rare	IX-XI
		M. filopes	Rare	IX-XI
		M. galopus	Rare	III-XI
		M. pseudocorticola	Rare	III-XI
		M. romagnesiana	Rare	VI-XI
		M. stipata	Rare	IX-XI
		M. vitilis	Rare	VI-XI
		M. zephirus	Com.	IX-XI
Omphalotaceae	Connopus	C. acervatus	Com.	IX-XI
	Gymnopus	G. foetidus	Com.	IX-XI
		G. hybridus	Com.	IX-XI
		G. impudicus	Rare	IX-XI
		G. ocior	Rare	IX-XI
		G. oreadoides	Com.	IX-XI
		G. perforans	Rare	IX-XI
		G. ubpruinosus	Rare	IX-XI
Physalacriaceae	Armillaria	A. gallica	Rare	IX-XI
		A. sinapina	Rare	IX-XI
	Flammulina	F. fennae	V. rare	IX-XI
	Strobilurus	S. esculentus	Rare	VI-XI
Pleurotaceae	Hohenbuehelia	H. fluxilis	Rare	IX-XI

Pluteaceae	Pluteus	P. ephebeus	Rare	VI-XI
		P. exiguus	Rare	IX-XI
		P. inquilinus	Rare	VI-VIII
		P. leoninus	Rare	VI-VIII
		P. podospileus	Rare	IX-XI
		P. primus	Rare	IX-XI
		P. robertii	Rare	IX-XI
	Volvariella	V. murinella	Rare	III-V
Psathyrellaceae	Coprinellus	C. saccharinus	Com.	III-XI
	Coprinopsis	C. romagnesiana	Rare	III-XI
	Coprinus	C. levisticolens	Rare	VI-XI
	Psathyrella	P. artemisiae	Com.	VI-XI
		P. corrugis	Rare	VI-XI
		P. melanthina	Rare	IX-XI
		P. multipedata	Com.	VI-XI
		P. spadicea	Rare	VI-XI
		P.tephrophylla	Rare	IX-XI
		P. typhae	V. rare	IX-XI
Strophariaceae	Agrocybe	A. dura	Rare	V-XI
	Flammula	F. pinicola	Rare	IX-XI
	Hebeloma	H.quercetorum	Rare	IX-XI
		H. pusillum	Rare	IX-XI
		H. submelinoides	Rare	VI-XI
		H. sarcophyllum	Rare	VI-XI
	Hemipholiota	H. populnea	Rare	IX-XI
	Hemistropharia	H. albocrenulata	Rare	VI-XI
	Pholiota	P. alnicola	Rare	VI-XI
		P. ochlochlora	Rare	IX-XI
		P. squarrosoides	Com.	VI-XI
	Stropharia	S. albonitens	Rare	VI-XI
		S. pseudocyanea	Rare	IX-XI
Tapinellaceae	Tapinella	T. panuoides	Rare	VI-XI
Tricholomataceae	Clitocybe	C. infundibuliformis	Rare	VI-XI
		C. phaeophthalma	Rare	VI-XI
		C. phyllophila	Rare	IX-XI
		C. rivulosa	Rare	IX-XI
	Lepista	L. panaeolus	Rare	IX-XI
	Melanoleuca	M. arcuata	Rare	IX-XI
		M. cinereifolia	Rare	IX-XI
		M. grammopodia	V. rare	VI-XI
		M. luteolosperma	Rare	VI-XI
		M. melaleuca	Rare	IX-XI
		M. tabularis	Rare	IX-XI
	Omphalina	O. discorosea	Rare	VI-XI
		O. pyxidata	Rare	IX-XI
	Phyllotopsis	P. rhodophyllus	Rare	IX-XI
	Pseudoomphalina	P. clusiliformis	Rare	IX-XI
		P. compressipes	Rare	IX-XI
	Tricholoma	T. atrosquamosum	Rare	IX-XI
		T. album	Rare	IX-XI
		T. argyraceum	Com.	IX-XI
		T. basirubens	Com.	IX-XI

		T. columbetta	Rare	IX-XI
		T. gausapatum	Rare	IX-XI
		T. saponaceum	Rare	IX-XI
		T. sejunctum	Rare	IX-XI
		T. tridentinum	Rare	IX-XI
		T. ustale	Com.	IX-XI
		T. ustaloides	Com.	IX-XI
	Tricholosporum	T. goniospermum	V. rare	IX-XI
Boletaceae	Boletus	B. depilatus	Rare	VI-XI
		B. ferrugineus	Rare	VI-VIII
		B. legaliae	Rare	VI-VIII
		B. luteocupreus	V. rare	VI-VIII
		B. pseudoregius	Rare	VI-VIII
		B. pulchrotinctus	Rare	VI-VIII
	Leccinum	L. albostipitatum	Com.	VI-XI
		L. molle	Rare	VI-VIII
		L. versipelle	Rare	VI-VIII
	Xerocomellus	X. armeniacus	Com.	V-XI
		X. pruinatus	Com.	V-XI
Gomphidiaceae	Gomphidius	G. glutinosus	Rare	IX-XI
Sclerodermataceae	Scleroderma	S. areolatum	Com.	IX-XI
	Pisolithus	P. arhizus	V. rare	VI-VIII
Suillaceae	Suillus	S. grevillei	V. rare	VI-XI
Geastraceae	Geastrum	G.pectinatum	Rare	IX-XI
Gomphaceae	Gautieria	G. graveolens	Rare	VI-VIII
	Ramaria	R. flavobrunnescens	Rare	IX-XI
Hymenochaetaceae	Inonotus	I. nidus-pici	Rare	VI-VIII
Phallaceae	Phallus	P.hadriani	Rare	IX-XI
Ganodermataceae	Ganoderma	G.resinaceum	Com.	I-XII
Meripilaceae	Physisporinus	P. vitreus	Com.	IX-XI
	Rigidoporus	R. ulmarius	Rare	IX-XI
Polyporaceae	Polyporus	P.leptocephalus	Rare	VI-XI
		P. meridionalis	Com.	I-XII
		P. picipes	Rare	IX-XI
Auriscalpiaceae	Lentinellus	L.inolens	Rare	VI-XI
Hericiaceae	Hericium	H.abietis	Rare	IX-XI
Russulaceae	Lactarius	L. acris	Rare	IX-XI
		L. chrysorrheus	Rare	IX-XI
		L.deterrimus	Rare	VI-XI
		L.evosmus	Rare	VI-XI
		L.illyricus	Rare	VI-VIII
		L.pyrogalus	V. rare	VI-XI
		L.romagnesii	Rare	VI-VIII

		L.rubrocinctus	Rare	VI-XI
		L.sanguifluus	Com.	IX-XI
		L.tabidus	Rare	VI-X
		L. trivialis	Rare	VI-VIII
		L.uvidus	Com.	IX-XI
		L. zonarius	Com.	VI-XI
	Lactifluus	L. rugatus	V. rare	VI-X
	Russula	R.amarissima	Com.	VI-VIII
		R. anatina	Rare	VI-XI
		R. atropurpurea	Rare	VI-X
		R. aurantiaca	V. rare	VI-X
		R. aurora	Rare	VI-X
		R. camarophylla	V. rare	Vi-VIII
		R. cuprea	Rare	VI-VIII
		R. curtipes	Rare	VI-VIII
		R. decipiens	Rare	VI-VIII
		R. faginea	Com.	VI-VIII
		R. fragilis	Rare	VI-YIII
		R. graveolens	Rare	VI-YIII
		R. laeta	Rare	VI-VIII
		R. lepidicolor	Com.	VI-VIII
		R.lilacea	Rare	VI-VIII
		R. melitodes	Rare	VI-XI
		R. minutila	Rare	VI-VIII
		R. nana	Com.	VI-VIII
		R. nobilis	Com.	VI-VIII
		R. nugarica	Rare	VI-VIII
		R. ochracea	Rare	VI-VIII
		R. pectinatoides	Com.	VI-XI
		R. persicina	Com.	VI-XI
		R.praetervisa	Rare	VI-VIII
		R.puellula	Com.	VI-XI
		R. raoultii	Rare	VI-VIII
		R. roseicolor	Rare	VI-XI
		R. rubra	Rare	VI-VIII
		R. rubroalba	Rare	VI-XI
		R. rutila	Com.	VI-VIII
		R. subfoetens	Com.	VI-XI
		R. subrubens	Rare	VI-VIII
		R.subterfurcata	Com.	VI-XI
		R. tinctipes	Rare	VI-VIII
		R. veternosa	Rare	VI-XI
		R. zvarae	Rare	VI-VIII
Sebacinaceae	Sebacina	S. concrescens	Rare	VI-XI

[X] - in this paper we used the taxonomic system from X-s edition of "Dictionary of the Fungi" [29] and in accordance with the current used by Kirk et al. [34].

CONCLUSIONS

The taxonomic diversity research of macromycetes in Moldova resulted in identifying 836 taxa belonging to 227 genres 81 families, 26 orders, 8 classes, falling into 3 phyla from 2 kingdoms - *Fungi* and *Protozoa*.

From 836 species recorded to date in Moldova, 263 are listed in premiere. From the inventory of macromycete mentioned for the first time 58 are rated as common, 186 as rare, 18 as very rare, of which 3 are listed in the endangered category.

Bazidiomycota phylum is the most representative of studied macromycobiota. This phylum enlists 765 species belonging to 188 genera from 58 families, 17 orders and 3 classes. It is followed by phylum *Ascomycota* with 55 species belonging to 29 genera from 15 families, 5 orders and 3 classes, and phylum *Micetozoa* represented by 16 species belonging to 10 genera, from 8 families, 4 orders of *Myxogastria* class.

The numerical distribution of the first 10 families (*Agaricaceae, Boletaceae, Cortinariaceae, Inocybaceae, Pluteaceae, Polyporaceae, Psathyrellaceae, Russulaceae, Strophariaceae, Tricholomataceae*) includes 491 species, which represents more than half (58.7%) of the total number of species recorded in the studied territory.

The *Tricholomataceae, Russulaceae* and *Cortinariaceae* families occupy the dominant position in the macromycobiota of the entire *Holarctic*. At the same time the top places occupied by *Agaricaceae, Boletaceae* and *Pluteaceae* families, whose representatives are widely spread in all deciduous forests, indicates a nemoral character of macromycobiota in Republic of Moldova.

BIBLIOGRAPHY

1. Begu A. ş.a. Lumea vegetală a Moldovei. Vol.1: *Ciuperci. Plante fără flori*. Chişinău: Ştiinţa, 2007. 200 p.

2. Constantinescu O. *Metode şi tehnici în micologie.* Bucureşti: Ceres, 1974. 215 p.

3. Manic Ş. ş.a. *Cercetări asupra macromicetelor din Rezervaţia „Codrii".* În: Tezele rapoartelor simpozionului jubiliar „Rezervaţia „Codrii"- 25 de ani. Realizări, probleme, perspective". Lozova, 1996, p. 199-201.

4. Manic Ş. ş.a. *Rezervaţia "Codrii " diversitatea biologică*. Chişinău: Ştiinţa, 2006. 92.

5. Manic Ş. ş. a. *Conspectul diversităţii biologice a Rezervaţiei "Codrii".* Chişinău: Ştiinţa, 2011. 328 p.

6. Negrean G., Manic Ş. *Micromicete din Rezervaţia „Codrii"* În: Materialele Conferinţei ştiinţifice a Botaniştilor, "Ocrotirea, reproducerea şi utilizarea plantelor". Chişinău, 1994, p. 186-187.

7. Negrean G., Manic Ş. *Ciuperci parazite din Rezervaţia „Codrii"* (excl. Hymenomycetes & Gasteromcetes). În: Tezele rapoartelor simpozionului jubiliar „Rezervaţia „Codrii"- 25 de ani. Realizări, probleme, perspective". Lozova, 1996, p. 215-217.

8. Obuh P. ş.a. *Diversitatea şi răspândirea Afiloforalelor (ord. Aphylophorales) în Rezervaţia "Plaiul fagului" şi pădurile adiacente.* În: Dezvoltarea durabilă a sectorului forestier al Republicii Moldova. Materialele conferinţei ştiinţifice internaţionale. Chişinău, 2003, p. 250-257.

9. Savulescu T., Rayss T. *Materiale pentru flora Basarabiei.* Bucureşti, 1924, p. 1- 192.

10. Sălăgeanu Gh., Sălăgeanu A. *Determinator pentru recunoaşterea ciupercilor comestibile*.

11. Ungureanu I., Rayss T., Obuh P. *Contribuţii la cunoaşterea florei ciupercilor din pădurile Moldovei.* În: Bilanţul activităţii ştiinţifice a USM în anii 2000-2002. *Tezele conf.corpului didactico-ştiinţific.* Chişinău, 2003, p. 213-214.

12. .Андреев В. Н. *Ядовитые растения Молдавской ССР.* - Кишинев: Госиздат Молдавии, 1949. – 80 с.

13. 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.

14. Вассер С. П. *Флора грибов Украины. Агариковые грибы.* Киев: "Наукова думка", 1980, 327 с.

15. Декенбах К.Н. *Грибы Бессарабии.* В: Бот. записи СПб университета, XY, 1899, 1-57 с.

16. Маник С.И. *Видовой состав агариковых грибов Центральной части Молдавии.* В: Известия АН. МССР. 1978. Серия биол. и химич. Наук. № 3 с. 45-51.

17. Маник С.И., *Новые для микофлоры СССР виды агариковых грибов Молдавии.* В: Изв. АН МССР. 1981. Серия биол. и химич. наук. № 2, с. 82- 83.

18. Маник С.И., Павел М.Н., *О профилактике отравлении грибами.* В: Тезисы докладов I съезда гигиенистов и санитарных врачей Молдавской ССР,1982, с. 184- 185.

19. Маник С.И. *Шляпочные грибы Реденского леса Молдавии.* В: Рукопись деп. в ВИНИТИ. 2843-В87. 1987. 12 с.

20. Нездойминого Э.Л. *Семейство паутинниковые.* Санкт-Петербург: Наука, 1996. 408 с.

21. Николаева М.Г. *Шляпочные грибы Лозовского лесничества.* В: Труды III научн. конф.молодых ученых Молдавии. Кишинев: Штиинца, 1964, с. 17-18.

22. Попушой И.С. *Плодовые гнили монилиальный ожог плодовых деревьев.* Кишинев: Картя Молдовеняскэ, 1963. 26 с.

23. Простакова Ф. Г. *Видовой состав грибов на плодах грецкого ореха.* В сб.: Грибы на культурных растениях Молдавии. Кишинев: Штиинца, 1976, с. 14-24.

24. Срединский Н.К. *Материалы для флоры Новороссийского края и Бессарабии.* Одесса, 1872-1873, 2, с. 73-129.

25. Толмачев А.*И. Введение в географию растений.* Л.: Ленингр. ун-т, 1974. 243 с.

26. Bon M. *Champignons de France et d´Europe occidentale.* Paris: Arthaud, 1988. 368 p.

27. Courtecuisse R. *Champignons d'Europe.* Paris: Delachaux et Niestlé Lausanne, 2000. 465 p.

28. Jülich W. *Guida alla deteminazione dei funghi. Aphyllophorales, Heterobasidiomycetes, Gastromycetes.* Saturnia, 1989. 553 s.

29. Kirk P. et al. *Dictionary of the fungi. 10th Edition.* CABI Bioscience, UK, 2008. 784 p.

30. Manic Ş., Manic T. *Contribution to the truffles researches in Republic of Moldova*. In: XV Congress of European Mycologists, Saint Petersburg, Russia, September 16-21, 2007, p. 133-134.

31. Moser M. *Guida alla determination dei funghi. Polyporales, Boletales, Agaricales, Russulales*). 3, Trento: Saturnia, 1993. 565 p.

32. Romagnesi H. *Les Russules d´Europe et d´Afrique du Nord.* Paris: Bordas, 1967b. 998 p.

33. Roux P. *Mille et un champignons.* France: Roux–Sainte Sigolène, 2006 . 876 p.

34. www.indexfungorum.org

RARE SPECIES OF THE GENUS *PAEONIA* L. UNDER INTRODUCTION IN REPUBLIC BASHKORTOSTAN

Reut A.A., Mironova L.N.

Federal State Institution of Science Botanical Garden-Institute, Ufa Scientific Center, Russian Academy of Sciences

Summary: On the basis of the Botanical Garden-Institute, Ufa Scientific Center, were created collections and seed orchards of four rare species of peony. Work began on their introduction study. It is shown that in a culture, these species are characterized by high stability, superior indices for most morphometric parameters and seed production.

INTRODUCTION

Peonies have appeared on our planet as scientists assume, during the cretaceous period. In A.L. Tahtadzhjana's opinion (1980) is an ancient deadlock branch of evolution with the extremely imperfect device of reproduction (slow development of seedlings, long formation of renewal buds, absence of annual forms) [3]. Therefore peonies demand careful studying and protection. Till our time family *Paeoniaceae* was kept as monotypic with the only genus *Paeonia* [7].

The majority of peonies have food and decorative value, are good bee plants. But they represent the greatest interest as herbs included in official medical practice. The growing requirement for raw material cannot be satisfied only with resources of natural flora. With the purpose of preservation of a gene pool of rare species of peony and creation of additional sources of medicinal raw material, a study on their biological features for introduction to culture and creation of artificial plantations in a forest-steppe zone of Bashkortostan is carried out.

Peons tend to slow seed germination and seedling development. Their seeds have underdeveloped embryo and low activity of the main enzymes [2]. Among the methods that accelerate the germination of seeds, the greatest attention is paid to the treatment of physiologically active substances [9]. Thus, according to a guide to the germination of dormant seeds [6], the treatment of seeds *P. suffruticosa* Andr. with gibberellin acid eliminates rest epicotyl, replacing cold stratification. We have not identified literary sources containing information about the effects of growth regulators on other types of peony.

Since the peonies need for germination decreased temperature, they are sown before winter, in the year when seeds are harvested [2]. Underground germination is typical of most wild herbaceous peonies [7].

The task of our research - identifying effective synthetic growth regulators for rapid seed multiplication of peonies to preserve the gene pool of economically valuable forms of culture.

In Ufa botanical garden, the work to identify opportunities for accelerated reproduction of Chinese peony was started in the 50-ies of XX century by Kravchenko O.A. To improve seed germination in the laboratory, different ways of processing were used: sulfuric acid, drying and heating at 35°, the removal of impaling shell and freezing. Significant positive results when using these methods were not mentioned. The best results were obtained by sowing seeds of Chinese peony immediately after harvest, under the wax ripeness in greenhouse. By next spring they sprouted 100% [4].

MATERIALS AND METHODS

As objects of researches, 4 species of a peony of a collection of Botanical garden - institute of the Ufa center of science of the RAS were used: *Paeonia anomala* L. - it is included in the Red book of Republic Bashkortostan (2001), it is related to the category 1 – a species threatened with extinction; *P. hybrida* Pall. – endemic of Altai, recently found out on the territory of Republic of Bashkortostan, it is offered for inclusion in the Red book of the Russian Federation; *P. tenuifolia* L. - it is included in the Red book of the USSR (1984); *P. wittmanniana* Hartwiss ex Lindl. – endemic of Caucasus, it is included in the Red book of the USSR (1984) [5].

Studies were carried out on plots of the collection section peonies of laboratory of introduction and selection of flower plants of Botanical Garden-Institute, Ufa Science. Agricultural activities include weeding, hoeing, watering as needed.

A study of decorative and economically useful features was carried out in the open ground according to the "Methodology state strain testing decorative cultures" (1960). A study of the seasonal rhythm of plants was carried out according to the standard procedure of phenological observations in the botanical gardens (1972). The seed production was calculated according to the method of I.V. Vaynagy (1974) [1].

RESULTS AND DISCUSSIONS

In 2011, on the basis of the Botanical garden, work has begun on seed breeding of rare species of peony in the Republic Bashkortostan in the open ground. Mature seeds were sown freshly harvested in late July at a depth of 4 cm, according to the recommendations of Dumitrashko A. [2].

In 2012, the first results were obtained. Field seed germination of *P. anomala* L. reached - 38%, *P. hybrida* Pall. - 47% i.e. it was sufficiently high.

In spring 2013, at *P. anomala* L. grew further 15 - 23% of seeds, at *P. hybrida* Pall. new shoots were not observed. Thus, the period of seed germination depends on the specific features of peonies.

Also, in 2011, the experiments on the intensification of seed germination of species of peonies were carried out in the open ground using 9 physiologically active substances (Heteroauxin, Krezatcina, Fitton, and new PAC: Riftal - synthesized in the Bashkir State University; Fetil, TD-2, TD-3, TD-4, TD-5 - synthesized in the Ufa State Oil Technical University [8]). Were tested different concentrations of PAC exposure and processing of freshly mature seeds before sowing [1]. Variants and experimental results are presented in Table 1.

The maximum value of seed germination (65%), in 2012, was obtained from *P. anomala* L. embodiment in Heteroauxin 0.01% with a 2-hour exposure. In spring 2013, rose another 5 to 43% of the number of seeds sown, depending on the version of the experience. Total (for two years) seed germination ranged from 30 (Heteroauxin 0.01% at 24 - hour exposure) to 83% (Heteroauxin 0.01% at 2- hour exposure). Compared with the control in the experiments: TD-2 0.0005%, TD-4 0.0005%, Heteroauxin 0.01%, Fiton 0.01%, Krezatcin 0.01% with 2 - hour exposure, the germination of seeds increased 1.2 - 1.6 times (Table 1). A further increase in processing time (24 hours) did not produce positive results, and in some versions of the experiment, even inhibited seed germination.

Table 1

The results of field experiments on seed germination *Paeonia anomala* L. (seeding of 2011)

№ p/p	Variants of experience	Concentration of physiologically active substances,%	% germination in 2012 / 2013 / total	
			exposure 2 hours	exposure 24 hours
1.	Kontrol	water	38/ 15/ 53	43/ 23/ 66
2.	Riftal	0,0005	28/ 23/ 51	60/ 5 / 65
3.	Fetil	0,0005	25/ 33/ 58	35/ 23/ 58
4.	TD-2	0,0005	40/ 28/ 68	20/ 43/ 63
5.	TD-3	0,0005	28/ 18/ 46	13/ 23/ 36
6.	TD-4	0,0005	50/ 20/ 70	13/ 33/ 46
7.	TD-5	0,0005	35/ 23/ 58	23/ 13/ 46
8.	Heteroauxin	0,01	65/ 18/ 83	5 / 25/ 30
9.	Fiton	0,01	40/ 20/ 60	23/ 8 / 31
10.	Kresacin	0,01	43/ 28/ 71	33/ 10/ 43

CONCLUSIONS

The received results will allow solving successfully a problem of preservation of rare and valuable genotypes of a peony in conditions of culture, to expand a raw-material base, to reduce terms of reception of a mass planting material, and also to reveal alternative sources of medicinal raw material.

Thus, the use of PAC to enhance seed germination of peony seems promising.

However, the feedback of regulators of growth depends significantly on the specific features of peonies. Thus, PAC influence on seed germination of *P. hybrida* Pall. in the studied experimental variants has not been identified. For each species is necessary to select individual physiologically active substances and the optimal conditions for their use.

BIBLIOGRAPHY

1. Реут А.А., Миронова Л.Н., Федяев В.В. Использование регуляторов роста при семенном размножении растений семейства *Paeoniaceae* Rudolphi // Вестник Башкирского университета.2006. Т. 11. № 4. С. 51-53.

2. Думитрашко А.И. Пионы. Кишинев: «Штиинца», 1984. 96 с.

3. Жизнь растений / Под. ред. Тахтаджяна А.Л. М.: Просвещение, 1980. Т. 5 (1). 432 с.

4. Кравченко О.А. Селекция пионов в Ботаническом саду БФАН СССР // Интродукция и селекция декоративных растений в Башкирии. Уфа. 1978. С. 36-52.

5. Красная книга Республики Башкортостан. Редкие и исчезающие виды высших сосудистых растений / Под ред. Е.В. Кучерова. Уфа: Китап, 2001. Т.1. 280 с.

6. Николаева М.Г., Разумова М.В., Гладкова В.Н. Справочник по проращиванию покоящихся семян. Ленинград: Наука, 1985. 346 с.

7. Успенская М.С. Пионы. М.: ЗАО «Фитон+», 2002. 208 с.

8. Хлебникова Т.Д., Покало Е.И., Кантор Е.А. Фэтил – новый регулятор роста растений для приусадебных и фермерских хозяйств. Уфа: УГНТУ, 1999. 77 с.

9. Эмбриология цветковых растений. Терминология и концепции / Под ред. Батыгиной Т.Б. СПб: Наука, 1997. С. 656-681.

BIOLOGICAL PECULIARITIES OF SPECIES OF THE GENUS *MEDICAGO* L. FROM BOTANICAL GARDEN OF THE ACADEMY OF SCIENCES OF MOLDOVA

Teleuță Alexandru, Țîței Victor

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

Abstract. We investigated the agrobiological peculiarities, biochemical composition and nutritional value of the natural fodder of 14 species of the genus Medicago L.: M. falcata L., M. varia Mart., M. borealis Grossh., M. tianschanica Vass., M. difalcata Sinsk., M. trautvetteri Sumn., M. intertexta Miller, M. transoxana Vass., M. agropyretorium Vass., M. cancellata M.B., M. polychroa Grossh., M. glutinosa M.B., M. hemicycla Grossh. Medicago sativa L. was used as control. It was found out that, at the first mowing, the species M. tianschanica, M. varia M. trautvetteri, M. polychroa and M. agropyretorium have a productivity of 1.79-2.14 kg/m^2 exceeding by 8-27% the control, with a nutritional value of the fodder – 0.20-0.23 n.u. /kg and a content of digestible protein – 170.0- 211.6 g/n.u.

