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I. STRUCTURAL AND FUNCTIONAL DIVERSITY OF PLANT ORGANISMS

CZU: 581.143.6

STUDY ON THE MORPHOGENETIC PARTICULARITIES IN THE CALLUS MASS

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Abstract: The study of the problem concerning tissue and organ culture in higher plants, separate from an organism, on artificial nutritive media and in aseptic, controlled conditions, considered in terms of biotechnology, opens up new possibilities of fundamental and applied research.

Key words: callus mass, androgenesis, morphogenesis, pollen sac, anther, tissue culture.

INTRODUCTION

Plant callus mass is a tissual formation, with proliferative cells, with particular morpho-anatomical and physiological characteristics, very special in comparison with other types of plant tissues, consisting of a mass of cells that are actively dividing and differentiate only if in these cells there is a certain hormonal balance, capable of influencing the triggering of organogenesis processes (callusogenesis, rhizogenesis, somatic embryogenesis).

Callus regeneration and its evolution are influenced by the conditions in which it (the callus) has been initiated and grown, as well as by the genotype of the species, the organ from which it has been obtained, the physiological state of the cells that have initiated the formation of callus tissue, the state that can be characterized by an active metabolic process, or by functional decline. For the first time, androgenesis was induced by *in vitro* culture of anthers [10] in *Datura innoxia* Mill., the technique of *in vitro* culture of anthers was further improved to obtain haploid plants in a large number of species [1].

Vegetal systems (*in vitro* cultures) are convenient models, suitable for the study of the mechanisms of the complex-compound systems underlying cell proliferation, differentiation, histogenesis, organo- and morphogenesis, somatic embryogenesis and regeneration of an entire organism from cultured cells characterised by totipotency. Experimental biology often operates with models that, under standard conditions, provide consistent and controlled reproduction. As models can serve: cells, tissues, organs, plantlets or plants derived from them, which, grown in natural or *in vitro* environment, are relevant in terms of their behaviour in particular life conditions, by testing their response at physiological, metabolic and biochemical level.

MATERIALS AND METHODS

The method of *in vitro* culture of anthers in order to obtain haploid plants can be implemented easily. The success of the *in vitro* culture of pollen sacs is firstly based on the choice of the right developmental stage of the

pollen grain at the time when they are collected and secondly – the composition of the growth medium. There are some parameters that determine the proliferation of androgenic callus, sometimes forms, lines from the same species respond differently to the same physical and chemical conditions.

The technique includes the following steps: collection of floral buds of appropriate size for the development of the microspore at the uninucleate stage (after the meiotic division), for *Artemisia balchanorum* Krasch. the corolla is the size of the calyx.

Different species, forms, lines, hybrids and varieties studied by *in vitro* culture served as research material. The donor material was grown in open ground. Anthers isolated from flower buds of 5-7 mm and 10 mm in the budding stage were used for inoculation. Sterilization was carried out in several variants: in 70 % alcohol for 1 minute, with subsequent washing of the material in three portions of autoclaved distilled water; with calcium hypochlorite solution (1 %) for 10 min., also washed in three portions of autoclaved water; with 1 % diacid solution for 7 min., rinsed with 4 portions of sterile water. The stages of microspore development were determined according to the method [4] with acetocarmine. After the treatment with sterilizing agents, undamaged anthers were placed in solid growth medium in Petri dishes or liquid – in tubes. For the culture of anthers, liquid and solid media were used. MS was used as basic medium and growth hormones were added to it. The growth media consisted of: MS – macro-micro-elements, Fe-chelate, vitamins (pyridoxine 0.5 g/l, thiamine 0.1 mg/l, nicotinic acid 0.5 mg/l, mesoinositol 100 mg/l, glycine 2 mg/l, sucrose 20 g/l, 2,4-D – 1.0-2.5 mg/l). The solid media were supplemented with agar 6.0 g/l. The inoculated anthers were placed in Petri dishes and tubes with gauze and cotton plugs at 25-26 °C, in full darkness for the first 2-3 days. Later, the cultivation takes place at 1200 lux light, with 16-hour photoperiodicity.

RESULTS AND DISCUSSIONS

As a result of the study on the regeneration processes of *in vitro* cultures, it has been determined the morphogenetic potential of the studied species, or the ability to form callus biomass from different parts of a plant, which (the callus) is a safe source of an unlimited quantity of homogenous and virus-free planting material. We have observed special aspects of the new callusogenic transformations through the inoculation and development of pollen and pollen sacs of some studied species on culture media (*Rosmarinus officinalis* L., *Artemisia balchanorum* Krasch., *Rubus fruticosus* L. (10 varieties), *Freesia hybrida* L., *Lycium barbarum* L. (3 varieties) etc.

After obtaining the first results in plant tissue culture, explants of various origin (fragments taken from plants, plantlets, roots, stems, leaves, inflorescences, microspores, fruits, seeds etc.) or formations thereof regenerated in the course of *in vitro* culture, namely callus, whole or sectional organs, taken from cormophytinocula, which have manifested morphogenesis of various types and amplitudes, and cell cultures, as a whole, have become subjects of study and subsequently experimental models [2].

The *in vitro* culture regime offers the possibility of complete control of the abiotic factors, only the living component that enters the experimental process remains variable. For this reason, in a properly chosen experimental model, when organizing the experiment, we shall consider all the endogenous factors that may

be involved in the stability and reproduction of the reactions of the inocula, so that the biological material cultivated has predictable manifestations (reactions), in comparison with which the behaviour of similar inocula will be analyzed later, in which case the procedure of *in vitro* culture should undergo some modifications, either changing the composition of the substrate or its physical state. The research on the morphogenetic processes of the structures has become a top priority, in relation to the possibility to act in the well-determined direction of further development [3, 6].

The relevance of the results, in relation to the biological material used as research model, will obviously be influenced by the endogenous factors, which are quite unpredictable in terms of way of exteriorization, as well as by the amplitude of the phenomena triggered under the influence of the conditions introduced in the experimental system. For example, when multiple explants are collected from the adult organs, it is almost impossible to achieve a morphoanatomic and physiological identity of all the explants or inocula that participate in the experiment, because within morphostructures there is a fluctuation of the histological elements, variable from one explant to another.

A number of experimental models, in plant tissue cultures, are focused on callus culture. Callus, due to its characteristics, has multiple uses in experiments that seek to analyze the morphogenic capacity of its cells (organogenic or embryogenic), in relation to environmental factors, the nature of the growth regulators introduced into the culture substrate, their concentration (in case of operation with subcultures, the type of hormonal balance used), the origin of the callus as a provenance from a primary, secondary or tertiary culture, of which type of organ, tissue or cell derives the callus area from which the subcultured fragments come (surface callus – compact or friable, morphogenic or non-morphogenic, hyperhydric or normal etc.).

Numerous studies on plant biotechnology emphasize the dependence of the morphogenic capacity of cormophytoinocula not only on the nature of explants and on culture conditions, in particular the species and the genotype, the morphogenesis (organogenesis and embryogenesis), being closely related to the way cells perceive the “messages” transmitted by the growth regulators present in the culture substrate, from the time of initiation of the *in vitro* cultures, during their course and in subculture [9, 7, 8]. The most critical factors in maintaining the morphogenic capacity of the explant are the physiological state and the developmental stage of the inoculum. So, often, the stage of development of the donor material conditions the regeneration and the response of the explant.

Morphogenesis in the *in vitro* cultures is largely influenced by the following factors:

a) *The optimal stage of the cell* (or microspore) for callus induction, for each culture, species, taxon is determined experimentally.

b) *The treatment and exposure of inocula to low temperatures* (3-7 °C), an important factor in callogenesis and androgenesis induction. Probably, low temperatures inhibit the normal differentiation processes, in the case of a microspore – gametophyte formation and leads to sporophyte formation instead, by increasing the embryoidogenic (morphogenic) potential.

c) *The endogenous content of phytohormones* in explants (anthers, microspores), their ratio and function, with the exogenous contribution of growth regulators in the composition of the growth medium.

Thus, the following types of differentiation have been identified after multiple experiments on different

cultures, performed under controlled conditions:

1. Dedifferentiation of initiated meristematic cells excised from the mother plant and developed into callus cells; this process takes place due to the restructuring of the initial cells and the induction of the capacity of consecutive division into them. It should be noted that proliferated callus cells are the most commonly found in the *in vitro* cultures (cells or tissues, pollen etc. cultured *in vitro*).

2. Differentiation of callus cells, which left the division cycle and lost the ability of organogenesis, but specialized in the synthesis of secondary compounds (*Glycine max* (L.) Merr. – callus rich in albumin, *Panax ginseng* C.A. Mey – callus rich in BAS) that are specific for the respective species.

3. Histodifferentiation – a process during which callus cells turn into phloem or xylem.

4. Organogenesis – initiation of incipient germs of vegetative and floral buds, root system.

5. Somatic embryoidogenesis – process, when the callus cell produces the zygote and gives rise to a bipolar structure, called *embryoid*.

Summarizing the above, we come to the conclusion that the wide range of physiological activities of exogenous phytohormones is the main factor determining *in vitro* morphogenesis.

The universal character of morphogenetic pathways in natural and *in vitro* conditions [6] offers the possibility of selecting and highlighting a model for experimental study of basic laws, morphogenetic features and pathways of morphogenesis. The pollen sacs (anthers), the most studied generative structure [3], can be used as model. Anther morphogenesis reflects the basic processes that are characteristic of plant as a whole, for example, the alternation of generations in the life cycle. The sporogenic cells of the anther, under culture conditions, show their morphogenetic potential, including the development of plants with reproductive capacity, and this process can be conducted under controlled conditions. One of the most promising experimental methods for identifying the features of the morphogenesis of pollen bags is *in vitro* culture. This method is based on a phenomenon called androgenesis – the formation of regenerated (initiated) haploid plants from the morphogenetically competent cell of the anther, in which, under the influence of stress factors, the development program changes, that is, it does not develop into a gametophyte as it would do in natural conditions, but develops into a sporophyte under *in vitro* culture conditions. During cultivation, the cells that are fully morphogenetically competent manifest their potential through morphogenetic pathways *in vitro* – embryoidogenesis and hemorhizogenesis, which lead to the formation of plants with sexual reproductive potential of the newly formed regenerants [1, 2, 5, 10].

During the *in vitro* cultivation of the separated anthers, we have identified two types of morphogenesis: embryoidogenesis and callogenesis, resulting in two types of structures: somatic embryoids and morphogenic or non-morphogenic callus. The microspore is in its optimal condition, highly vacuolated, a favourable phase to induce sporophytic morphogenesis *in vitro*. The initial cell (the microspore in the microscopically morphogenic phase) in the *in vitro* culture changes its development program – from gametophyte to sporophyte. By this phenomenon, we find the existence of the totipotency of the cell, namely the morphogenic microspore, with the ability of implementing its morphogenetic capacity in two different ways.

The process of culturing anthers of *Artemisia balchanorum* Krasch. is performed by realizing both pathways of sporophytic morphogenesis *in vitro* – embryoidogenesis and callogenesis. The process of embryoidogenesis occurs as follows: the initial cell (the microspore or the pollen grain cell) gives rise to the embryoid – an embryo-

like structure which, under appropriate conditions, develops into a regenerant plant [5, 9].

The process of callogenesis is characterized by the fact that the initial cell produces, at the beginning, undifferentiated callus mass. Its inoculation on a nutrient medium, appropriate for the induction of the organogenesis, promotes the initiation of the processes of histogenesis, hemogenesis, hemorhizogenesis and the formation of somatic embryoids (meristemoids) from a specific cluster of cells of callus tissue.

The realization of the morphogenetic potential of microspores by *in vitro* culture is largely determined by the hormonal composition of the growth medium. We studied the effects of the MS medium, supplemented with synthetic auxin 2,4-D, at different concentrations of 1.0, 1.5, 2.0 and 2.5 mg/l, on the induction and proliferation of morphogenetic processes of microspores *in vitro*, according to the sporophytic program. In the variants with high concentrations of 2,4-D (2.5 mg/l), we observe the initiation of non-morphogenic callus, which does not regenerate meristemoids and plantlets. On the media with a lower concentration of 2,4-D (2.0 mg/l), we noticed two types of morphogenesis – embryoidogenesis and callogenesis. According to the obtained data, anthers of the same size had different capacity to proliferate embryos and morphogenic callus mass on culture media, and the variants differed only in the 2,4-D concentration. In the process of determining the androgenic callogenetic potential, the optimal stages of collection and inoculation of pollen and pollen sacs, their exposure and sterilization were identified. From about 30 tested growth media, the proliferation of callus mass occurred on 7 media. Morphogenesis was initiated on Murashige & Skoog (MS) substrate supplemented with cytokines in various proportions. It has been found out that the callus tissue can be subcultured 3-4 times, but the organogenic potential significantly diminishes after each transfer to a fresh growth medium.

CONCLUSIONS

1. The production and multiplication of plantlets *in vitro* from callus tissue, including androgenic tissue, is a promising and effective method of propagation. The androgenic callogenetic potential is realized directly by androgenic somatic embryoids, or indirectly by induction and proliferation of callus mass in stages, ultimately reproducing meristemoids.
2. Depending on the concentration and the hormonal composition of the growth medium and the developmental stage of the pollen grain, the sporogenic cells of the inoculated anthers go through different pathways of morphogenesis *in vitro* or stop developing and subsequently degenerate.

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II. CONSERVATION OF BIOLOGICAL DIVERSITY

CZU: 581.9:582.972:502.75:582(478)

THE RED LIST OF BEDSTRAW FAMILY (RUBIACEAE JUSS.) FROM THE FLORA OF REPUBLIC OF MOLDOVA

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Abstract: The paper contains the preliminary Red List of Bedstraw family (Rubiaceae Juss.) plants species from the flora of Republic of Moldova. The list comprises 15 species of various categories of rarity. Each species is provided with the following characteristics: latin name, synonyms, status, local and common distribution (with map of distribution in the region), habitat, quantitative aspect, limitation factors, biological and ecological characteristics, cultivation, protection status and protection measures.

Key words: rare plants, spontaneous flora, conservation, Republic of Moldova.

INTRODUCTION

Due to the large number of species on the edges of geographical areas of distribution and extremely low preservation of natural plant communities, one of the features of the flora of Republic of Moldova is the presence of a significant number of rare and endangered species. Rare species of vascular plants now account for about 30% of the total composition of the flora of different categories of rarity, and the number continues to increase. In accordance with the rarity categories, all these species are vulnerable due to the small number of populations and limited distribution throughout the territory.

This article analyzes rare species of the bedstraw family (Rubiaceae Juss.) in the Republic of Moldova. The family includes 4 genera and 31 species, half of them (15 species) are rare. They are represented by a variety of populations and unequal distribution in the region.

MATERIAL AND METHODS

During our investigation concerning rare species of the Rubiaceae family in the flora of the Republic of Moldova we performed all necessary research on field and laboratory examination. Firstly, we reviewed all published information on the presence of species in the territory, and consulted specimen materials in different scientific herbaria (Herbarium of the National Botanical Garden (Institute), Herbarium of the State University of Moldova, etc.).

Rare species are identified on the basis of their local distribution in the Republic of Moldova. The map of distribution was made using the map of Moldova, compiled by Head of the Laboratory of Geomorphology and Soil Science Ecology of Institute of Ecology and Geography, PhD G. Syrodov. The following symbols are used to denote the spread:  – locality, where the species has grown in the past (before 1980) and  – locality, where the species grows in the present time (from 1980 to 2018).

The rarity of species was assessed according to the categories and criteria of IUCN. Limiting factors are indicated by the literature data¹ [6].

1 1.1.2.1 – small-scale wood plantations; 1.1.3 – non-timber plantations; 1.1.4.2 – Small-holder; 1.2.2 – change of land management of non-agricultural areas regime; 1.3.3 – wood; 1.3.3.3 – clear-cutting; 1.5 – invasive alien species (directly impacting habitat); 1.8 – other causes; 9.1 – limited dispersal; 9.2 – poor recruitment/reproduction/regeneration; 9.3 – high juvenile mortality; 10.1 – recreation/tourism; 10.6 – other human disturbance; 10.7 – unknown human disturbance.

The taxonomy of bedstraw family species followed by the recent taxonomical literature. [11-15]

RESULTS AND DISCUSSIONS

In the flora of the Republic of Moldova, the Rubiaceae family is represented by 31 species. Almost half of them (15 species): *Asperula rumelica* Boiss., *A. tenella* Heuff. ex Degen, *Cruciata glabra* (L.) Ehrend., *C. laevipes* Opiz, *C. pedemontana* (Bell.) Ehrend., *Galium boreale* L., *G. physocarpum* Ledeb., *G. rivale* (Sibth. et Smith) Griseb., *G. rubioides* L., *G. ruthenicum* Willd., *G. spurium* L., *G. tinctorium* (L.) Scop., *G. tricornutum* Dandy, *G. volhynicum* Pobed. and *Sherardia arvensis* L. are threatened in the wild. They differ in the number and status of populations, local distribution and along with the of relatively high risk of extinction all these taxa are extremely rare.

In the article rare plants of the Rubiaceae family are given in alphabetical order, each with the indication of the following characteristics: Latin name, synonyms, status, local and common distribution (with map of distribution in the region), habitat, quantitative aspect, limitation factors, biological and ecological characteristics, cultivation, protection status and protection measures.

***Asperula rumelica* Boiss.** (= *Asperula montana* Waldst. et Kit., *A. cynanchica* L. var. *graveolens* (M.Bieb. ex Schult. et Schult. fil.) Stojan. et Stef., *A. cynanchica* L. subsp. *rumelica* (Boiss.) Pjatunina, *A. graniticola* Klokov, *A. hypanica* Klokov).

Status. Data Deficient species (category DD).

Distribution. In the Republic of Moldova can be met in the districts of Rezina, Sangerei, Rabnita, Orhei, Criuleni, Anenii Noi, Hancesti, Cahul; mun. Chisinau; Comrat and Vulcanesti (ATU Gagauzia), Grigoriopol and Slobozia (Transnistrian region). (Fig. 1) Outside the country is spread in the Balkans (Romania, Bulgaria), southern part of eastern Europe, Asia Minor (Turkey). [2-4, 11, 15]

Habitat. Steppe and calcareous slopes.

Quantitative aspect. In the places of growth there are solitary individuals or groups of 2-3(10) plants.

Limitation factors. 1.1.2.1; 1.1.4.2; 9.1; 10.7.

Biological and ecological characteristics. A semi-shrub, microphanerophytic plant. Blooms in April-September and fructifies from May. The species propagates by seeds. A xerophylous typically steppe species. The plant was used one time in traditional medicine to treat peritonsillar abscess, also known as a quinsy [7]. A red dye is obtained from the root [5].

Cultivation. No information.

Protection status. No measures have been taken.

Protection measures. Monitoring the status of extant populations; identification of new places of the growth; conservation of the species in *ex-situ* conditions.

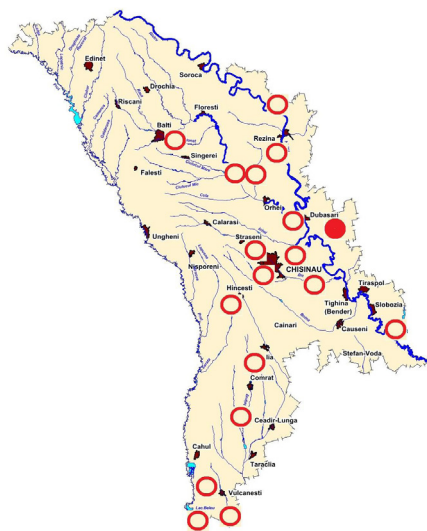


Fig. 1. Distribution of *Asperula rumelica* Boiss. in the region.

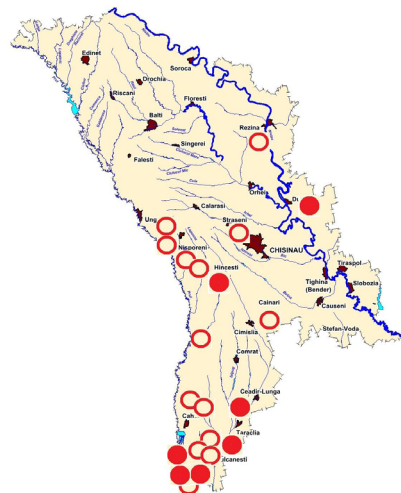


Fig. 2. Distribution of *Asperula tenella* Heuff. ex Degen in R. Moldova.

Asperula tenella Heuff. ex Degen (= *A. cynanchica* L. var. *elongata* Stev., *A. longiflora* C.Koch, *A. stevenii* V.Krecz., *A. maotica* M.Pop. et Chrshan., *A. bidentata* Klokov, *A. hypanica* Klokov, *A. attenuata* Klokov).

Status. Vulnerable species (category **VU**: A2ce+4ce; B2ab(i,ii,iii,iv); D2).

Distribution. In the Republic of Moldova can be met in the districts of Rezina, Nisporeni, Hancesti, Cimislia, Leova, Cahul; in the vicinity of Chisinau city; Comrat, Taraclia and Vulcanesti (ATU Gagauzia); Grigoriopol (Transnistrian region). (Fig. 2) Outside the country is spread in the central and southern parts of eastern Europe, Crimea, the Mediterranean region, Asia Minor (Turkey). [2-4, 11, 15]

Habitat. Steppe and calcareous slopes.

Quantitative aspect. In the places of growth there are solitary plants or groups of 2-3(5) individuals.

Limitation factors. 1.1.2.1; 1.1.4.2; 9.1; 10.7.

Biological and ecological characteristics. A semi-shrub, microphanerophytic plant. Blooms in April-August and fructifies in May-September. The species propagates by seeds. A xerophyllous, typically steppic species.

Cultivation. No information.

Protection status. No measures have been taken. Territorially protected in area with multifunctional management – sector with steppe vegetation in the south of Bugeac (Ciumai village) and natural forest rezervation "Sărata Galbenă".

Protection measures. Inclusion in the list of the species protected by law; monitoring the existent populations; identification of new places of growth; conservation of the species in *ex-situ* conditions.

Cruciata glabra (L.) Ehrend. (= *Valantia glabra* L., *Galium verum* Scop.).

Status. Near Threatened species (category **NT**).

Distribution. In the Republic of Moldova it is currently sporadically met in the northern areas of the forested districts: Briceni, Dondușeni, Edineț, Ocnița, Soroca and Șoldănești. (Fig. 3) Outside the country is spread in the Scandinavian peninsula (Finland), Atlantic, Central and eastern Europe, the Mediterranean region, Asia Minor, Caucasus, Western Siberia (Altai); introduced in North America. [2, 13]

Habitat. Usually wet and shady places on limestone slopes – under the canopy, glades and edges of oak forests, cuts, shrubberies, sunny glades.

Quantitative aspect. It grows solitary or forms small groups of several mature and juvenile specimens.

Limitation factors. 1.1.2.1; 1.1.4.2; 1.3.3; 1.5; 10.6; 10.7.

Biological and ecological characteristics. A perennial, hemicyptophytic plant. Blooms in (April)May-July and fructifies from May. The species propagates by seeds. A mesophyllous plant, typically forest plant. The plant is medicinal, tinctorial and ornamental. It has diuretic and haemostatic activity. The aerial part of the plant is a good remedy in digestive and cardiovascular problems, tumours, skin disorders. It treats liver diseases,

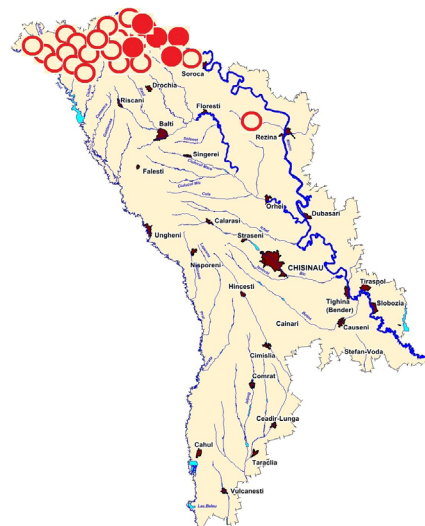


Fig. 3. Distribution of *Cruciata glabra* (L.) Ehrend.

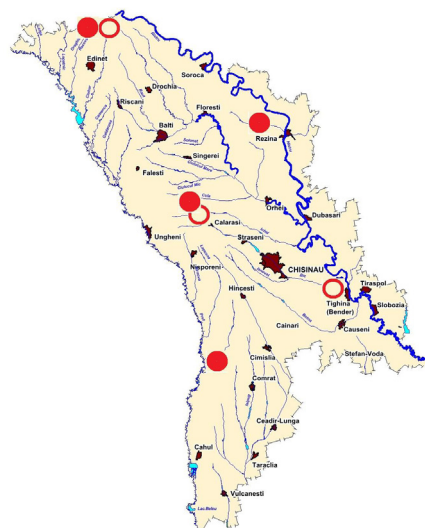


Fig. 4. Distribution of *Cruciata laevipes* Opiz

hemorrhoids, dyspepsia, ascites, hypertension, wounds [10].

Cultivation. No information.

Protection status. No measures have been taken. Territorially protected only in the wetland of international importance "Unguri-Holoșnita" (No. 1500 on the Ramsar List). [9]

Protection measures. Monitoring the status of extant populations; identification of new places of growth.

Cruciata laevipes Opiz (= *Valantia cruciata* L., *Galium cruciata* (L.) Scop.).

Status. Endangered species (category EN: A2ce+4cc; B2ab(i,ii,iii,iv).

Distribution. In the Republic of Moldova it is rarely met in the forested districts: in the commune of Dângeni, Clocușna, distr. Ocnița; in the vicinity of the town Șoldănești; commune Bahmut, Sipoteni, distr. Călărași; commune Hârbovăț, distr. Anenii Noi; commune Pleșeni, distr. Cantemir. (Fig. 4) Outside the country is spread in Scandinavia (Finland), Atlantic, Central and southern parts of Eastern Europe, Crimea, Mediterranean region, Asia Minor, Iran, Caucasus; introduced in North America. [2, 13]

Habitat. Brushwood on steppe limestone hills, glades and edges of oak forests with cherries, roadsides.

Quantitative aspect. Forms small groups of several plants.

Limitation factors. 1.1.2.1; 1.1.4.2; 1.3.3; 1.5; 10.6; 10.7.

Biological and ecological characteristics. A perennial, hemicryptophytic plant. Blooms in May-July and fructifies in June-August. The species propagates by seeds. A mesophyllous, typically meadow plant.

The plant is medicinal and forage. It has diuretic, haemostatic and wound healing activity. It is used in the treatment of digestive, nervous and cardiovascular problems, tumours, skin disorders. The aerial part of the plant is a good remedy in liver cirrhosis, ascites, wounds, metrorrhagia, hypertension, epilepsy [10].

Cultivation. No information.

Protection status. No measures have been taken.

Protection measures. The taxon inclusion in the list of the species protected by law; identification of new growing sites of the species and organization of its protection; *ex-situ* conservation, propagation and its repatriation to the natural habitats.

Cruciata pedemontana (Bell.) Ehrend. (= *Valantia pedemontana* Bell., *Galium pedemontanum* (Bell.) All.).

Status. Data Deficient species (category DD).

Distribution. In the Republic of Moldova, it can be is currently sporadically met in central and southern districts: in the districts of Nisporeni, Strășeni, Ialoveni, Hâncești, Cimișlia, Cantemir, Cahul. (Fig. 5) Outside the country is growing in the Atlantic, Central and south-western parts of Eastern Europe, Crimea, the Mediterranean region, Asia Minor and Middle East, Iran, Caucasus. [2, 13]

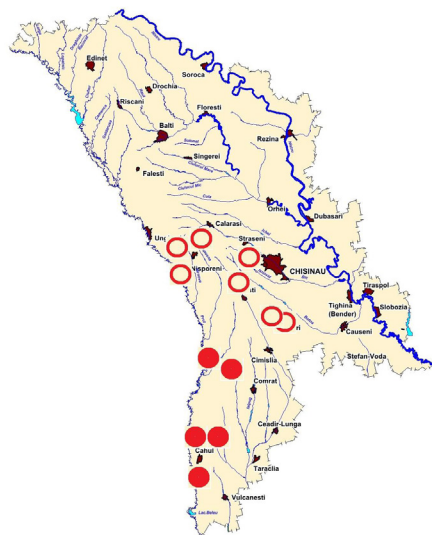


Fig. 5. Distribution of *Cruciata pedemontana* (Bell.) Ehrend.



Fig. 6. Distribution of *Galium boreale* L.

Habitat. Steppe hills, glades and edges of arid forests with *Quercus robur* and *Quercus pubescens*.

Quantitative aspect. Forms small groups of several plants with abundance 1-2.

Limitation factors. 1.1.2.1; 1.1.4.2; 1.3.3; 1.5; 10.6; 10.7.

Biological and ecological characteristics. An annual plant, therophyte. Blooms in April-June and fructifies in May-July. The species propagates by seeds only. A xeromezophyllous typically steppe species.

Cultivation. No information.

Protection status. No measures have been taken.

Protection measures. Monitoring the status of extant populations; identification of new places of growth; conservation of the species in *ex-situ* conditions in botanical gardens.

Galium boreale L.

Status. Regionally Extinct species (category **RE**).

Distribution. In the Republic of Moldova it had been rarely met in the northern area – near the commune of Balasinești, Briceni distr. (date of collection 1953) and southern area – near the Cahul town (Zelenetzki herbarium, no collection date). (Fig. 6) Recently it has not been met and we consider it as regionally extinct species. Outside the country, the area of distribution stretches from the Arctic, Scandinavian peninsula, Atlantic, Central and Eastern Europe, the Caucasus, Iran, Middle Asia (northwest), Siberia and Mongolia. [4, 14]

Habitat. Wet places in the glades and edges of oak forests, meadows.

Limitation factors. 10.7.

Biological and ecological characteristics. A perennial, hemicryptophytic plant. Blooms in June-July and fructifies in July-August. The species propagates by seeds. A mesophyllous plant, typical for meadows.

The plant is medicinal, tinctorial, ornamental and forage. The plant possesses contraceptive, diaphoretic [7], diuretic, haemostatic, sedative, cardio tonic, wound healing activities [10]. It is a good remedy in digestive, ophthalmic and respiratory problems, skin disorders, and diseases of reproductive and cardiovascular systems, in the treatment of rheumatic pain [10]. In traditional medicine has been used in hot poultices to stop bleeding and reduce swelling. The plant juice was applied to heal sunburn, rashes, cuts, insect bites, eczema, ringworm and other skin problems.

It is also an edible plant. Young leaves are used raw and cooked [7]. As ornamental plant this it makes great ground cover.

Cultivation. No information.

Protection status. No measures have been taken.

Protection measures. Inclusion in the list of the species protected by law; identification of new places of the growth.

Galium physocarpum Ledeb. (= *Galium salicifolium* Klokov, *G. rubioides* auct. non L.).

Status. Data Deficient species (category **DD**).

Distribution. In the Republic of Moldova is rare in the northern zone: in the distr. Briceni, Ocnița, Camenca (Transdnistrian region); central: Ungheni, Călărași, Strășeni, Nisporeni, Hîncești and southern: in the distr. Leova and Cahul. (Fig. 7) Outside the country, is growing in Central (Romania) and eastern Europe, Middle Asia, Western Siberia. [4, 14]

Habitat. Floodplain forests, meadows.

Quantitative aspect. In the places of growth there are solitary individuals or groups of 2-3 (5) plants. [17]

Limitation factors. 10.7.



Fig. 7. Distribution of *Galium physocarpum* Ledeb.

Biological and ecological characteristics. A perennial, hemicryptophytic plant. Blooms in June-September and fructifies in July-September. The species propagates by seeds and vegetative. A mesophyllous plant, typical for forests. It is a tinctorial and forage species.

Cultivation. No information.

Protection status. No measures have been taken. Territorially protected in the Scientific Reservation "Codru" and natural forest rezervation "Sărata-Râzeși".

Protection measures. Monitoring the extant populations; identification of new growing places.

Galium rivale (Sibth. et Smith) Griseb., (= *Asperula rivalis* Sibth. et Smith).

Status. Critically Endangered species (category **CR**: A4ce; B2ab(iii,iv).

Distribution. In the Republic of Moldova can be met only in the central part of the territory in the scientific reservation "Codru". (Fig. 8) Outside the republic is growing in Central and Eastern Europe, the Mediterranean region, Asia Minor and Middle East, Iran, Western Siberia. [4, 14]

Habitat. Marshy grassy meadows with Poaceae and Cyperaceae. [8]

Quantitative aspect. Grows singly or in small groups with abundance 1(2).