Key words: agrobiological peculiarities, fodder leguminous plants, nutritional value, productivity, species of genus *Medicago*

INTRODUCTION

The development of the animal husbandry sector requires provision and diversification of fodder production so that it will be balanced in terms of quantity and quality throughout the year, according to the physiological requirements of animals and the stability of animal production that will meet the market requirements. In the world flora, have been identified more than 50 000 species of plants that are used as foods by animals, but, only about 150 species are cultivated. It is known that the plants of the family *Fabaceae* Lindl. are characterized by a high content of protein and essential amino acids, but, of the approximately 19 000 species, very few are used as crop plants. The fodder leguminous plants contribute to biological nitrogen accumulation in the soil, to the improvement of soil's physical and chemical characteristics, to the formation of soil's structure and its recovery, they play an important role in increasing the quality of feed because they contain significant amounts of protein, vitamins and minerals, increasing the nutritional value of fodder and animal production [3, 5, 14]. Alfalfa is considered one of the primary herbs used as fodder and the main source of production of vegetable protein. The genus *Medicago* L. of the family *Fabaceae* Lindl. subfamily *Papilononoidae*, tribe *Trifolieae,* comprises three subgenera and 87

species [7]; in our country, six species are known [6]; alfalfa (*Medicago sativa* L.) is often grown as fodder crop [4]. Alfalfa species show a high ecological plasticity through their resistance to heat, drought, salts and low temperatures, efficient use of water resources, their capacity to regenerate quickly after mowing and the fact that they can be cultivated in different geographical areas (arid steppes and forest steppes, in meadows, on various types of soils, but, with neutral or low alkaline reaction). In the world, alfalfa is cultivated on an area exceeding 35 million hectares. The forage value, very high digestibility and high content of estrogenic substances make alfalfa influence positively the productivity and the reproductive cycle of animals and that's why it is considered "the queen of the forages" [1, 2, 4, 10,11,14]. After over six decades of scientific research on plant resource mobilization, the Collection of nontraditional fodder plants of the Botanical Garden (Institute) of the ASM, which includes over 300 species and cultivars, including 70 fodder leguminous plants, has been founded. The genus *Medicago* L. is represented by 26 species from different floristic regions of Central and South Europe, Caucasus, Central Asia. The seed material was collected as a result of expeditions and international exchange of seeds [8, 9, 17, 18]. In order to improve the situation regarding fodder productivity and quality, the areas where fodder crops grow need to be expanded and the range of fodder leguminous plants needs to be widened mobilizing native species and species from other floristic regions whose biological peculiarities, productivity, biochemical composition and nutritional value must be studied. These issues have determined the choice of the object of study.

MATERIALS AND METHODS

The species of the genus *Medicago* L.*: M. falcata* L., *M. varia* Mart. and *M. borealis* Grossh. (Central European flora), *M. tianschanica* Vass*., M. difalcata Sinsk., M trautvetteri Sumn., M. intertexta Miller, M. transoxana* Vass*.,* and *M. agropyretorium* Vass*.* (Middle Asian flora), *M. cancellata* M.B., *M. polychroa* Grossh*., M. hemicycla* Grossh. and *M.glutinosa* M.B. (Caucassus flora) were the object of study. *Medicago sativa* L. (alfalfa), served as control variant. The experiments were performed on non-irrigated experimental land in the Botanical Garden (Institute) of the ASM, on usual chernozem; they started in spring, when the soil had reached the physical readiness. The seeds were sown at a depth of 1.5-2.0 cm with soil compaction before and after sowing. The evidence area of the plot was of 10 m^2. The number of repetitions –4. The scientific researches on growth and development, productivity and nutritional value of first mowing were carried out according to the methodical indications [12, 13, 16].

RESULTS AND DISCUSSIONS

As a result of the performed researches, Table 1, it was found that the studied species of the genus *Medicago* L. differ significantly regarding the period of seed germination and seedling emergence at the soil surface. At the species *M. tianschanica*

and *M. hemicycla* the seedlings emerge at the surface after 7 days, that is 4 days earlier than the control *M. sativa,* and at the species *M. falcata, M. polychroa* and *M. agropyretorium* this period starts 5 days later in comparison with the control. The species M. *cancellata, M. glutinosa* and *M. trautvetteri* are characterized by the latest period of seedlings' emergence (28-31 days). The species *M. agropyretorium, M. transoxana, M. borealis* and *M. hemicycla* need a longer period until bud formation than the control. We could mention that the flowering period and ripening of seeds of the species *M. intertexta* start 19 days earlier in comparison with *M. sativa*. A very long period of formation of flower buds, flowering and ripening of seeds is characteristic of the plants of *M. hemicycla*. The species *M. tianschanica* and *M. cancellata* need 121-128 days and *M trautvetteri*, *M. polychroa, M. agropyretorium, M. transoxana*, *M. borealis* – 152-159 days until the complete ripening of seeds.

Table 1

Biological peculiarities and productivity of plants of the genus *Medicago* L.

Indices	M. sativa	M. falcata	M. varia	M. tianschanica	M. agropyretorium	M. cancellata	M. glutinosa	M. difalcata	M. borealis	M. hemicycla	M. polychroa	M. intertexta	M. transoxana	M. trautvetteri
Sowing – emergence of seedlings, days	11	16	11	7	16	30	28	15	14	7	16	11	14	31
Seedlings – emergence of flower buds, days	57	63	61	55	56	43	51	60	57	76	63	41	70	62
Seedlings - flowering, days	68	83	69	72	90	72	73	77	92	102	88	56	90	89
Seedlings - ripening of seeds, days	112	144	111	121	155	128	140	147	159	163	154	93	155	152
Plant height at flowering, cm	96.6	81.7	108.2	83.4	82.5	80.6	43.9	84.8	87.2	77.3	72.0	55.2	83.5	84.0
Yield of fresh mass, 1 mowing, kg/m^2	1.68	1.36	2.02	2.14	2.00	1.21	0.64	1.29	1.57	1.03	1.79	0.43	1.24	1.93
Yield of dry mass, kg/m^2	0.50	0.36	0.61	0.66	0.58	0.33	0.19	0.39	0.46	0.31	0.48	0.09	0.35	0.65
Seed production, g/m^2	27.1	56.0	20.0	19.2	14.8	15.0	16.5	8.62	2.09	17.1	2.90	14.39	3.90	8.04
The weight of 1000 seeds, g	1.8	1.8	2.3	2.0	1.9	1.8	1.9	1.7	2.0	2.0	2.0	1.3	1.7	1.9

The studied species have a different rate of growth and development. Thus, in the flowering period, the plants of *M. varia* are 108.2 cm tall that is by 11.6 cm taller than the control, the species *M. agropyretorium, M. borealis, M. cancellata, M. difalcata, M. transoxana*, *M. trautvetteri, M. tianschanica* reach 82.5 – 87.2 cm

tall, and the shortest are the plants of *M. intertexta* and *M. glutinosa*. It is known that the rate of growth and development influence the formation of natural fodder and the accumulation of dry mass. A high productivity of fresh mass at the first mowing is found at the species *M. tianschanica* – about 2.14 kg/m^2 that is 27% higher compared with the control, and the species *M. polychroa, M. trautvetteri, M. varia*, *M. agropyretorium* – 1.79-2.02 kg/m^2. *M. intertexta* and *M. glutinosa* plants have a very low productivity of fresh mass because they are small. Analyzing the seed productivity, we can mention that the some studied species of the genus *Medicago* L. (*M. borealis, M. polychroa, M. transoxana, M. trautvetteri*) have a very low seed yield in comparison with alfalfa (2.09 - 8.04 g/m^2). *M. falcata* forms 56.0 g/m^2. The weight of 1000 seeds of studied species of the genus *Medicago* L. is different. The smallest seeds were found at the species *M. intertexta* (1.3 g), but the highest – at *M. varia, M. tianschanica* (2.0 g).

A higher dry matter content in the natural fodder is observed at the species *M. difalcata, M. polychroa, M. borealis, M.tianschanica* reaches 31.0-33.5% and it exceeds essentially the control; the species *M. falcate, M. cancellata, M. transoxana* are characterized by a low content of up to 27%. The natural fodder of the species *M. intertexta* is characterized by a very low dry matter content-19.9%. The animal body, in order to maintain its vital functions and to give different production, needs permanently exogenous nutrients. Protein substances are essential as a limiting factor for the manifestation of the productive potential. The content of raw protein in the studied species, Table 2, is of 29.5 g/kg in *M. intertexta*, it reaches 53.8- 62.1 g/kg in *M. varia, M. polychroa*, *M. hemicycle, M. tianschanica, M. agropyretorium* compared with 48.7 g/kg in *M. sativa*. The vegetable fats in fodder are the main source of energy for the animals because they are necessary for the organism in order to ensure the normal development of vital processes and transportation of soluble vitamins in fatty acids and it also contributes to the accumulation of fat in the milk. The studied species of the genus *Medicago* L. are distinguished by a high content of fat. The species *M. polychroa , M.tianschanica ,M. agropyretorium, M. glutinosa* and *M. cancellata* are the richest in fats (7.1-10.0 g/kg natural fodder). It is known that the cellulose content in feed, its insufficiency, but in most cases its excess, adversely affects the metabolic processes of organisms. The species *M. agropyretorium, M. cancellata ,M. varia, M. glutinosa* are characterized by a low content of cellulose (86.6-101.1 g/kg natural fodder), *M. difalcata* has the highest index.

The nitrogen free extractive (NFE) substances consist of soluble mono and polysaccharides (sugar, starch etc.) and provide animals with necessary energy for vital processes, contributing to the formation and storage of fat. The species *M. difalcata* is notable for its high content of nitrogen free extractive substances, *M. intertexta, M. falcata* and *M. hemicycla* have the lowest content of nitrogen free extractive substances, the other species are at the same level as the control. The organic

Table 2

Biochemical composition and nutritional value of natural forage of plants of the genus *Medicago* L.

Indices	M. sativa	M. falcata	M. varia	M. tianschanica	M. agropyretorium	M. cancellata	M. glutinosa	M. difalcata	M. borealis	M. hemicycla	M. polychroa	M. intertexta	M. transoxana	M. trautvetteri
Nutritive Units	0.20	0.17	0.25	0.20	0.23	0.21	0.23	0.23	0.22	0.18	0.23	0.14	0.19	0.21
Metabolizable energy, MJ/kg	2.63	2.33	2.86	2.73	2.64	2.45	2.66	3.02	2.83	2.48	2.95	1.70	2.49	2.70
Dry matter, g/kg	295.1	265.4	302.0	310.0	291.9	269.0	300.0	335.0	318.0	285.0	330.0	199.0	279.0	301.0
Raw protein, g/kg	48.7	48.7	62.1	56.4	53.8	41.5	50.4	42.1	51.3	58.2	60.6	29.5	46.9	47.6
Raw fats, g/kg	4.7	5.8	4.8	7.1	8.8	8.1	8.1	5.8	5.5	6.3	10.0	4.4	6.1	6.2
Raw cellulose, g/kg	104.7	102.0	95.4	117.5	87.6	90.7	99.9	121.3	113.2	108.8	114.2	76.2	101.1	107.5
NFE substances , g/kg	112.0	86.5	111.9	103.9	116.0	110.2	114.3	142.5	121.7	85.8	118.7	68.0	103.0	116.5
Minerals, g/kg	25.0	22.0	27.8	25.1	25.7	19.4	27.3	23.3	26.3	25.8	26.5	20.9	22.0	23.2
Calcium, g/kg	5.0	5.2	5.0	5.7	10.3	5.9	7.8	9.3	5.9	10.0	9.7	4.2	7.6	8.4
Phosphorus, g/kg	1.3	1.2	1.7	1.5	1.4	1.4	2.0	2.0	1.4	1.7	1.6	1.1	1.2	1.6
Iron, mg/kg	77.8	57.3	130.6	58.0	54.6	71.9	210.0	65.8	72.0	84.0	75.9	112.6	66.9	51.62
Carotene, mg/kg	4.7	7.5	3.2	8.5	9.2	7.8	10.7	9.8	10.0	10.1	13.0	2.0	9.7	9.5
Digestible protein, *g/n.u.*	182.6	242.7	196.2	211.6	175.6	148.2	164.5	137.2	174.8	242.7	198.2	157.9	185.2	170.0

matter content, the chemical composition and the digestibility reflect the nutritional value of the fodder. Thus, 100 kg of natural fodder contains 14 – 25 nutritive units supplied with metabolizable energy of 170 - 302 MJ. We found that the species *M. agropyretorium, M. varia, M. glutinosa, M. difalcata, M. borealis, M. polychroa, M. trautvetteri* and *M. tianschanica* have a high nutritional value of the fodder and *M. intertexta , M. falcata* – a low one, due to the low content of dry matter. The natural forage of the studied species of the genus *Medicago* L. contains a normal amount of protein which corresponds to the zootechnical standards, so, 137. 2 – 247.2 grams of digestible protein correspond to a nutritional unit and the highest content is found in the forage at the species *M. falcata*, *M. tianschanica* and *M. varia.* The presence of minerals in animal nutrition is indispensable for their growth and health, because they are essential components of all tissues and organs that maintain osmotic pressure at a constant level, participate in the regulation of acid-base balance, activate a number of enzymes, moderate the neuromuscular activity, prevent the emergence and development of diseases of animals. The minerals in the natural fodder of the studied species of the genus *Medicago* L. constitute 19.40 – 27.80 g/kg, the species *M. varia, M. borealis* and *M.glutinosa* surpass the control at this index, having also a high content of phosphorus of 1.7-2.0 g/kg and iron – 130.6- 210.0 mg/kg. Biologically active substances (vitamins, hormones) are in very small quantities and play a crucial role in obtaining the desired animal products. Carotene is a precursor of vitamin A. The studied species have a high content of carotene, especially *M. polychroa, M. glutinosa, M. agropyretorium, M. difalcata, M. borealis*, *M. borealis, M. trautvetteri* and *M. tianschanica* (8.5-13.7mg/kg).

CONCLUSIONS

The species *Medicago tianschanica*, *Medicago varia, Medicago trautvetteri, Medicago polychroa* and *Medicago agropyretorium* have a productivity of 1.79-2.14 kg/m^2 exceeding by 8-27% the control, with a nutritional value of the fodder – 0.20-0.23 n.u. /kg and a content of digestible protein – 170.0- 211.6 g/n.u.

These species can serve as initial material for improving and implementing new varieties of leguminous plants for fodder production.

BIBLIOGRAPHY

1. Crochemore M. L. 1998. Variabilidade genética da alfafa: marcadores agromorfológicos e moleculares. Londrina: IAPAR. 59p.

2. Gholami A, De Geyter N, Pollier J, Goormachtig S, Goossens A**.** 2014. Natural product biosynthesis in *Medicago* species. *Natural Product Reports* **31** (3): 356–380.

3. Lewis G., Schrire B., Mackinder B., Lock M.. 2005. Legumes of the world. Royal Botanic Gardens, Kew, UK.

4. Lupascu M. 2004.Lucerna: importanța ecologică şi furajeră. Ştiința. Chişinău. 304 p.

5. Lüscher A., Mueller-Harvey I., Soussana J.F., Rees R.M., Peyraud J.L.2013. Potential of legume-based grassland-livestock systems in Europe. Grassland Science in Europe,18, 3-29.

6. Negru A.2007. Determinator de plante din flora Republicii Moldova. Universul. Chişinău. 391 p.

7. Small E.2011. Alfalfa and relatives:Evolution and classification of Medicago CABI. 727p.

8. Teleuță A. 2010. Introducerea şi studierea plantelor furajere netradiționale: realizări şi perspective. Mat. Simpozion "Conservarea diversității plantelor ". Chişinău . p. 425-432.

9. Teleuță A., Sergentu E. 1995.Toleranța la secetă a speciilor de lucernă. Rezumatele lucrărilor simpozionului național de fiziologie a plantelor. Bucureşti, p. 37.

10. Varga P., Moga I., Kellner E., Bălan C., Ionescu M. 1973. Lucerna. Ceres. Bucureşti. 301 p.

11. Vîntu V., Stavarache M., Samuil C., Muntianu I.C.. 2012 Chemical composition dynamics of alfalfa (Medicago sativa L.) at different plant growth stages, Grassland Science in Europe - Grassland a European Resource?. Vol. 17. p. 394-396.

12. Ермаков А.И. (ред). 1987. Методы биохимического исследования растений. Агропроиздат. Л.. 430 с.

13. Иванов А.И. 1985. Изучение коллекций многолетних кормовых растений (методические указания). Л. 48 с.

14. Колясникова Н. Л. 2012. Эмбриология некоторых кормовых растений семейства Fabaceae Lindl. Вестник Пермского университета. Серия: Биология. 2.с.4-7.

15. Ларин И.В и др. 1951. Кормовые растения сенокосов и пастбищ СССР. II том. Двудольные. Сельхозгиз. М. 948с.

16. Новоселов Ю.К. (ред). 1983. Методические указания по проведению полевых опытов с кормовыми культурами. ВНИИК.М. 197 с.

17. Телеуцэ А. 1989. Люцерна тяньшанская – перспективная кормовая культура в Молдавии.Тезисы докл. всесоюзн. семинара «Кормовые растительные ресурсы–резерв интесификации кормопроизводства». Орджоникидзе. с. 27.

18. Телеуцэ А., Цыцей В. 2012. Нетрадиционные растения семейство бобовых - кормовые достойнство и продуктивность в условиях Республики Молдова. *Таврійський науковий вісник № 80 частина 2.* с. 338-342.

STUDIES ON THE VEGETATION OF STEPPES DOMINATED BY *SALVIO NUTANTI-NEMOROSAE - FESTUCETUM RUPICOLAE*

Titica Ghenadie
Botanical Garden (Institute) of the Academy of Science of Moldova
email: ghena20@ymail.com

Abstract: The present study is an overview of the vegetation of the communities dominated by *Salvio nutanti-nemorosae - Festucetum rupicolae* Zólyomi ex Soó 1964, proposed to analyze the structure, ecology and syntaxonomy of the communities in the semidesert steppes of Moldova. This study has been achieved during our research on plant communities, conducted in 2007-2013. A number of 14 vegetation relevés have been carried out according to the Braun-Blanquet's methodology, in the spontaneous communities of Salvio nutanti-nemorosae - Festucetum rupicolae. The results are then analysed in systematic and economical groups, bioforms, floristic elements and ecological indices.
***Key words**:* xerophile vegetation, semidesert steppes, Festuco-Brometea.

INTRODUCTION

The associations *Salvio nutanti-nemorosae - Festucetum rupicolae* are described on the southern part of the Republic of Moldova. Plant communities are less dominated in the semidesert steppes, as a whole is xerophytic steppe formation localized in three districts: Vulcăneşti, Taraclia and Cahul. More species are assigned to the order *Festucion valesiacae.* In more places associations *Salvio nutanti-nemorosae-Festucetum rupicolae* have coverage of 5-10% and are widespread in the dry valley and small hills. Characteristic species here are *Festuca rupicola* and *Salvia nemorosa*.

MATERIALS AND METHODS

Phytocoenoses of *Salvio nutanti-nemorosae - Festucetum rupicolae* were investigated in the southern Moldova, during our recent field works in years 2007-2013. Coenological samples were collected according to the (Braun-Blanquet, 1964) method, but the cover rate of the species was given in percents. Herbarium data were examined at the herbarium of the Botanical Garden (A.S.M.). The present study is based on 14 vegetation relevés.

RESULTS AND DISCUSSIONS

The ecology and phytocoenological characterisation. Phytocoenoses of *Salvio nutanti-nemorosae - Festucetum rupicolae,* consisting of *Festuca rupicola* and *Salvia nemorosa* community, occupy the transition zone between the vegetation of the semidesert fragment and the vegetation of the grazing pastures in the river valleys. This community occupies degraded coastal lands with southern exposure and dominated by species *Festuca rupicola*. Floristic composition consists of 47 species. Associations were found around localities: Văleni, Giurgiuleşti, Câşlița Prut, Colibaş, Brânza, Vadul lui Isac, Alexandru Ioan – Cuza, Slobozia Mare (Cahul), Etulia, Cişmichioi (Vulcăneşti), Ciumai (Taraclia). **The spectrum of the bioformes -** the hemicryptophytes are clearly dominant 53,1%, followed by the therophytes with 14,8%, biennial terophytes 8,5%, geophytes, nanofanerophytes and mezofanerophytes 6,3% each, chamaephytes 4,2%. **The analysis of the phytogeographic elements –** Eurasian element 51% and Pontic species 21,2%, followed by the European 10,6%, Carpathian 6,3%, Central-European and Mediterranean 4,2% each, Atlantic – by one species. **The analysis of the ecologic spectra –** xeromesophytes species 59,5%, the xerophytes 32%. **The thermic factor** is predominantly moderate-thermophile and microtherm 46,8% each, amphytolerant 14,8%, thermophile one species. According to **soil reaction,** the most of species are slightly acid-neutrophilious – 57,4%, acid-neutrophilious and amphytolerant – 14,8% each, neutrobasiphile – 10,6% and acidophile is represented by one species. **Trophic soil reaction** is represented by oligotrophic – 23,4%. The most numerous, ensured with nutritive elements, are the plants of poor soil N2 – 8,5%, very poorly supplied N1 – 6,3%, and medium soil N3 is represented by 4,2%. **The economical plant importance**. Analyses of plants from wild flora are represented by four categories of economical plant importance. The most numerous are the medicinal plants – 55,3%, melliferous – 53,1%, alimentary – 25,5%, aromatic – 10,6% and toxic – 8,5%.

CONCLUSIONS

From the point of view of cenological character, phytocoenoses of *Salvio nutanti-nemorosae - Festucetum rupicolae* are considerably poorer elements from the class Festuco-Brometea. Instead of these species, different elements and members of weed associations appeared. There are significant differences in the microclimate of the zones, as a consequence of the geomorphological differences within the southern zones Republic of Moldova. The floristic composition of the *Salvio nutanti-nemorosae - Festucetum rupicolae* is represented by vegetal communities of semidesert steppes, fact that confirms that *Festuca rupicola* is a dominant species. The analysis of presence of communities *Salvio nutanti-nemorosae - Festucetum rupicolae* conducted by the researchers allowed them to identify the most valuable objects which should be subject to protection.

BIBLIOGRAPHY

1. Borza A., Boscaiu N., 1965 – Introducere în studiul covorului vegetal, Edit. Acad. Române, Bucureşti.

2. Chifu T., Minzu C., Zamfirescu O., 2006 – Flora şi vegetația Moldovei (România). II. Vegetația, Edit. Universității „Alexandru Ioan Cuza", Iaşi.

3. Cristea V., 2004 – Fitosociologie, Edit. Presa Univ. Clujeană, Cluj-Napoca.

4. Postolache Gh. Vegetația Republicii Moldova, Chişinău, Ştiința, 1995. 340 pag.

5. Tofan Burac T., Chifu T., 2002 – Flora şi vegetația din valea Prutului, Edit. Corson, Iaşi.

6. Săvulescu Tr. Die Vegetation von Bessarabien mit Besonder Beruckcsichtigung der Steppe. Buc. 1927.

7. Doniță N., Popescu A., Paucă Comănescu Mihaela, Mihăilescu Simona, Biriş I. – A., Habitatele din România, Editura Tehnică, Bucureşti, 2005.

8. Постолаке Г.Г. Растительность степей Республики Молдова. // Известия АН РМ. Серия биол. и хим. наук. 1993, № 4, с. 3-10.

9. Ciocârlan V., 2009 - Flora ilustrată a României. Pteridophyta et Spermatophyta (Illustrated Flora of Romania. Pteridophyta et Spermatophyta). 2nd Ed., Edit. Ceres, Bucureşti, 1141 pp.

10. Weber H.E., J. Moravec, J.P. Theurillat, 2000 - International Code of Phytosociological Nomenclature. 3rd Ed., J. Veg. Sci., 11: 739-768.