Limitation factors. 1.1.2.1; 1.3.3.3; 9.1; 9.2; 9.3; 10.7.

Biological and ecological characteristics. A perennial, hemicryptophytic plant. Blooms in May-July(August) and fructifies in July-August. The species propagates by seeds. A mesophyllous plant, typical for meadows. The plant is ruderal.

Cultivation. No information.

Protection status. No measures have been taken. Territorially protected in the Scientific Reservation "Codru". [8]

Protection measures. Monitoring the extant populations; identification of new places of growth.



Fig. 8. Distribution of *Galium rivale* (Sibth. et Smith) Griseb.

Galium rubioides L. (= *Galium articulatum* Lam., *G. dasypodium* Klokov).

Status. Data Deficient species (category **DD**).

Distribution. In the Republic of Moldova it is sporadically met all over the territory in distr. Râșcani, Glodeni, Fălești, Ungheni, Călărași, Nisporeni, Hâncești, Leova, Cantemir and Cahul, as well as in Slobozia (Transnistrian region). (Fig. 9) Is spread in eastern Europe, Crimea, Caucasus. [4, 14]

Habitat. Wet glades in the forests, meadows, shrubs.

Quantitative aspect. Grows singly or in small groups with abundance 1(2).

Limitation factors. 1.3.3.3; 9.1; 10.7.

Biological and ecological characteristics. A perennial, hemicryptophytic plant. Blooms in June-August and fructifies from July. It propagates by seeds and vegetative by rooted stems. A mesophyllous plant, typical for meadows. The plant is medicinal,

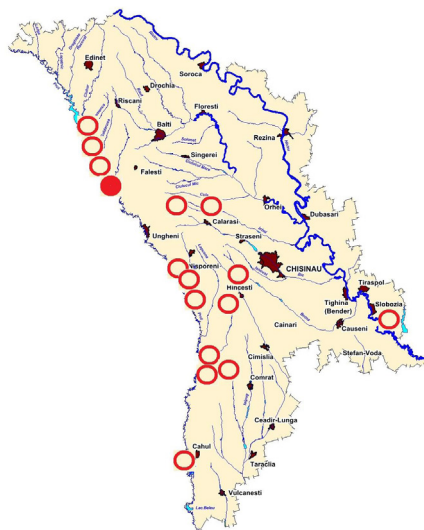


Fig. 9. Distribution of *Galium rubioides* L.

ornamental, forage. It possesses diuretic, haemostatic, sedative, wound healing, analgezic, antibacterial effects.

The plant is used in the treatment of digestive, cardiovascular, skin disorders, diseases of reproductive system, tumours. The aerial part of the plant is a good remedy in gastric ulcer, eczema, metrorrhagia, heart diseases, toothache, ascites. [10]

Cultivation. No information.

Protection status. No measures have been taken. Territorially protected in the Scientific Reservation "Padurea Domneasca".

Protection measures. Monitoring the existent populations; identification of new places of the growth.

***Galium ruthenicum* Willd.** (= *Galium tomentellum* Klokov, *G. verum* auct. non L.).

Status. Critically Endangered species (category CR: A2cde+4ce; B2ab(i,ii,iii,iv).

Distribution. In the Republic of Moldova rarely met in the central and southern area: Făleşti, Teleneşti, Ialoveni, Hânceşti, Cantemir, Cahul, Comrat and Vulcanesti (ATU Gagauzia), Dubăsari (Transnistrian region). (Fig. 10) Outside the republic is growing in eastern Europe, Caucasus, Middle Asia, Western Siberia (southern part). [4, 14]

Habitat. Steppe slopes, limestone hills, shrubs, glades of arid forests with *Quercus robur* and *Quercus pubescens*.

Quantitative aspect. Grows solitary or forms small groups of several mature and juvenile plants.

Limitation factors. 1.1.2.1; 1.1.4.2; 1.3.3; 1.5; 10.6; 10.7.

Biological and ecological characteristics. A perennial, hemicryptophytic plant. Blooms in June-August and fructifies in July-September. The species propagates by seeds and vegetative. A xerophyllous, typically steppic plant.

The plant is medicinal, tinctorial, ornamental and melliferous. It has antispasmodic, astringent, haemostatic, sedative, analgezic, diaphoretic, tonic wound healing, diuretic and restorative effects. [10] A powder made from the fresh plant is used to soothe reddened skin and reduce inflammation. It is also used as a poultice on cuts, skin infections, and slow-healing wounds. A red dye is obtained from the root and a yellow dye from the flowering tops. The young leaves are edible. A yellow dye from the flowering stems is used as a food coloring. The roasted seed is a coffee substitute [7].

Cultivation. It is cultivated in the collection of medicinal plants of the National Botanical Garden (Institute) from Republic of Moldova.

Protection status. No measures have been taken.

Protection measures. Inclusion in the list of the species protected by law; identification of new growing sites of the species and organization of its protection; monitoring the extant populations; *ex-situ conservation of the species*.

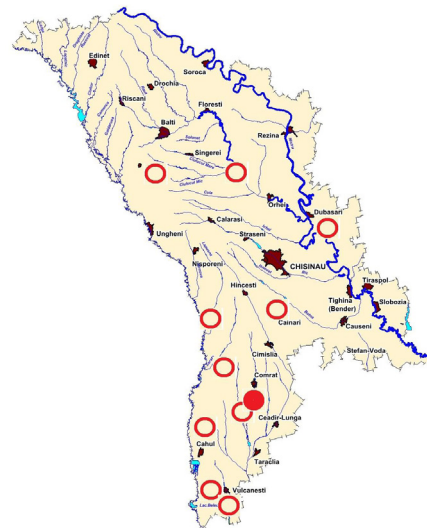


Fig. 11. Distribution of *Galium spurium* L.

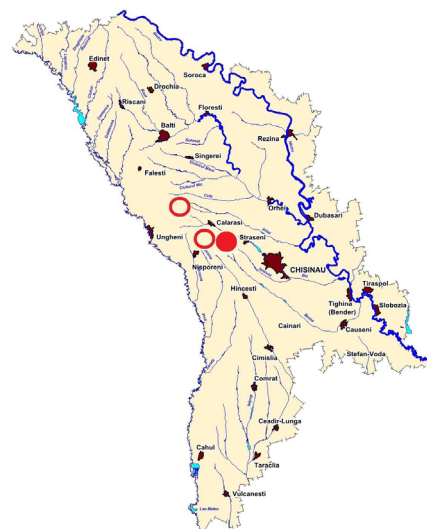


Fig. 10. Distribution of *Galium ruthenicum* Willd.

***Galium spurium* L.** (= *Galium vaillantii* DC., *G. aparine* L. γ. *spurium* (L.) Koch).

Status. Critically Endangered species (category **CR**: A2c+4c; B2ab(i, iii)).

Distribution. In the Republic of Moldova it is a very rare in the forest district in the central area: near commune of Rădenii Vechi, distr. Ungheni; Căpriana and Lozova, distr. Straseni. (Fig. 11) Outside the country grows in Eurasia, North America. [4, 14]

Habitat. Shrubs, meadows, cultivated places.

Quantitative aspect. Forms small groups 1-2 m².

Limitation factors. 10.7

Biological and ecological characteristics. An annual plant, therophyte. Blooms in May-September and fructifies from June. The species propagates by seeds only. A xeromezophylous weed. Medicinal, technical, oil, food, fodder, ornamental, ruderal plant.

The plant has diuretic activity. It is a good remedy in the treatment of liver diseases, tumours, hypovitaminosis, toothache, rheumatism, goiter. [10] As other *Galium* L. species, *G. spurium* contains asperuloside that can be converted into prostaglandins (hormone-like compounds that stimulate the uterus and affect blood vessels), making the genus of great interest to the pharmaceutical industry. It had been used as edible in famine years. The leaves are used raw or cooked. A red dye is obtained from the roots. [7]

Cultivation. No information.

Protection status. No measures have been taken. Grows in landscape rezervation "Căpriana-Scoreni".

Protection measures. Identification of new places of the growth.

***Galium tinctorium* (L.) Scop.** (= *Asperula tinctoria* L., *Galium triandrum* (L.) Hyl.).

Status. Critically Endangered species (category **CR**: A2ce+4ce; B2ab(i, iii)).

Distribution. In the Republic of Moldova is vary rare in the northern area: around the town Briceni (Rosoşeni Forest), distr. Briceni and commune Feteşti, distr. Edinet. In the region grows at the southern limit of the distribution area. (Fig. 12) Outside the country is spread in the Scandinavian peninsula, the Atlantic, Central and Eastern Europe, Western Siberia. [4, 14]

Habitat. Limestone hills, steppe slopes, forest edges.

Quantitative aspect. The total number of plants has not been established.

Limitation factors. 1.1.2.1; 1.1.4.2; 1.2.2; 1.5; 1.8; 9.1; 9.2; 9.5.

Biological and ecological characteristics. A perennial, hemicryptophytic plant. Blooms in May-June, fructifies in June-August. The species propagates by seeds. A mesophylous plant, typical for forests.

The plant is medicinal and tinctorial. It is used in the treatment of skin disorders. [10] An infusion of the whole plant



Fig. 12. Distribution of *Galium tinctorium* (L.) Scop.



Fig. 13. Distribution of *Galium tinctorium* (L.) Scop.

has been used for its beneficial effects on the respiratory system. A red dye is obtained from the roots [7].

Cultivation. No information.

Protection status. No measures have been taken. Protected only territorially in natural geological and paleontological monument "Defileul Fetești".

Protection measures. Inclusion in the list of the species protected by law; monitoring the extant populations; identification of new growing places.

Galium tricornerutum Dandy (= *Galium tricorne* Stokes).

Status. Regionally Extinct species (category RE).

Distribution. In the Republic of Moldova in the past (1948-1954) rarely met in the central area: Orhei distr., municipality Chisinau, the south-eastern area: Anenii Noi distr. and the southern area: Leova, Taraclia, Cahul distr. At present we consider it as regionally extinct species. (Fig. 13) Outside the country the area of distribution covers the Atlantic, Central and eastern Europe (southwest), Crimea, the Mediterranean region, Asia Minor and Middle Asia, Iran, Caucasus, Africa (north); introduced in North America. [4, 14]

Habitat. As a weed in ruderal places and agricultural fields, along road, sometimes on argillaceous and sandy slopes, meadows, along the watercourses.

Quantitative aspect. The total number of plants has not been established.

Limitation factors. 10.7.

Biological and ecological characteristics. An annual plant, therophyte. Blooms in May-July and fructifies in June-July. The species propagates by seeds. A mezoxerophyllous weed. Medicinal and ruderal plant. The aerial part of the plant contains saponins, alkaloids, flavonoids, tannins, steroids, coumarins, glycosides, etc. The plant extracts possesses diuretic, antimicrobial, wound healing activity. It is a good remedy for wounds, skin ulcers, scurvy. [10]

Cultivation. No information.

Protection status. No measures have been taken.

Protection measures. Identification of new growing sites of t

Galium volhynicum Pobed. (= *Asperula tyraica* Bess., *A. glauca* (L.) Bess. f. *hirsuta* (Wallr.) Borza).

Status. Vulnerable species (category VU: A2c+4c; B2b(i, iii, iv)).

Distribution. In the Republic of Moldova it occurs sporadically in the following districts: Drochia, Orhei, mun. Chișinău, Hâncești, Anenii Noi, Cimișlia, Cahul, Taraclia; Camenca, Râbnîța, Dubăsari (Transdnestrian region); Comrat, Vulcănești (ATU Găgăuzia). (Fig. 14) Outside the country is spread in the southwestern part of eastern Europe. Endemic. [4, 14]

Habitat. Steppe hills, limestone slopes, shrubs, glades of arid forests.

Quantitative aspect. In the places of growth there are solitary individuals or groups of 2-3 (5) plants.

Limitation factors. 1.1.4.2; 1.5; 9.1; 9.2; 9.5; 10.1.

Biological and ecological characteristics. A perennial, hemicryptophytic plant. Blooms in June-July, fructifies in July-August. The species propagates by seeds and vegetative through the stolons. A mesoxerophyllous plant, typical for steppe. The plant is ornamental.

Cultivation. No information.

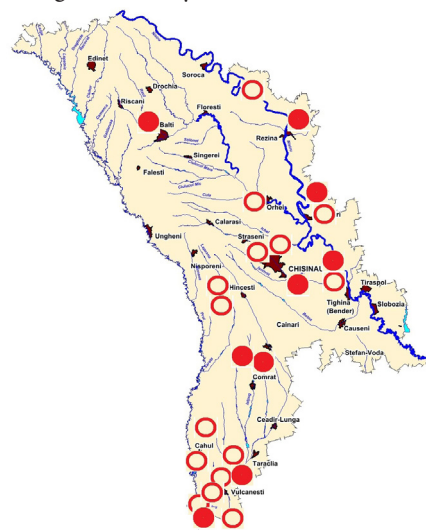


Fig. 14. Distribution of *Galium volhynicum* Pobed.

- управления Рамсарского сайта №1500 «Унгурь-Голошница» (проект). Chişinău, 2007, 120 p. <http://www.biotica-moldova.org>
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THE FLORISTICAL DIVERSITY OF THE ZONE WITH INTEGRAL PROTECTION FROM THE “CODRII” RESERVE

Natalia JARDAN
„Codrii” Reserve

Abstract: The floristical diversity from the strictly protected area of the „Codrii” Reserve is presented in this article. This area includes a genofond consisting of 222 species of vascular plants, including 16 tree species, 19 species of shrubs and 187 species of herbaceous plants. Flora is analyzed under the taxonomical, the bioforms, ecological and phytogeographical aspects.

INTRODUCTION

The forest fund of „Codrii” Reserves extends an area of 5040.7 ha, which constitutes for about 97.5% of the entire territory. From a geomorphological point of view, the territory occupied by the forest vegetation is located in the central part of the central Moldavian plateau and represents a nucleus of Codrii [7]. The territory presents a specific region of the Codrii Plateau with a fragmentary relief, with the altitude range between 382 m and 140 m. Relief presents a set of hilly hills (few potholes, surrounded by hills) whose peaks descend to the south and south-east (less to the northeast) after the watercourses, which fragment them and separate them from narrow valleys.

The forestry fund of the „Codrii” Reserve is located within three hydrographical basins: Bâc, Botna, and Cogâlnic rivers. The point of branching of the interfluvial tangles separating the 3 basins is in the immediate vicinity of the intersection of public roads “Chişinău-Leuseni” and “Lozova-Hânceşti”. The “Balkans” road, which overlaps on an interfluvial peak separates the basin of the river Bâc from the other two basins, which in turn are separated from the road to Hâncesti, to the west - the basin of the Cogâlnic river and to the east - the basin of the Botna river. The northern part of the reserve forms the drainage basin of a small tributary of Bucovăţ - a tributary of Bâc. In the southwest passes the water shed that separates the Dniester river basin from the Cogâlnic basin, thus directly from the Black Sea Basin. The southeast of the reserve includes the upper parts of the Botna Basin [9]. On this territory, the strictly protected area of 723.2 ha (714.8 ha - forest, 8.3 ha - forest roads, parcels, 0.1 ha - glades) was delineated and represents 14% from the territory of the reserve. The strictly protected area of the reserve is located within 8 parcels: 40, 41, 42, 46, 48, 49, 50, 51 [1].

The floristical researches in order to highlight the floristical diversity in the strictly protected area were carried out during the vegetation period of 1993 by N. Sturza, P. Pînzaru, V. Chirtoacă, A. Istrati and others. As a result, 188 species of vascular plants were identified: Equisetophyta - 4 species, Pteridophyta - 7 species, Magnoliophyta - 177 species, belonging to 139 genres and 67 families [2].

In order to highlight the changes that took place in the taxonomic composition of the flora during the 20 years, the taking stock of the herbaceous cover was performed on the parcels.

MATERIALS AND METHODS

The floristical diversity of the strictly protected area was researched during the vegetation periods of 2014-2016 by the itinerary method. The names of the plant species are presented after Черепанов С. К. [12]. For each species, the biological form, the floristical element, the ecological indices have been established, according to V. Sanda et al. [8].

RESULTS AND DISCUSSIONS

As a result of the research, the strictly protected area includes a genofond consisting of 222 species of vascular plants, including 16 tree species, 19 species of shrubs and 187 species of herbaceous plants. Table 1 lists the vascular plant species present in the 8 parcels of intact zone.

List of taxa in the strictly protected zone

Table No. 1.