Table 1

As. Salvio nutanti-nemorosae - Festucetum rupicolae Zólyomi ex Soó 1964; Syn.: (*Salvio nutantis - Paeonietum tenuifoliae* Mititelu 1990)

No.	The economic importance	Bioform	The floristic element	Environmental categories						The number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	K	ADm
				Halofitia	Nitrogen scale	U	T	R	Trophicity	Area (mp)	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
										Coverage (%)	80	90	90	90	90	80	90	90	80	90	90	90	90	80		
1		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	27	28
										Car. de as.																
1		H.	Eua.		N2	1,5	4	4		Festuca rupicola	4	4	3	4	4	4	3	3	3	4	3	4	3	3	V	50
2	Arom. Decor. Fr. Med. Mel. In. Alim.	H.	Ec.			2,5	4	3		Salvia nemorosa	1	+	1		+	+	1	1	1	1		1	+	+	V	2,67
										Festucion valesiacae																
3	Arom. Decor. Fr. Med. Mel. In. Alim.	Ch	Med.			1,5	4	4,5		Teucrium polium	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V	0,5
4	Mel. In.	H.	Pt.			2	4	4,5		Taraxacum serotinum	+					+	+	+	+			+			III	0,21
5	Fr. Med. Mel. In.	H.	Eua.			2	3,5	5	oligotr.	Onobrychis arenaria	+	+				+	+	+	+			+			III	0,25
6	Arom. Decor. Med. Mel. In.	H.	Pt.			2	3,5	4		Salvia austriaca	+					+	+	+	+			+			III	0,21
7		G.	Eua.			1,5	3,5	4	oligotr.	Gagea pusilla	+					+	+	+	+			+			III	0,21
8	Decor. Med. Mel. In.	H.	Pt.			1,5	3,5	4		Inula oculus-christi	+	+				+	+	+	+						III	0,21

9	Fr. Med. Mel. In. Alim.	H.	Eua.		N 3 - 4.	2	3	4		Artemisia absinthium	+	+										+			II	0,10
10		Th.	Pt.			2	4	4		Echium russicum	+	+				+	+	+	+		+		+	+	IV	0,32
11	Mel.	Th.	E.			2	4	3		Nonea pulla	+	+								+		+			II	0,14
12	Med. Alim. In.	Th.	Eua.		N 2 - 3.	2	4	4		Falcaria vulgaris	+					+	+	+	+			+			III	0,21
13	Decor. Med. Mel.	H.	Med.			1,5	3,5	5		Althaea cannabina	+	+				+	+	+	+			+			III	0,25
14	Decor. Fr. Mel.	H.	Eua.		N1	1,5	3,5	4	oligotr.	Astragalus austriacus	+	+				+	+	+	+			+			III	0,25
15		G.	Pt.			2	4	4		Scorzonera mollis	+	+				+	+	+	+			+			III	0,25
										Festucetalia valesiacae																
16	Decor. Med. Mel. In.	N.	Pt.		N1	2	3,5	4	oligotr.	Chamaecytis-us austriacus	+	+				+	+	+	+			+			III	0,25
17	Fr. Med.	T.	Eua.			2,5	4	4		Ceratocarpus arenarius		+			+	+	+	+	+						III	0,21
18	Decor. Fr. Med. Mel. In. Alim.	H.	E.			2	3	0	oligotr.	Sedum maximum		+	+			+	+	+	+			+			III	0,25
19		H.	Pt.			1,5	3,5	4,5		Astragalus corniculatus	+	+				+	+	+	+			+			III	0,25
20	Decor. Mel. Med. In.	H.	Eua.			1,5	4	5	oligotr.	Astragalus onobrychis	+	+	+			+	+	+	+	+		+			IV	0,32
21	Decor. Fr. Med. Mel. Alim.	H.	Eua.			2	4	3	mezotr.	Fragaria viridis	+	+				+	+	+	+	+		+			III	0,28
22	Decor. Fr. Med. Mel. Tox. In.	H.	Ec.			2	3	4		Coronilla varia	+											+			I	0,07

23		H.	Pt.			1,5	4	0		Onobrychis gracilis			+									+			I	0,07
24	Decor. Mel. In.	N.	Eua.			2	4	4,5		Caragana frutex	+	+				+	+	+	+			+			III	0,25
25		T.	E.			2	3,5	0		Holosteum umbellatum			+							+		+			II	0,10
26		T.	Atl.			1,5	4	3		Kohlrauschia prolifera	+	+			+	+	+	+	+						III	0,25
27	Fr.	T.	Cp.			2,5	5	0		Arenaria serpyllifolia	+	+	+			+	+	+	+	+					III	0,28
28	Med. Mel.	H.	Eua.		N2	2	4	2		Potentilla argentea	+											+				
29	Arom. Decor. Fr. Med. In.	T.	Eua.			2	3	5	oligotr.	Achillea setacea		+	+	+								+			II	0,14
30	Fr. Mel. In.	Ch.	Eua.			2	3	3,5		Artemisia campestris	+	+	+		+	+	+	+	+			+			IV	0,32
31		H.	Pt.			1,5	4	4,5	oligotr.	Echinops ruthenicus	+				+	+	+	+	+			+			III	0,25
32	Med. Tox. In.	H.	Eua.		N1	1	3,5	4	oligotr.	Euphorbia seguieriana	+		+		+	+	+	+	+			+			III	0,28
										Molinio-Arrhenath-eretea		+								+		+			II	0,10
33	Med. Mel. Alim. In.	Th.	Eua.		N2-3	2,5	3	0		Daucus carota		+								+		+			II	0,10
34	Fr. Med.	H.	Eua.			2,5	0	4,5		Plantago media	+	+	+	+		+	+	+	+	+		+			IV	0,35
35	Decor. Med. Tox. In.	H.	Eua.			0	3,5	4	oligotr.	Linum perenne			+			+	+	+	+						II	0,17
										Artemisietea vulgaris																

36	Decor. Mel. Med. Alim. In.	H.	Cp.		N3-4	2,5	3	4		Artemisia vulgaris	+								+		+			II	0,10
37	Fr. Med. Alim. In.	G.	Cp.			0	0	0		Elytrigia repens	+	+				+	+	+	+		+			III	0,28
										Diverse															
38		H.	Eua.			1,5	4	5		Adonis wolgensis	+	+				+	+	+	+		+			III	0,25
39	Arom. Decor. Fr. Med. Alim. Mel.In.	M.	Eua.			2	4	4,5	mezotr.	Amygdalus nana	+	+				+	+	+	+		+			III	0,28
40		N.	E.			2,5	3	3		Rosa corymbifera	+	+				+	+	+	+		+			III	0,25
41	Decor. Fr. Mel. Med. Alim. In.	M.	E.			2	3	3	mezotr.	Prunus spinosa	+	+				+	+	+	+		+			III	0,28
42		M.	Eua.			0	3,5	4		Tamarix ramosissima	+	+	+		+						+			II	0,17
43		H.	Pt.			1,5	4,5	4,5		Achillea coarctata		+	+			+	+	+	+					III	0,21
44	Decor. Med.	T.	Eua.			1	3	0	oligotr.	Filago arvensis	+	+				+	+	+	+		+			III	0,25
45	Med. Mel. Alim. In.	T.	Eua.			2,5	4	4	eutr.	Hibiscus trionum		+								+				I	0,07
46	Decor. Med. Mel. In.	H.	Eua.			2,5	4	4	mezotr.	Viola suavis	+	+				+	+	+	+		+			III	0,25
47	Decor. Mel. Tox.	H.	Eua.			0	4	4,5		Lactuca tatarica	+					+	+	+	+	+				III	0,21

Place and date of relevés:
1, 2, 3, 4, 5 - v. Văleni, v. Giurgiuleşti, v. Câşliţa Prut, v. Colibaşi, v. Brânza d. Cahul, lat : 45.610492° long 28.169074°, 14.06.2008;
6, 7, 8, 9, 10, 11 - v. Slobozia Mare, v. Vadul lui Isac, v. Alexandru Ioan – Cuza, d. Cahul, lat : 45.602723° long 28.165247°, 14.06.2008;
12, - v. Ciumai, d. Taraclia, lat : 45.794521° long 28.538236°, 07.06.2009;
13, 14 - v. Etulia, v. Cişmichioi, d. Vulcăneşti. lat : 45.578560° long 28.165539°, 07.06.2009.

III. INTRODUCTION OF PLANTS AND SUSTAINABLE USE OF PLANT RESOURCES

GENE POOL OF DOMESTIC APPLE BREEDS OF AZERBAIJAN

D. B. Bayramova, A. A. Aliyeva

Genetic Resource Institute of the Azerbaijan National Academy of Sciences

Abstract. The spreading area of several domestic, ancestral breeds of apple in Azerbaijan, their economic-biological specifications, usage, compositions are stated in this article.

INTRODUCTION

Azerbaijan, land of ancient horticulture, is a country with richness of natural recourses, flora and fauna. Fruit productions play an important role in people's nutrition. Planting of fruits has ancient stems in Azerbaijan and it is considered the main homeland of many fruit plants. Thus, Strabon, Plini, Theatrast and Kolumella noted in their historical documents that Greeks and Romans brought fruit trees - quince, peach, apricot, orange and apple from regions of Azerbaijan: (Midia) Djar, Gabala, Guba, Shabran in forth century BC.

Wild fruit plants are vastly spread in several territories of Azerbaijan that possess fertile land and available climatic conditions. Therefore, in ancient times, people started to select wild fruits in the forests, formed domestic Azerbaijani breeds improving them gradually, improved good ones from domestic breeds and wild forms through national selection, laid on fruit gardens in broad areas and increased their number. Presently such breeds are used in different areas of Azerbaijan as domestic breeds peculiar to the area.

At the result of selection, continuing through centuries, domestic and ancestral breeds of Azerbaijan became better than imported ones –for their biological features, quantity of sugar (saccharic acids) and different acids, vitamins, mineral substances in composition of fruits, durability against pests and diseases and other specifications.

Holding the first place among fruit trees, cultivated in Azerbaijan, apple covers 70 (seventy) percent of orchards and spreads mainly in Guba – Khachmaz, Sheki-Zakatala, Shirvan, Ganja – Gazakh, Lankoran – Astara and Upper – Karabagh.

Apple, being highly, specifically influential between fruit trees, has biological-economical features, frost-resisting ability, easy acclimatization, less feeding requirements, provides harvest of highly qualified products and responses to people's requirements on consumption of fresh apple products, depending on the terms of maturing, and therefore apple has big importance for economy.

The composition of apple is efficient for treatment, normal growing and development of human body, rich with carbohydrates, organic acids, oils, tannins, mineral salts, proteins, ferments, vitamins, several valuable agents.

The composition of fruits consists of approximately 11,0 – 16,9% of dry substances, 13,3 – 23% of total saccharin substances, 0,18-0,71% of acidity, 0,07-0,26% of tannin acids substances, 0,28-0,50% of ash substances and various vitamins (A1, B1, B2, C, P and PP), depending on breeds.

Beside eating apple in fresh condition, juice, jam, apple jam, lavasha, candied fruit jelly (marmalade), kvass, dried apple, kissel, apple vinegars and other types of product are produced from apple. These have great treating importance for human organism, heart weakness and anemia. Especially, apple, rich with iron, has great effect in human body.

MATERIALS AND METHODS

Different parts of Azerbaijan are famous for their specific domestic, ancestral breeds of apple. So, Gizil Ahmadi, At bashi in **Gabala-Oghuz regions**; Kapanj, Ilik alma in **Zagatala and Balakan**; Khoncha alma, Irazbayi in **Sheki**; Tiggini, Aghboz in **Garabagh**; Jir Haji, Eyyubi, Shikhi Jani, Ispik, Jibir, Khush alma, Sari-Tursh, Arazbayi, Mehdi Jiri, Gand alma, Araz bari, Seyid Shukri, Abi alma, Agh alma, in **Guba**; Shirvan gozeli in **Shamakhi**; Daraghi, Rejebi, Stekan alma, Loghazbayi, Misri in **Ordubad**; Mishki, Jannat alma, Vahab alma, Hilal alma, Guzu goren, Girda shirin in **Nakhchivan AR**. One of the principle goals of research is the study of spreading area of domestic breeds of apple of Azerbaijan, economic-biological features and their usage. Object of research is the domestic and ancestral breeds, such as Jir Haji, Gizil Ahmadi, Eyyubi, Shikhi Jani, Sari Tursh, Jibir, Seyid Shukri.

The study of the targeted topics is carried out on the basis of "Program and method of fruit, berries and nuts plants" (Michurinsk 1973), "Program and method on study of breeds of fruits, berries and subtropical and plants with nuts within collection." (1970) V. K. Zaytsev, "Methodology on the study of breeds of fruit and berries (Michurinsk 1994).

RESULTS AND DISCUSSIONS OF RESEARCH

Apple (Malus Mill) belongs to Rosaceae family, Maloideae semi-family and Malus species.

Information about breeds of national selection, domestic breeds of Azerbaijan is provided on the followings.

Jir Haji- is widely spread domestic breed in Guba-Khachmaz regions in Azerbaijan. Trees are high and their crown - large, round, hanging form, provide complete productivity in the 8th 9th years. The productivity in hectare is 220-260 quintals. The weight of fruit is 120-150 grams; the shape is flat and round. When maturing it becomes in dark yellow or dark blue stripy. Its flesh is white, medial watery, aromatic, hard and sweet. There is 11, 3% of sugar, 0, 08% acidity in composition. Their fruits mature in October and it's possible to store them till May. Beside, reasonability for domestic purposes, it is widely used in industry. It has treatment significance at the result of microelements, as well as Fe in its composition.

Gizil Ahmadi – its origin is Gabala and Ismailly regions, one of the most ancient breeds of Azerbaijan. Breed for winter season, mainly planted in Sheki-Zagatala regions. The main reasons of transportation to Southern centers are sweetest taste of fruit, thick peel and beautiful image. It provides complete productivity at the 7th-8th years under high inoculation and at the 4th-5th years under vegetative inoculation. Tree has sufficient height, its height reaches to 6-7 meters in the 9th-10th years; the crown has round form. Productivity is 180-230 quintals per hectare, weight of fruit is 100-120 grams, form is round, reaches to ruddy red colour in time of maturity. The flesh is sweet. There is 14% of dry substance, 12.5% of total sugar, 0, 48% of acidity and 4-5% of vitamin C in the composition. Fruits mature at the end of September and storage during 180-200 days in normal conditions is possible. Durability of fruit during transportation is in average level.

Sari-Tursh –domestic breed widely spread in Guba-Khachmaz regions. Breed for winter season, planting in Guba regions more than three centuries. Tree has sufficient height, wide, round pyramid crown. It provides complete productivity in the 6th-7th year. Productivity is 220-280 quintals per hectare. Weight of fruit is about 145-155 grams, form is oblong-oval, lateral side is red, there are white spots on it. Composition consists of 11, 3% of sugar, 0,55% acidity. It gets yellow colour on time of maturity. Peel is a little bit thick, oily smooth, taste is sweet- acidulous, watery in average degree, and it has a special odour, pleasant for sense. Fruits mature during first 10 days of October. Storage of fruits is possible up to April-May months under normal conditions. This breed has importance for domestic and industrial fields. It is, as well, durable during transportation.

Jibir –breed of national selection of Azerbaijan, origin is the village of Jibir of Gusar region. It is a frequently planting breed for winter season in foothills orchards of Guba. Tree has sufficient height (6m), diameter of crown is wider than 12 m, has wide, flat-round hanging form. It provides complete productivity at the 6th-7th years. Productivity is 150-200 quintals per hectare. Weight of fruit is 135-150 grams, form is round cone and colour is dark yellow, with red strips on surface. Peel is thin, hard

smooth. The flesh is white, acidulous-sweet, this breed is good for domestic purposes. Composition of fruit consists of 12.1% of dry substance, 9.55 total sugar. Storage of fruits is possible up to April-May months under normal conditions.

Eyyubi – one of the old breeds of Azerbaijan for winter season, origin is Guba region. The tree is very strong, has sufficient height, round crown. Provides harvest at the 9^{th}-10^{th} years, possess high productivity. Productivity is 120-130 quintals per hectare. Weight of fruit is 140-160 grams, form is flat cone, big-scale, with thick peel, shining, majority of part is dark-red, becomes green-yellowish colour in mature condition. The flesh is white, sweet, has pleasant odour peculiar for this breed. Matures at the end of September, the storage is possible up to April-May months. This breed is for domestic purposes, may be used for industrial purposes too. It shows sufficient durability during transportation.

Shikhijani- breed for winter season among domestic breeds, known to peoples from ancient times. Origin is Guba region. Beside the fact that it has sufficient height, round crown, the tree is strong, durable and has long life. It provides complete productivity at the 9^{th} and 10^{th} years. Productivity is 160-180 quintals per hectare. Weight of fruit is 120-130 grams, round form, has cone shape on both sides. Peel is thick, smooth, oily and bright. Becomes yellow, cheeks have light red colour. There are a lot of white spots under its peel. The flesh is white, watery in average degree, its sweet taste has a higher degree than its acid taste. Composition consists of 9,7% of sugar, 0,05% of acidity. This breed is for domestic and industrial purposes. Fruits shall be collected in September, become mature in November and may be stored up to the end of May under normal conditions. Durability during transportation is in average level.

Seyid Shukri-breed for winter season, planting in Nugadi village of Guba. Tree has sufficient height, crown is wide, round, dense, oval form. Flourishes late in spring season. Provides complete productivity in the 6^{th} and 7^{th} years. Productivity is 180-210 quintals per hectare. Weight of fruit is approximately 160-180 grams, elongated, cone, angle-form, light yellowish, sometimes reddish, with stripes. Peel is thick, oily and bright. Surface is covered by a wax layer. There are white spots under its peel. The flesh is white, dense, soft, juicy, sweet, insignificant acidity. This breed has importance for domestic and industrial fields. Fruits shall be collected at the end of September, may be stored up to the end of May. Durability during transportation is in average level.

CONCLUSIONS

Domestic breeds of apple, being studied in Azerbaijan, are very rich for their economy-biological parameters, productivity, quality of product, richness of composition of fruit, period of maturity, storage, durability against diseases-pests. It is reasonable to use them on direction of selection, getting of new improved breeds,

food industry and medicine in future. From this point of view, it is important to plant new gardens, consisting of new breeds, to enrich the gene pool.

LITERATURE

1. Rajabli A.J. "*Fruit plants of Azerbaijan",* "Azerneshr" Baku 1966, pages 14-17.
2. Bayramova D.B.and others. *"Booklet of Gardener"* "Seda", Baku, 1997, pages 17-28.
3. Rajabli A.J, "*Plant of apple in Azerbaijan",* "Teknur", Baku, 2010, pages 3-19.
4. Program and method of fruit, berries and nuts plants". Michurinsk , 1973.
5. Methodology on the study of breeds of fruit and berries, Michurinsk, 1994.

BOTANY-BIOLOGICAL FEATURES OF *CARTHAMUS TINCTORIUS* AT GROWING IN THE CONDITIONS OF IRRIGATION IN SOUTHERN UKRAINE

Fedorchuk M.I., Doctor of Agricultural Sciences, Professor
Pashtetsky V.S., Doctor of Agricultural Sciences
Filipov E.G., graduate student
Kherson State Agrarian University, Ukraine

Abstract. Results of research concerning the influence of agrotechnical methods on productivity of plants of Carthamus tinctorius grown under the conditions of irrigation of the South of Ukraine are given in the article. Grounding on the results it was set, that growing of the Carthamus tinctorius on the irrigated lands of southern Ukraine it is necessary to conduct ploughing on a depth 20-22 cm, to use row spacing 30 cm, to conduct sowing in early terms (III ten-day period of March) and bring in the mineral fertilizers rate $N_{60}P_{60}$ for achievement of productivity level of seeds within the limits of 2.0-2.5 t/ha. The terms of sowing and fertilizing have most particle of influence on forming of seeds' productivity.

***Key words**:* carthamus tinctorius, irrigation, terms of sowing, water consumption, coefficient of water consumption, productivity of seeds, force of factors influence.

INTRODUCTION

Oil-bearing cultures have the large economic value due to the various and wide use of products of their processing in different industries of national economy. The plants are united in the group of oil, a seed and garden-stuffs of which contain a lot of fat (from 20 to 60%) and are basic raw material for the receipt of vegetable butter. On the prognoses of scientists-climatologists, on the territory of Europe, in 2030, the temperature of air will rise on 1-4°C approximately. After the amount of precipitations, a tendency is forecast to more droughty weather in summer and moist the winter. The change of climate will affect agroclimatic terms, namely the duration of period of vegetation, providing of plants with moisture, dynamics of hydrothermal indexes.

Currently over 50 types of medical and aromatic plants are grown in Ukraine, and their amount continues to increase due to newly introduced objects. Medical industry of our state needs over 15 thousand tons of dry vegetable medical raw material a year, however, due to domestic agro production it is provided with it only for 20-30%. The absence of state support of growing of medical crops, out-of-date technologies of their growing and processing, share divisions of the specialized economies and others

like that are the factors of such negative situation. There is the urgent necessity of enlargement of sowing areas under medical crops, increase of their productivity and quality through development and improvement of growing technologies.

MATERIALS AND METHODS

Field and laboratory research with *Carthamus tinctorius* were conducted during 2010-2012.

According to the chart of the research the study of such factors and their variants was foreseen:

Factor A – soil tillage: shallow disk tillage with depth 14-16 cm; ploughing with depth 20-22 cm.

Factor B – terms of sowing: 3^{d} ten-day period of March; 2^{d} ten-day period of April; 3^{d} ten-day period of April.

Factor C – row spacing: 30 cm; 45 cm; 60 cm.

Factor D – rates of nitric fertilizers: without fertilizers; N_{30}; N_{60}; N_{90}.

The use of experimental variants was conducted with the method of the randomization split areas with the fourfold reiteration. Area of sowing areas – 120 m^2, registered areas of fourth order – 56 m^2.

Thermal-gravimetric method was used for determination of soil humidity; it was based on the taking out of samples of certain soil layer with the following weighing in laboratory. The hydrothermal coefficient was determined after method of Selyaninov. Total water consumption of *Carthamus tinctorius* during the whole vegetation period and during separate phase period was determined using the method of water balance, coefficient of water consumption – using correlation to the harvest of seed of every variant.

RESULTS AND DISCUSSIONS

Indices to the hydrothermal coefficient (HC) in the years of conducting of researches substantially changed depending on a temperature condition and amount of atmospheric precipitations. The greatest values HC are fixed in May, 2010 (phase of formation of basket at *Carthamus tinctorius*) – 0,73, and June - July, 2011 (between phase period of «flowering - poured a seed») – 0.48-0.55, accordingly, that had a favorable influence on seminal productivity of plants.

Total water consumption of *Carthamus tinctorius* in the years of conducting of researches substantially changed depending on actual weather conditions and factors which were put on the study. On the average for years of conducting of researches, in relation to influencing of basic till soil on total water consumption showed up weak advantage of ploughing above shallow disk till, as correlation of these indexes was evened according to 3128 and 3071 m^3/ha, or differed on 1.8%.

The middle factorial indexes represented general tendencies which showed up in the years of conducting of researches. Yes, advantage of ploughing above shallow till was fixed soil, early term of sowing, width of spaces between rows 30 cm and bringing of mineral fertilizers by doses $N_{60}P_{60}$ and $N_{90}P_{90}$.

On the average on a factor and advantage of ploughing above shallow basic till soil showed up in relation to forming of harvest of *Carthamus tinctorius*, which was evened 0.18 t/ha, or 11%. The increase of width of spaces between rows from 30 to 45 and 60 cm stipulated the reduction of productivity of the explored culture on 0.34-0.53 t/ha, or on 18.7-29.0%, that is explained by the biological features of *Carthamus tinctorius*, in particular by the negative reaction on the width of space between rows 60 cm.

In the years of conducting of researches, the productivity depended on the terms of sowing. On the average on a factor C this index was most (1,89 t/ha) at early term sowing (III ten-day period the March), at late term (III ten-day period the April) he diminished to 1.24 t/ha. Also, it is necessary to underline that the terms of sowing changed depending on weather conditions in the years of conducting of researches.

High level increase of the soil moisture use by the crops of *Carthamus tinctorius* provided the nitric and phosphoric fertilizers. So the given coefficient of water consumption was equal in the unfertilized areas, averagely according to factor D, 2,801 m^3/t, and when fertilizers were brought in with the rate of $N_{30}P_{30}$-$N_{90}P_{90}$, the decline was marked to 2,089-2,332 m^3/t, or by 16.7-25.4%.

The indices of *Carthamus tinctorius* productivity fluctuated over 2010 in scopes from 0.66 t/ha when such factors and variants were united – disk soil tillage with depth 14-16 cm, row spacing 60 cm, late term of sowing (3^d ten-day period of April) and without bringing in of mineral fertilizers to 2.38 t/ha – when ploughing, row spacing 30 cm, term sowing in the 3^d ten-day period of March and bringing in the rate of mineral fertilizers $N_{90}P_{90}$ were incorporated.

In moist 2011 as a result of favorable weather conditions permanent growth of *Carthamus tinctorius* seed productivity was recordered 1.1-1.6 times. Difference according to factor A (soil tillage) between ploughing with depth 20-22 cm (1.94 t/ha) and disc tillage with depth 14-16 cm (1.75 t/ha) made 0.19 t/ha, or 9.8%.

Unfavorable weather conditions of 2012 even under the conditions of the use of irrigation negatively affected productivity of *Carthamus tinctorius* and stipulated the substantial decline of crop productivity in all variants 1.2-2.2 times.

The middle factorial indices represented general tendencies which showed up in the research years. So, advantage of ploughing over shallow soil tillage was recordered, early term of sowing, of row spacing 30 cm and bringing in of mineral fertilizers rate $N_{60}P_{60}$ and $N_{90}P_{90}$ (fig. 1).

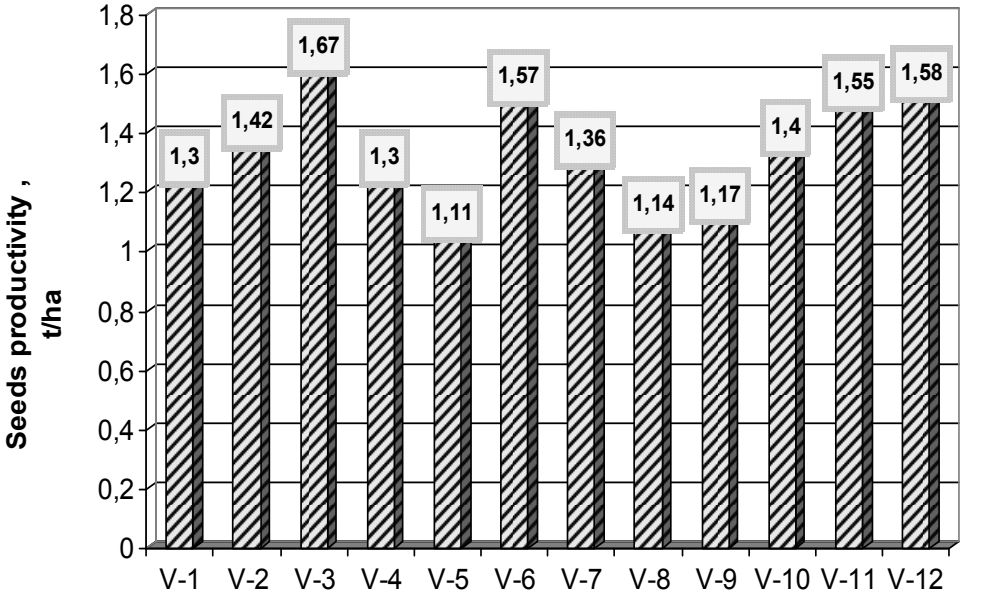


Figure 1. Average factorial indices of *Carthamus tinctorius* seeds productivity depending on factors and variants:

V-1 – disk soil tillage with depth 14-16 cm (factor A); V-2 – ploughing with depth 20-22 cm (factor A); V-3 – row spacing 30 cm (factor C); V-4 – row spacing 45 cm (factor C); V-5 – row spacing 60 cm (factor C);

V-6 – early term of sowing (factor B); V-7 – middle term of sowing (factor B); V-8 – late term of sowing (factor B); V-9 – without fertilizers (factor D); V-10 – $N_{30}P_{30}$ (factor D); B-11 – $N_{60}P_{60}$ (factor D); B-12 – $N_{90}P_{90}$ (factor D)

On the average according to factor A advantage of ploughing over shallow basic soil tillage showed up in relation to forming of *Carthamus tinctorius* yield, which was equal to 0.18 t/ha, or 11%.

Bringing in of mineral fertilizers was instrumental in the permanent increase of *Carthamus tinctorius* seed productivity by 0.24-0.42 t/ha, or by 15.9-24.1%, thus the rate of fertilizers $N_{60}P_{60}$ appeared to be the best variant. Increase of nitric-phosphoric background from 60 to 90 kg of a./ha caused insignificant (by 0.02 t/ha, or 1.1%) growth of plants productivity, but it was lower than LSD_{05}.

In the years of conducting of researches difference in the beginning and going on of inter-phase periods in different calendar dates showed up as a result of variability of weather conditions. In addition, the explored factors, especially, sowing terms (factor C), also affected the beginning of certain phases of development.

Under the conditions of favorable hydro thermal indices of 2011 shoots were got at the early term of sowing on April, 12. At sowing in the II and III ten-day periods

of April there was accordingly marked the transference of shoots appearing on April, 28 and May, 12. Basic soil tillage practically did not affect the calendar dates of the beginning of phases of growth and development. On the average over factor D phase of seed ripening was traced on the unfertilized areas on August, 28-31, and at bringing of mineral fertilizers by different doses – on September, 2-5.

In drought 2012 reduction of inter-phase periods was noticed as a result of acceleration of growing processes and ripening of *Carthamus tinctorius*, the analysis of calendar dates testifies this fact. Conducting of sowing in the third ten-day period of March shoots appeared on April, 9, and on the second and third terms – on April, 24 and May, 9 accordingly. At the end of vegetation, as a result of ever-higher temperatures of air and low relative humidity, the phase of ripening on the first sowing term is fixed on August, 1, and on the second and third – on August, 8-11.

Duration of inter-phase and vegetation periods of *Carthamus tinctorius* changed substantially after both the phases of development and under the influence of weather conditions in the separate years of researches and studied factors. Inter-phase period *sowing - shoots* lasted, averagely, 10 days, and inter- phase period flowering-ripening increased to 51 days. Vegetation period made 105 days averagely during the experiment.

Terms of sowing (factor C) had the most substantial influence on duration of inter-phase periods. Even at the beginning of vegetation during inter-phase period «shoots - phase of rosette» and «phase of rosette - formation of anthodium» at sowing in the III ten-day period of March (early term) this index was on 2-5 days greater, than at sowing in the II and III ten-day periods of April. Vegetation period also was the longest (112 days) at areas with the early term of sowing, at the second term it reduced to 105 days (or by 5.7%), and on the third – to 97 days (or by 13.3%).

Basic soil tillage practically did not affect the duration of inter-phase periods at the beginning of vegetation; but weak influence of ploughing comparing with shallow disk tillage in relation to increase of inter-phase periods for 1-3 days showed up from at the phase of rosette forming. At the areas with disc tillage on 14-16 cm depth the period of vegetation of *Carthamus* lasted, averagely, 103 days; and in a variant with ploughing it increased to 106 days.

Direct positive action of factor D was seen on increase of inter-phase periods of *Carthamus tinctorius* beginning from the period the «phase of rosette - formation of anthodium». During the inter-phase period of «flowering - ripening of seed» this index made 48 days at the unfertilized areas, and at bringing of nitrogen and phosphorus with doses from 30 to 90 kg of agent per 1 ha it was accordingly increased to 50-54 days, or by 2.7-11.3%. On the whole during vegetation the difference between unfertilized and fertilized variants made 4-11 days, or fluctuated in scopes from 3.4 to 10.1%.

CONCLUSIONS

Indexes of water consumption of *Carthamus tinctorius* of dyeing and to the coefficient water consumption of culture substantially depend on the weather conditions of vegetation period and agrotechnical measures, especially terms of sowing. It is set as a result of three-year researches, that at growing of *Carthamus tinctorius* of dyeing on the irrigated lands South Ukraine for achievement of level of productivity of seed of culture within the limits of 2.0-2.5 t/ha it is necessary to conduct ploughing on a depth 20-22 cm, to use space between rows 30 cm, to conduct sowing in early terms (III ten-day period the March) and bring in the mineral fertilizers by a dose $N_{60}P_{60}$. The terms of sowing and fertilizer have most particle of influence on forming of productivity of seed.

BIBLIOGRAPHY

1. Ahmed M. Effectiveness of *Carthamus tinctorius* L. in the Restitution of Lipid Composition in Irradiated / A.M. Zahran, M. F. Omran, S. Z. Mansour, N. K. Ibrahim. // Rats. Egypt. J. Rad. Sci. Applic. – 2007. – № 20(1). – P. 75-94.

2. Bruneton J. Pharmacognosy, phytochemistry, medicinal plants / J. Bruneton.- Paris: Lavoisier, 1995.- P. 267.

3. Dweck A.C. Nature provides huge range of colour possibilities / A.C. Dweck // Personal Care Magazine. – 2009. – Vol. 5. – P. 61–73.

4. Financing of water infrastructure / Report of the World Panel on Financing Water Infrastructure // Camdessus panel. – GWP, 2003. – 44 p.

5. Hillel D. Salinity Management for Sustainable Irrigation / D. Hillel // AgroTech. – 2000. – Vol. – P. 34-37.

(*PUCCINIA HORIANA* HENN.) – A DISEASE OF *CHRYSANTHEMUMS* IN MOLDOVA

Ludmila Kleshnina, Svetlana Gargalik

Botanic Garden (Institute) of ASM Chisinau, 18 Padurii str.

Abstract. The results of the symptomatic and biomorphological diagnostic of the chrysanthemum white rust agent (Puccinia horiana Henn.) in Republic of Moldova are obtained.

INTRODUCTION

In the autumn of last year, in the laboratory of floriculture of Botanical Garden (Institute) of the ASM, specimens of contaminated chrysanthemums, cultivated for the cut, were found. Previously, similar symptoms on chrysanthemum in the Republic of Moldova had not been observed. After a phytopathological analysis, it has been established that in infectious patterns (samples) is revealed the white rust of chrysanthemums disease, which is the pathogen of fungus *Puccinia horiana* Henn. The first manifestation of the disease was in 2004. After ten years the disease has been identified for the collection of the Botanical Garden chrysanthemums. [1,2] *Puccinia horiana* Henn. - originates in Japan and has spread to other Far Eastern countries, to South Africa, and from there to Europe. Since about 1964, locally established in Austria, Belgium, Denmark [13], Netherlands [10]. It was widespread in France and Germany; [12] Ireland 1977 and Luxembourg, Poland [15] Sweden [9] and Yugoslavia [11]. It was reported but not established in Cyprus 1987, eradicated – in Hungary 1989, in UK – accepted as established: in Great Britain since 1988 and in Northern Ireland since 1990. Asia, China, Cyprus (reported but not established), Hong Kong, Japan, Korea Democratic People's Republic, Korea Republic, Malaysia, Taiwan, Thailand, USSR - Far East [3,4]. In USA – there was an outbreak in New Jersey and Pennsylvania in late 1970. It outbroke in Oregon and Washington in 1990, declared eradicated. In Australia, it was declared absent despite interception reports, Walker, 1983; it outbroke in Victoria in 1986, Catley, 1987, New Zealand 1965.

MATERIALS AND METHODS

Infectious material was obtained from the greenhouses of the private farming, village of Yaloveni, engaged in cultivation of chrysanthemums and diseased plants

from the collection of the Botanical Gardens. The initial planting material was imported from Poland. Investigations were carried out only in the conditions of mycological box and after the finalization of the work the specimens were totally destroyed, the used tools and utensils were washed and sterilized. The determination of the fungal pathogen of the disease was performed by morphological characters of spores (shape, size, color) according to special methods [5, 6 and 7]. The intensity of development of the rust disease was taken into account using the following scale (in points): 0 – there is no damage; the damage is absent; 1 – the pustules (telia) of the fungus are less visible, single, is affected up to 10% of all the green surface of the plant; 2 – a considerable number of pustules on the lower and upper layers of the leaves, occasionally occur on the stem, is affected up to 20% of the plant; 3 – pustules in large numbers, leaf epidermis breaks out, pustules dust and plague, is affected up to 30% of the surface; 4 – more than 50% of the green surface is covered with the pustules of the fungus, the plant is depressed; 5 – about 80-100% of the surface are affected, the plant dies.

RESULTS AND DISCUSSIONS

Chrysanthemum white rust is extremely difficult and costly to eradicate. The intensification of chrysanthemum production, with high plant densities in humid glasshouses, provides an ideal environment for the fungus. The fungus can be positively identified on the basis of symptoms and morphological features. In the case of weak degree of affection on the spots are formed single pustules up to 5 mm, at a strong degree of affection, hundreds of small pustules on the leaf are numbered. The first symptoms appear on young leaves. On the top of the leaf, small pale yellow spots reveal. The symptoms at this stage remind signs of disturbance of mineral nutrition (Fig 1).

Fig. 1. Symptoms on leaves, pale-green to yellow spots.

The centres of these spots become brown and necrotic with aging. On the corresponding lower surface, raised, buff or pinkish, waxy pustules (telia) are found. As the spots on the upper surface become sunken, so these pustules become quite prominent and turn whitish when basidiospores are produced. (Fig. 2). Telia are occasionally found on the upper leaf surface. Severely attacked leaves wilt, hang down the stem and gradually dry up completely. The bicellular teliospores germinate in situ to produce unicellular basidiospores which are dispersed in air currents. No other spores are known. High humidity and a film of moisture appear to be necessary for the germination of both teliospores and basidiospores. Teliospores are capable of germination as soon as they are mature; germination and discharge of basidiospores occur between 4 and 23°C and, at the optimum temperature of 17°C, discharge of basidiospores starts within 3 h. Basidiospores can germinate over a wide temperature range and, at 17-24°C, either surface of the leaf may be penetrated within 2 h. Thus, only 5 h of wetness is sufficient for a new infection to become established. Within the leaf, abundant, hyaline, intercellular hyphae are produced with intracellular haustoria. The incubation period is normally 7-10 days, but short periods of high temperatures (over 30°C) can apparently prolong the period to 8 weeks.

The agent of chrysanthemums white rust is the fungus *Puccinia horiana*, highly specialized haustoria and it has no intermediate host. The stage of uredospores is absent, the infection occurs from basidiospores.

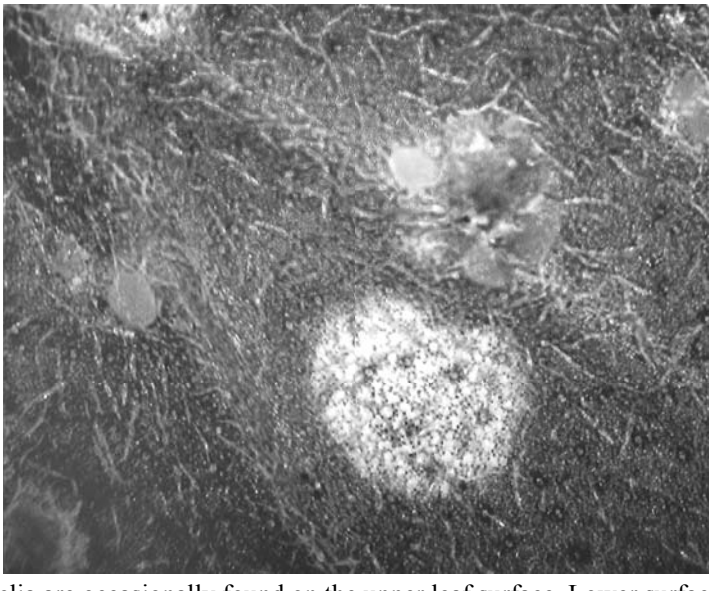


Fig. 2. Telia are occasionally found on the upper leaf surface. Lower surface, raised, buff or pinkish, waxy pustules (telia) are found.

Basidiospores develop from teliospores, compact, pinkish - buff to white, 2 - 4 mm in diameter. Teliospores on pedicels up to 42 - 58 microns long; pale-yellow, oblong to oblong-clavate, slightly constricted, 30 - 45 x 13-17 microns, with thin walls, 1-2 microns thick at sides, thicker commonly 4-9 microns at apex. Germination of teliospores can be observed in situ. Basidiospores hyaline, slightly curved, broadly ellipsoid to fusiform, 7-14 x 5-9 microns (Fig 3).

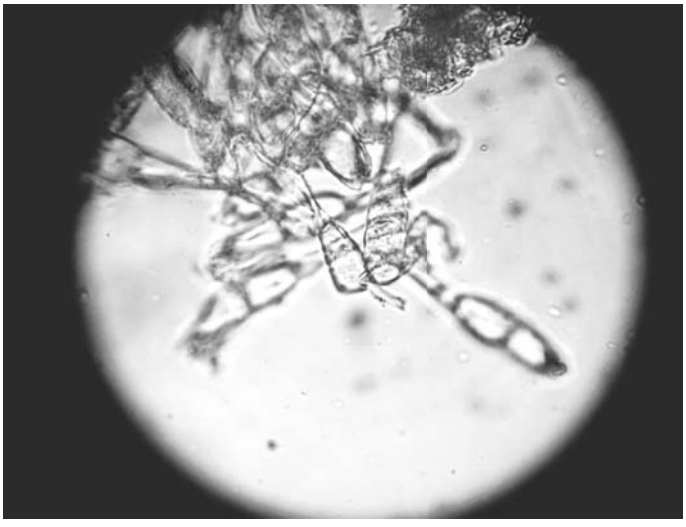


Fig. 3. Basidiospores hyaline and teliospores on pedicels up to 42 -58 microns long.

The fungus can be positively identified on the basis of symptoms and morphological features. Numerous other rust fungi have been reported on chrysanthemums, but they can be distinguished by their teliospore shape, size, surface ornamentation and colour.

CONCLUSIONS

It was established, in 2004, that the pathogen was introduced initially by planting varieties of chrysanthemums Reagan purchased in Poland. Then, from host to host with planting material the disease has spread to the villages Yaloveni, Nisporeni, Ghidighici. The most infected chrysanthemum sorts are: Reagan, Anastasia, the Super-White.

After ten years the disease has been identified for the collection of the Botanical Garden chrysanthemums, at the sorts Axima white, Bucuria, Lobel purple, Galantino. Some chrysanthemum cultivars appear to be more susceptible than others and there is evidence that there is more than one pathotype of the fungus.

The fungus can be positively identified on the basis of symptoms and

morphological features. Until 1963, P. horiana was confined to China and Japan. However, it has since spread rapidly on infected imported cuttings and is now a feared and serious disease in nurseries in Europe, frequently causing complete loss of glasshouse chrysanthemum crops.

BIBLIOGRAPHY

1. Левченко В.И., Петина В.В. Карантинные заболевания хризантем. // В журн.: Защита и карантин растений, № 1, 2005, с. 32-34.

2. Клешнина Л.Г. Карантинное заболевание хризантем. В сбор.: Акад. Жуковскому П.М. – 120 лет Есо – TIRAS Кишинёв – 2008 г стр 59 -61.

3. Недолужко А.И. Белая ржавчина хризантем в Приморском крае.// В журн.: Защита и карантин растений,№2, 2008, с.52-53.

4. Скрипка О.В., Дудченко И.П., Шероколава. Карантинные болезни хризантем. // В журн. :Защита и карантин растений.№8, 2004, с. 37-39.

5. Тарр С. Карантин растений. // В кн,: Основы патологии растений. М.: изд-во «Мир», 1975, стр. 515-518.

6. Методические указания по обследованию цветочных культур на выявление карантинных болезней. М.: «Колос», 1971, 17 стр.

7. Методы определения болезней и вредителей сельскохозяйственных растений. М.: «Агропром», 1987, 223 с.

8. Шамонин М.Г., Сметник А.И. Карантин растений СССР. М.: «Агропромиздат», 1986, 250 с.

9. Akesson, I. (1983) Plant protection year 1982 - horticulture. Växtskyddsnotiser 47, 5-7.

10. Boerema, G.H.; Vermeulen, H. (1964) [Puccinia horiana, the Japanese rust, also in Dutch chrysanthemum houses]. Vakblad voor de Bloemisterij 19, 697.

11. Dordevic, Lj. (1983) [Occurrence of white rust of chrysanthemum in the vicinity of Belgrade]. Zastita Bilja 34, 169-172.

12. Grouet, D.; Allaire, L. (1973) La rouille blanche du chrysanthème. Evolution et méthodes de lutte. Horticulture Française 30, 1-8.

13. Jorgensen, H.A. (1964) [Japanese chrysanthemum rust, a dangerous disease discovered in Denmark]. Gartner Tidende 80, 234-235.

14. Matta, A.; Gullino, G. (1974) [White rust of chrysanthemum]. Informatore Fitopatologico 24, 47-50.

15. Zamorski, C. (1982) [Effectiveness of fungicides in the control of white rust Puccinia horiana]. Acta Agrobotanica 35, 251-256.

SUSTAINABLE USE OF SOILS RESOURCES FOR THE PLANTS

Ecaterina Kuharuk, Olesea Cojocaru

Institute of Pedology, Agrochemistry and Soil Protection "Nicolae Dimo"

Abstract: The estimation of future condition of soil resources of eroded arable lands of Moldova based on a long term prediction for several options of land use has been carried out. Predictions showed that current land use of eroded soils promotes further reduction of humus layer depth and humus supplies, restoration of the lost soil resources is practically impossible.

Key-words: soil erosion, development dynamics, monitoring, plants resources.

INTRODUCTION

There is pressing need for soil protection in the Republic of Moldova. First, on account of the crucial role of soil in the biosphere: it is a powerful energy accumulator; it regulates the composition of the atmosphere and the water cycle and it is a reliable barrier to the migration of pollutants [1].

Secondly, Moldova has become, once again, an essentially agricultural country. Its main capital asset is its soil and this is a critical condition, suffering significant degradation, especially from soil erosion. Soil erosion is a constant threat governed by relief, climate, land cover, soil type and management. In Moldova, beginning in 1987 but, especially from the beginning of land privatization in 1992, all soil and water conservation activities came to a halt.

At the same time, all the conditions for unrestrained soil erosion were created. The new owners who came into possession sometimes of less than hectare of sloping land neither knew nor cared about soil and water conservation. Erosion containment is not the immediate concern of poor people in rural areas: much more important for them is to obtain crops from the gift and profit from it.

Although agriculture is the basis of local and export markets, it has been left to its own devices and both soil fertility and productivity have declined.

There are many reasons for this: demographic, economic and social [2]. Even the reform of the fiscal system creates perverse incentives: in 2012, farms with an income not exceeding 25200 lei (about SUA 2100) will be assessed 7 per cent tax income but, if their income exceeds this level, agricultural producers will be assessed at 18% tax [3].

MATERIALS AND METHODS

Qualitative estimation of soil particularities in the field, soil description and sampling were executed according to the methodology Rowell [4]. Cartometric analysis of the degree of soil erosion was undertaken according to the procedures detailed by Kuharuk [5] using soil maps at scales 1:50000 and 1:200000.

RESULTS AND DISCUSSIONS

A full profile chernozem with topsoil intact contains, on average, 3.52 per cent of humus in the 0 - 50 cm layer. At the low level of erosion, the average humus content decreases by 20 per cent; at the medium level of erosion the average loss of humus is 42 per cent; at the high level of erosions, the loss is 64 per cent.

Soil productivity declines along with soil fertility. Crop losses on highly eroded soils amount to 90 per cent and for the medium category up to 60 per cent.

Table l summarises the condition of the soil cover of all agricultural lands and their degree of erosion according to natural climatic zones of the country.

According to the data on January 1, 2008 soil erosion afflicted more than one third of all agricultural land. Annual economic losses from loss of crop yields, alone, amount to 3.61 billion lei (260 million U.S. dollars), not including Transnistria [6].

These losses are surely dwarfed by the costs to water supply, infrastructure and the environment as yet not properly assessed.

In August 2011, the Government of Moldova ratified a program for Soil Fertility Conservation and Increase, 2011-2020, which stipulates mitigation measures against processes of soil erosion and landslides and for blocking gulleys. But the budget for scientific investigation of erosion containment measures and new research was cut; development and improvement of technology, taking account of local natural and agricultural conditions has been suspended.

Table 1

Erosion of agricultural land in the Republic of Moldova as of 1 January, 2008

Zones	Total area, ha	Total eroded:		Erosion level:					
				low		medium		high	
		ha	%	ha	%	ha	%	ha	%
Northern	875176	296685	34,0	194340	22,2	73515	8,4	28881	3,4
Central	696345	314748	45,2	165730	23,8	102363	14,7	46655	6,7
Southern	732411	285640	39,0	157468	21,5	91551	12,5	36621	5,0
South-Eastern	234753	51880	22,1	36152	15,4	12442	5,3	3287	1,4
Total	2538685	949468	37,4	553433	21,8	279255	11,0	116780	4,6

It has been proven by experiment in long term field trials at Lebedenco, in Cahul Region, and discussed elsewhere in this symposium that correct and competent usage of anti-erosion measures has clear and unambiguous economic benefits: crop yields have increased by 30 - 40 per cent and there are big environmental benefits from keeping the topsoil on sloping land. Scientific investigation should not stop with the long term field experiments; their practical results should be implemented in other places. When assessing the future perspectives of soil erosion, we should take account of not only modern erosion processes but, also, likely changes of climatic and agricultural conditions that will affect the intensity of these processes. Fragmented land ownership and under financed management aggravates the problem of inadequate land cover. Consequently, if present trends continue, the area of land damaged by erosion will expand and the severity of erosion will increase and future policy should be informed by reliable information. In the present state of the country, and of the farming community in particular, erosion-containment measures have to be funded by the government. Otherwise, even the best policies and plans remain only on paper. At the same time, we know that without whole hearted and competent involvement of the people, in the first place by the entire rural population, no government and no authority is able to tackle this issue effectively.

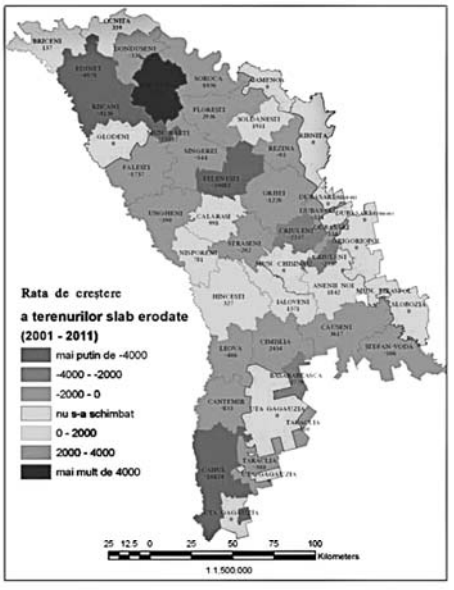
According to the schematic map drawn up in 2012 in the laboratory "Combating Soil Erosion", erodible land area increases markedly (Fig. 1, 2, 3). This material reflects the contemporary status of the soil cover with allocation of powers of erosion of soil: low -, medium -, and heavily eroded by administrative district. There is also a new material for the growth of gullies and landslides on the territory of Moldova.

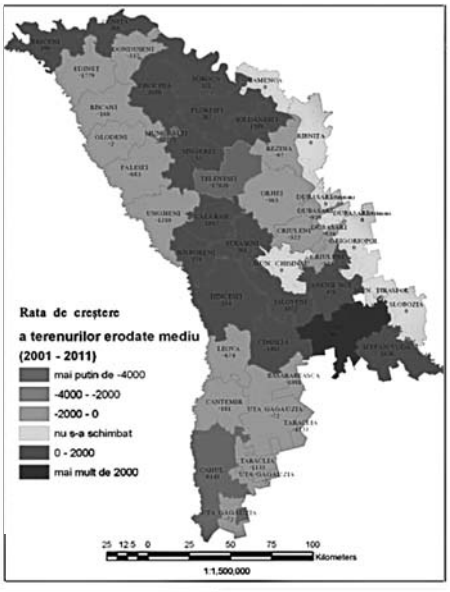
Broadly defined urban soil – is any kind of soil functioning in urban environment. This term comprises soils under urban load and formed by anthropogenic activity in city, which is simultaneously a mechanism and constant regulator of urban soil`s formation.

Urban soils have significant differences from natural ones, the most important being:

- Soils forming on fill-up, alluvial grounds and manipulated soils;
- The presence of construction and domestic waste in higher horizons;
- Changes in acid-base balance to alkanization;
- A high pollution by heavy metals and radiochemical isotopes;
- Changes in physical and chemical soil`s features (decreased water capacity, compactness, stoniness and other);
- Profile increase because of anthropogenic sedimentation.

Urban soils are subjected to entire pedology, field and laboratory investigation methods, knowledge of interaction processes of various pollutants with soil and soil`s ecological estimation. Classification approach applied in foreign countries is very important for urban soils estimation.





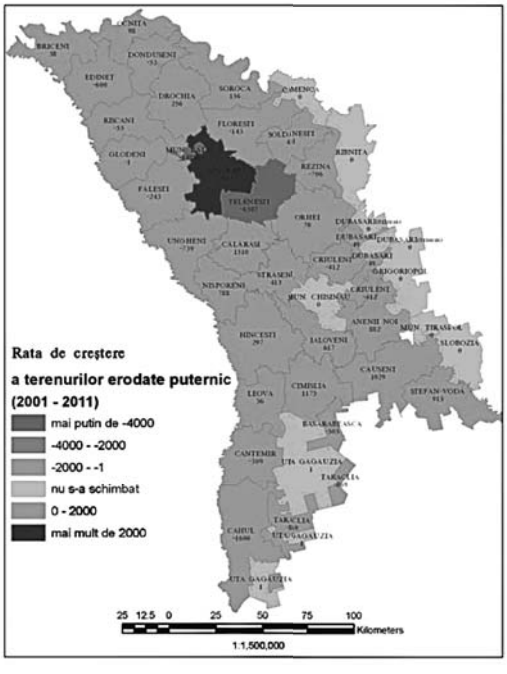


Fig. 1, 2, 3. Heavily eroded soil

CONCLUSIONS

1. Sound agricultural policy depends on sound information and this should include information on the status and trends of the soil cover. Equally it is important to be able to assess the effectiveness of land policy which can only be done if accurate and until data on the ecological and economic effectiveness of specific erosion containment measures, technologies and their combined application at local and regional level.

2. Therefore, it is necessary to introduce the concept and practice of soil erosion monitoring as part of a systematic state program of land quality monitoring.

3. Under the influence of anthropogenic pollutants, soil becomes a toxic element of biosphere, especially for flora, soil-dwelling animals and microorganisms.

4. Toxic elements accumulation in soil makes it unfit for agricultural plants that are grown on the territory of waste treatment plant and adjacent territory of Chisinau.

5. On Riscani Sector territory a heightened concentration of As, Bi, Cl, Cr, Cs, Sb, Se, Zn was revealed.

6. In order to prevent and mitigate urban population`s morbidity degree, further practical and theoretical developments in the field of maximal allowable load of dangerous environmental factors, which create a real threat for human`s health, are necessary.

7. In order to save biodiversity and urban population`s health and protect them from the consequences of anthropogenic pollution of environment, from hazardous substances accumulation, from accumulation in natural environment`s objects, it is very important to monitor urban soils quality.

BIBLIOGRAPHY

1. Добровольский Г. В., Никитин Е. Д. Экология почв. М. Изд-во Моск. Ун-та; Наука, 2006. – с. 364.

2. Кухарук Е. С. Почвенный покров от Л.С. Берега до настоящего времени. Сб.: Академику Л. С. Бергу - 130 лет. Eco-Tiras, Бендеры, 2006. – с. 20.

3. Михеева Л. www.plus.md, N5(401) 17.02.2012. - с. 11.