Order nr.	Family	Species	Parcel							
			40	41	42	46	48	49	50	51
	Equisetaceae	Equisetum arvense L.				*	*	*		
		Equisetum palustre L.						*		
		Equisetum telmateia Ehrh.	*				*	*		*
		Hypochaete hyemalis L. (Bruhin)	*	*		*		*	*	
	Polypodiaceae	Polypodium vulgare L					*			
	Athyriaceae	Athyrium filix-femina (L.) Roth				*			*	
		Cystopteris fragilis (L.)Bernh.					*			
	Aspidiaceae	Dryopteris caucasica (A.Br.) Fraser-Ienkinset Corley						*		
		Dryopteris filix-mas (L.) Schott				*	*			
	Thelypterida- ceae	Thelypteris palustris Schott						*		
	Aspleniaceae	Asplenium trichomanes L.					*			
	Aristolochiaceae	Asarum europaeum L.	*	*	*	*	*	*	*	*
	Ranunculaceae	Actaea spicata L.	*			*	*	*	*	*
		Anemonoides ranunculoides (L.) Holub.	*	*	*	*	*	*	*	*
		Ficaria verna Huds.	*	*	*	*	*	*	*	*
		Isopyrum thalictroides L.	*	*	*	*	*	*	*	*
		Ranunculus auricomus L.	*	*	*	*	*	*	*	*
		Ranunculus repens L.	*			*		*		
		Ranunculus sceleratus L.				*				
		Thalictrum lucidum L.				*	*	*		
	Papaveraceae	Chelidonium majus L.		*	*					
	Fumariaceae	Corydalis bulbosa (L.) DC.	*	*	*	*	*	*	*	*
		Corydalis marschalliana Pers.	*	*	*	*	*	*	*	*

	Caryophyllaceae	<i>Moehringia trinervia</i> (L.) Clairv.		*	*	*	*	*		*
		<i>Myosoton aquaticum</i> (L.) Moench					*			
		<i>Oberna behen</i> (L.) Iconn.						*		
		<i>Stellaria holostea</i> L.	*	*	*	*	*	*	*	*
		<i>Stellaria media</i> (L.) Vill.		*	*	*		*		
	Chenopodiaceae	<i>Chenopodium polyspermum</i> L.				*	*			
	Polygonaceae	<i>Fallopia convolvulus</i> (L.) A. Love						*		
		<i>Fallopia dumetorum</i> (L.) Holub		*	*				*	
		<i>Persicaria hydropiper</i> (L.) Spach.					*			
		<i>Rumex acetosa</i> L.						*		
		<i>Rumex conglomeratus</i> Murr.				*		*		
		<i>Rumex sanguineus</i> L.		*	*			*		
	Fagaceae	<i>Fagus sylvatica</i> L.	*			*	*	*		
		<i>Quercus petraea</i> (Mattuschka) Liebl.	*	*	*	*	*	*	*	*
		<i>Quercus robur</i> L.			*	*	*	*		
	Betulaceae	<i>Betula pendula</i> Roth				*				
		<i>Carpinus betulus</i> L.	*	*	*	*	*	*	*	*
		<i>Corylus avellana</i> L.			*					
	Hypericaceae	<i>Hypericum hirsutum</i> L.			*	*				
	Primulaceae	<i>Lysimachia nummularia</i> L.	*	*	*	*		*		
		<i>Lysimachia vulgaris</i> L.				*		*		
		<i>Primula veris</i> L.				*	*			
	Violaceae	<i>Viola alba</i> Bess.	*	*	*	*	*			*
		<i>Viola hirta</i> L.		*	*	*		*	*	
		<i>Viola mirabilis</i> L.	*			*	*	*		
		<i>Viola odorata</i> L.		*	*	*	*	*		
		<i>Viola reichenbachiana</i> Jord.ex Boreau	*	*	*	*	*	*	*	*
		<i>Viola suavis</i> Bieb.			*		*			*
	Salicaceae	<i>Populus tremula</i> L.			*			*		*
		<i>Salix fragilis</i> L.				*		*		

	Brassicaceae	<i>Alliaria petiolata</i> (Bieb.) Cavara et Grande	*	*	*	*	*	*	*	*
		<i>Arabis turrita</i> L.	*						*	
		<i>Cardamine impatiens</i> L.	*	*		*	*	*		
		<i>Dentaria bulbifera</i> L.	*	*	*	*	*	*	*	*
		<i>Lunaria annua</i> L.				*	*			
	Tiliaceae	<i>Tilia cordata</i> Mill.	*		*	*	*	*		
		<i>Tilia tomentosa</i> Moench	*			*	*	*		
	Ulmaceae	<i>Ulmus glabra</i> Huds.				*	*	*		
		<i>Ulmus laevis</i> Pall.			*	*	*	*		
		<i>Ulmus minor</i> Mill.			*	*	*	*		
	Cannabaceae	<i>Humulus lupulus</i> L.	*				*	*		
	Urticaceae	<i>Urtica dioica</i> L.	*	*	*	*	*	*		*
	Euphorbiaceae	<i>Euphorbia amygdaloides</i> L.	*	*	*	*	*	*	*	
		<i>Mercurialis perennis</i> L.	*	*	*	*	*	*	*	
	Crassulaceae	<i>Hylotelephium maximum</i> (L.) Holub		*						
	Saxifragaceae	<i>Chrysosplenium alternifolium</i> L.	*					*		*
	Rosaceae	<i>Agrimonia eupatoria</i> L.		*			*			
		<i>Cerasus avium</i> (L.) Moench	*		*	*	*	*		
		<i>Crataegus monogyna</i> Jacq.	*	*		*	*	*		*
		<i>Filipendula ulmaria</i> (L.) Maxim.				*	*	*		
		<i>Fragaria vesca</i> L.			*		*			*
		<i>Geum urbanum</i> L.	*	*	*	*	*	*	*	*
		<i>Malus sylvestris</i> Mill.			*		*			
		<i>Pyrus communis</i> L.					*			
		<i>Rubus caesius</i> L.	*		*	*	*	*		*
		<i>Rubus idaeus</i> L.						*		
		<i>Sorbus torminalis</i> (L.) Crantz.	*		*	*	*	*		
	Lythraceae	<i>Lythrum virgatum</i> L.				*		*		
	Onagraceae	<i>Circaea lutetiana</i> L.	*		*		*			*
		<i>Epilobium hirsutum</i> L.						*		
		<i>Epilobium roseum</i> Schreb.					*	*		

	Fabaceae	<i>Astragalus glycyphyllos</i> L.								*
		<i>Lathyrus niger</i> (L.) Bernh.			*	*	*	*	*	*
		<i>Lathyrus venetus</i> (Mill.) Wohlf.						*	*	
		<i>Vicia sepium</i> L.						*		*
	Staphyleaceae	<i>Staphylea pinnata</i> L.					*			*
	Aceraceae	<i>Acer campestre</i> L.			*	*	*	*		
		<i>Acer platanoides</i> L.	*			*	*	*		
		<i>Acer pseudoplatanus</i> L.			*	*	*	*		
		<i>Acer tataricum</i> L.					*			
	Geraniaceae	<i>Geranium palustre</i> L.				*	*			
		<i>Geranium robertianum</i> L.	*	*	*	*	*	*	*	*
	Balsaminaceae	<i>Impatiens noli-tangere</i> L.	*		*	*		*		*
	Celastraceae	<i>Euonymus europaea</i> L.	*			*	*			
		<i>Euonymus verrucosa</i> Scop.	*			*	*	*		*
	Rhamnaceae	<i>Frangula alnus</i> Mill.						*		
	Cornaceae	<i>Cornus mas</i> L.				*	*	*		
		<i>Swida sanguinea</i> (L.) Opiz.					*	*		
	Araliaceae	<i>Hedera helix</i> L.	*	*	*	*	*	*	*	*
	Apiaceae	<i>Aegopodium podagraria</i> L.	*	*	*	*	*	*	*	*
		<i>Aethusa cynapium</i> L.								*
		<i>Angelica sylvestris</i> L.	*			*	*	*		
		<i>Anthriscus cerefolium</i> (L.) Hoffm.	*	*		*				
		<i>Anthriscus sylvestris</i> (L.) Hoffm.	*	*		*	*	*		
		<i>Chaerophyllum aromaticum</i> L.				*	*			
		<i>Chaerophyllum bulbosum</i> L.			*		*	*		
		<i>Chaerophyllum temulum</i> L.	*	*	*	*	*	*	*	*
		<i>Sanicula europaea</i> L.	*	*	*	*	*	*	*	*
		<i>Sium sisaroides</i> DC.				*				
		<i>Viburnum lantana</i> L.			*			*		*
	Caprifoliaceae	<i>Viburnum opulus</i> L.					*	*		
		<i>Sambucus ebulus</i> L.			*			*		
		<i>Sambucus nigra</i> L.		*	*					
		<i>Adoxa moschatellina</i> L.			*	*				
	Valerianaceae	<i>Valeriana officinalis</i> L.				*		*		

	Dipsacaceae	<i>Dipsacus laciniatus L.</i>			*					
		<i>Dipsacus pilosus L.</i>								*
		<i>Dipsacus sylvestris Huds.</i>			*	*		*		
	Rubiaceae	<i>Galium aparine L.</i>	*	*	*	*	*	*	*	*
		<i>Galium intermedium Schult.</i>	*				*	*	*	*
		<i>Galium odoratum (L.) Scop.</i>	*	*	*	*	*	*	*	*
		<i>Galium palustre L.</i>	*			*	*			
	Asclepiadaceae	<i>Vincetoxicum hirundinaria Medik.</i>				*				
	Oleaceae	<i>Fraxinus excelsior L.</i>	*	*	*	*	*	*	*	*
		<i>Ligustrum vulgare L.</i>						*		
	Solanaceae	<i>Scopolia carniolica Jacq.</i>			*					*
		<i>Solanum dulcamara L.</i>	*			*		*		
	Convolvulaceae	<i>Calystegia sepium (L.) R.Br.</i>				*	*	*		
	Boraginaceae	<i>Aegonichon purpureo-caeruleum (L.) Halub.</i>		*			*	*	*	
		<i>Myosotis arvensis (L.) Hill</i>						*		
		<i>Omphalodes scorpioides (Haenke) Schrank</i>		*	*	*				*
		<i>Pulmonaria officinalis L.</i>	*	*	*	*	*	*	*	
		<i>Symphytum officinale L.</i>				*		*		
		<i>Symphytum tauricum Willd.</i>				*			*	*
	Scrophulariaceae	<i>Lathraea squamaria L.</i>	*		*	*		*		
		<i>Melampyrum nemorosum L.</i>						*		
		<i>Scrophularia nodosa L.</i>	*		*		*	*	*	
		<i>Scrophularia vernalis L.</i>					*			
		<i>Veronica beccabunga L.</i>				*				
		<i>Veronica chamaedrys L.</i>	*					*		
		<i>Veronica hederifolia L.</i>	*		*	*		*		
		<i>Veronica serpyllifolia L.</i>		*				*		
	Plantaginaceae	<i>Plantago major L.</i>					*			

	Lamiaceae	<i>Ajuga reptans</i> L.	*	*		*	*	*	*	*
		<i>Galeobdolon luteum</i> Huds.	*	*	*	*	*	*	*	*
		<i>Galeopsis speciosa</i> Mill.			*					
		<i>Glechoma hirsuta</i> Waldst. et Kit.	*	*	*	*	*	*	*	*
		<i>Lamium maculatum</i> (L.) L.	*	*	*	*	*	*	*	*
		<i>Lamium purpureum</i> (L.) L.	*			*		*		
		<i>Leonurus cardiaca</i> L.			*					
		<i>Lycopus europaeus</i> L.	*			*				
		<i>Lycopus exaltatus</i> L. fil.					*			
		<i>Mentha longifolia</i> (L.) L.	*			*		*		
		<i>Mentha pulegium</i> L.	*					*		
		<i>Mentha verticillata</i> L.						*		
		<i>Prunella vulgaris</i> L.		*	*			*		
		<i>Scutellaria altissima</i> L.	*	*	*	*	*	*	*	
		<i>Stachys palustris</i> L.						*		
		<i>Stachys sylvatica</i> L.	*	*	*	*	*	*	*	*
	Campanulaceae	<i>Campanula persicifolia</i> L.					*		*	
		<i>Campanula rapunculoides</i> L.	*	*	*	*	*	*	*	*
		<i>Campanula trachelium</i> L.	*	*	*	*	*	*		*
	Asteraceae	<i>Arctium minus</i> (Hill) Bernh.	*			*		*	*	
		<i>Arctium tomentosum</i> Mill.				*	*			
		<i>Cirsium oleraceum</i> (L.) Scop.	*			*		*		
		<i>Cirsium palustre</i> (L.) Scop.				*	*			
		<i>Eupatorium cannabinum</i> L.	*			*	*	*		*
		<i>Inula helenium</i> L.	*			*	*			
		<i>Lapsana communis</i> L.	*	*	*	*	*	*	*	*
		<i>Mycelis muralis</i> (L.) Dumort.		*			*		*	*
		<i>Petasites hybridus</i> (L.) Gaertn., Mey. et Scherb.	*			*	*	*		
		<i>Pyrethrum corymbosum</i> (L.) Scop.						*		
		<i>Sonchus arvensis</i> L.		*	*					
		<i>Tussilago farfara</i> L.	*				*			
	Liliaceae	<i>Gagea lutea</i> (L.) Ker-Gawl.	*	*	*	*	*	*	*	*
		<i>Lilium martagon</i> L.					*			
		<i>Tulipa biebersteiniana</i> Schult.et Schult.fil.	*		*					

	<i>Hyacinthaceae</i>	<i>Ornithogalum flavescens</i> Lam.				*				
		<i>Scilla bifolia</i> L.	*	*	*	*	*	*		
	<i>Alliaceae</i>	<i>Allium ursinum</i> L.	*	*	*	*	*	*	*	*
		<i>Nectaroscordum bulgaricum</i> Janka		*	*	*	*	*		
	<i>Convallariaceae</i>	<i>Convallaria majalis</i> L.	*	*	*	*	*	*		*
		<i>Polygonatum hirtum</i> (Bosc. Ex Poir.) Pursh	*	*	*	*	*	*	*	*
		<i>Polygonatum multiflorum</i> (L.) All.	*	*	*	*	*	*	*	*
	<i>Asparagaceae</i>	<i>Asparagus tenuifolius</i> Lam.	*			*	*	*		*
	<i>Trilliaceae</i>	<i>Paris quadrifolia</i> L.	*			*		*		
	<i>Orchidaceae</i>	<i>Cephalanthera damasonium</i> (Mill.) Druce	*							
		<i>Cephalanthera longifolia</i> (L.) Fritsch	*	*			*	*		
		<i>Epipactis helleborine</i> (L.) Crantz	*			*	*	*		*
		<i>Epipactis purpurata</i> Smith	*	*	*	*	*	*	*	*
		<i>Listera ovata</i> (L.) R.Br.	*			*		*	*	
		<i>Neottia nidus-avis</i> (L.) Rich.	*	*		*		*	*	
		<i>Platanthera chlorantha</i> (Cust.) Reichenb.	*	*		*	*	*	*	*
	<i>Juncaceae</i>	<i>Juncus effusus</i> L.						*		
	<i>Cyperaceae</i>	<i>Carex brevicollis</i> D.C.	*	*	*	*	*	*	*	*
		<i>Carex digitata</i> L.	*			*	*		*	*
		<i>Carex divulsa</i> Stokes					*			
		<i>Carex pendula</i> Huds.	*			*	*			*
		<i>Carex pilosa</i> Scop.	*	*	*	*	*	*	*	*
		<i>Carex polyphylla</i> Kar.et Kir.		*						
		<i>Carex remota</i> L.	*			*	*	*	*	
		<i>Carex riparia</i> Curt.	*			*	*			
		<i>Carex sylvatica</i> Huds.	*			*		*	*	*
		<i>Carex vulpina</i> L.	*							
		<i>Scirpus sylvaticus</i> L.	*			*				

	Poaceae	<i>Brachypodium sylvaticum</i> (Huds.) Beauv.			*		*		*
		<i>Bromopsis benekenii</i> (Lange) Holub	*	*	*	*	*	*	*
		<i>Dactylis glomerata</i> L.	*	*	*		*	*	*
		<i>Festuca gigantea</i> (L.) Vill.					*		
		<i>Glyceria nemoralis</i> (Uechtr.) Uechtr. et Koern.				*			
		<i>Hordelymus europaeus</i> (L.) Harz		*	*		*	*	*
		<i>Melica uniflora</i> Retz.	*	*	*		*		*
		<i>Milium effusum</i> L.	*	*	*	*	*		*
		<i>Phragmites australis</i> (Cav.) Trin. ex Steud.	*			*	*	*	
		<i>Piptatherum virescens</i> (Trin.) Boiss.	*						
		<i>Poa nemoralis</i> L.	*	*		*	*		*
		<i>Poa palustris</i> L.		*			*		
	Araceae	<i>Arum orientale</i> Bieb.	*	*	*	*		*	
	Typhaceae	<i>Typha latifolia</i> L.	*						

In the flora of the researched area there were registered 32 species of state-protected plants (figure 1), which represents 53% of the total species protected by the state on the territory of „Codrii” Reserve [5]. Of these, 10 species are included in the Red Book of the Republic of Moldova (3rd edition): *Athyrium filix-femina*, *Cephalanthera damasonium*, *Cephalanthera longifolia*, *Dryopteris filix-mas*, *Epipactis purpurata*, *Nectaroscordum bulgaricum*, *Ornithogalum flavescens*, *Polypodium vulgare*, *Scopolia carniolica* and *Thelypteris palustris* [3].

As a result of the inventory of the flora as compared to 1993, 34 new species were recorded for the strictly protected area, including 4 rare species: *Listera ovata*, *Lunaria annua*, *Ornithogalum flavescens* and *Scrophularia vernalis* (figure 2.).

Taxonomic analysis. In the strictly protected area of the „Codrii” Reserve, 222 species of vascular plants were

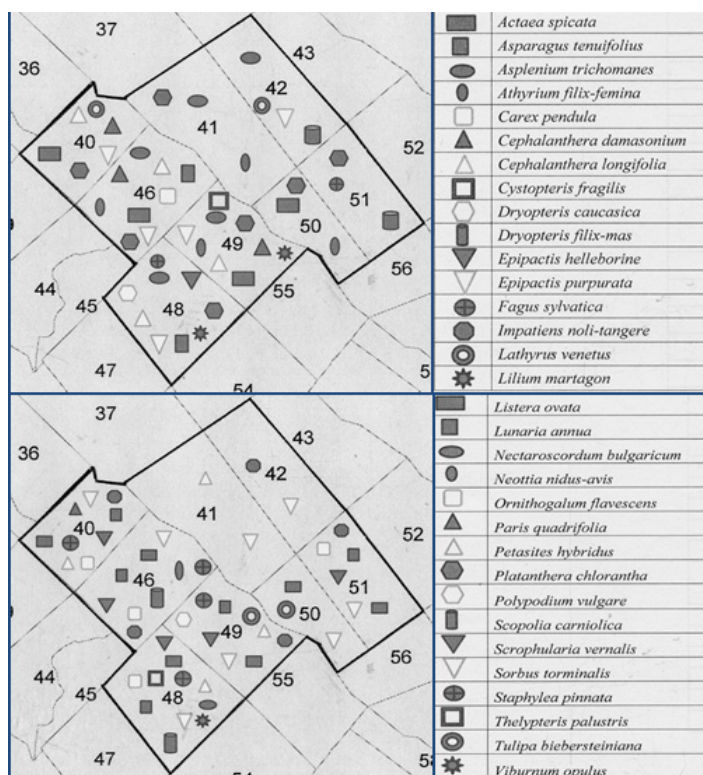


Fig. 1. Spread of rare plants species in the strictly protected area

identified, belonging to 67 families and 157 genres. The largest families in species are: *Lamiaceae* (16 species), *Asteraceae*, *Poaceae* (12 species), *Cyperaceae*, *Rosaceae* (11 species) and *Apiaceae* (10 species). These 6 families comprise 71 species, which make up 32% of all species highlighted in the strictly protected area. The most representative genres are: *Carex* (10 species), *Viola* (6 species), *Acer*, *Galium* and *Veronica* (4 species each).

Bioform analysis. The highlighted species of plants belonging to 6 categories of bioforms. Numerically, the hemicryptophytes predominate with 46.7%, followed by geophytes – 17.3% and phanerophytes – 15.6%. This spectrum of bioforms is characteristic for sessile oak and pedunculated oak forests from Central of Europe. The terrophytes forming 14.7%, the other categories have insignificant share.

Ecological aspects. The **moisture indices** show the predominance of mesophytes - 52.5%, followed by mezohigrophytes - 23.1%, xeromesophytes - 17.2%, hygrophytes - 6.8% and amphotolerant species - 0.4%. This spectrum of the analyzed flora highlights the mesophyll and mesohigrophyll character of the strictly protected area of the reserve.

Analysis of temperature indices. According to the air temperature requirements, mesothermal species prevail - 76.8%. Microthermophilous species constitute 8.6%, amphotolerant species - 7.7% and moderately thermophilous - 6.4%. Thermophilic species have the smallest percentage - 0.5%.

Analysis of soil reaction indices. Regarding the behavior towards edaphic preferences, the weight of light acid neutrophilic - 41.8% are highlighted, followed by acid-neutrophilic plants - 30.9% and eurionic - 21.8%. Lower percentages are found in neutro-basiphilic species - 3.2% and acidophilic - 2.3%.

Geoelements analysis highlight the high share of Eurasian species (48.3%) and European (22.8%). The circumpolar species are 10.9%, but the other categories of floristical elements have insignificant weights in the formation of the spectrum.

*Listera ovata**Lunaria annua**Ornithogalum flavescens**Scrophularia vernalis*

Fig. 2. Species of rare plants

Conservation of biodiversity. The „Codrii” Reserve was created by the Decision of the Soviet Ministers of September 27th, 1971, aiming to protect in a natural state the forest land typical for central part of the Republic of Moldova with the whole natural complex. In the same year the area with full protection was established. The current surface of the reserve is 5170.7 ha. In the Law on the Natural State Protected Areas (1998) the “Codrii” Reserve was assigned to the category - Scientific Reserves.

CONCLUSIONS

There are 222 species of vascular plants, 10 species included in the Red Book of the Republic of Moldova, in the strictly protected area. The analysis of the vital forms shows that the flora of the strictly protected zone is predominant by the hemicryptophyte species (46.7%). Ecologically, flora is dominated by mesophytes (52.5%) and mesohigrophytes (23.1%); of mezoterms (76.8%); light acid-neutrophilic species (41.8%) and acid-neutrophils (30.9%). Examination of the weight of phytogeographical elements in the strictly protected area highlights the predominance of Eurasian species (48.3%).

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CENTAUREA X PULBERIANA PÎNZARU NOTHOSP. NOVA (ASTERACEAE) IN THE FLORA OF THE REPUBLIC OF MOLDOVA

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Abstract: The article brings up a description of morphological, biological and chorological features of a new hybrid species *Centaurea x pulberiana* Pinzaru in the flora of the Republic of Moldova.

Key words: Asteraceae, *Centaurea x pulberiana* Pinzaru nothosp. nova, biology, ecology, distribution, illustration.

INTRODUCTION

The genus *Centaurea* L. *sensu lato* includes about 400-746 species, found mostly in the Mediterranean Region [16]. In the wild flora of the Republic of Moldova, the genus *Centaurea* L. *sensu lato* includes 27 species [8, 13] and *sensu stricto* – 24 [9]. The genus *Centaurea* L. *s.l.* comprises annual, biennial and perennial herbaceous plants. They produce one or several anthodia, which are heterogamous, polifloral, of different size, spheroid, ovate, oblong or, rarely, cylindrical. The involucre is imbricate, the hypsophiles – pilose, ending with an appendicle (at least the internal ones) or without appendicle, with a narrow, transparent membrane on the edge. The appendicles are erect or recurved at the tip, with the margin entire or pectinate-fimbriated (with an aculeus at the tip), feathery or with a simple or branched thorn (the central one – obviously bigger). The flowers are of various colours, tubular, with 5 teeth. In some species, the marginal flowers are sterile, tubular-funnel-shaped (divided in 4 lacinia), clearly larger than the tubular, fertile, central ones. The receptacle with caducous squamas or setae. Achenes without rostrum, usually smooth, more rarely rugulose, disperse pubescent, rarely glabrous. Double pappus ± as long as the achene, with unequal, scabrous, serrate, serrate-ciliated setae, more rarely setaceous-squamiform setae. Rarely, the pappus is simple or absent, or replaced by a small caruncle at the tip of the achene [1-3, 8-13, 12, 16].

MATERIALS AND METHODS

For the study, the literature in the given field was consulted [1-6, 8-13, 15-16], as well as materials collected in June-July 2017 and those from the Herbarium of the Botanical Garden of Chisinau [CHIS], in the State University of Chisinau [CHIS-US] and Botanical Museum of the University "A.I.Cusa", Iasi (România).

Specimens of plants from the vicinity of Rădulenii Vechi commune, Floresti district are preserved in the Herbarium of the Botanical Garden of Chisinau and are considered as typical examples.

The plants were identified according to the classical comparative-morphological method [14]. The species indicated in the paper are presented according to "Flora vasculară din Republica Moldova" (Vascular Flora of the Republic of Moldova) [9].

RESULTS AND DISCUSSIONS

According to the International Code of Nomenclature for algae, fungi and plants the hybrid species of

the genus *Centaurea* L.: *C. x moehrleniana* Vetter (*C. orientalis* x *scabiosa*), *C. x barbeyana* Vetter (*C. diffusa* x *maculosa*), *C. x favratii* Vetter (*C. orientalis* x *sadleriana*), *C. x aschersoniana* Vetter (*C. barbeyana* x *solstitialis*), indicated by L.Favrat (1889), at the request of the botanist J.J.Vetter, are not valid according to Art. 32.4, because they are not accompanied by a Latin description of the morphological characteristics [7].

The hybrid *Centaurea x podolica* Prodan, 1930 (*C. orientalis* x *scabiosa*), described for the flora of Romania, cannot be considered valid because in the specialized literature this name has already been published by V. Gugler (1907) – *Centaurea x podolica* Gugler (*C. arenaria* x *maculosa*).[6]

As a result of the floristic research carried out in the field in Rădulenii Vechi commune, Floresti district, Republic of Moldova, several plants with similar or intermediate morphological characteristics between *Centaurea orientalis* L. and *C. scabiosa* L. were observed, these two being the only species of the genus *Centaurea* L. on the hill with steppe vegetation from there.

The critical analysis of the exsiccatae of *C. orientalis* L. from the Herbaria of the Botanical Garden (I) and Moldova State University allowed the identification of other 15 exsiccatae of plants that are similar to those from Rădulenii Vechi commune:

- Glodeni district, Cobani commune, on toltry (limestone), 07.VII.1986, collected and determined by M. Mârza [CHIS-US];
- Făleşti district, Măgura commune, slope with steppe vegetation, 29.VI.1948, collected by V. Andreev, determined by A. Ivankov [CHIS];
- Bălți city, slope with steppe vegetation, 02.VII.1953, collected by Vladimirov, determined by V. Kononov [CHIS];
- Soroca district, Trifăuți commune, scrubland on steep slope of the Dniester river, 29.VII.1962, collected and determined by K. Vitko [CHIS];
- Florești district, Țîrgul-Vertiujeni commune, the edge of the forest, limestone slope of Dniester river, 24.VI.1976, collected by T. Gheideman, determined by D. Gociu [CHIS];
- Telenești district, in the vicinity of Telenești town, slope with steppe vegetation, 07.VIII.1948, collected and determined by A. Ivankov [CHIS-US];
- Orhei district, Trebujeni commune, forest, on rocks, 08.VII.1988, collected and determined by P. Pînzaru [CHIS];
- Strășeni district, Lozova commune, slope with steppe vegetation, 30.VI.1957, collected and determined by Gaikovskaia [CHIS-US];
- Călărași district, Sadova commune, glades forest, 30.VI.1953, collected and determined by Sârbul [CHIS-US];
- Ungheni district, Petrești commune, glades forest, 23.VII.1952, collected by V. Andreev, determined by L. Nicolaeva [CHIS];
- Anenii Noi district, Cobusca Nouă commune, slope with steppe vegetation, 24.VII.1949, collected and determined by L. Pojarisscaia [CHIS];
- Ștefan-Vodă district, Olănești commune, 06.VII.1955, collected by L. Nicolaeva, determined by H. Davidova [CHIS-US];
- Taraclia district, Tvardița commune, glades forest, 12.VI.1949, collected and determined by A. Ivankov [CHIS];
- Administrative-Territorial Units of the Left Bank of the Dniester: Camenca town, slope with steppe vegetation, 16.VI.1950, collected and determined by T. Gheideman; Iantarnoe village, slope with steppe vegetation, 10.VII.1987, collected by P. Pînzaru, determined by D. Gociu [CHIS].

Three exsiccatae of *Centaurea x podolica* Prodan (*C. orientalis* x *scabiosa*), from the Herbarium of the Botanical Museum of the "A.I.I.Cuza" University of Iasi (Iași county, locality Apărești on Valea Lupului, hayfields, 12.VII.1972, leg. I.Sârbu, no. 36951; Vânători, 28.VII.1939, no. 4921, Mârzești village, Oct. 1938, no. 4722), which are similar to those indicated above, have been found recently.

Taking into account that the hybrid species indicated above – *Centaurea x moehrleniana* Vetter ex Favrat, 1889 and *Centaurea x podolica* Prodan, 1930 – are not valid, a new name is proposed, *Centaurea x pulberiana* Pinzaru, with the morphological description of the new taxon.

Centaurea x pulberiana Pinzaru (*C. orientalis* L. x *C. scabiosa* L.) nothosp. nova (Asteraceae). – *C. x moehrleniana* (*C. orientalis* x *scabiosa*) Vetter ex Favrat, 1889, Bull. Soc. Bot. Genève, 5: 11, nom. nud.; Gugler, 1907, Annal. Mus. Nat. Hung. VI : 227, 284. – *C. x podolica* Prod. (*C. orientalis* x *scabiosa*) 1930, Cent. Rom.: 107, nom. illeg., non Gugler 1907: Prodan, E.Nyárády, 1964, Fl. R.P.Rom. 9: 943; Beldie, 1979, Fl. Rom. Determ. Ilustr. Pl. Vasc. 2: 212; Sârbu, Ștefan et Oprea, 2013, Pl. Vasc. Rom. Determ. ilustr.: 874. – **Centauree-Pulbere**. – **Василек Пулбере**. – **Fig. 1a, 2.**

Perennial plants, 30-110 cm tall. The stem is erect, angular, as a rule, purple at the angles and white-puberulent between them, branched at the top, ± arachnoid pubescent or glabrescent. The leaves are alternate, simple, lanceolate, pinnatisect and scabrous. The lower leaves grow up to 32 cm long and 14 cm wide, petiolate, the petiole and the rachis are dispersedly arachnoid pubescent, the middle laciniae of the leaf blade are partite-sectate, the terminal lacinia of the leaf has 1-2 lobes. The middle and upper leaves are smaller, gradually short petiolate to sessile. The anthodia – by (1) 3-7 on a stem, 15-20 mm in diameter. The appendices of the hypsophiles of the involucre are short pubescent, ovate-triangular, triangular-lanceolate, with a central, blackish-brown macula, with brown, 1-3 mm long fimbriae on the edges, the sinus between fimbriae is rounded, with an aculeus at the tip. The marginal flowers are sterile, tubular-funnel-shaped, towards the tip – deeply divided in 4 linear, white laciniae. The central flowers are fertile, tubular, with 5 teeth, yellow. The achenes are blackish-brown, 4-5 mm long, shortly pubescent. The pappus is double, greyish-white, with unequal setae, up to 3 mm long. Flowers in June-July. Fruits in July-August.

Plante perene, de 30-110 cm înălțime. Tulpină erectă, costată, de regulă, cu coaste purpurii, între coaste alb-puberulentă, ramificată în partea superioară, ± arahnoideu pubescent sau glabrescentă. Frunze alterne, simple, lanceolate, penat-sectate, scabre. Frunze inferioare până la 32 cm lungime și până la 14 cm lățime, pețiolate, pețiol și rahis dispers arahnoideu pubescent, lacinii mijlocii ale laminei partit-sectate, iar lacinia terminală cu 1-2 lobi. Frunze mijlocii și superioare mai mici, treptat scurt pețiolate până la sesile. Antodii pe o tulpină câte (1) 3-7, de 15-20 mm în diametru. Apendiculi hipsofilelor involucrelui scurt pubescent, ovat-triunghiulari, tiunghiular-lanceolați, cu o maculă centrală brun-negricioasă, pe margini cu fimbrii brune, lungi de 1-3 mm, sinusul între fimbrii rotunjit, la vârf cu un aculeu. Flori marginale sterile, tubular-pâlniate, spre vârf adânc divizate în 4 lacinii liniare, albe; flori centrale fertile, tubuloase, cu 5 dinți, gălbui. Achene brun-negricioase, lungi de 4-5 mm, scurt pubescente. Papus dublu, alb-cenușiu, cu sete inegale, lungi până la 3 mm. Înflorește în iunie-iulie. Fructifică în iulie-august.