4. Rowell D. L. Soil science: methods and aplications. Longman Grup UK Limited, 1994. Пер. на русск. яз. – М.: Колос, 1998. с. 15-34, 349-359.

5. Кухарук Е. С. Картометрический анализ почвенного Молдовы и использование крупномасштабных почвенных карт. Автореф. дисс…к.с-х. наук, Баку, 1991. – с. 24.

6. Программа освоения деградированных земель и повышения плодородия почв. Ch.: Pontos, Ч. I. 2005. – с. 76.

PHYTOPATHOLOGIC ESTIMATION OF COTTON INTRA- AND INTERSPECIFIC HYBRIDS RESISTANCE TO FUNGI *VERTICILLIUM DAHLIAE* KLEBAHN

Mammadova N.Kh., Shikhli H.M.

Institute of Genetics Resources of the Azerbaijan National Academy of Sciences

Abstract. The phytopathological estimation of wilt resistance in cotton varieties belonged to G.hirsutum L. and G.barbadense L. species on an artificial infectious background was carried out. As a result of the research, resistant and tolerant cotton varieties to pathogen were determined. These varieties can be used in selection as donors of resistance to this disease.

INTRODUCTION

Creation of highly productive varieties of the cotton resistant against diseases and their introduction in agriculture is a very important link in the system of actions for struggle against them. Researches of immunity and, also, selection of cotton are conducted concerning the most harmful diseases. One of the most dangerous diseases of cotton is wilt. This disease is caused by fungi *Verticillium dahliae* Klebahn, which concerns to imperfect fungi. The objective of this study was to assess the tolerance level of some cotton varieties (*G.hirsutum* L. and *G.barbadence* L.) against *Verticillium* wilt (*Verticillium dahliae* Kleb.) disease. The study was carried out at Absheron EB of Azerbaijan [1, 2, 3].

MATERIALS AND METHODS

We studied the resistance to wilt of varieties of *G.hirsutum* L. and *G.barbadense* L. cotton species. The phytopathologic estimation of cotton varieties resistance was carried out on an artificial – infectious background by Vaytenoks method on a five-grade scale. A symptom of this disease is the appearance of yellowish round and angular spots on leaves [4].

RESULTS AND DISCUSSIONS

Cotton is one of the valuable agricultural crops. A significant attention is being paid to production of this culture. Creation of highly productive varieties of the cotton

resistant against diseases and their introduction in agriculture is a very important link in the system of actions for struggle against them.

Researches of immunity and selection of cotton are conducted concerning the most harmful diseases. One of the most dangerous diseases of cotton is wilt. This disease is caused by fungi *Verticillium dahliae* Klebahn, which concerns to imperfect fungi. The objective of this study was to assess the tolerance level of some cotton varieties (*G.hirsutum* L. and *G.barbadence* L.) against *Verticillium* wilt (*Verticillium dahliae* Kleb.) disease. The study was carried out at Absheron EB of Azerbaijan.

As can be seen from the table, the estimation of cotton varieties' resistance has shown different sensitivity of crops to diseases which has allowed to reveal the most resistant variety to this one (Table). On the results of our data of the varieties of the *G.barbadense* L. cotton species turned out to be more resistant to this disease [5, 6]. The amount and percentage of sensitive to wilt varieties at *G.hirsutum* L. species fivefold exceeded the varieties of *G.barbadense* L. cotton species, i.e. these made accordingly – 22,9% and 4,0%. The percentage of immune varieties at this cotton species equalled accordingly – 20,0% and 4,3%. The most resistant ones: Gandja-97, AP-391, Pima-5-1, Gandja-102, RAM-35, S-6040, Ash.-24, C-6029, Ap-376, L-2637, AP-369, Ap-368, Tura-45 APB, Sapel-12.

Table 1

Phytopathological estimation of wilt resistance in cotton varieties belonged to G.hirsutum L. and G.barbadense L. species

Degree of affection	Resistance in scores	G.hirsutum L.		G.barbadense L.	
		number	%	number	%
Immune – (0)	0	3	4,3	10	20,0
Highly resistant– (1-5%)	1	5	7,1	16	32,0
Resistant – (6-10%)	2	10	14,3	12	24,0
Tolerant – (11-25%)	3	36	51,4	10	20,0
Susceptible – (26-50%)	4	16	22,9	2	4,0
Highly susceptible - (51-100%)	5	0	0	0	0
Amount:		70		50	

The phytopathological estimation of wilt resistance in cotton varieties belonged to *G.hirsutum* L. and *G.barbadense* L. species on an artificial infectious background was carried out. As a result of this research, resistant and tolerant cotton varieties to pathogen were determined.

CONCLUSIONS

According to the above-stated, one can make conclusion, that the *G.barbadense* L. cotton varieties are more resistant to wilt, than the varieties of *G.hirsutum* L.

cotton species. These hybrids can be used in selection as donors of resistance to this disease.

BIBLIOGRAPHY

1. Frisbie, E., K.M. El-Zik and L.T. Wilson. 1989. Strategies and tactics for managing plant pathogens and nematodes. Integrated Pest Management Systems and Cotton Production, John Wiley and Sons. New York.

2. Allen, S.J. and P.A. Lonargan. 1998. The development of new strains of verticillium dahlia in Australia. Proceedings of the World Cotton Research Conference-2, Athens, Greece; 1989, 923-926.

3. Mammadova N.Kh. Evaluation of cotton collection varieties resistans to fungi V.dahliae Klebahn. Materials of III International Scientists conference Biodiversity. Ecology. Adaptation. Evolution. Odesa, 2007, p.91-92.

4. Voytenok F.V. Methodology of long term prognosis of Verticillium wilt of cotton. Moscow, Kolos, 1970; 15 p.

5. Ruhengiz Mammadova, Shamsaddin Asadov, Volkan Sezener, Mammadova N.Kh., Firuze Yunusova 2011. Assessment of tolerance level of cotton collection varieties against Verticillium wilt (Verticillium dahliae Kleb.). International conference “Diversity, characterization and utilization of plant genetic resources for enhanced resilience to climate change”, Baku, ELM, 2011, p.52-53.

6. El-Zik, M.K. 2002. Effect of Verticillium and Fusarium Wilts on Cotton Yield and Quality. Timing of Xcm broth inoculums for field evaluation. In: Herber, D.J. and D.A. Richters (eds.) Proc. Beltwide Cotton Conf., Nat’l. Cotton Council of Am., Memphis, TN.

NEW CULTIVAR MULTIPLICATION OF *WEIGELA FLORIDA* (BGE.) A. DC. IN THE REPUBLIC OF MOLDOVA

Palancean A., Roşca I., Elisaveta Onica
Botanical Garden (Institute) of A.S.M.

INTRODUCTION

The environmental status of our country mobilizes us in creating green areas with a high landscaping level, a rich assortment of ornamental woody plants, resistant to biotic and abiotic factors. The decorativeness of present species and cultivars, their implementation perspective in landscape arrangement is described in the scientific literature [1, 2]. The new form possesses a high decorativeness level, is drought and frost resistant, grows well on rich and light soils. The plants do not prefer special conditions and support urban conditions. Species and cultivars are ornamental and they distinguish among themselves by the lengthy period of flowering, attractive vivid colors of flowers and leaves.

MATERIALS AND METHODS

As a biological experimental material the annual stems of *W. florida* 'Bristol Ruby' and *W. florida* 'Variegata Nana' cultivars, from which the lignified cuttings – in March-April and semilignified ones – in July-August were produced. The obtained cuttings were treated with solution of 0,01% of $KMnO_4$ and heteroauxin according the methods [3]. *W. florida* may be multiplied by lignified and semilignified cuttings, when the intense growth and development take place and the stems are a little lignified. The collection and production of the cuttings with sharp tools was performed, in the morning, in a short period of time, depending on the climatic conditions of each year, in which the annual stalks have been developed. The cuttings were treated with $KMnO_4$ solution of 0.01% and heteroauxin 0.01%, being at the exhibition of 16 and 8 hours, respectively. In the cold seedbeds, in two types of substrates, they were planted: sand or sand + peat, applying the 24% of minimal fog. The rooting of the cuttings took place more than 30-45 days and they grew in such conditions until the next year. After

1 year of vegetation, the obtained cuttings were incorporated in containers or under field conditions.

RESULTS AND DISCUSSIONS

The new cultivars *W. florida* 'Bristol Ruby' and *W. florida* 'Variegata Nana' grow up and develop well in the Botanical Garden (photo 2).

W. florida 'Bristol Ruby' possess ruby red flowers, erect growth habit, free – flowering, a hybrid betwen *W. florida* and 'Eva Rathke' in 1954. This beautiful flowering shrub is vigorous and easy to grow. It has mid-green leaves which are complemented in late spring and early summer by deep red, funnel-shaped flowers. Each May-June, ruby-red trumpet shaped flowers smother the Bristol Ruby Weigela with hundreds of blooms. Some repeat blooms until frost. It prefers sun or semi-shade. Attracts butterflies. To prune, cut back shoots to a strong pair of buds just after they have bloomed. Once the plant is established, cut back about a quarter of the older stems to ground level every year to encourage new growth.

W. florida 'Variegata Nana' represents a very compact and dense growing selection with variegated leaves and deep rose blooms. Leaves are edged with pale yellow to creamy white all season long. It is an attractive addition to the landscape. It is primarily grown for its compact size (the smallest of the weigelas), profuse late spring flowers and variegated foliage. Rose-pink, funnel-shaped flowers (to 3.15 cm long) appear singly or in clusters along the branches of the previous year's growth in late spring, with sparse and scattered repeated bloom often occurring on new growth as the summer progresses. Elliptic to obovate, variegated green leaves (to 10 cm long) are edged with creamy white. This versatile plant is excellent for foreground of shrub beds or as background for flower borders.

We established that the heteroauxin solution had a greater impact than $KMnO_4$ one over the process of cuttings semilignified rhizogenesis, especially on their form nr. 2 ("Variegata Nana"). The stimulators impact of rhizogenesis also during growth process of rooted cuttings, especially number of roots (5-6 per/unit) and greater root length (7-8 cm) was revealed (Table 1).

Table 1

Heteroauxin impact on the rhizogenesis process stems cuttings at the cultivars of flowering weigela

Species, form	Cuttings	Lignified cuttings		Semilignified cuttings	
		Rooting percentage,%			
		control	0,01% heteroauxin (16 hours)	control	0,01% heteroauxin (8 hours)
Weigela florida	50	20	40	35	60
W. f. "Bristol Ruby"	50	25	45	40	65
W. f. "Variegata Nana"	50	30	50	45	65

CONCLUSIONS

As a result of propagation by lignified and semilignified cuttings, genetically uniform material was obtained, so that vigorous plantlets possess the properties and qualities of the mother plants.

The process of rooting cuttings depends on many factors: the quality of cuttings and of the substratum, the conditions for mother plants growth and development, the stems until the cuttings (graftage), respecting the optimal terms of cuttings and of technology during cuttings, the density of cuttings in the in seedbeds etc.

A very important role plays the correct sampling of cuttings and strictly respecting of its technology. It was established that heteroauxin is the optimal variant for semilignified cuttings at *W. florida* 'Bristol Ruby' and *W. florida* 'Variegata Nana' cultivars.

BIBLIOGRAPHY

1. Palancean A., Comanici I. *Dendrologie*. Chişinău: Tipogr. Centrală, 2009. 520 p.

2. Palancean A. *Reproducerea speciilor lemnoase* (Lucrare metodică). Chişinău, 2013. 75 p.

3. Хромова Т.В. *Метод. указания по размножению интродуцированных древесных растений черенками*. М. 1980. 45 с.

CONTEMPORARY SPECIALITY OF INTRODUCTION AND WAYS FOR IMPROVEMENT OF VINE GRAPES ASSORTMENT IN BELARUS

Popoff E.H.*, Oleshuk E.N.**

**Central Botanical Garden, Nat. Ac. Sci. of Belarus*
***Institute of Experimental Botany, Nat. Ac. Sci. of Belarus*

Abstract: The contemporary state of viticulture in Belarus has been analyzed. The social need and economic expediency of grape gardening development is shown. The feasibility of viticulture introduction in the republic agroclimatic zones on the basis of a large-scale Vitis nursery foundation (by using new resistant high-quality cultivars) is scientifically proved. The article presents the assessments of regionalized and new cultivars of Vitis for covered and uncovered crops; the perspective grape cultivars with high biological plasticity and winter-hardiness, which are the most promising ones as candidates for introduction, have been selected. The conclusion based on the long-term laboratory and field tests has confirmed that Belarus industrial vine growing is capable to provide high profitability and competitiveness of the corresponding production. Therefore, it is one of the most perspective branches in the general structure of gardening.

INTRODUCTION

The first official mentions about viticulture on Belarus territory concern XVI century. Then grapevines arrived concurrently with Queen Bona Sforza d'Aragona [1]. But scientific foundations for grape wine introduction with regard to different climatic zones were developed by A.M. Negrul since 1938 [2] and the scholar proved successful attempts of cultivation were fulfilled in the Republic of Belarus (RB) by auspice of National Academy of Sciences (NASB) only at 1946-1958 on Central botanical garden vineyard (CBG of NASB, Minsk). Here rather big collection of *Vitis* cultivars (*cvs*) planted (predominately of early & super early grades). In separate years they yielded more than 100 metric centners of berries per ha. The sorted grapevines were assembled substantially from introduced European *V. vinifera cvs* (*Early Malengre*, *Madeleine Angevine*, *Chasselas White* & *Pink* etc.) – unfortunately those ones lacked ecological plasticity (stability), also froze slightly in severe winters and were long restored [3]. Further, a 'base station of viticulture' had established in more convenient climatic region of southern Belarus (near Pinsk city), that becomes a main source of ampelographic collection and local 'origin centre' for *Vitis* cultivar propagation. Now

Viticulture products are overwhelmingly important because of negative Chernobyl consequences and building in RB the Ostrovetskaya nuclear pover plant: dark-red grapes are not only delicious berries but also contain the natural substances possessing high antioxidant & radioprotecting activities. That is why principal ampelographic collection (more than 400 *cvs*) are concentrated at village Samokhvalovichy (10 km southward from Minsk) by specialized Institute for fruit growing and Institute of experimental botany at Minsk (IFG & IEB, NASB). Now IFG, CBG and IEB carry out significant work on studying of adaptation and development processes concerning perspective grapes *cvs* & hybrids [4–7].

MATERIALS AND METHODS

Analytical methods applied to analyze the situation that has developed in the Republic of Belarus on grapevine cultivars introduction and viticulture promotion. In addition, authors accomplished ampelographic long-term laboratory and field-tests.

RESULTS AND DISCUSSIONS

As for climatic conditions all RB territory is of risky agriculture (located between 56º & 51º of northern latitude) and according to the international classification relates to the 5-th winter hardiness zone (WHZ 5, winter ***T*** diapason: from -23,3ºC to -28,9ºC) [5]. The total duration of plants vegetation period constitutes in Belarus 120…145 days depending on geographic latitude of region. The insolation levels vary from 3500 MJ/m² to 4100 MJ/m² [5, 6].

The essential changes of weather were not observed since 1881 (when tool supervision in Belarus has begun) until 1989. Steady warming of RB climate has begun in the late eighties of the XX century. A distinct trait of warming is appreciable increase of temperatures during the winter period and spring months. Summer also changed to some extent – August became warmer and more arid. The mid-annual temperature of air in Belarus has risen approximately on 1.1ºC in comparison with previous ones. With all this going on for winter months, the temperature has raised on 3ºC and for spring months on 2ºC. Seasons were displaced almost on two weeks. Winter snow cover comes to naught. Depth of soil's freezing has decreased for 6…10 centimeters. Vegetation period begins for 15 days earlier [6].

Unfortunately, climate warming has not only positive, but also the negative effects. In particular, the droughts become customary for RB south (at Byelorussian' woodlands 'Polesye'). Occurrences of new phytoinfectious diseases were registered. Local warm winters often weaken the vital strength of plants in many respects.

Gradual expansion of northern borders of grapes and other thermophilic cultures is observed due to global warming of a climate. Perfection of grape assortment is quite natural process in Belarus. Because the republic industrial vine growing only arises, own selection of viticulture yet has not received development.

It is characteristic of the RB economic sector that practically all *Vitis* assortment is introduced. As is well-known, clonal selection (CS) serves as the considerable lever for increase of grapevine productivity in France, Germany, Hungary, but in RB, due to some obstacles, CS is absent.

Thus, viticulture of Belarus holds a formation stage. The works mainly aimed to search and select grapes *cvs* perspective for RB climatic regimes.

A future success in the vine repertory enrichment depends on cultivars ecological plasticity (including their positive reactions to technologies of cultivation) [7].

Note should be taken – northern viticulture gives some advantages. Thus, more durable winter period with low temperature in RB prevents development of *Viteus vitifolii* – quarantine grape pest phylloxera. In addition several hazardous grape diseases (grapevine fanleaf virus, grapevine yellow mosaic *virus*) are absent in Belarus. The grape fungal infections (powdery mildew, oidium, gray mold) are less aggressive due to moderate temperatures of *Vitis* vegetation period. Thus, a number of pesticide treatments is excluded or reduced to prophylaxis.

The *Vitis cvs* of Russian (*Krasa Severa, Cosmonaut, Cosmos, Agat Donskoj*), and Baltic (*Zilga, Supaga*) selection are already zoned (regionalized) in RB.

Biologically plastic & steady against diseases grape *cvs* (new for RB & of value for wine growing) are: *Bianca, Kristall, Platovskij*, *Augusta* & *Regent,* also of neukryvnyh grape varieties: *Maréchal Foch* & *S-675*. Now they are under the state variety trials. Among the perspective it is necessary to name as well other grapes of the Russian, Ukrainian, Moldavian selection. The big potential possibilities for assortment perfection represent the passing field tests complex-steady grapes: *Muscat Platovskij, Krasen, Citron Magaracha, Gift Magaracha, Riton*, and also dessert *cvs*: *Augustine, Euro Pleven, Nero, Delight Oval, Flame Seedless, Codreanca* etc. As for RB viticulture industry, because grape nurseries are absent, the choice of grapes *cvs* is limited and appreciably defined by available material. The diagram (Fig. 1) shows contemporary Byelorussian ratio of areas under grapevine *cvs* (the data of 2013). Thus, we denote the fact, that existing assortment requires serious improvement and perfection – taking into account considerable successes and achievements of *Vitis* selection (including regions of risky agriculture) [5, 7].

The choice of perspective grape's varieties conducted taking into account conformity of their biological requirements to climatic conditions of RB regions.

For instance, only about 60 grape *cvs* grow now on our partner's plantation of JSC «Pinskij wine producing factory». They acquired from the leading selection centres and vine nurseries of Russia, Ukraine, Hungary, Germany and USA. We want to choose the most proof and reliable from them (the most suitable to a climate of Belarus 'neukryvnyh'). Perspective grapes should correspond to following criteria: to be of high winter hardiness, to have a biological plasticity and a short period of vegetation. Besides, there is a plan to make a re-grafting of vines that already fructify

(*cvs Alpha*, *Moskovskij Ustojchivy*, *Taiga Emerald*) having replaced them on more valuable – corresponding to the international standards and EU requirements [5, 7].

Vitis cvs should be unpretentious, resistant to pests & diseases (1–2 credits) and at the minimal management to give stable rich berries' harvest of high quality.

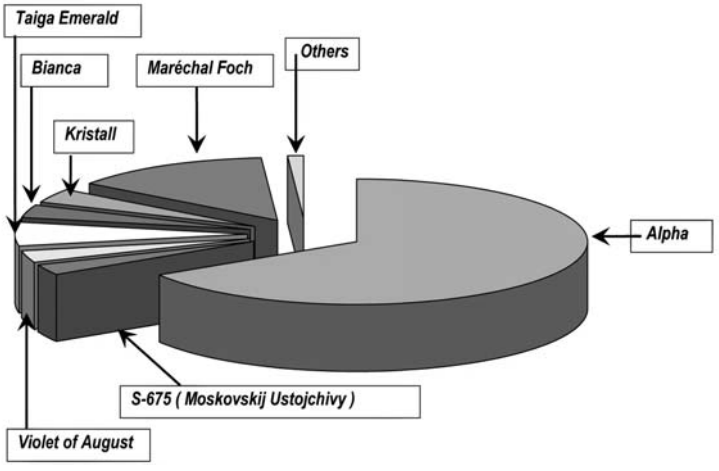


Figure 1. Ratio of the areas under cultivated in Belarus grape's cultivars [7]

Some 'complex-resistant' sorts and hybrids were created during last decades by crossing the best Franco-American hybrids (FAH) and European *V. vinifera* (Table 1). For instance, rather new among 'neukryvnyh' vine *cv Frontenac* of American selection (University of Minnesota, 1996) is received by consecutive hybridization of six different grape's types and has the genetic formula: 25.96% *V. vinifera* + 2.05% *V. labrusca* + 11.00% *V. rupestris* + 7.81% *V. berlandieri* + 51.27% *V. riparia* + 1.91% *V. lincecumii* [7].

Table 1

The areas occupied with new grape's *cvs* of the American selection (acres) [7]

Cultivars	Vineyards younger than 4 years	Vineyards older than 4 years
Marquette	**109,500**	3,779
Frontenac	**63,338**	53,044
Sabrevois	7,592	6,003
Frontenac Gris	**61,577**	13,887
La Crescent	**55,951**	29,790
Prairie Star	12,954	9,703
Brianna	10,500	0,562
Marechal Foch	9,574	16,174
St. Pepin	4,274	4,462
Bluebell	2,056	7,185

As one can see from the data of Table 1, the industrial vineyards of USA (Wyoming, Wisconsin, Minnesota, Northern Dakota) exploits the best selection achievements: *Marquette, Frontenac, Frontenac Gris, La Crescent, Prairie Star*. Their qualities are at levels of the traditional European *cvs*.

The Belarus *Vitis*' growing experience [7] demonstrates additionally the greatest value of American selection reliable 'neukryvnyh' *cvs* (*Adalmiina, Prairie Star*) and some novelties (*Briana, Marquette, Frontenac Gris, Somerset Seedless*). They need not winter sheltering and can grow with a minimum of chemical protection – good possibility for the RB organic viticulture development. Certainly, northern organic vine growing is risky, but no more than any other new business. Not entering polemic, we will remind a known proverb: «Who does not risk – that does not drink some champagne»!

Now world practice already has assured example of successful organic vine agriculture. For example, Peru produced 'ecologically pure' grape berries for USA and European consumers due to special usage of new safe biopreparations for plant protection. The Peruvian winegrowers have taken advantage of unique regional climatic features (good insolation, heat abundance, minimal quantity of atmospheric precipitates) and of best world selection variety achievements (*Red Globe*, *Sugraone*, *Flame Seedless*, *Autumn Royal*) [7].

CONCLUSIONS

Soon we plan to set additional nurseries (maternal plantations) of grapes on the territories of specialized organizations (CBG, IFG … of NASB) and at some enterprises (JSC "Pinskij wine producing factory").

The creation of joint projects and the conclusion of contracts are expected with the interested partners & owners (rightholders, originators) of grape selection novelties (within the framework programs of the international cooperation). The purposes are: 1) receiving the right to study new *cvs* and their pertinences to the local RB conditions; 2) the best *cvs* reproduction and promotion through state variety trials (in limited scales – one subject of managing).

Development of the international cooperation is perspective on participation of Belarus in the programs of the specialized selection centers of vine growing (NIViW "Magarach" of UAAS at Yalta, VNIIViV at Novocherkassk & etc.). We mean joint creation of new grape *cvs* (adopted for nothern viticulture) and their probing in geographically remote regions.

RESUME

1) Successes of modern selection and climate warming create favorable conditions for a sustainable viticulture development in Belarus.

2) Ecologically oriented viticulture presents a most perspective branch in the general structure of gardening.

3) The introduction of modern complex-resistant *Vitis* cultivars (of the newest selection) is a basic in actual Belarus practice for organic viticulture ecotechnology realization.

BIBLIOGRAPHY

1. Lojko, R.E. Nothern grapes / Ed. R.E. Lojko. – Moscow: MSP, 2003 – 256 p.

2. Negrul, A.M. Terrain and grape cultivars matching for vineyard / A.M. Negrul, A.K. Krylatov. – Moscow: Kolos, 1964. – 217 p.

3. Lunina, N.M. History of formation and development of the Central botanical garden of National academy of Sciences of Belarus / N.M. Lunina. [Electronic resource] – 2014. – Mode of access: http://cbg.org.by/history. – Date of access: 16.03.2014.

4. Ustinov, V.N. I-st Int. conf. of nothern viticulture and wine-making / V.N. Ustinov, 8–10 Nov. 2006, Riga, Latvia. [Electronic resource] – 2006. – Mode of access: http://vinograd. info/gallery/act,categories/cid,70/. – Date of access: 16.03.2014.

5. Oleshuk, E.N. Viticulture of Belarus: state and perspectives / E.N. Oleshuk, E.H. Popoff // NSH J. Agronomy (Minsk). – 2013. – № 13. – P. 94–98.

6 Loginov, V.F. Global and regional climate changes: Causes and consequences / Ed. V.F. Loginov. – Minsk: TetraSystems, 2008 – 496 p.

7. Oleshuk, E.N. Zoned and perspective grape cultivars for Belarus / E.N. Oleshuk, E.H. Popoff // NSH J. Agronomy (Minsk). – 2013. – № 15 (71). – P. 84–90.

THE CONDITION OF FUNGUS CAUSED TO ROTTING OF GRAPE ROOT INFECTED BY PHYLLOXERA IN BEYLAGAN REGION

Shikhli H.M., Mammadova N.Kh.

Genetic Resources Institute of the Azerbaijan National Academy of Sciences, Baku, Azerbaijan.

e-mail: sh.haci@yahoo.com

Abstract: Phytopathogen fungus species: Fusarium, Gliocladium, Cylindrocarpon; phytopathogen bacterium species: Pseudomonas, Bacillus; saprotroph fungus species: Mucor, Absidia, Molissia, Penicillium and Rhacodiella caused rotting the roots of grape by phylloxera were determined in Beylagan region of Azerbaijan.

INTRODUCTION

Phytopathogen organisms and losses of agricultural crops caused so much damage. Thus, production is around $ 75 billion, 34.9% of the product is lost each year at the result of diseases and pest damage, according to the information of FAO-Food and agriculture Organization of the United Nation's experts. This means that more than 1/3 of potential production is lost. 13,8% are affected by the pests, 11,6% - by disease - and 9,5% - by weeds [1].