Typus: «R. Moldova, Florești district, Rădulenii Vechi commune, 47°968'248" N and 28°292'763" E, slope with steppe vegetation, 16.VI.2017, 22.VII.2017, P. Pinzaru» [CHIS] (Fig. 1a, 2).

T i p: «R. Moldova, raionul Florești, comuna Rădulenii Vechi, 47°968'248" lat. Nord, 28°292'763" long. Est, colină stepizată, 16.VI.2017, 22.VII.2017, P. Pinzaru» [CHIS].

Paratype: «R. Moldova, Anenii Noi district, Cobusca Nouă commune, slope with steppe vegetation, 24.VII.1949, collected by L. Pojarisscaia» [CHIS]; «R. Moldova, Glodeni district, Cobani commune, on toltry (limestone), 07.VII.1986, leg. M. Mârza» [CHIS-US].

Affinity. The hybrid species *Centaurea x pulberiana* is similar to *C. orientalis* L. (Fig. 1b, 3) and *C. scabiosa* L. (Fig. 1c, 4) in stem, leaves, colour of the achenes and pappus, but differs from both in the intermediate size of the anthodia – 15-20 mm in diameter (not 20-25 mm like *C. orientalis* and 10-15 mm like *C. scabiosa*), the colour of the flowers – the outer ones white and the inner ones pale yellow (not all cream, rarely reddish like *C. orientalis* or purple like *C. scabiosa*), in the appendices of the hypsophiles of the involucre – non-decurrent, triangular-ovate appendices with a central, blackish-brown macula, rounded sinus between fimbriae, light

brown fimbriae (not non-decurrent appendices but wide-ovate, yellowish, with or without light-brown macula, acute sinus between fimbriae, yellowish fimbriae like *C. orientalis* or decurrent appendices, with rounded sinus between fimbriae, but smaller, and blackish fimbriae like *C. scabiosa*).

Specii înrudite. Specia hibridă *Centaurea x pulberiana* se aseamănă cu *C. orientalis* L. (Fig. 1b, 3) și *C. scabiosa* L. (Fig. 1c, 4) după tulpină, frunze, culoarea achenelor și a papusului, dar se deosebește de ambele după mărimea intermediară a antodiilor – de 15-20 mm în diametru (nu 20-25 mm cum la *C. orientalis* și 10-15 mm la *C. scabiosa*), culoarea florilor – externe albe, interne palid gălbui (nu toate crem, rareori roșietice cum la *C. orientalis* sau purpurii cum la *C. scabiosa*), după apendiculi hipsofilelor involucrului - apendiculi nedecurenți, triunghiulari-ovați cu o maculă centrală brun-negricioasă, sinusul între fimbrii rotunjit, fimbrii brun deschis (nu apendiculi nedecurenți dar lat-ovați, gălbui, cu sau fără maculă brun deschisă, sinusul între fimbrii acut, fimbrii gălbui la *C. orientalis* sau apendiculi decurenți, cu sinusul între fimbrii rotunjit, dar fimbrii mai mici și negricioase la *C. scabiosa*).

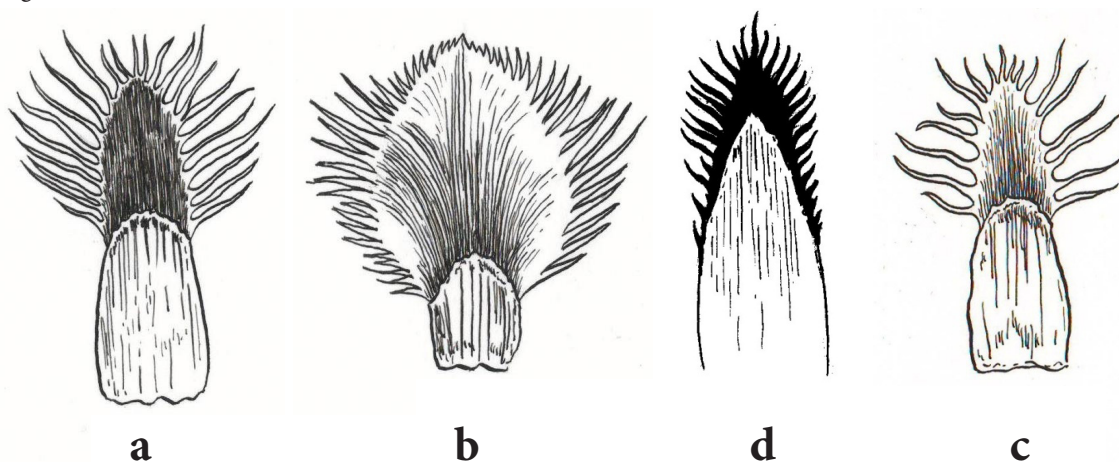


Fig. 1. Middle hypsochloids: a – *Centaurea x pulberiana*; b – *C. orientalis*; c – *C. scabiosa*; d – *C. neiceffii*



Fig. 2. *Centaurea x pulberiana* Pinzaru (typus)

Fig. 3. *C. orientalis*Fig. 4. *C. scabiosa*Fig. 5. *C. neiceffii*

The hybrid species *C. x pulberiana* is also similar to *Centaurea neiceffii* Degen et J. Wagner (Fig. 1d, 5), which have in common such characteristics as non-decurrent, triangular-ovate and triangular-lanceolate appendices of the hypsophiles of the involucre and rounded sinus between fimbriae, but differ in appendices of the hypsophiles of the involucre with a blackish-brown central macula (not pale-brown), with fimbriae that are up to 3 mm long (not 4 mm), yellowish tubular central flowers (not yellow or white), achenes that are 4-5 mm long (not 3-4 mm long) and pappus 3 mm long (not 5 mm long).

Some botanists consider that *Centaurea neiceffii* Degen et J. Wagner, 1908, Period. Spis. Bulg. Kníž. Druž. 20 (69) is a hybrid between *C. orientalis* L. and *C. apiculata* Ledeb. subsp. *spinulosa* (Rochel ex Spreng.) Dostál [2], or *C. orientalis* L. and *C. stereophylla* Besser [12]. In the studied literature, the corolla of *C. neiceffii* plants is indicated as yellow [1, 2, 6], but in the pictures put on a web site by Alexandru Bădăraș [17], the corolla is white (plants cultivated in a garden in Florești, Cluj county, obtained from seeds collected on Babadag plateau, Tulcea county).

Habitat and ecological characteristics. *Centaurea x pulberiana* – xeromesophilic hemicryptophyte, it grows on hills with steppe vegetation, limestone slopes, at the edge of forests, in glades and scrublands. This species is characteristic of the vegetation of the alliance *Festucion valesiacae* Klika 1931.

The plants of the newly found species grow on hills with steppe vegetation, in clayey-sandy soil. They are found on slopes with western and eastern exposition. The inclination of slopes varies between 25 ° and 35 °. The coverage of the herbaceous layer is 90-100 %.

It grows in phytocoenoses dominated by *Inula ensifolia* L. and *Cytisus austriacus* L. accompanying species: *Adonis vernalis* L., *Agrimonia procera* Wallr., *Allium albidum* Waldst. & Kit., *A. sphaerocephalon* L., *Anemone sylvestris* L., *Asparagus officinalis* L., *Asperula cynanchica* L., *Aster amellus* L., *Astragalus austriacus* Jacq., *A. onobrychis* L., *Ajuga laxmannii* (Murray) Benth., *Bromus inermis* Leys., *Campanula glomerata* L. var. *cervicarioides* (Schult.) A. DC., *C. sibirica* L., *Carex humilis* Leys., *Centaurea orientalis* L., *C. scabiosa* L., *Cephalaria uralensis* (Murray) Roem. et Schult., *Cichorium intybus* L., *Clematis integrifolia* L., *Dianthus andrzejowskianus* (Zapal.) Kulcz., *Eryngium campestre* L., *Erysimum canescens* Roth, *Euphrasia* sp., *Festuca valesiaca* Gaudin, *Filipendula vulgaris* Moench, *Galatella linosyris* (L.) Rchb.f., *Galium verum* L., *Goniolimon bessermanum* (Schult.) Kusn., *Helichrysum arenarium* (L.) Moench, *Hieracium umbellatum* L., *H. virosum* Pall., *Hypericum elegans* Steph., *Iris halophylla* Pall., *I. pumila* L., *Jurinea mollis* (L.) Rchb., *Klasea radiata* (Waldst. & Kit.) Á. Löve & D. Löve, *Knautia arvensis* (L.) Coult., *Koeleria pyramidata* (Lam.) P. Beauv., *Leopoldia tenuifolia* (Tausch) Heldr., *Linum flavum* L., *Origanum vulgare* L., *Oxytropis pilosa* (L.) DC., *Pilosella echioides* (Lum.) F.W. Schultz & Sch. Bip., *Plantago media* L., *Potentilla arenaria* Borkh., *P. patula* Waldst. & Kit., *Pseudolysimachion spicatum* (L.) Opiz, *Rapistrum perenne* (L.) All., *Reseda lutea* L., *Salvia nemorosa* L., *S. nutans* L., *Securigera varia* (L.) Lassen, *Seseli tortuosum*

L., *Silene otites* (L.) Wib., *Stachys officinalis* (L.) Trevis., *S. recta* L., *Stipa pennata* L., *Tanacetum corymbosum* (L.) Sch.Bip., *Teucrium chamaedrys* L., *Thalictrum minus* L., *Thlaspi perfoliatum* L., *Thymus pannonicus* All. s.l., *Verbascum phoeniceum* L., *Vincetoxicum hirundinaria* Medik., *Viola hirta* L.

Range. In the Republic of Moldova, it has been found in the districts: Glodeni (Cobani), Făleşti (Măgura), Soroca (Trifăuți), Florești (Rădulenii Vechi, Țîrgul-Vertiujeni), Telenești (Telenești), Orhei (Trebujeni), Strășeni (Lozova), Călărași (Sadova), Ungheni (Petrești), Anenii Noi (Cobusca Nouă), Ștefan-Vodă (Olănești), Taraclia (Tvardița), Bălți town and the Administrative-Territorial Units of the Left Bank of the Dniester (Camenca, Iantarnoe). It has also been found in Romania (Galați and Iași counties), Hungary and Switzerland (obtained and cultivated in gardens in Orbe city).

The species is named in honour of the Pulbere family – my university professors Eugenia and Pavel Pulbere, from Tiraspol State University.

CONCLUSIONS

As a result of the floristic research conducted in the field and in the laboratory, after consulting literature on the genus *Centaurea* L., it was identified a hybrid species in the flora of the Republic of Moldova, which is new to science – *Centaurea x pulberiana* Pînzaru.

The typus and paratype specimens of the species *C. x pulberiana* were established.

According to the data from the Herbarium, *C. x pulberiana* is rarely found on the entire territory of the Republic of Moldova.

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THE VASCULAR FLORA OF MIRAFLORES PARK (BOSCHETTO), PROVINCE OF TURIN (ITALY)

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Abstract: The composition of the vascular flora of Miraflores Park (Boschetto), which comprises 256 species of native and allochthonous plants, belonging to 181 genera and 62 families, has been determined for the first time. Rare species of the flora of Piedmont region are considered: *Thalictrum delponteanum* (Pinzaru) Pinzaru, *Sagina subulata* (Sw.) Presl, *Plantago virginica* Viv., *Lysimachia minima* (L.) U. Manns & Anderb, and the species *Colchicum autumnale* L., *Leucojum vernum* L. and *Scilla bifolia* L. are rare for the flora of the studied park. We are proposing to include the species *Thalictrum delponteanum* (Pinzaru) Pinzaru in the Red Book of Italy.

Key words. Protected area, overview of the vascular flora, rare species, Piedmont region, Italy

INTRODUCTION

Miraflores Park, called "Il Boschetto", (19 ha) is located along Sangone River and is part of the protected area "Parco fluviale del Po Torinese" (Fig. 1). Since 2006, it has been included in the heritage of Nichelino commune, Province of Turin, Italy. Even if "Miraflores" Park and Castle dated back to 1585, belonging to the Duke of Nemours, no complete floristic studies and inventory of the vascular flora of this area have been done so far. In order determine the floristic composition of this park, we have carried out new floristic studies and the obtained results are summarized in this paper.



Fig. 1. Miraflores Park in spring

MATERIALS AND METHODS

The floristic synopsis was obtained as a result of the floristic studies carried out in the field, by the author, in 2011. To determine the most difficult species, we studied the exsiccatae from the collection of the Herbarium from Botanical Garden, Turin, (TO-HP) and literature in the given filed. Floristic nomenclature [1-6]. There are some herbarized plants in the author's own collection in Chisinau (CHIS-PP), and for the species *Sagina subulata* (Swartz) Presl, there are also exsiccatae in Herbaria in Turin (TO-HP) and Florence (FL).

RESULTS AND DISCUSSIONS

At present, the vegetation of the Miraflores Park (also called Boschetto) features fragments of floodplain forest, herbaceous plant communities of meadow, pastures and weeds, and the whole area is crossed by a network of paths for visitors. The forest fragments consist of the following native species: *Quercus robur* L., *Ulmus minor* Mill., *Carpinus betulus* L., *Prunus avium* L., *Fraxinus excelsior* L., *Acer campestre* L., *Populus alba* L., *Salix alba* L. or exotic North-American species: *Robinia pseudacacia* L. and *Prunus serotina* Ehrh. The shrub layer includes few species: *Sambucus nigra* L., *Corylus avellana* L., *Crataegus monogyna* Jacq., *Cornus sanguinea* L., *Euonymus europaeus* L. In the herbaceous layer, there are abundant clusters of *Aegopodium podagraria* L., *Anemonoides nemorosa* (L.) Holub, *Ficaria verna* Huds., *Vinca minor* L.; such species as *Convallaria majalis* L., *Polygonatum multiflorum* (L.) All., *Clematis recta* L., *Sedum maximum* (L.) Hoffm., *Campanula rapunculoides* L. grow sporadically and *Colchicum autumnale* L., *Leucojum vernum* L. and *Scilla bifolia* L. occur very rarely. The native woody species make up about 26 % of the total number. The meadows and pastures are characterised by higher species richness, but the negative impact of the anthropic factor is also noticeable, dominant species in these areas: *Brachypodium sylvaticum* (Huds.) P.Beauv., *Carex hirta* L., *Glechoma hederacea* L., *Poa pratensis* L., *Elymus repens* (L.) Gould., *Trifolium pratense* L., *T. repens* L., *Vicia sativa* L.

As a result of the inventory of the flora of Miraflores Park, 256 species of 181 genera and 62 families were detected. Three of these species are part of the class POLYPODIOPSIDA, 206 – MAGNOLIOPSIDA and 47 – LILIOPSIDA.

The flora of the park includes 31 exotic species (marked with *), most of them are native to South America and Asia, among them the most representative are *Prunus serotina* Ehrh., *Robinia pseudacacia* L., *Parthenocissus quinquefolia* (L.) Planch., *Solidago gigantea* Aiton, *Ambrosia artemisiifolia* L., *Erigeron annuus* (L.) Desf. and *E. canadensis* L.

Forty-seven native species (marked with ◇) are characteristic of plant communities that consist of weeds. Some of them form, along the river, clusters of tall grass, consisting of few species, characterised by high abundance (4-5): *Artemisia vulgaris* L., *Calamagrostis canescens* (Weber) Roth, *C. epigeios* (L.) Roth, *Sambucus ebulus* L., *Solidago gigantea* Aiton, *Urtica dioica* L., others occur sporadically or in small groups.

The flora of Miraflores Park also includes a species that is new for science and has been described for the first time – *Thalictrum delponteanum* (Pinzaru) Pinzaru, named in honour of the Italian botanist Giovanni Battista Delponte (1812-1884), who first collected a specimen of this plant, naming it *Thalictrum majus* (the exsiccata is preserved in the Herbarium of the Department of Plant Biology of the University of Turin, TO-HG).

Thalictrum delponteanum (Pinzaru) Pinzaru, 2016, in Pinzaru et Sirbu, Flora Vasc. R. Moldova, ed. 2, 33-34 (Ranunculaceae). – Fig. 2, 2a.

Basionym. – *T. foetidum* L. var. *delponteanum* Pinzaru, 2013, Novosti Sist. Vyssh. Rast. 44: 221.

T y p e : «Italia, forest glades in Miraflores park, valley of river Sangone, prope nearcommune Nichelino, prov. Turin». [CHIS-PP], isotype [LE], paratype [TO-HG], [CHIS].

Hemicryptophyte, 100-225 cm tall, glandular pubescent, with slightly graveolent smell. The basal leaves are 3-pinnatisect, up to 45 cm long and up to 56 cm wide, the segments of the last order about 22-28 mm

long and wide, with obtuse teeth. The leaves from the stem gradually decreasing in size, the upper ones with segments of the last order of 10-15 mm, at the tip with acute teeth. Blooms in June. The flowers have 4 tepals, 4-5 mm long. The stamens are yellow, pendant. Denticulate stigma. The fruits become mature in August, are 3 mm long, glandular pubescent.

Station. It grows in glades, on alluvial and sandy soils, is a mesophilic species.

Range. It has been detected only in the floodplain forests from the valley of the Sangone River, the Province of Turin.

Cultivation. It is cultivated only in the author's private garden in Chisinau, the plants grown from seeds bloom in the 4th year.

The following rare species have been found:

Sagina subulata (Sw.) C.Presl (Caryophyllaceae) – it was found for the first time in the flora of Piedmont region – camaephyte, West-European, mesophilic, hilly-mountain (-subalpine) species. It grows in small groups, in glades, on alluvial and sandy soils, covered with moss, at the altitude of 229 m, 11.IV.2011, leg. P.Pinbaru [7]. Blooms and produces fruit in April-August (Fig. 3, 4).

Plantago virginica L. (Plantaginaceae) – annual or biennial, North-American, mesophilic species, in Italy it has been found only in Piedmont region [2, 6]. It grows in small groups, on moist soils, along an alley in the park (10.VI.2011, leg. P.Pinbaru) (Fig. 5).

Lysimachia minima (L.) U. Manns & Anderb. (Primulaceae) – annual, Eurasian, mesophilic species, grows in small groups, together with *Plantago virginica* L. (10.VI.2011, leg. P.Pinbaru) (Fig. 6).

Note. We have noticed a vigorous growth of plants belonging to the species *Clematis recta* L. (225 cm tall, but usually it grows only 100-150 cm tall) and *Impatiens glandulifera* Royle (230 cm, usually 50-200 cm).

The synopsis of the vascular flora of the park is given below.

Class **POLYPODIOPSIDA** 1. EQUISETACEAE: *Equisetum arvense* L., *E. palustre* L.; 2.

DENNSTAEDTIACEAE: *Pteridium aculeatum* (L.) Kuhn;

Class **MAGNOLIOPSIDA** 3. ADOXACEAE: $\diamond$ *Sambucus ebulus* L., *S. nigra* L., *Viburnum opulus* L.; 4. AMARANTHACEAE: $\diamond$ *Chenopodium album* L.; 5. APIACEAE: *Aegopodium podagraria* L., *Daucus carota* L., *Eryngium campestre* L., *Heracleum sphondylium* L., *Peucedanum cervaria* (L.) Lapeyr., *P. oreoselinum* (L.) Moench, *P. venetum* (Spreng.) W.D.J.Koch; 6. APOCYNACEAE: *Vinca minor* L., *Vincetoxicum hirundinaria* Medik.; 7. ARISTOLOCHIACEAE: $\diamond$ *Aristolochia clematidis* L., *A. pallida* Willd.; 8. ASTERACEAE: *Achillea collina* (Becker ex Rchb. f.) Heimerl., *Ambrosia artemisiifolia* L., $\diamond$ *Arctium lappa* L., *Artemisia annua* L., $\diamond$ *A. vulgaris* L., *Bellis perennis* L., $\diamond$ *Carduus nutans* L., *Centaurea jacea* L., *C. stoebe* L., *Cichorium intybus* L., *Crepis nicaeensis* Pers., $\diamond$ *Cirsium arvense* (L.) Scop., $\diamond$ *C. vulgare* (Savi) Ten., *Erigeron annuus* (L.) Desf., *E. canadensis* L., *Eupatorium cannabinum* L., *Galinsoga ciliata* (Raf.) Blake, *Helianthus tuberosus* L., *Leontodon hispidus* L., $\diamond$ *Onopordum acanthium* L., *Solidago gigantea* Aiton, $\diamond$ *Sonchus asper* (L.) Hill, $\diamond$ *Tanacetum vulgare* L., *T. officinale* L. s.l.; 9. BALSAMINACEAE: *Impatiens glandulifera* Royle, *I. parviflora* DC.; 10. BETULACEAE: *Carpinus betulus* L., *Corylus avellana* L.; 11. BORAGINACEAE: *Anchusa officinalis* L., *Echium vulgare* L., *Myosotis arvensis* (L.) Hill, *M. ramosissima* Rochel, *Symphytum tuberosum* L.; 12. BRASSICACEAE: *Alliaria petiolata* (M.Bieb.) Cavara & Grande, *Arabidopsis thaliana* (L.) Heynh., *Arabis glabra* (L.) Bernh., *Biscutella laevigata* L., $\diamond$ *Capsella bursa-pastoris* (L.) Medik., *Cardamine impatiens* L., *Erophila verna* (L.) DC., $\diamond$ *Lepidium graminifolium* L., *Rorippa pyrenaica* (All.) Rchb., *R. sylvestris* (L.) Besser, $\diamond$ *Sisymbrium officinalis* (L.) Scop., $\diamond$ *Thlaspi arvense* L.; 13. CAMPANULACEAE: *Campanula rapunculoides* L., *C. rapunculus* L.; 14. CANNABACEAE: *Celtis australis* L., *Humulus lupulus* L.; 15. CAPRIFOLIACEAE: *Lonicera japonica* Thunb., *Scabiosa triandra* L., *Valerianella locusta* (L.) Laterr.; 16. CARYOPHYLLACEAE: *Arenaria serpyllifolia* L., *Cerastium glomeratum* Thuill., *C. holosteoides* Fr., *C. ligusticum* Viv., *C. semidecandrum* L., *Moehringia trinervia* (L.) Clairv., *Sagina apetala* Arduino, *S. subulata* (Sw.) C.Presl, $\diamond$ *Saponaria officinalis* L., *Scleranthus annuus* L., *Silene pratensis* L., *S. vulgaris* (Moench) Garcke, *Stellaria aquatica* (L.) Scop., *S. graminea* L., $\diamond$ *S. media* (L.) Vill.; 17. CELASTRACEAE: *Euonymus europaeus* L.; 18. CISTACEAE: *Helianthemum nummularium* (L.)

Mill.; 19. CONVULVULACEAE: $\diamond$ *Calystegia sepium* (L.) R.Br., $\diamond$ *Convolvulus arvensis* L.; 20. CORNACEAE: *Cornus mas* L., *C. sanguinea* L.; 21. CRASSULACEAE: *Sedum maximum* (L.) Hoffm.; 22. CUCURBITACEAE: *Bryonia dioica* Jacq.; 23. EUPHORBIACEAE: *Euphorbia cyparissias* L., *E. dulcis* L., *E. esula* L., **E. maculata* L.; 24. FABACEAE: *Astragalus glycyphyllos* L., **Gleditsia triacanthos* L., *Lotus corniculatus* L., *Medicago lupulina* L., *Melilotus alba* Medik., *M. officinalis* (L.) Pall., *Ononis spinosa* L., **Robinia pseudacacia* L., *Securigera varia* (L.) Lassen, *Trifolium campestre* Schreb., *T. pratense* L., *T. repens* L., *Vicia sativa* L.; 25. FAGACEAE: *Quercus pubescens* Wiild., *Q. robur* L.; 26. GENTIANACEAE: *Centaurium pulchellum* (Sw.) Druce; 27. GERANIACEAE: *Erodium cicutarium* (L.) L'Hér., *Geranium columbinum* L., *G. pusillum* L., *G. robertianum* L.; 28. HYPERICACEAE: *Hypericum perforatum* L.; 29. LAMIACEAE: *Ajuga reptans* L., $\diamond$ *Ballota nigra* L., *Clinopodium menthifolium* (Host) Stace, *C. vulgare* L., *Galeopsis tetrachit* L., *Glechoma hederacea* L., *G. hirsuta* Waldst. & Kit., $\diamond$ *Lamium purpureum* L., *Mentha suaveolens* Ehrh., *Prunella vulgaris* L., *Stachys recta* L., *Teucrium chamaedrys* L., *Thymus pulegioides* L.; 30. MALVACEAE: *Althaea officinalis* L., *Malva alcea* L., *M. sylvestris* L.; 31. MORACEAE: **Broussonetia papyrifera* (L.) Vent.; 32. OLEACEAE: *Fraxinus excelsior* L., *Ligustrum vulgare* L.; 33. ONAGRACEAE: **Oenothera biennis* L.; 34. OXALIDACEAE: **Oxalis stricta* L.; PAPAVERACEAE: $\diamond$ *Chelidonium majus* L.; 35. PHYTOLACCACEAE: **Phytolacca americana* L.; 36. PLANTAGINACEAE: *Linaria vulgaris* Mill., *Plantago lanceolata* L., *P. media* L., **P. virginica* L., $\diamond$ *Veronica arvensis* L., *V. chamaedrys* L., **V. persica* Poir.; 37. PLATANACEAE: **Platanus orientalis* L.; 38. POLYGONACEAE: $\diamond$ *Persicaria maculosa* (L.) Gray, *Rumex acetosa* L., *R. acetosella* L., $\diamond$ *R. longifolius* DC.; 39. PORTULACACEAE: **Potulaca oleracea* L.; 40. PRIMULACEAE: $\diamond$ *Lysimachia arvense* (L.) U. Manns & Anderb., *L. minima* (L.) U. Manns & Anderb., *L. vulgaris* L.; 41. RANUNCULACEAE: *Anemonoides nemorosa* (L.) Holub, *Clematis recta* L., *Ficaria verna* Huds., *Ranunculus bulbosus* L., *R. repens* L., *Thalictrum delponteanum* (Pinzaru) Pinzaru; 42. RESEDACEAE: *Reseda lutea* L.; 43. RHAMNACEAE: *Rhamnus cathartica* L.; 44. ROSACEAE: *Aphanes arvensis* L., *Crataegus monogyna* Jacq., *Geum urbanum* L., *Prunus avium* L., **P. insititia* L., **P. persica* (L.) Batsch, **P. serotina* Ehrh., *P. spinosa* L., *Rubus caesius* L., *R. ulmifolium* Schott, *Potentilla argentea* L., *P. erecta* (L.) Raeusch., *P. hirta* L., *P. recta* L., *P. reptans* L., *P. rupestris* L., *Sanguisorba minor* Scop.; 45. RUBIACEAE: *Cruciata glabra* (L.) Ehrend., $\diamond$ *Galium aparine* L., $\diamond$ *G. mollugo* L., *G. parisiense* L., *G. verum* L.; 46. SALICACEAE: *Populus alba* L., *P. nigra* L., *P. tremula* L., *Salix alba* L., *S. caprea* L., *S. purpurea* L., *S. triandra* L.; 47. SAPINDACEAE: *Acer campestre* L.; 48. SCROPHULARIACEAE: *Scrophularia nodosa* L., *Verbascum lychnitis* L., *V. phlomoides* L.; 49. SIMAROUBACEAE: **Ailanthus altissima* (Mill.) Swingle; 50. SOLONACEAE: *Solanum dulcamara* L., $\diamond$ *S. ngra* L.; 51. ULMACEAE: *Ulmus minor* Mill.; 52. URTICACEAE: $\diamond$ *Parietaria officinalis* L., $\diamond$ *Urtica dioica* L.; 53. VERBENACEAE: $\diamond$ *Verbena officinalis* L.; 54. VIOLACEAE: *Viola odorata* L., *V. reichenbachiana* Jord. et Boreau; 55. VITACEAE: **Parthenocissus quinquefolia* (L.) Planch., **Vitis vinifera* L.;

Class **LILIOPSIDA**, 56. AMARYLLIDACEAE: *Allium oleraceum* L., *A. vineale* L., *Leucojum vernum* L.; 57. ASPARAGACEAE: *Asparagus officinalis* L., *Convallaria majalis* L., *Leopoldia comosa* (L.) Parl., *Muscari neglectum* Guss. ex Ten., *Ornithogalum gussonei* Ten., *Polygonatum multiflorum* (L.) All., *Scilla bifolia* L.; 58. COLCHICACEAE: *Colchicum autumnale* L.; 59. CYPERACEAE: *Carex brizoides* L., (?) *C. guestphalica* O.Lang, *C. halleriana* Asso, *C. hirta* L.; 60. JUNCACEAE: *Juncus bufonius* L., **Juncus tenuis* Willd., *Luzula multiflora* (Retz.) Lej.; 61. POACEAE: *Agrostis capillaris* L., *Aira elegantissima* Schur, *Anthoxanthum odoratum* L., *Apera interrupta* (L.) P.Beauv., **Arundo donax* L., $\diamond$ *Avena fatua* L., *Brachypodium sylvaticum* (Huds.) P.Beauv., $\diamond$ *Bromus hordeaceus* L., $\diamond$ *B. tectorum* L., $\diamond$ *Calamagrostis canescens* (Weber) Roth, $\diamond$ *C. epigeios* (L.) Roth, $\diamond$ *Cynodon dactylon* (L.) Pers., *Dactylis glomerata* L., *Deschampsia cespitosa* (L.) P. Beauv., $\diamond$ *Digitaria ischaemum* (Schreb.) Mühlenb., $\diamond$ *D. sanguinalis* (L.) Scop., $\diamond$ *Elymus repens* (L.) Gould., $\diamond$ *Eragrostis minor* Host, *Holcus mollis* L., $\diamond$ *Hordeum murinum* L., $\diamond$ *Poa annua* L., *P. bulbosa* L. var. *vivipara* Koeler, *P. pratensis* L., $\diamond$ *Setaria pumila* (Poir.) Roem. et Schult., $\diamond$ *S. verticillata* (L.) P.Beauv., $\diamond$ *S. viridis* (L.) P.Beauv., **Sorghum halepense* (L.) Pers., *Vulpia myuros* (L.) Gmelin; 62. XANTHORRHOACEAE: **Hemerocallis fulva* L.

CONCLUSIONS

1. For the first time, the composition of the vascular flora of the Miraflores Park has been determined. It consists of 256 species of 181 genera and 62 families, 225 of which are native and 31 – allochthonous species, and 7 species are rare.
2. The presence of some spontaneous species, characteristic of floodplain forests, such as *Quercus robur* L., *Ulmus minor* Mill., *Fraxinus excelsior* L., *Populus alba* L., *Salix alba* L., *Sambucus nigra* L., *Humulus lupulus* L., *Solanum dulcamara* L., *Rubus caesius* L., *R. ulmifolium* Schott, *Aegopodium podagraria* L., *Ficaria verna* Huds. and *Heracleum sphondylium* L. suggests that the park was created by transforming a natural floodplain forest.
3. The 31 allochthonous species and the 47 native species of the group of weeds account for more than 30 % of the total number of taxa, which indicates the impact of the anthropic factor on the studied vegetation.
4. We are proposing to include the species *Thalictrum delponteanum* (Pinzaru) Pinzaru in the Red Book of Italy, and the species *Sagina subulata* (Sw.) C.Presl, *Plantago virginica* L. and *Lysimachia minima* (L.) U. Manns & Anderb. in the List of Rare Species of Piedmont Region.

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Fig. 2. *Thalictrum delponteanum* (Pinzaru) Pinzaru:
general view



Fig. 2a. *Thalictrum delponteanum* (Pinzaru)
Pinzaru: leaf, flower, fruits



Fig. 3. *Sagina subulata* (Sw.) C.Presl

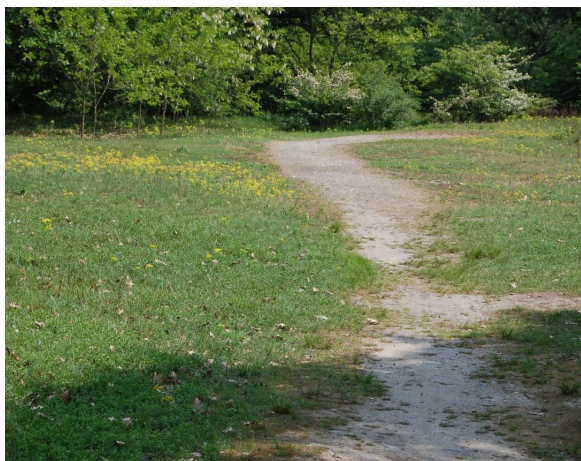


Fig.4. Glade with *Sagina subulata* (Sw.) C.Presl



Fig. 5. *Plantago virginica* L.