Up to now, on grape plants, about 800 pests and over 1,000 fungi, bacteria, viruses and pathogenic phytoplasmas have been detected. At the same time, about 250 vintage branches ekto-and endoparasitical nematode species have been identified. Endoparasitical nematode species are characterized by a more extensive damage caused to their roots that relate to the type of Europe and Asia (*V.vinifera* L.) grape varieties and forms [2].

As well, up to 70 species of ticks have been found at grape plants. Each year, the grape branch productivity is reducing by 25-50% as a result of the damage caused by ticks. In addition, nearly 50 viruses have been discovered in grape varieties and forms and every year about 10% of the product is destroyed by viral diseases [3].

The known loss of product is 20-30% every year in the viticulture plantations, despite the regular chemical control measures. This loss is even 52% in some years and this is more than half of product [4].

A number of methods (quarantine, agro technical, physical, mechanical, chemical, biological, radical, sandy soils, inoculation, clone selection, thermotherapy, allelopathy, immunoselection) is used to reduce viticulture diseases and minimize pest damage. Those measures separately or any other disease and pest damage can be reduce at least, but it is not completely possible to protect all of the product and the plants.

At the last times using immunoselection method provides more benefits in viticulture. The main function of immunoselection method is creating new high-quality sorts and forms of grape which are steady and tolerant to different disease and, at the same time, chemical toxic preparations aren't used. For creating new sorts and forms of grape which are steady against different diseases and vermin onset, collection materials have to make phytopatalogical and immunological evaluation in background of complex artificial infection. The steady and tolerant sorts can choose and, possible, get the new high-quality, steady sorts of grape at the result of interspecies and between species hybridization at the time of evaluation. The advantage of immunoselection method from others is that there are neither environmental pollution nor poisoning and dying of humans, warm-blooded animals and useful insects.

Grape is cultivated in 10 natural-economic regions of Azerbaijan. Ganja-Gazakh, Shirvan, Upper Garabagh, Sheki-Zagatala, Lankaran-Astara, Garabagh-Mil, Mugan-Salyan, Guba-Khachmaz, Absheron, Nakhchivan. The most dangerous and fearful enemy of grape plants is phylloxera vermin. They can be divided into the following areas in accordance with the spread of the phylloxera:

a) Completely infected with phylloxera: Ganja-Gazakh region;

b) Partially infected with phylloxera: Shirvan, Upper Garabagh, Sheki-Zagatala, Baku, Lankaran-Astara, Garabagh-Mil, Mugan-Salyan;

c) A few infected regions (free zones) with phylloxera: Guba-Khachmaz, Absheron, Nakhchivan.

This distribution is almost conditional because there are also the pests in partially infected and a few infected regions (free zones). It is enough to mark the fact that phylloxera was found on just 9 hectares of grape plantations, but now about 50-60% of plantations are infected with phylloxera [1].

At the first time, the phylloxera was found in 1881 in the Gusar region. That was caused by bringing numerous infected grapevines from Kuban (Russia) by the commander of kazak regiment colonel Linevich. Although those grapevines had been found and destroyed with radical methods by the experts of Caucasus phylloxera Committee, but later, Azerbaijan viticulture plantations couldn't be freed from this dangerous pest [5, 6, 7].

In spite of phylloxera discovered in 1925, the pests were spread out Aghstafa region (by Hasansu River), Tovuz region (by Tovuz River), passing through with the irrigation water from Armenia in 1914-1917 [8].

After Aghstafa and Tovuz regions the pests were found in 1936-1938 in Shamkir region, in 1939-1942 in Gakh region, in 1938 nearby of Ganja and Khanlar (present Goy-gol region) region, in 1962 in the vineyards of Goranboy region. The vineyards of other regions of Azerbaijan were considered free zones which weren't infected until 1965. But the pests were found in the grape plantations of Aghdara and Hadrut (present Khocavand region) regions in 1966. At the present, all vineyards of Upper Garabagh are infected with the phylloxera. In recent years, the phylloxera is found in the vineyards of Aghdam, Calilabad, Shamakhi, Aghsu and other regions and started to spread more rapidly [6].

At the result of researches, it has been found that the microorganisms (fungi and bacterias) carry out the main role on decay and destruction of grape roots. Thus phylloxera biting the trunk of grapevine and its roots, after sucking food from it, opens "a door" for entering the root rotting microorganisms there and this processes' results are the destruction of grapevine.

MATERIALS AND METHODS

The samples of grape sorts (Tabrizi, Khindoghni, Bayanshira and Madrasa) infected with phylloxera have been taken from viticulture plantations of Beylaqan region with the purpose of determination of species' composition of microorganisms which is cause of rotting the roots of grapevines in Azerbaijan conditions.

The separation from roots of grape and reproduction of phytopathogen and saprotrophs root rotting microorganisms, which cause rotting of grapevines infected with phylloxera, is carried out with the method prepared by P.N.Nedov [9], Nedov, Guler [10] with the purpose of creating complex artificial infection background. The roots have been divided into 2 groups with the purpose of separation of root rotting microorganisms from grapevine roots which were infected with the phylloxera:

The thick roots. Before the roots of grape infected with phylloxera are washed clearly with flowing water, cleaned with gauze, veil tissue of root as well as rotten points until healthy parts are taken with the sterile lancet (scalpel). Then those roots are washed with the 96% ethyl alcohol. The roots are planted with the condition 10 pieces from each sample in the test glass and the Petri dish in the artificial nutritious environments. 5 pieces of this are taken from necrosis tissue and another 5 pieces are taken from healthy tissue near to necrosis part.

The thin roots. The roots are washed clearly with flowing water and are cleaned. The roots are cleaned from the veil tissue and the rotten spots. Then the roots are disinfected keeping in the 96% ethyl alcohol by dividing smaller parts having 2-3 mm in size. For the cleaning ethyl alcohol from root samples they are washed in the distilled water for a certain time. They are kept in solution of mercuric chloride (1:1000) in Petri dish for a few minutes for sterilization of root samples. And then, for cleaning the solution of mercuric chloride from root samples, they are washed in

the distilled water again. After these processes, the root samples are planted in the artificial nutritious environments.

The microorganisms (fungi and bacteria) separated from grape roots damaged by phylloxera reproduce in the artificial nutritious environments by the following order:

- Fungi in the sterile oat;
- Bacteria in the nutritious wort.

The fungi arising two weeks in the sterile oat stuffed to flask are kept in thermostat at 24-26° C. The flask is shaken up 2-3 days to ensure the speedy spreading of fungi micelle in oat. The infected oats by fungus have unloaded to plastic pocket and are kept for infecting grape roots planted in the field [8, 9].

The new prepared material MPA (the Meat Peptone Agar) is planted again in the Petri dish in nutritious environments to reproduce bacteria and the bacteria sprout better in such environments. The bacteria planted in Petri dish are kept in thermostat at 25° C and the nutritious liquid is transferred to flake of wort at the same temperature as soon as colony of bacteria being maximal size. The reproduced fungi and bacteria with this form mixed in some bottle are poured to the soil (with the condition of 20 gram for each grapevine bottom).

RESULTS AND DISCUSSIONS

Root samples from infected by phylloxera grape varieties Tebrizi, Xindogni, Bayanshirae and Madrasa collected from farms of Beylagan region were analyzed and species composition of microorganisms caused to the second pathologic process-rotting were determined. The amount of microorganisms obtained from roots, of Tebrizi grape variety was 100%. The phytopathogenes belonged to *Cylindrocarpon* genus were 26%, phytopathologenes of *Gliocladium* genus were 34%, whereas phytopathologenes of *Fusarium* genus were 28%. Also among phytopathologenes of this grape variety 4% were saprotroph fungi from *Penicillium* genus, 2% were fungi from *Mucor* genus, 3% were fungi from *Molissia* genus and 3% were fungi from *Rhacodiella* genus. Spreading rates of phytopathogens from *Gliocladium* (34%) and saprotroph fungi from *Penicillium* (4%) genera were wider.

Pathogens obtained from roots, of Xindogni grape variety infected by pests were 100%. These were fungi from *Gliocladium* genus - 25,7%, fungi from *Cylindrocarpon* genus - 23,3% and fungi from *Fusarium* genus - 35%. There were 4% saprotroph fungi from *Penicillium* genus, 3% fungi from *Mucor* genus, 3% fungi from *Molissia* genus, 3% fungi from *Rhacodiella* genus and 3% fungi from *Absidia* genus on roots of grape variety Xindogni. As can be seen, spreading rates of phytopathogens from *Fusarium* genus (35%) and saprotroph fungi from *Penicillium* genus (4%) were much wider.

The amount of microorganisms got from roots of Bayanshirae grape variety was 100%. These were fungi from *Gliocladium* genus-31%, fungi from *Cylindrocarpon*

genus-35% and from *Fusarium* genus-30%. Also, 4% of saprotroph fungi from *Absidia* genus. Spreading rates of phytopathogens from *Cylindrocarpon* genus (35%), saprotroph *Absidia* genus (4%) were higher on the roots infected by pests.

Pathogens obtained from roots, of Madrasa grape variety infected by pests were 90%. These were fungi from *Gliocladium* genus-24%, fungi from *Cylindrocarpon* genus-29% and fungi from *Fusarium* genus-22%. There were 4,5% saprotroph fungi from *Penicillium* genus, 2,5% fungi from *Mucor* genus, 2% fungi from *Molissia* genus, 3% fungi from *Rhacodiella* genus and 3% fungi from *Absidia* genus on roots of grape variety Madrasa. As can be seen, spreading rates of phytopathogens from *Cylindrocarpon* genus (29%) and saprotroph fungi from *Penicillium* genus (4,5%) were wider.

CONCLUSIONS

Phytopathogen fungus species: *Fusarium, Gliocladium, Cylindrocarpon;* phytopathogen bacterium species: *Pseudomonas, Bacillus;* saprotroph fungus species: *Mucor, Absidia, Molissia, Penicillium* and *Rhacodiella* that caused rotting of the roots of grape affected by phylloxera were determined in Beylagan region of Azerbaijan.

REFERENCES

1. Shikhlinski H.M. The phylloxera of grape and the microorganisms root rotting. Baku: Chashioglu, 2001, 172 p.

2. Kozar, I.M. Reference to protect the grapes from diseases, pests and weeds. Kiev: Vintage, 1990, 112 p.

3. Reference viticulture. Kiev: Vintage, 1988, 205 p.

4. Melnikov N.N. Chemistry and pesticide technology. Moscow: Chemistry, 1974, 768 p.

5. Kiskina P.H. Phylloxera. Khishinev: Shtiinsa, 1977, 210 p.

6. Afandiyev M.M. The viticulture in Azerbaijan. Baku: ASP, 1972, 187 p.

7. Shikhlinski H.M. The diseases, pests and method of struggled against them. Baku: Azerneshr, 2004, 134 p.

8. Kasas I.A., Gorkavenko A.S., Kiruxin G.A., Asriev E.A. The protection of viticulture from phylloxera. Moscow: Kolos, 1971, 263 p.

9. Nedov P.N. Immunity of grape vine to phylloxera and root rots. Kishinev: Shtiinsa, *1977,* 171 p.

10. Nedov P.N., Guler A.P. Normal and pathological anatomy of the roots in grape. Kishinev: Shtiinsa, *1987,* 153 p.

CYTOGENETIC RESEARCH INTO SEEDLESS AND NATIVE BULGARIAN SEEDED VINE CULTIVARS (*VITIS VINIFERA* L.)

Stefan Topale*, Constantin Dadu, Venelin Roychev*****

Botanical Garden, Academy of Sciences – Chisinau, Moldova Practical Scientific Institute of Horticulture and Food Technology (ISPHTA) – Chisinau, Moldova***Agricultural University – Plovdiv, Bulgaria*

Abstract: A cytogenetic investigation of 29 seedless and 70 native Bulgarian seeded vine cultivars has been conducted. It has been found that only one of the seedless cultivars is polyploid with a doubled chromosome number (2n=76), while all the rest are diploid. Triploidy (2n=57) is not one of the possible causes for the appearance of parthenocarpy in vine, and the discovered triploid seedlings originate from valent crosses between tetraploid (4n) and diploid (2n) cultivars. The cluster in triploid forms is comprised almost entirely of seedless berries, and the larger-sized seeded berries are extremely rare. The native vine cultivars from Bulgaria do not include polyploid forms. Only a single cytochimera has been observed, while all the others are diploid – 2n=38.

Key words: cytogenetic analysis, triploidy, seedless and native vine cultivars.

INTRODUCTION

The cytogenetic method has not been widely applied for researching into the causes for parthenocarpy in vine. These studies in different vine cultivars are limited due to the large diploid number of chromosomes – 2n=38, which are situated very close to one another in the metaphase lamellae and have small sizes of 0,4 - 0,8 μm. Methodological difficulties in the preparation of the material for karyological investigations are still encountered nowadays, but the determination of morphology and chromosome number is important for the selection-genetic studies of each cultivar. Topale (2011) investigated the polyploidy of 826 cultivars, 820 of which are diploid, and he considers that, despite the existing relativity, it is the most accurate to determine the chromosome number in vine using the meristem from tips of shoots and adventive roots. There are few cytogenetic investigations of seedless vine cultivars and idiograms of their karyotype are not available (Ghimpu 1941; Randhawa, Lyer 1960; Sudharsan, Seethaiah, 1973; Lavie 1970; Haas et al., 2000). Apart from sex hybridization between diploid vine cultivars and inbreeding (Todorov 2009), it is possible to use another method for the development of seedless forms – through triploidy (Olmo 1937; Scherz 1940; Mitsukuri, Hayashi 1953; Patel, Olmo 1957;

Wakana et al., 2007). This selection direction presumes the presence of tetraploid vine forms, having originated spontaneously in the cultivated plantations, or created on purpose by crossing with other diploid cultivars. The hybrid seeded progeny consists of diploid (2n), triploid (3n) and tetraploid (4n) seedlings. Only after direct counting of chromosomes, it is possible to separate the triploid hybrid plants and ampelographic studies can be carried out in order to establish the commercial efficiency of triploidy as a different method for the production of seedless forms. In Bulgaria a diverse native vine assortment is available, created as a result of many years of selection, which should be the subject of cytogenetic investigations. The chromosome number of some of the most widely distributed seeded and seedless cultivars has been reported by Genchev, Zankov (1964); Dimitrov, Gadeva (1974); Angelov (1987); Tsolova (1990). The purpose of the current research is to determine the chromosome number of well-known seedless and native Bulgarian seeded vine cultivars.

MATERIALS AND METHODS

Karyological studies have been conducted using cultivars and clones from the ampelographic collections of the National Institute of Viticulture and Wine Making "Magarach" – Yalta, the National Institute of Viticulture and Wine Making in Chişinău – Republic of Moldova, and some selection forms from Bulgaria. The somatic chromosome number of 10 collection plants from each cultivar has been determined, this being one of the most significant karyological characteristics, which makes it possible to analyze their influence on the phenotypic manifestation of the different morphological traits, the causes for pollen sterility in triploids, etc. At the beginning of the investigations the chromosome number was determined in tips of young roots from rooted cuttings, included in permanent preparations obtained in accordance with the standard methods in cytology (Raibin 1967). The fixation was conducted in different solutions of Navashin, Levitski, Karnua, and after that the materials were washed in running water and immersed into ethyl alcohol solutions with rising concentration. Their following treatments include the preparation of microtome cuts with thickness of 8-10 μm, attaching to slides, removing paraffin and staining with ferrum-hematoxylin according to Heidenhain. In order to study a large number of hybrid plants in a short time, a faster way for the development of preparations was used – a propionate-orcein or propionate-lacmoid method for chromosome staining (Topale 1983). A scanning electron microscope observation of the micro-morphological specific features of pollen grains in the various seedless and seeded vine cultivars was performed (Roychev 2008).

RESULTS AND DISCUSSIONS

The analysis of the cytological investigations of 29 seedless vine cultivars grown in different parts of the world, shows that the majority of them are diploid

with a somatic chromosome number 2n=38, and only the clone with large-sized berries Kishmish belai krupnoiagodnai is a spontaneous tetraploid with 2n=76. 22 of them have become a subject of cytological research for the first time. The data on the cultivars Askery, Kishmish belai ovalnai, Kishmish belai krupnoiagodnai, Kishmish mramornai, Kishmish rozovai, Korinka belaia and Korinka chernaia, entirely supports the results obtained by other authors. The information about the ploidy of Kishmish belai krupnoiagodnai completely corresponds to the cytological results for the cultivar with large-sized berries Sultanina gigas, reported by Olmo (1935), which prove for the first time that this cultivar is a naturally generated polyploid. Studies confirm that, in accordance with the law of homologous series, these are analogous somatic alterations, which appeared in both seedless cultivars as a result of a genomic mutation, in spite of the differences in the years and geographical locations of their cultivation (Vavilov 1987).

The clone Kishmish belai krupnoiagodnai is a large-berry somatic (bud) mutation of the diploid cultivar Kishmish belai ovalnai, which radically differs from the initial cultivar in a number of agrobiological and technological characteristics (Iakimov, Kovshova 1968). The cluster has a cylindrical shape, with one or two wings, and often with fewer berries in the middle section. The average cluster weight is 400-687,5 g, and the average berry weight – 1,84 g, while in Kishmish belai ovalnai the values of these indices are 140-178,1 g and 1,07 g respectively. Kishmish belai krupnoiagodnai is not distributed in production vineyards – it is only grown in ampelographic collections. The commercial disadvantages of this clone include low yield, low percentage of first-class vines obtained through grafting, limited capacity for root development etc.

The main results from the cytological investigations of the native Bulgarian vine cultivars indicate that most of them are diploid with a chromosome number 2n=38. Only in Rosa mena di Vacca, a cytological chimera has been found, with 2n=76 and 2n=38, but the basic chromosome number is diploid. The polyploid cells having originated as a result of endomitosis, are found single or in a group of 4-8, and sometimes even more than 10. Cells with a doubled chromosome number have been reported in the upper growth cone only in some of the studied shoots, but an entirely polyploid shoot has not been observed in any of the cases. The karyological data on the cultivars Bolgar, Dimiat and Zabalkanski confirms previously obtained results by other authors (Todorov, Dimitrov 1974; Todorov, Dimitrov 1980; Krastanova 1986).

In the world collection of viticulture literature until 1968, no cytological data regarding triploid vines is available, nor information about their commercially significant ampelographic characteristics – growth dynamics, yield, shape and size of cluster and berry, pollen sterility, ovum fertility, etc. Cytogenetic research has revealed a fundamentally new method in the selection of cultivated plants – development and utilization in agriculture of heterotic triploid forms. They are characterized by high sterility of the male and female gametophyte and low fertility. A large number of positive

examples are also known in horticulture, such as triploid bananas, watermelons, sugar beet, etc. Since triploid development through self-pollination is based on accidental generation of unreduced gametes whose probability in vine is extremely low, this method has not been applied. The first triploid vines obtained through valent crosses (2n x 4n, 4n x 2n) have been created in the "Magarach" Institute (Topale 1971). During investigations into the Bulgarian hybrid forms, developed by the selection researcher V. Valchev, triploid vine plants have been found with a chromosome number 2n=57 – XIX-28/4, XX-29/8 and XIX-20/48 (Fig. 4). In XX-29/8 the cluster has normal size and structure; the predominating small-sized berries are seedless, while the larger berries are fewer and seeded. The cluster in XIX-20/48 is winged, loose, with comparatively identical in sizes and shape seedless berries.

No significant differences exist in the shape, sizes and superficial microstructures of pollen grains in the studied seedless and native vine cultivars. They are tricolporate, which once again indirectly confirms their diploid chromosome number.

CONCLUSIONS

1. In the studied seedless vine cultivars, only one polyploid with a doubled chromosome number (2n=76) has been found, while all the rest are diploid. Since triploidy (2n=57) is not one of the possible causes for the appearance of parthenocarpy in vine, seedless cultivars have most probably originated as a result of natural mutations and hybridization. The reported triploid seedlings originate from valent crosses between tetraploid (4n) and diploid (2n) cultivars. The cluster in triploid forms is comprised almost entirely of seedless berries, and the larger-sized seeded berries are extremely few.

2. Spontaneous polyploids or genomic mutations in vine are observed very rarely in comparison to gene mutations and recombinations, which determine the rich cultivar diversity of *Vitis vinifera* L. There are no polyploid forms among the researched native table and wine Bulgarian vine cultivars, in spite of their typical large-sized berries and clusters. Only a single cytochimera has been found, while all remaining 69 cultivars are diploid with a chromosome number 2n=38. The scanning electron microscope examination of pollen grains indirectly confirms the diploid chromosome number in the investigated seedless and seeded vine cultivars.

BIBLIOGRAPHY

1. Angelov B., 1987. Morphological and cytological research into vine forms with various ploidity. Dissertation, Sofia, p. 35.

2. Dimitrov B., P. Gadeva, 1974. An improved method for the development of temporary cytological preparations in chromosome investigations of *Vitis vinifera* L. Genetics and breeding, year 7, 2, 175-177.

3. Genchev G., Z. Zankov, 1964. Research into natural polyploid forms in vine. Scientific publications of the Higher Agricultural Institute “G. Dimitrov”, Sofia. Agricultural faculty, Horticulture, Viticulture and Plant protection series, XIV /XLII/, 65-77.

4. Haas H. U., G. Allewedt, A. Bouquet, J. M. Boursiquot, 2000. The karyotype of grapevine (*Vitis vinifera* L.). Proceedings of the Seventh International Symposium on Grapevine Genetics and Breeding, Montpellier, France, 6-10 July 1998, Volume 1. Acta-Horticulturae. N528, 247-255.

5. Iakimov L. M., G. A. Kovshova, 1968. Kishmish belai krupnoiagodnai – a natural polyploid. Horticulture, viticulture and wine production in Moldova, 12, 20-22.

6. Krastanova S. V., 1986. Research into the intravarietal diversity of certain commercially significant traits of the cultivar Pamid aiming at its genetic improvement through clone selection. Dissertation, Plovdiv, p. 170.

7. Mitsukuri Y., M. Hayashi, 1953. Studies on triploid vines. Chromosome number of Japanese Vitaceae // La Kromosomo (Japan).-V.17, P.633-638.

8. Olmo H. P., 1935. Bud mutation in the vinifera grape. II. Sultanina gigas // Proc.Amer. Soc.Hort.Sci..-Vol. 33.-P.437-439.

9. Patel G. I., H. P. Olmo, 1957. Interspecific triploid hybrid in grape. Cariologia, IX, 2, 340-352.

10. Roychev V., 2008. Cytoembryological, biotechnological, ampelographic and selection-genetic research into seedless vine cultivars (*Vitis vinifera* L.). Dissertation, Plovdiv, Part I – p. 491, Part II – p. 372.

11. Scherz W., 1940. Uber somatische Genom mutationen der Vitis vinifera varietat “Moselriesling” // Zuchter.- N 12-S. 212-225.

12. Todorov I., B. Dimitrov, 1974. Research into some indirect methods for determination of ploidity in the cultivar Bolgar (*V. vinifera* L.). Genetics and breeding, 7, 3, 218-225.

13. Todorov I., B. Dimitrov, 1980. Studies on chimeric plants of the grapevine (*Vitis vinifera* L.) cultivar Bolgar. Sonderdruck aus der Zeitschrift “Vitis” Band 19, Seite 317-320.

14. Topale St. G., 1971. Development of triploid vine forms and their morphological characteristics. Genetics and breeding in Moldova, Kishinev, p.174-176.

15. Topale St. G., 1983. Polyploidy in vine. Systematics, karyology, cytogenetics. Kishinev, “Shtiinca”, p. 215.

16. Topale St. G., 2011. Karyology, polyploidy and distance hybridization in vine (systematics and cytogenetics of vine), Second supplemented edition, Kishinev, p. 560.

17. Wakana A., H. Sarikhani, N. Hanada, I. Fukudome, K. Kajiwara, K. Yasukochi, M. Hiramatsu and K. Sakai, 2007. Characteristics of seedless berries of triploid hybrid grapes (*Vitis vinifera* complex) derived from eighteen crosses. *J. Fac. Agr. Kyushu Univ.*,52(2): 337-344.

EVALUATION OF THE GENETIC DIVERSITY OF *ORIGANUM* GENUS' SPECIES

Rodica Martea[1], Ana Mutu[1], Steliana Clapco[1], Oleg Budeanu[1], Elvira Gille[2]

[1]University of the Academy of Sciences of Moldova, Chisinau Moldova
[2]"Stejarul" Biological Research Center Piatra Neamt, Romania

Abstract: Origanum belonging to the Lamiaceae family is one of the most wide-spread genera in the spontaneous flora of many landscapes. It has a precious natural resource, as it provides raw material for pharmaceutical industry, modern and traditional forms of medicine and generates employment and income in addition to conservation of biodiversity. The RAPD - PCR analysis of genetic polymorphism in two species of the Origanum genus – O. vulgare L. and O. laevigatum Boiss. collected from a region of spontaneous flora in Moldova (Orheiul-Vechi) indicated a high heterogeneity of the results by tested primers. Based on the electrophoretic spectrum, 82 amplification products were identified with an average of 11,71 bands per primer. The comparative analysis of molecular polymorphism across the named species revealed that the RAPD-PCR generated 45 bands for O. vulgare L. and 37 for O. laevigatum Boiss. 33 of them are polymorphic and 46 – monomorphic fragments. The obtained results allowed concluding that the most informative primers are: for O. vulgare L. – OPG_5 and for O. laevigatum Boiss. - OPA_{19} showing a maximum number of fragments (7, respectively 10). The most specific bands were revealed in the case of OPA_{19} O. vulgare L.- 7 and O. laevigatum Boiss. 6 decamers.

INTRODUCTION

Aromatic plants have been used since ancient times for their preservative and medicinal attributes, as well as to impart flavor to food. Recently, there has been considerable interest in essential oils and extracts of medicinal and edible plants, herbs, and spices for the development of alternative food additives, in order to prevent the growth of food-borne pathogens or to delay the onset of food spoilage [1]. Medicinal plants are a precious natural resource, as they provide raw material for pharmaceutical industry, modern and traditional forms of medicine, in addition to conservation of biodiversity and traditional knowledge.

The genus *Origanum* belongs to *Lamiaceae* family with the great morphological and phytochemical variations [2]. The genus includes the annual and perennial species growing on stony slopes at a wide range of altitudes. The herb of this genus is collected from natural sites and used as a raw material in the pharmaceutical, cosmetic and food industry. It is also a commonly used seasoning [3].

Origanum vulgare L. is the most variable species of the genus in most European countries [3]. The taxonomic reference for the genus *Origanum*, distinguishes six subspecies of *O. vulgare* on the basis of morphological characters presenting high variability determined by the color of the leaves, the flowers, the report leaves/stems, productivity et al. [4].

Origanum laevigatum Boiss. (*Prolaticorolla*) is another important representative of the genus *Origanum*, is a species native to Cyprus and Turkey, with strongly aromatic leaves, and loose clusters of pink funnel-shaped flowers with persistent purple bracts, throughout the summer [5]**.** This plant is used as a culinary herb, and as an ornamental plant in herb gardens and as groundcover in sunny, well-drained places. It tolerates poor soil, but dislikes winter wetness.

Taxonomic studies based on morphological characters [6] and on the results of biochemical analysis of the essential oils and their constituent compounds [7] indicate a high degree of variability across species of the *Origanum* genus. In the present work, we analyzed genetic differences between two *Origanum* species = *Origanum vulgare* L. spp. *vulgare* and *Origanum laevigatum* Boiss., collected from the spontaneous flora of Moldova (Cultural and Natural Reservation "Orheiul-Vechi") using a DNA fingerprinting method: RAPD (random amplified polymorphic DNA) analysis.

MATERIALS AND METHODS

Plant material of *Origanum vulgare* L. and *Origanum laevigatum* Boiss. was used in the form of dried leaves.

Genomic DNA was extracted using CTAB extraction protocol [8] by gradually increasing the liquid nitrogen concentration. The quality of the DNA was determined using agarose gel electrophoresis stained with ethidium bromide.

RAPD reaction was performed with a total of 7 single decamer random oligonucleotide primers of arbitrary sequence (Table 1) were tested for PCR amplification.

Table 1

Oligonucleotides used in RAPD - PCR analysis

No.	Code	Sequences 5' to 3'
1.	**OPA_{02}**	*TGCCGAGCTG*
2.	**OPA_{09}**	*GGGTAACGCC*
3.	**OPA_{19}**	*CAAACGTCGG*
4.	**OPB_{01}**	*GTTTCGCTCC*
5.	**OPG_{05}**	*CTGAGACGGA*
6.	**OPK_{17}**	*CCCAGCTGTG*
7.	**UBC_{250}**	*CGACAGTCCC*

DNA amplification according to a basic PCR protocol was performed in a total volume of 15 µL. PCR reaction for RAPD analysis consisted of 2,5 mM $MgCl_2$, 200 µM of each dNTP, 1 U Taq polymerase in buffer, 0,4 - 0,6 µM of each primer, 50 ng of plant DNA and sterile water.

Amplification was obtained as follows: 1 cycle of 5 min at 95^0 C, followed by 35 cycles of 1 min at 95^0 C, 1 min at 34 - 36 ^{0}C and 1 min at 72^0 C, then terminating with 3 min at 72^0 C.

RAPD amplification products (represented by bands of specific molecular weight) were separated on 1.4% agarose gel by electrophoresis. The gel was under ultraviolet light.

RESULTS AND DISCUSSIONS

RAPD technique, developed by Williams et al. [9], has been already largely used in identification of medicinal plants [10, 11, 12, 13], so representing a possible aid to quality control of herbal medicine. These arguments have motivated our analysis of the genetic polymorphism with seven primers for *Origanum* genus species.

The RAPD-PCR analysis of the *Origanum sp.* genotypes indicated a high heterogeneity of the results by tested primers. Thus the results have contributed to primary knowledge of *Origanum sp.* from an area not previously explored. Based on the electrophoretic spectrum, 82 amplification products were identified with an average of 11,71 bands per primer. The number of amplified fragments varied in the range from 0 to 12 depending on the primer used.

The comparative analysis of molecular polymorphism across the named species revealed that the RAPD-PCR generated 45 bands for *Origanum vulgare* L. and 37 for *Origanum laevigatum* Boiss. 33 of them are polymorphic and 46 – monomorphic fragments, 30 for *O. vulgare L.*, respectively 16 fragments for *O. laevigatum* Boiss. (Table 2).

For each primer is proving a varied number of amplicons, depending on the species studied (Figure 1).

Of the analyzed primers for *Origanum vulgare* L., UBC_{250} presents the highest number of amplicons - 12; same situation is noted for OPA_{19} in the case of *Origanum laevigatum* Boiss.

The maximal number of specific bands was revealed in the case of OPA_{19} – 7 for *O. vulgare* L. and 6 for *O. laevigatum* Boiss. (Figure 2).

Table 2

Banding representing revealed by RAPD primers

Primer	No.	bp	O. vulgare	O. Laavegatum	
OPA02		1500			S
		1100			S
		100			C
		900			S
		800			C
		750			C
		700			C
		T	6	6	
OPB01	1.	1400			C
	2.	1000			S
	3.	700			C
	4.	600			C
	5.	500			C
	6.	400			S
	7.	300			C
	8.	280			S
	9.	200			S
		T	6	8	
OPK17	1.	1300			C
	2.	1250			C
	3.	1200			C
	4.	800			C
	5.	750			S
	6.	700			C
	7.	600			S
	8.	400			C
		T	4	6	
OPA09		1500			S
		1300			S
		750			C
		500			S
		450			C
		T	5	2	
OPG05		1000			S
		900			S
		850			C
		800			S
		700			S
		650			S
		500			C
		450			S
		400			C
		T	7	5	
OPA19	1.	3000			C
	2.	2800			S
	3.	2500			S
	4.	2000			C
	5.	1800			S
	6.	1650			S
	7.	1600			S
	8.	1500			C
	9.	1250			S
	10.	1100			C
	11.	900			S
		T	5	10	

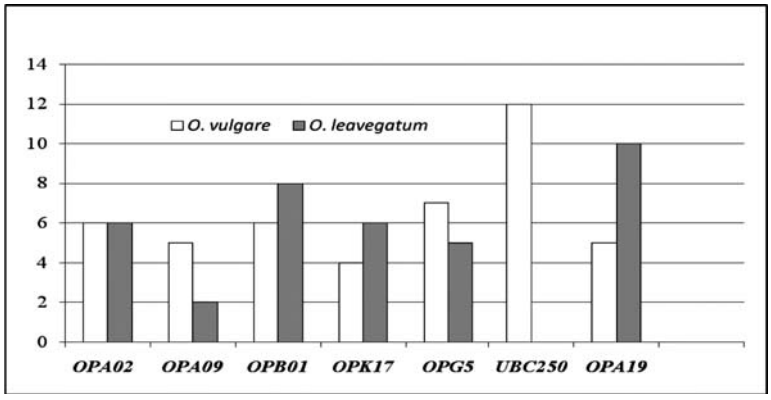


Fig. 1. Number of the fragments for each primer

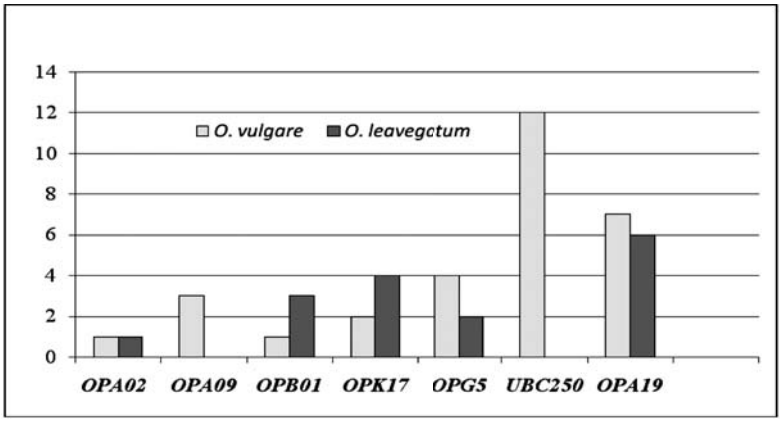


Fig. 2. Number of the specific fragments for each primer

The obtained bands have a molecular weight comprised between 200 - 3000 bp. Analysis has generated 28 species electrophoretic bands: 12 specific for *O. vulgare* L. and 16 specific for *O. laevigatum* Boiss.

Also, it evidencing common to the species 33 amplicons, of which the largest number is revealed by OPK_{17} (Figure 3.).

The results of our work would provide valuable information for decision making in future *Origanum* breeding studies as well as germoplasm management activities to maximize genetic diversity in *Origanum* germoplasm.

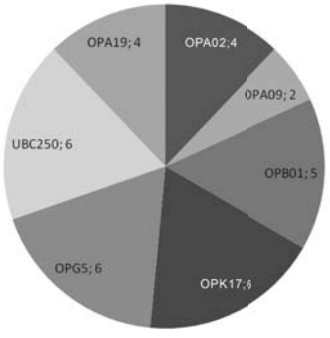


Fig. 3. Common bands for Origanum vulgare L. and Origanum laevigatum Boiss. revealed by RAPD primers

CONCLUSIONS

The PCR-based technique for RAPD could clearly characterize the genetic differences between *Origanum vulgare* L. and *Origanum laevigatum* Boiss. The most primers showed a high degree of molecular polymorphism. Specific particularities of each species have established a high heterogeneity depending on tested primers. The most informative primers are UBC_{250} for *O. vulgare L.* and OPK_{17} for *O. laevigatum* Boiss.

BIBLIOGRPHY

1. Marino, M; Bersani, C.; Comi, G. *Impedance measurements to study the antimicrobial activity of essential oils from Lamiaceae and Compositae.* Int J Food Microbiol, 2001, 67:187-195.

2. Aligiannis, N.; Kalpoutzakis, E.; Mitaku, S. et al. *Composition and antimicrobial activity of the essential oils two Origanum species.* J Agric Food Chem, 2001, 49:4168-4170.

3. Tucker, A.O.; Maciarello, M.J. *Oregano: botany, chemistry, and cultivation. In: CHARLAMBOUS*, G. (ed.) Spices, herbs and edible fungi. Amsterdam, Elsevier Science, 1994, 439-456.

4. D'antuono, L.F.; Galletti, G.C.; Bocchini, P. *Variability of essential oil content and composition of Origanum vulgare L. Populations from a North Mediterranean Area (Liguria Region, Northern Italy).* Annals of Botany, 2000, 86: 471-478.

5. Tucker, A.O.; Maciarello, M.J., *The essential oil of Origanum laevigatum Boiss. Labiatae*. Journal of Essential Oil Research, 1992: 4(4):419-420.

6. Ietswaart, J.H. *A taxonomic revision of the genus Origanum (Labiatae*). Leiden Botanical Series 4, Leiden University Press, The Hague, 1980.

7. Sivropoulou, A.; Paranikolaou, E. et al. *Antimicrobial and cytotoxic activities of Origanum essential oils.* J. Agric. Food. Chem., 1996, 44: 1202-1205.

8. Murray, M.G.; Thompson, W.F. *Rapid isolation of high molecular weight plant DNA*, Nucleic Acids Res. 1980, 8(19):4321-4325, PMCID: PMC324241.

9. Williams, J.G.K.; Kubelik, A.R.; Livak, K.J. et al. *DNA polymorphisms amplified by arbitrary primers are useful as genetic markers,* Nucl. Acids Res, 1990, 18(22):6531.

10. Duca, M.; Port, A.; Levițchi, A. *Characteristics of RAPD markers in breeding of Cucumis sativus L.* / Roumanian Biotechnological Letters, 2008, 13(4):3843-3850.

11. Joy, P.; Maridass, M. *Inter Species Relationship of Cinnamomum Species Using RAPD Marker Analysis.* Ethnobot Leaf, 2008, 12:476–480.

12. Cheng, K.T.; Su, C.H.; Chang, H.C. et al. *Differentiation of genuines and counterfeits of Cordyceps species using random amplified polymorphic DNA.* Planta Medica. 1998, 64:451-3.

13. Zhang,Y.B; Ngan, F.N; Wang, Z.T. et al. *Random primed polymerase chain reaction differentiates Codonopsis pilosula from different localities.* Planta Medica. 1999; 65:157-60.

These studies are the part of Moldova-Romanian project *"Genetic intraspecific polymorphism analysis for the elaboration of molecular markers of some medicinal and aromatic plants chemotypes"*.

THE SCIENTIFIC JUSTIFICATION AND THE RESULTS OF RICE BREEDING IN UKRAINE

Raisa Vozhegova, Sergey Vozhegov

Institute of Irrigating Agriculture NAAS of Ukrainian
73483, Kherson, Naddneprianskoe, e-mail: izpr_ua@mail.ru

Abstract. As a result of the study of the rice genetic collection the theoretical principles have been worked out and priority directions of rice breeding in the South of Ukraine have been outlined. As the main directions of rice breeding were chosen a reduction of the duration of the vegetative period, dwarfism, increasing of the genetic potential of grain productivity and plant adaptability to unfavorable biotic environmental factors. The optimal morphological, genetic and physiological parameters of an intensive variety model of rice have been justified. The plants which meet these parameters are capable to use efficiently the agro-ecological potential of this climatic region, and to ensure the formation of grain yield potential at the level of 8,0-10,0 t/ha with high grain quality.

Key words: rice, genetic pool, hybrid, plant breeding, trait, selection, inheritance, variability, correlation, productivity, grain quality.

INTRODUCTION

Rice is among the most widespread agricultural cultures in the world. In Ukraine average annual production of raw rice in the last few years was about 80 thousand of tons, and the volume of consumption – 170-180 thousand of tons. At such correlations, the domestic production satisfies the consumers' needs only on 40-45%. Introduction of new varieties of rice with high technological and consumer qualities is a significant reserve of increase of production of rice goods.

After potential properties, the rice is among the most productive cultures. In particular, in 2005, on the entire area where rice was sown - 21,4 thousand ha, its productivity was of 4,4 t/ha, that was 0,1 t/ha higher than the productivity of corn and 1,5 t/ha – than winter wheat. But the yield from every hectare of 3,5-4,0 t grains of rice doesn't guarantee providing the necessary production yet, it is possible only after the level of productivity is over 5,0-6,0 t/ha and profitability is higher than 50%.

The culture of rice is not adapted enough to the temperature terms of this area, due to its long period of vegetation. Most varieties are affected by *Piricularia orisae* Cav. that limits the degree of realization of the productive potential. The absence of fundamental researches of mechanisms of correlation «genotype-environment»

influences the effectiveness of selection and of high quality policy. For this reason, subsequent development of selection-genetic bases and perfection of methods of creation of adaptive to the unfavorable biotic and abiotic factors of environment of productive varieties of rice with high quality of grains is actual [1, 2, 3].

MATERIALS AND METHODS

Researches took place in 2001-2009 in Institute of rice of NAAN Ukraine.

The source materials of rice from genetic collection (more than 500 were used), commercial varieties and internal hybrids were got from cross-pollination of different varieties and from native forms and foreign selection served as initial material for implementation of experimental researches: the total quantity of created hybrids were about 315 combinations from the simple and backcrossing hybrids based on about 46 paternal forms.

RESULTS AND DISCUSSIONS

For the performance of objective after creation of new varieties it is necessary to mobilize and rationally use the genetic resources of rice, to select from them necessary donors and sources of the important signs and in the basis of selection work to lay down genetic conformities to the law on the selection of initial material for a selection. In the selection of varieties of rice for the south of Ukraine it is important to own information about the quantitative signs, features of their inheritance and variation, efficiency of selections after signs which are related to adaptive and productive potentials in a region and others like that.

Table 1

Collection of botanical taxa of *Oriza* L.

Botanical taxon	Number of chromosomes	Distribution
1	2	3
1. *O. sativa* L.	24	Tropical, subtropical and moderate areas of earth
2. *O. glaberrima* Steud.	24	Western Africa
3. *O.fatua* Koenig.	24	India, Indo-chinese (Vietnam)
4. *O. rerennis* Moench.	24	South-east Asia, Africa, America
5. *O. latifolia* Desv.	48	South America central and
6. *O. coarctata* Roxb.	48	India, Burma
7. *O. minuta* Presl.	48	Philippine islands
8. *O. punctata* Kotschy.	48	Tropical Africa
9. *O. officinalis* Wall.	24	India, indo-chinese, islands Probes
10. O. *meyeriana* Baill.	24	Philippine islands, South China
11. *O. granulata* Nees.	24	India, China, Ceylon

12. *O. Ridleyi* Hook.	48	Australia, New Guinea, Malatsciy peninsula
13. *O. brachyanthsa* Chev. et Roehr.	24	Tropical Africa (Sudan)
14. *O. breviligulata* Chev. et Roehr.	48	Tropical Africa (Sudan)
15. *O. schlechteri* Pilg		Australia, New Guinea
16. O. *australiensis* Domin	24	Australia a north
17. *O. grandiglumis* Prog.	48	North America central and, and Brazil
18. *O. rerrieri* Camus.	24	Tropical Africa

The results of research of vegetation period allow to determine the maturity groups of commercial varieties for every area of growing, including for the south of Ukraine, as duration of period of vegetation of plants must fit to bioclimatic potential of area for growing [98, 220]. The result of many researchers, which are the witness that intervals between the separate groups of maturity must be within the limits of 10 days, it is an original norm which is confirmed by our researches. As an example, we gave variable data concerning the duration of vegetation period of varieties obtained at the Institute of rice of NAAS Ukraine (tabl. 2).

In keeping to long-term research, the vegetation period at early maturity varieties on the south of Ukraine lasts 100-115 days, middle - 116-125 and late - 126-135 days, but in separate years, depending on weather conditions, both, minimal and maximal duration of vegetation at different genotypes, can substantially change in comparison with average annual indexes.

Table 2

Duration of vegetation period of the verities created in the Institute of rice of NAAN Ukraine, 2005-2007

Variety	Group of ripeness	Duration of vegetation period on years, days			$\bar{x}$, days	V%
		2005	2006	2007		
Dnepr	early maturity	116	115	109	113	5,6
Yantarniy	early maturity	117	118	110	115	6,3
Prestige	early maturity	118	120	112	117	4,8
August	early maturity	115	117	110	114	5,3
Ukraine-96	middle maturity	125	123	112	120	10,4
Indent	middle maturity	126	124	114	121	12,2
Slavoutich	middle maturity	124	123	117	121	11,5
Memory Gichcina	middle maturity	126	125	116	122	13,0
Premioum	middle maturity	125	124	118	122	9,3
Viscount	middle maturity	126	124	115	122	8,7
Antaeus	middle maturity	127	124	120	124	8,5

The duration of under the water period to the troop landing of panicle at the varieties of early maturity group was on average 77,3 days, middle maturity – 85,0 days and late maturity group – 91,6 days. That is, the vegetative phase was the shortest at the early maturity group of varieties, the longest – at the late maturity group, and the varieties of middle maturity group occupied intermediate position.

The period from the troop landing of panicle to the harvesting was also the shortest at early maturity group – on average - 26,0 days, instead at the varieties of middle maturity and late maturity groups it was 7,4 and 8,7 days longer, respectively. That is why, difference in duration of the period of grain forming in middle-late varieties on average on the training genotypes was insignificant.

For the years of researches there were different weather conditions, which influenced the duration of vegetation period, which had a considerable influence on forming of productivity of new varieties of rice. It showed, that in the early maturity group of varieties, the productivity varied within the limits of 5,81-9,94 t/ha, in the middle maturity group this index was 7,95-11,79 (tabl.3). Thus, the limits of variation of productivity at the varieties of the first group was 4,13 t/ha, second – 3,84 t/ha. In the module of factors variety / year – it is a small difference – 0,29 t/ha. The yield of early – middle variety was less than the yield of middle maturity group – 1,35 t/ha.

Data analysis of table 3 show, that in more favourable years (2004, 2006, 2007 and 2009) among early maturity group, August kept the highest grade of productivity. In unfavorable years (2005 and 2008) the productivity for all early maturity varieties decreased, but this decline has taken place without certain conformity. On average for 6 years of tests the greatest productivity was shown by varieties Agate (8,47 t/ha) and August (8,62 t/ha).

The richest harvests in the competitive test formed middle maturity varieties Admiral, Antaeus, Viscount, Ukraine-96 – on the average for 6 years the yield of grain from a hectare was about 10 t/ha, and in the favourable year 2007 - their productivity was over 11,0 t/ha.

The new varieties of rice are characterized by different indexes of physical properties of quality of grain. Among early maturity varieties, the best indexes of mass of 1000 grains have the varieties Agate, Amber and Debut, less grain gaping have the varieties Agate and August. A higher glassiness is also characteristic of Agate Amber and Debut. By the general output of groats and output of whole kernel of varieties differed inconsiderably, they were at a high enough level.

The middle maturity varieties of rice by the physical indexes of grain quality differed little from the early maturity group.

Table 3

Productivity of varieties of rice in Ukraine (t/ha)

Variety (factor A)	Years (factor B)						Middle on a factor A
	2004	2005	2006	2007	2008	2009	
Early verities							
Dnepr	7,40	7,51	8,88	9,45	6,40	7,65	7,89
Agate	9,50	7,76	7,92	9,82	6,82	8,98	8,47
Yantarniy	8,78	7,49	7,50	9,84	6,24	9,20	8,18
Prestige	8,10	7,38	9,04	9,70	5,81	8,39	8,07
August	9,54	7,84	8,91	9,94	6,80	8,64	8,62
Debut	8,22	6,78	8,02	8,06	6,26	6,95	7,39
Middle on a factor B	8,59	7,46	8,38	9,47	6,39	8,31	8,10
Middle verities							
Ukraine-96	8,24	8,73	10,12	11,43	10,32	8,62	9,58
Antaeus	8,77	8,88	10,75	11,79	9,64	8,11	9,66
Memory Gichcina	8,02	8,57	8,90	10,60	7,42	9,93	8,91
Premioum	7,96	7,95	8,46	10,25	8,10	9,24	8,66
Viscount	9,01	8,92	9,10	11,51	9,32	9,62	9,58
Ontario	7,95	8,95	9,87	10,77	9,56	9,34	9,41
Admiral	9,25	9,23	9,84	11,40	9,65	10,35	9,96
Middle on a factor B	8,46	8,75	9,58	11,11	9,15	9,32	9,40

As result of researches of new varieties, we can show some ascertaining, that at variable weather condition on the south of Ukraine the new early created varieties of rice Agate, Amber, Prestige and August are able to achieve a productivity in average for 6 years of about 8,0 t/ha, and in the most favorable years – 9,5 t/ha and more. The productive potential of middle varieties – Antai, Memory Gichcina, Premioum, Viscount, Ontario and Admiral is about 10,2-11,8 t/ha; and it was successfully realized in the favorable years on optimum agro- technical conditions.

CONCLUSIONS

On the basis of the research of the genetic diversity of the rice varieties, an investigation of inheritance features, variability, genotype-environment interactions and correlations between productivity quantitative characters, the principles of selection of the initial parent plants have been developed, as well as the methodology of the breeding process has been improved. The identification of the factorial productivity traits (leaf surface area, panicle length, grain weight of a panicle, number of spikelets and grains in a panicle) allowed increasing incredibly the efficiency of selection using different growing spaces and applying different doses of nitrogen fertilizer. A valuable

breeding material has been developed. 9 varieties of rice (Agat, Yantarny, Prestyzh, Serpnevy, Antey, Pam'yati Gichkina, Premium, Vikont and Ontario) entered in the State Register of Plant Varieties of Ukraine, and 2 varieties (Debyut and Admiral) are currently in the State Variety Trial.

BIBLIOGRAPHY

1. Vozhehova R. Varieties and directions of rice breeding in Ukraine. Proceedings or the conference "Challenges and opportunities for sustainable rice-based production systems", 13-15 September 2004. – Torino, Italy, 2004. – P. 399-403.

2. Vantsovskyy A., Marushchak A., Vozhehova R. Comparative characteristic of groats quality of new rice varieties // Proceedings or the conference "Challenges and opportunities for sustainable rice-based production systems", 13-15 September 2004. – Torino, Italy, 2004. – P. 323-327 37.

3. Вожегова Р.А., Шпак Д.В., Петкевич З.З. Прогнозирование селекционной ценности гибридных популяций риса / Р.А. Вожегова, // Фактори експеременталної еволюції організмів: зб. наук. пр. – К., 2004. – С. 283-287.

ANALYSIS AND PROGNOSIS OF RESULTS OF INTRODUCTION OF GYMNOSPERMS FROM THE WORLD FLORA IN THE CONDITIONS OF REPUBLIC MOLDOVA

V. Bucatsel

Botanical Garden (Institute) Academy of Sciences of Moldova
MD-2002 Chisinau, 18 Padurii str.
e-mail: vbucatsel@mail.ru

Abstract. The issue on introducing of Pinophyta in pedoclimatic conditions of Republic of Moldova is approached in the paper. Taxonomic structure, the number of species and cultivars, which are in specific collections green plantings, forest culture, private gardens etc. were established. As a rezult 785 taxons of Pinophyta were specified.

Key words: pinophyta, mobilization, floristic region, species, cultivars.

INTRODUCTION

Gymnosperms by their exceptionally high decorative qualities, which ensured them a wide implementation in creating green plantings, are distinguished. It should be noted that the gymnosperms possess the property of purifying the air, the ability to neutralize harmful substances and also bactericidal effect. The Division *Pinophyta* in the Republic of Moldova by the classes of *Gnetopsida*, *Ginkgopsida* and *Pinopsida* is represented.

Gnetopsida class includes 3 families: *Ephedraceae* (Central and Southern Europe); *Welwitschiaceae* (South America) and *Gnetaceae* (tropical regions of America, Asia and Africa) and only the representatives of the first family (genus *Ephedra* L.) in Europe, some species that are identified in the wild flora are cultivated. On the territory of our country only one wild species which pertain to Division *Pinophyta* – *Ephedra distachya* L. is registered.

Ginkgopsida class includes one single family *Ginkgoaceae*, one genus *Ginkgo* L. and one species of *Ginkgo biloba* L., the natural habitat is China.

The class *Pinopsida* includes 7 families (*Taxaceae*, *Podocarpaceae*, *Araucariaceae*, *Cephalotaxaceae*, *Pinaceae*, *Taxodiaceae*, *and Cupressaceae*), 55 genera and more than 600 species, growing mainly, in the northern hemisphere. In the southern

hemisphere the coniferous plants are more numerous in temperate regions (Tierra del Fuego, Patagonia, New Zealand, and Tasmania). In the tropics, they are identified only in the mountainous regions with lowered temperature.

According to the new classification of gymnosperms [8], subclass *Pinidae* (*Pinopsida*) includes 6 families (*Pinaceae*, *Araucariaceae*, *Podocarpaceae*, *Sciadopityaceae*, *Cupressaceae and Taxaceae*) and 70 genera. Recent phylogenetic studies have shown the close relatives ties of *Taxaceae* and *Cephalotaxaceae* families that is why they are classified into one *Taxaceae* family. Genetic investigations also established that all the plants of the *Taxodiaceae* family, except the genus *Sciadopitys*, must be integrated with the *Cupressaceae* family, because there is no one peculiarity, according to these families that could be separated. The only exception is the genus *Sciadopitys*, which is genetically different from the other genera. This present genus to be classified in *Sciadopityaceae* family has been decided.

The analysis of the geographical extension of gymnosperms has established that 66% of them are growing in the northern hemisphere, 31% - in the southern hemisphere, and 3% - in both hemispheres. In regions with temperate and cold climates are growing approx. 370 species, belonging to 21 genera [6, 9, 31]. According Krüssmann [28], in the districts of the Northern Hemisphere, also in the same climatic conditions, the conifers form significant plantings (6 families and about 43 genera). Some kinds of conifers (genera *Picea*, *Pinus*, *Abies*, *Juniperus*, *Thuja*, *Chamaecyparis*) are characterized by very expressed polymorphism, are known more than 6000 systemic units (subspecies, cultivars, forms, varieties etc.) [7].

MATERIALS AND METHODS

The gymnosperms, introduced in the Republic of Moldova, served as biological object of the investigations with the target of expanding the taxonomic diversity and identifying their biological and ecological peculiarities, for development of scientific fundamentals and sustainable use in ornamental landscaping-gardening. Revealing of taxonomic composition was performed by routing investigations of ornamental plantings, botanical gardens, dendroparks, nurseries, of ancient parks, private gardens etc. Studying the distribution of species by floristic regions of the Earth was performed according the A.L. Tahtadjean monograph [32].

RESULTS AND DISCUSSIONS

The natural conditions of the Republic Moldova are sufficiently suitable for growing various woody plants. This fact is explaining the relative richness of dendroflora (more than 140 species of trees and shrubs, including 1 species of gymnosperms – *Ephedra distachya*). The soil and climatic conditions of the region also represent great opportunities for the enrichment of natural dendroflora with new economically

valuable species by the way of introduction from different floristic regions. A special place properly belongs to the species and intraspecific taxa of *Pinaceae* and *Cupressaceae* families, which are present here by the greatest diversity, in comparison with other families. However, some species of gymnosperms adapted rather difficult to soil and climatic conditions of the Republic Moldova, because of limiting factors such as late spring and early autumn frosts, frequency of droughts, swelter, the strong calcareous soils and other adverse edaphic conditions. Therefore, during more than 150 years, the works under mobilization of species, varieties and forms from different geographical regions, with the target of their introduction in the soil and climatic conditions of our country were carried out. During the last 30-40 years comprehensive investigations concerning the introduction of gymnosperms have been performed. The biological and ecological peculiarities, ornamental qualities were studied, the most perspective for green building were identified, the technologies for their reproduction have been elaborated, and recommendations for using in different types of green plantings were carried out. The ways to express introduction by the transplantation methods were developed [5, 12, 13, 14, 15, 16, 20, 27].

For revealing the taxonomic composition of gymnosperms in the Republic of Moldova, the literature references known up to the present time were analyzed [10, 11, 24, 29, 25, 26, 33]. Meanwhile, the presence or absence in our country of some taxa registered before it was revealed.

The taxonomical composition of Botanical Garden gymnosperms, as well as Chisinau Dendrological Garden has been carefully tested [22]. In addition with this, analogous works in dendrological collections of research and educational institutions, nurseries, private gardens, a number of new taxa were identified. As a result of investigation 161 species and more than 600 cultivars of conifers, belonging to 28 genera and 6 families have been established (table 1) [1, 2, 3, 4, 5, 17, 19, 21, 23].

The greatest number of taxa represents the genera: *Picea* (24 species, 125 cultivars); *Thuja* [3, 82]; *Juniperus* [22, 105]; *Pinus* [37, 92]; *Chamaecyparis* [5, 82]; *Abies* [25, 37]; *Larix* [11, 16]. The other genera presented considerably smaller number of taxa.

According to the floristic regionalization of Earth, the introduced gymnosperms in our country belong to 7 regions of the Holarctic Kingdom [32].

Most of all species in the Republic of Moldova have been introduced from the East Asian floristic region, which extends from the Amur and of Southern Sakhalin in the north to the mountains of North Vietnam and North Burma in the south, from the east of Shikotan Island on the east to the Greater Khingan and Eastern Himalayas. Dendroflora of this area is extremely rich and diverse by endemic families, in genera and species. Of the gymnosperms are endemic 15 genera and 29 [31] species (*Ginkgo* – 1, *Cephalotaxus* – 6, *Amentotaxus* – 3-4, *Pseudotaxus* – 1, *Cathaya* – 1, *Keteleeria* – 6, *Pseudolarix* – 1, *Cryptomeria* – 1, *Cunninghamia* – 2-3, *Metasequoia*–1,

Table 1

Taxonomical composition of gymnosperms cultivated in the Republic of Moldova

Nrs.	Family	Genus	Quantity		
			species	cultivars	taxons
1.	*Ginkgoaceae* Engelm.	*Ginkgo* L.	1	12	13
2.	*Taxaceae* Lindl.	*Torreya* Arn.	1	-	1
		Taxus L.	5	15	20
		Cephalotaxus Sieb. et Zucc.	2	-	2
3.	*Pinaceae* Lindl.	*Abies* Mill.	25	37	62
		Pseudotsuga Carr.	1	8	9
		Tsuga Carr.	3	6	9
		Picea Dietr.	24	125	149
		Pseudolarix Gord.	1	-	1
		Larix Mill.	11	16	27
		Cedrus Trew	3	6	9
		Pinus L.	38	92	130
4.	*Sciadopityaceae* Luerss.	*Sciadopitys* Sieb. et Zucc.	1	-	1
5.	*Cupressaceae* F. Neger	*Sequoiadendron* Buchh.	1	2	3
		Taxodium Rich.	1	1	2
		Cryptomeria Don.	1	3	4
		Cunninghamia R. Br.	1	-	1
		Metasequoia Hu et Cheng	1	5	6
		Thujopsis Sieb. et Zucc.	1	1	2
		Thuja L.	3	82	85
		Platicladus Spach	1	21	22
		Microbiota Kom.	1	-	1
		Calocedrus Kurz	1	1	2
		x *Cupressocyparis* Dall.	1	1	2
		Cupressus L.	3	3	6
		Chamaecyparis Spach	5	82	87
		Juniperus L.	22	105	127
6.	*Ephedraceae* Wettst.	*Ephedra* L.	2	-	2
	Total: *Pinophyta*	**28 genera**	**161**	**624**	**785**

Sciadopitys – 1, *Taiwania* – 2, *Fokienia* – 1, *Microbiota* – 1, *Thuyopsis* - 1). Out of 107 species of the East Asian conifers were tested 47, which constitute 31.5% of total coniferous exotic plants belonging to the genera of boreal flora. They belong

to the 6 families and 19 genera. Among them are 42 species – trees and 5 species – shrubs. Of the East Asian gymnosperms it should be noted the following types of coniferous plants, such as: *Abies holophylla, A. homolepis, A. koreana, A. nephrolepis, A. recurvata, A. sachalinensis, A. veitchii, Cephalotaxus drupaceae, Chamaecyparis pisifera, Ch. obtusa, Cryptomeria japonica, Cunninghamia lanceolata, Ginkgo biloba, Juniperus chinensis, Ju. procumbens, Ju. rigida, Ju. sargentii, Ju. sibirica, Ju. squamata, L. kaempferi, L. maritima, Metasequoia glyptostroboides, Microbiota decussata, Picea bicolor, P. jezoensis, P. glehnii, P. koraiensis, P. montigena, P. polita, Pinus armandii, P. densiflora, P. funebris, P. koraiensis, P. parviflora, P. sinensis, P. thunbergii, Platicladus orientalis, Pseudolarix amabilis, Sciadopithis verticilata, Taxus cuspidata, Thuja standishii, Thujopsis dolobrata, Torreya nucifera, Tsuga diversifolia etc.*

The second – distinguished by the richness of species, the source of introduction of coniferous plants in the Republic of Moldova occupies the Circumboreal region which comprises the northern part of the Eurasian and North American continents. On the whole, they are the representatives of the genera – *Abies*, *Picea*, *Larix* and *Pinus*. Majority of them are the forest forming rocks of the Northern Hemisphere, which have found their application in the landscape design (*Picea abies*, *Larix decidua*, *Pinus nigra* etc.). From this area were tested 39 species of available 48, registered in its flora, which constitute 26.2% of total implemented conifers (*Abies alba, A. nordmanniana, Picea mariana, P. obovata, P. omorica, P. orientalis, Pinus cembra, P. mugo, P. pallasiana, P. peuce, P. sibirica, P. sylvestris, Juniperus communis, Ju. horisontalis, Ju. sabina, Taxus baccata* etc.).

A rich source of the introduction of coniferous plants is Atlantic North American floristic region. It stretches off the Atlantic coast of North America to the Great Plains from the Gulf Coast down to the southern regions of Canada. Flora of the present region is characterized by high endemism. From the coniferous plants, the following endemic species *Abies fraseri*, *Picea rubens*, *Tsuga canadensis*, *Pinus rigida*, *P. taeda*, *Taxodium distichum* etc. may be mentioned. In the Republic of Moldova, from the 26 coniferous species of Atlantic North American Region – 18 kinds were tested. Positive results for 14 species, representing 9.4% from the total number of exotic coniferous plants were obtained. Among them are: *Abies fraseri*, *A. balsamea*, *Picea glauca*, *P. rubens*, *Pinus strobus*, *P. resinosa*, *P. banksiana*, *P. monticola*, *Thuja occidentalis*, *Juniperus virginiana*, *Chamaecyparis thyoides*. Some of these species had settled far to the north and became part of the Canadian province dendroflora of Circumboreal region.

Floristic region of the Rocky Mountains covered the mountain system of western Canada and the western United States from Alaska to the New Mexico. Flora of above-mentioned region is very close to the Circumboreal Region flora. Is dominated by coniferous forests of various species composition (*Pseudotsuga menziesii*, *Pinus*

ponderosa, *P. contorta*, *Thuja plicata*, *Tsuga heterophylla*, *T. mertensiana*, *Picea sitchensis*, *and Chamaecyparis nootkatensis*), the floristic region of the Rocky Mountains is characterized by very high degree of endemism of species, among which it may be underlined: *Taxus brevifolia*, *Abies amabilis*, *A. grandis*, *Pseudotsuga menziesii*, *Tsuga heterophylla*, *T. mertenciana*, *Picea pungens*, *P. sitchensis*, *Larix lyallii*, *L. occidentalis*, *Pinus albicaulis*, *P. contorta*, *P. flexilis*, *P. lambertiana*, *P. monticola*, *Chamaecyparis nootkatensis*, *Cupressus bakeri*, *Juniperus occidentalis*. Out of the 27 species of coniferous, growing in the given region, for the primary testing, in the Republic Moldova, 18 species were introduced. Positive results on 15 species that constitute 10.1% of the total number of introduced coniferous plants in Moldova were obtained. Thus, dendroflora of floristic region of the Rocky Mountains is one of the rich sources of coniferous plants. From the given region were introduced: *Picea pungens*, *Abies concolor*, *A. balsamea*, *A. arizonica*, *A. lasiocarpa*, *Pseudotsuga menziesii*, *Picea sitchensis*, *P. engelmanii*, *Larix occidentalis*, *Pinus flexilis*, *P. ponderosa*, *P. jefreyi*, *P. contorta*, *Thuja plicata*, *Chamaecyparis nootkatensis*.

Flora of the Mediterranean region covers the northern, southern and eastern coast of the Mediterranean Sea, is extending from Spain to Syria, from Morocco to the Black Sea coast. Dendroflora of this region comprises one endemic genus (*Tetraclinis*) which in Republic of Moldova is not introduced. In our conditions were tested 12 species (8,0%) and among these are the following: *Juniperus excelsa*, *Ju. foetidissima*, *Ju. oxicedrus*, *Abies cephalonica*, *A. numidica*, *A. pinsapo*, *Cedrus atlantica*, *C. libani*, *Pinus halepensis*, *P. pinaster*, *P. kohiana*, *P. laricio.*

Irano-Turanian region encompasses Asia Minor, the Iranian plateau, Central Asia, the Western Himalayas and Central Asia. The arboreal woody vegetation is concentrated in the mountainous regions, the climate of which is quite diverse. Flora of this region is rich in the endemic genera and species: *Cedrus deodara*, *Abies spectabilis*, *A. pindrow*, *Picea smitchiana*, *Taxus wallichiana*, *Pinus wallichiana*, *P. gerardiana* etc. Flora of region consists of 23 species of conifers from which in Republic of Moldova 16 kinds have been tested. Currently, in the collection plantings are growing 11 species or 7.4% of total coniferous exotic plants. Among these, the following species may be mentioned: *Picea asperata*, *P. schrenkiana*, *P. smitchiana*, *Abies cilicica*, *A. spectabilis*, *Juniperus semiglobosa*, *Ju. pseudosabina*, *Ju. turkestanica*, *Cedrus deodara*, *Pinus bungeana*, *P. wallichiana* etc.

Madrean region is extending from the South-West Oregon across California to the Northern part of Baja California and comprises torrid deserts, begining from Southern California to Arizona, New Mexico and Texas and further to the South to the Mexican plateau, much of Nevada and Utah. The climate on the best part is subtropical. Flora of this region is very similar with the flora of the Ancient Mediterranean. At the foothills and a the lower mountain zone are growing heat-loving plants (*Sequoia*, *Sequoiadendron*, *Cupressus*, *Torreya*, and 28 species of pine); in the upper belt are

spread the kinds characteristic for the Rocky Mountains (*Abies concolor*, *A. lowiana*, *A. arizonica*, *Pseudotsuga menziesii*, *Picea engelmanii*, *Pinus ponderosa*, *P. jeffreyi*, *P. aristata*). Here there are enclaves, characteristic species for Atlantic North American region, as *Pinus strobus*. In the Republic of Moldova, from this region 11 species of coniferous plants have been tested: *Chamaecyparis lawsoniana*, *Cupressus arizonica*, *C. lusitanica*, *C. macnabiana*, *Sequoiadendron giganteum*, *Pinus quadrifolia* etc.

As a result of summarizing the testing of gymnosperms and the analysis of floras of the Earth has revealed the basic centers for further replenishment with new kinds of the region. In the perspective, the mobilization over 100 species, one third of them belonging to the Eastern Asiatic floristic region, is planned. Perspective assortment includes 102 species belonging to the following areas: Circumboreal - 8; East Asian - 34; Atlantic North American - 13; Rocky Mountains region - 14; Mediterranean - 12; Irano-Turanian - 8; Madrean - 13.

From the above-mentioned, it follows that introduced plants, belonging to the Eastern Asiatic region is of great interest. Considerable increase the number of species is real due to the richest genera such as: *Pinus*, *Abies*, *Picea*, *Juniperus*, and *Larix*. Expansion of collections is also possible on the basis of the vast diversity of ornamental cultivars, varieties and forms.

CONCLUSIONS

The results of years of experience on the introduction of gymnosperms in the Republic of Moldova point to the great potential on enrichment of the assortment by new decorative species, cultivars, varieties and forms, with the target of their use in ornamental gardening.

Based on the performed investigations on the state of introduced gymnosperms, the assessment of their decorativeness, sustainability and reproductive capability in the Republic of Moldova conditions, for the green building, three categories of assortments (basic, additional and limited use) comprising 262 taxa were elaborated.

The creation of the largest collections of generic complexes, such as: *Picea*, *Pinus*, *Abies*, *Larix*, *Juniperus* etc. allowed us to estimate the perspective of their use and to develop the most appropriate methods of reproduction and their cultivation.

REFERENCES

1. Bucaţel V. Diversitatea taxonomică a pinaceelor (*Pinaceae* Lindl.) introduse în R. Moldova. In: ”Biodiversitatea vegetală a R. Moldova”. Chişinău. 2001. P. 202-208.

2. Bucatsel V. Gymnospermae taxonomic composition introduced in the Republic of Moldova. In: Сохранение биоразнообразия растений в природе и при интродукции. Сухум. 2006.

3. Bucatsel V. Some contributions on introduction of the genus *Abies* in the Republic of Moldova. In: Scientific Papers. Series B, Horticulture. Bucharest, Roumania. 2013, vol. LVII, p. 285-288.

4. Bucatsel V. Species of the genus *Pinus* L. in the plantings collection of Moldova and perspectives of their use. In: The 12th International Symposium „Prospects for the 3rd Millenium Agriculture", 26-28 septembrie 2013, Abstracts, Cluj-Napoca, Romania, p. 74.

5. Bucatsel V. Perspectives of using *Ginkgo biloba* L. in landscape-gardening. În: Rev. Bot., Chisinau. 2013, vol. V, nr 2(7), p. 101-106.

6. Cronquist A. The natural Geography of plants. New York Columbia University Press. 1964.

7. Encyclopedia of Conifers: Comprehensive Guide to Cultivars and Species by Aris G. Auders and Derek P. Spicer, 2012, Hardcover, 2 vol., 1507 p.

8. Farjon A. A Natural History of Conifers. Timber Press, Portland, Oregon, USA, 2008, 304 p.

9. Александрова М. С. Интродукция хвойных в ГБС АН СССР. В кн.: Интродукция древесных растений. М.: Наука, 1980, с. 48-65.

10. Андреев В. Н. Деревья и кустарники Молдавии. М., РИО АН СССР, 1957, вып. 1, 207 с.

11. Ботанический сад Приднестровья. В. С. Рущук, И. Н. Маяцкий и др. ГУ «Республиканский ботанический сад». Тирасполь: Литера, 2009. 88 с.

12. Букацел В. А. Межвидовая прививка ели. In: Научные основы озеленения городов и сел Молдавии. Тез. докл. Кишинев,1984, с. 24-25.

13. Букацел В. А., Жунгиету И. И. Вегетативное размножение ели. In: Сел. хоз-во Молдавии. 1986, 3, с. 43.

14. Букацел В. А. Биологические особенности и размножение интродуцируемых видов рода *Picea* A. Dietr. в Молдавии. Автореф. дисс. канд. биол. наук. Кишинев,1987, 16 с.

15. Букацел В. А. Ускоренный способ интродукции видов ели (*Picea* A. Dietr.). In: Научные основы озеленения городов и сел Молдавии. In: Тез. докл. Кишинев.1990, с. 23.

16. Букацел В. А. Роль прививки в ускорении семеношения видов ели. In: Репродуктивная биология интродуцированных растений. In: Тез. докл. 1Х Всесоюз. совещ. по семеноведению интродуцентов. Умань.1991, с. 27.

17. Букацел В. А. Старинные парки Молдовы – очаги интродукции *Pinaceae* Lindl. În: Старовини парки и проблеми іх сбереження. Умань. 1996, с. 86.

18. Букацел В. А. Принципы формирования экспозиционно-рекреационного участка «Пинариум» в Ботаническом саду АН Молдовы. In: Мат. III Междунар. конф., 8-11 июня 2011 г. «Ландшафтная архитектура в ботанических садах и дендропарках». Киев. 2011, с. 20-25.

19. Букацел В. А. Интродукция хвойных растений в Республике Молдова. In: Матер. Міжнар. Наукової Конф. «Старовинні парки і ботанічні сади – наукові центри збереження біорізноманіття рослин та охорони історико-культурної спадщини». 5-7 жовтня 2011 року, Умань, 2011, с. 58-60.

20. Букацел В. А. Прививка – ускоренный и эффективный метод интродукции хвойных. In: Матер. III міжнар. наукової конференціі "Інтродукція, селекція та захист рослин". (Донецьк, 25-28 веревня 2012 р.) - Донецьк, 2012. С. 31.

21. Букацел В. А. Краткий очерк истории интродукции голосеменных растений в Республике Молдова. In: Матер. Междунар. конференции «Интродукция, сохранение и использование биологического разнообразия мировой флоры», посв. 80-летию Центрального ботанического сада НАН Беларуси (19-22 июня 2012), В 2 ч. Ч. 1, Минск, 2012. С. 40-42.

22. Букацел В. А., Манжуловская Г. Д. Коллекции *Pinophyta* Ботанического сада АН Молдовы и Кишиневского дендрологического парка. In: IV Междунар. Научн. конф. «Сохранение и реконструкция ботанических садов и дендропарков в условиях устойчивого развития» 23-26 сентября 2013 года, Государственный дендрологический парк «Александрия» НАН Украины, 2013, с. 85-90.

23. Букацел В. Виды и культивары рода *Juniperus* L. в ландшафтном дизайне Молдовы. In: Матер. V Междунар. научн. конф.: «Ландшафтная архитектура в ботанических садах и дендропарках», 5-8 ноября 2013. Баку. 2013, с. 48-53.

24. Гусев Ю. Д. Деревья и кустарники садов и парков Молдавской ССР и Заднестровья Одесской области. Тр. Ботан. Ин-та им. В. А. Комарова АН СССР. Л., 1958, вып. 6, сер. 6, с. 82-148.

25. Денисов В. А. Тираспольский Дендропарк. In: Методика исследований в орошаемом овощеводстве. Кишинев, 1971, Т. 12, вып. 4, с. 59-77.

26. Денисов В. А. Дендрарий Молдавского ордена Трудового Красного Знамени научно-исследовательского института орошаемого земледелия и овощеводства. Кишинев: Тимпул, 1982. 156 с.

27. Жунгиету И. И., Букацел В. А. Размножение декоративных форм пихты белой (*Abies alba* Mill.) прививкой. In: Сел. хоз-во Молдавии. 1987, с. 54.

28. Крюссман Г. Хвойные породы. М.: Лесн. пром-сть, 1986. 256 с.

29. Леонтьев П. В. Парки Молдавии. Кишинев: Картя Молдовеняскэ. 1967. 94 с.

30. Манжуловская Г. Д. Некоторые результаты интродукции рода *Thuja* в условиях Кишиневского дендрологического сада. In: Mat-le Simp. Şt. Int.”Conservarea diversităţii plantelor” consacr. aniv. a 60-a de la fond. G.B. (I) a A.Ş.M. 7-9 octombrie 2010. Chişinău, 2010. p. 502-506.

31. Славкина Т. И. Дендрология Узбекистана. Ташкент: ФАН, 1968. Т. 2, с.

32. Тахтаджян А. Л. Флористические области земли. Л.: Наука, 1978. 248 с.

33. Холоденко Б. Г. Деревья и кустарники для озеленения в Молдавии. Кишинев: Штиинца. 1974. 267 с.

IV. SCIENTIFIC CHRONIC

CORRESPONDING MEMBER VASILE ŞALARU ON HIS 80TH BIRTHDAY

Biologist, branches of science: algology, hydrobiology, algal biotechnology, protection and rational use of plant resources. Habilitated Doctor of Biological Sciences (1972), Professor (1975), Corresponding Member of the Academy of Sciences (1995).

He was born on September 26, 1934, in the village Văratic district Rîşcani. He comes from arespectable family.Vasile Şalaru graduated from the Faculty of Biology and Soil Science from the State University of Moldova and then he began his research activity, attending the scientific circle at the Department of Botany in the hope of obtaining further knowledge to achieve his childhood dream of becoming a botanist.

Only persons endowed with exceptional intellectual capacities, with deep thinking and a thorough preparation are capable of realizing something essential in science, taking into account the high level of its development. It is difficult to impose oneself especially in such an area of activity as algology.

From an early age, the corresponding member V. Şalaru was interested in botany and, particularly, in algology. As a child, he liked to wander the forest near his native village Văratic looking for different wild plants.In 1959, which was a good year for his scientific career, he decided to transfer to the Institute of Biology of Moldovan branch of ASM of ex-USSR.As a researcher, he stood out among colleagues in terms of innovation and strategic investigations. Thecreative environment of the institute, the favourable working conditions, the exchange of views at scientific councils and

the ability to visit themost famous institutes in Kiev, St. Petersburg, Borovsk in order to improve knowledge helped him facilitate the conducting of scientific research. Soon he identified new research directions concerning phytoplankton.

The impressive number of about 300 rivers, rivulets, tributaries, reservoirs, lakes and ponds that he researched testify about the volume the researches on algal flora organized by Vasile Şalaru. As for the significance of scientific results, about 2,000 species of algae, the most of which were detected for the first time,are a convincing proof.

In the early years of the twentieth century,Vasile Şalaru paid particular attention to the study of development of phytoplankton in the Dubăsari reservoir, towards which all efforts of hydrobiologists of the former Institute of Zoology of the ASM were directed.Not incidentally, his PhD thesis, defended successfully in 1964, was devoted to the peculiarities of development of algal flora in this basin.

Important scientific achievements were assessed as a significant contribution to the development of algology and were exposed in his habilitation thesis, defended in 1972, at the prestigious Institute of Botany "V.L. Komarov" in St. Petersburg.

Together with colleagues, hepointed out algae species producing biologically active substances and those with a high content of edible and forage protein, selected strains with high productivity and developed modern industrial biotechnologies of intensive growth under controlled conditions, including: Spirulina platensis, Dunaliellasalina, Synechocystissalina etc. These biotechnologies were highly appreciated at various international exhibitions, being mentioned with gold and silver medals.

Due to high moral and professional skills, corresponding member Vasile Şalaru enjoys much respect and authority among the scientific community. At the age of 30, he became doctor, at 38 - habilitated doctor, at 41 – university professor, at 58 – Man Emeritus, and at 61 - corresponding member of the Academy of Sciences.

In this context, it is natural for us, the staff of the Botanical Garden (I), to congratulate Mr corresponding member Vasile Şalaru, to show him all our respect and support to realize his hopes and expectations. We wish him health, happiness and new achievements in the realm of science that heserved faithfully for a lifetime.

Ph. D. Alexandru Teleuță
Ph. D. Maricica Colțun
Ph. D. Alina Cutcovschi-Muştuc
Academician Alexandru Ciubotaru
Dr. Hab. Ion Comanici
Botanical Garden (I) of the Academy of Sciences of Moldova

Bun de tipar 3.12.2014
Coli de tipar 9,25
Format 84x108/16
Comanda 51
Tiraj 150 ex.

Tipografia Academiei de Ştiinţe a Moldovei
mun. Chişinău, str. Petru Movilă, 8