Fig. 6. *Lysimachia minima* (L.) U.Manns & Anderb.

THE DIVERSITY OF ROSA L. SPECIES OF THE STEPPE HABITAT IN THE REPUBLIC OF MOLDOVA

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Abstract: This article includes the results of a multi-annual study on *Rosa* species throughout the Republic of Moldova, which was conducted during 2012-2017. In addition to our own results, we used the botanical material found in the Herbarium of the Botanical Garden as well as scientific literature in this area. Studying the species diversity of the genus *Rosa* in the territory of the Republic of Moldova, we can conclude that the steppe sectors that have been preserved, host species of wild rose such as *Rosa gallica* L., *R. pimpinellifolia* L., *R. villosa* L., *R. rubiginosa* L., *R. micrantha* Borrer ex Smith, *R. inodora* Fries., as well as *R. canina* L. Most often, *Rosa* species are found on stony slopes along large rivers, where steppe habitats are interrupted by ravines and canyons. In such areas, there are favourable conditions for xeromesophilic vegetation, and the species of wild rose form scrubs together with other species of following genera: *Spiraea* L., *Crataegus* L., *Caragana* Fabr., *Berberis* L., *Prunus* L. etc.

Keywords: steppe habitat, *Rosa*, Republic of Moldova.

INTRODUCTION

In the last decades, the natural ecosystems of the Republic of Moldova have been severely affected because of the often irresponsible actions of people. One can say that the steppe vegetation suffered the most, being the most actively anthropized because of agricultural activities and the use of steppes as pastures over hundreds of years. At present, steppe habitats, which in the past occupied 2/3 of the territory of the country, are only fragmentary [1, 9]. If several decades ago, the biggest problem of habitats with steppe vegetation was their conversion into agricultural land, now the two main problems of these ecosystems are: intensive grazing, for easily accessible areas and the inclusion of valuable steppe sectors in afforestation programs. The current situation requires the essential expansion of protected areas with steppe vegetation by identifying new sectors and including them in the natural areas protected by the state.

Today we can find better-preserved fragments of steppe in protected areas such as “Vrănești” in the north of the country, as well as sectors with representative steppe vegetation in the south of the republic: “Bugeac”, “Ciumai”, “Dezghingea”, “Andriașevca Nouă”. Habitats with steppe vegetation have remained intact in hard-to-reach areas, on stony slopes, in the canyons of large rivers – Dniester, Prut and Răut. Other steppe fragments can be found in glades and at the edge of arid downy oak forests. A characteristic feature of the downy oak forests is the combination of pasture and steppe vegetation. Most *Stipa* species that occur in the Republic of Moldova, and sometimes even all of them, can be found in downy oak forests [8].

Representative and main dominant species of the steppes of Republic of Moldova are: *Stipa pennata* L., *S. pulcherrima* C. Koch, *S. ucrainica* P. Smirn., *S. lessingiana* Trin. et Rupr., *Festuca valesiaca* Gaud., *Koeleria cristata* (L.) Pers. [8]. In addition to grasses, in the composition of the steppe plant communities, there are some species of subshrubs and shrubs. The shrubs of the genera *Caragana* Fabr., *Amygdalus* L., *Chamaecytisus* Link, *Spiraea* L. and some species of *Rosa* L. play a special phytocenotic role.

MATERIALS AND METHODS

This article includes data on the multiannual study on the species of the genus *Rosa* throughout the territory of the Republic of Moldova, which was conducted in 2012-2017. In addition to our own results, we

used the botanical material found in the Herbarium of the Botanical Garden as well as literature in this field. To carry out the field research, expeditions were undertaken to study the diversity of as many sites as possible. The plants were collected and the specimens for the herbarium were prepared in accordance with the classical method of field research [6]. The determination of the taxonomic belonging of species was performed on the basis of the literature in the given field [2]. The nomenclature is presented according to the specialized papers on floristics [7].

RESULTS AND DISCUSSIONS

After researching the specific diversity of the genus *Rosa* L. in the Republic of Moldova, we can mention that the steppe sectors that have been preserved, host such species of wild rose as *Rosa gallica* L., *R. pimpinellifolia* L., *R. villosa* L., *R. rubiginosa* L., *R. micrantha* Borrer ex Smith, *R. inodora* Fries and *R. canina* L. Most often, *Rosa* species are found on stony slopes along large rivers, where steppe habitats are interrupted by ravines and canyons. In such areas, there are favourable conditions for xeromesophilic vegetation, and the species of wild rose form scrubs together with species of genera: *Spiraea* L., *Crataegus* L., *Caragana* Fabr., *Berberis* L., *Prunus* L. and others [3].

Therefore, one of the most common species of wild rose in the



Rosa pimpinellifolia L.

steppe habitats is *Rosa gallica*, which can be found in the steppe sectors of the southern areas of Republic of Moldova, being part of the herbaceous layer of *Stipa* and *Festuca* associations, as well as in the steppe glades of downy oak forests. It is a small shrub, up to 80 cm tall, with often creeping, branched, ascending stems. The flowers are bright pink to purple, 5-6 cm in diameter, solitary. It grows solitarily or in small groups forming clusters. *Rosa gallica* does not form scrubs or does not spread on large areas and



Rosa gallica L.

is often accompanied by shrubs like *Amygdalus nana* L., *Caragana mollis* (Bieb.) Bess.

Rosa pimpinellifolia grows mainly on slopes with steppe vegetation, in glades and forest edges; sometimes it is part of the shrub layer of downy oak forests. It is a shrub with strongly branched stem, up to 1 m tall, and with straight, ascending branches. The flowers are creamy-white with yellowish base, solitary. It grows sporadically or in groups throughout the country, forming not too large but



Rosa villosa L.



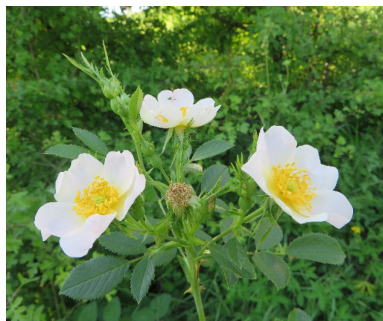
Rosa rubiginosa L.

quite thick scrubs, along with the species *Spiraea crenata* L., *Crataegus microphylla* C.Koch, *Caragana frutex* (L.) C.Koch and *Chamaecytisus austriacus* (L.) Link.

Rosa villosa is another species characteristic of the glades with steppe vegetation of the petrophytic forests of the northeast of the country. This shrub is 1-1.5 m tall, with short and dense branches. The flowers are dark pink, grouped by 1-3 in inflorescences. It grows sporadically in forest edges, glades, on hills with steppe vegetation or forms scrubs along with other species of shrubs. This species is not very common, having small populations, given that its habitat is constantly diminishing.

Rosa rubiginosa grows on stony slopes with steppe vegetation, in glades and forest edges. It is also a shrub, 1-1.5 m tall, with straight, ascending branches. The flowers are pale pink, arranged in multifloral inflorescences, rarely solitary. *Rosa rubiginosa* can be found mainly in the steppe sectors in the southeast of the republic. It grows solitarily or forms not too large thickets, accompanied by other species of *Rosaceae* shrubs.

Rosa micrantha can be found on sunny, stony slopes with steppe vegetation, on rocks and in forest edges. It is a strongly branched shrub, 2-2.5 m tall, with arched branches. The flowers are bright pink, small and solitary, rarely grouped in inflorescences. It grows solitarily or in small



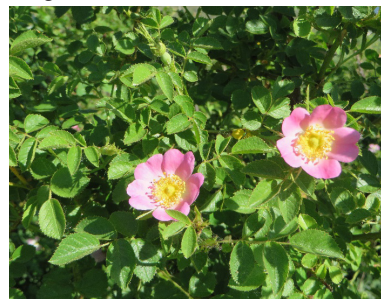
Rosa inodora Fries

groups, forming scrubs that are not too large, along with *Rosa inodora* Fries and *Prunus spinosa* L. For the territory of the Republic of Moldova, it is a rare species; several dozen specimens were recorded in the south of the republic, in the representative sector with steppe vegetation "Ciumai" and on the slopes with steppe vegetation in the area of the Middle Dniester [4].

Rosa inodora has been recently found in a steppe sector in the south of the republic. It is a densely branched shrub, 1.5-2 m tall. The flowers are pale pink to white, solitary or grouped in inflorescences. *Rosa inodora* grows on sunny slopes with steppe vegetation, in glades and forest edges.

It grows solitarily and in small groups, accompanied by *Rosa gallica* and *R. micrantha*. This steppe sector is of particular interest because apart from *Rosa inodora*, there are many rare species such as *Stipa dasyphylla* (Lindem.) Trautv., *Stipa tirsia* Stev., *Bellevalia sarmatica* (Georgi) Woronow, *Adonis wolgensis* Stev. and species of international interest such as *Echium russicum* J.F.Gmel., *Crambe tataria* Sebeok and *Colchicum arenarium* Waldst. et Kit. [5].

Rosa canina is not a species that grows exclusively in steppe habitats, but it is a frequently met species, mainly found on the slopes with steppe vegetation near localities as well as in steppe habitats along the roads. It is a shrub, 1-3 m tall the stems are arched, more rarely straight, branched. The flowers are pale pink to white, solitary or grouped in inflorescences. It forms thickets together with *Caragana mollis* (Bieb.) Bess., *Prunus spinosa* L., *Crataegus monogyna* Jacq. and other species of wild rose.



Rosa micrantha Borrer ex Smith



Rosa canina L.

CONCLUSIONS

The floristic composition and the phytocenotic structure of habitats with steppe vegetation is fairly rich and of high value. In steppe sectors, in addition to dominant species, there is a large number of accompanying ones, including species of shrubs. The species of the genus *Rosa* along with the species of the genera *Caragana*, *Chamaecytisus*, *Crataegus*, *Spiraea*, *Prunus* and others are valuable elements for maintaining the balance of steppe habitats. Of all *Rosa* species grown in steppe vegetation habitats, the species *Rosa micrantha*, *Rosa inodora* and *Rosa villosa* are more vulnerable and should be included in the list of protected vascular plants in the Republic of Moldova.

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III. INTRODUCTION OF PLANTS AND SUSTAINABLE USE OF PLANT RESOURCES

CZU: 633:582.6 (478)

SPONTANEOUS MEDICINAL PLANTS RESEARCH AND *EX-SITU* CONSERVATION IN THE NATIONAL BOTANICAL GARDEN (INSTITUTE), REPUBLIC OF MOLDOVA

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Abstract: This paper presents data on ex-situ conservation and cultivation of spontaneous medicinal species in the collections of National Botanical Garden (Institute) of Republic of Moldova. During the last decade more than one hundred autochthonous medicinal species were added to the collection. The results of bio-morphological studies of some spontaneous therapeutically important species are given. The study results aimed at developing methods of propagation and ecological optimization of their agro-technical practices were obtained. The research in various aspects of medicinal species with different rarity status, determining the optimal strategy for preservation perspectives is presented.

Key words: medicinal plants, spontaneous flora, ex-situ collection, conservation, Republic of Moldova.

INTRODUCTION

The uncontrolled collection and sale of large quantities of medicinal plant material from wild flora lead to destruction of many plant populations and their natural habitats.

Sustainable use of medicinal and aromatic plants (MAPs) can be achieved by promoting the cultivation of wild plants in suitable environments. This aspect takes on special importance nowadays because it allows to use wild useful plants in a more rational manner and to enrich the cultivated flora with new valuable species. Cultivation of spontaneous MAPs, especially those with high economic value is also creating new dimensions in the field of agriculture, acquiring various methods of assessing the spontaneous flora for industrial utilization [26, 30]. Growing plants under controlled conditions allows undertaking a complex research, which helps to highlight their multiple features, which then become useful in their introduction into the culture. The research regarding plant biology features, ontogenetic cycle, growth and development during the vegetative period in new conditions, etc. is very important. At the same time, cultivation of medicinal plants is a challenging task because less is known about their seed biology, methods of propagation, ecological requirements. Indubitable, there is a need for a scientific approach for propagation of medicinal plants and to collect relevant information regarding agro-technology, genuine planting material, elite specimens with high yielding varieties, breeding programs for improvement of the plant species etc. [22].

In this context research programs on wild MAPs conducted by Botanical Gardens are of great importance not only for improvement of their cultivation process, but also for the conservation and restoring their genetic recourses in natural habitats. Currently, in more than 480 botanical gardens worldwide are recorded collections of medicinal plants [18].

The present study is focused on *ex-situ* conservation, research and cultivation of spontaneous medicinal species in the collections of National Botanical Garden (I) (fig.1, 2).

MATERIALS AND METHODS

The research was carried out during the years 2006-2017. As the base of this study, the Collection of

Medicinal Plants from the National Botanical Garden (Institute) has served. Studies for new plant species acclimatization were carried out in the Experimental subdivision of the collection. The genetic resource mobilization of medicinal plants was achieved by collecting seeds and plant material from the wild flora during field expeditions. Phenologic observations and biometric measurements were performed annually during the entire vegetation period according to widely used methodological guidelines [22, 26, 29]. Nomenclature used is in line with the contemporary floristic works [11, 21, 25].

RESULTS AND DISCUSSIONS

Over many years of research in the collection has been accumulated a good number of wild medicinal and aromatic plants [27, 30]. In the last two decades, in order to safeguard the gene pool of autochthonous MAPs, 114 species belonging to 43 families and 99 genera were added to the Collection of Medicinal Plants from National Botanical Garden (Institute) [2, 4, 6]. Thus, in the period 2006-2017 more than one hundred



Leonurus cardiaca



Astragalus dasyanthus



Valeriana officinalis

Figure 1. Medicinal plants used in cardiovascular diseases

spontaneous species valuable in terms of their therapeutic and scientific value were added to the collection. The most frequent genera are: *Adonis* L., *Althaea* L., *Artemisia* L., *Astragalus* L., *Convolvulus* L., *Digitalis* L., *Phlomis* L., *Plantago* L., *Thymus* L., *Salvia* L.

In the collection are included a good number of native medicinal plants used, both in traditional and modern medicine in the treatment of various diseases of the human body:

- medicinal plants used to treat cardiovascular diseases (*Leonurus cardiaca* L., *Valeriana officinalis* L., *Astragalus dasyanthus* Pall. (fig. 1), *Convallaria majalis* L., *Digitalis lanata* Ehrh., *Vinca minor* L., *Geum urbanum* L.); plants with haemorrhagic effect (*Achillea millefolium* L., *Hypericum perforatum* L., *Potentilla recta* L., *Rumex confertus* Willd., *Urtica dioica* L. etc.).

- plants with expectorant, antiasthmatic and emollient effects, used to treat respiratory ailments (*Borago officinalis* L., *Inula helenium* L., *Tussilago farfara* L., *Marrubium vulgare* L., *Primula veris* L., *Pulmonaria officinalis* L., *Saponaria officinalis* L., *Althaea officinalis* L., *Viola tricolor* L., *Thymus marschallianus* Willd. etc.);

- plants used to treat digestive diseases (*Althaea officinalis* L., *Achillea millefolium* L., *Chelidonium majus* L. (viermifuge), *Matricaria chamomilla* L., *Mentha longifolia* L. etc.);

– plants used in the treatment of urinary disorders (*Agrimonia eupatoria* L., *Epilobium parviflorum* Schreb., *Lamium album* L., *Urtica dioica* L., *Ononis spinosa* L., *Potentilla anserina* L., *Primula veris* L., *Solidago virgaurea* L., etc.);

– plants used in the treatment of liver and biliary diseases (*Centaurea cyanus* L., *Cichorium intybus* L., *Berberis vulgaris* L., *Helychrisum arenarium* (Roth.) G. Don, *Scutellaria altissima* L., *Taraxacum officinale* Web., etc.);

– plants used in skin disorders (*Achillea millefolium* L., *Arctium lappa* L., *Chelidonium majus* L., *Hippophaë rhamnoides* L., *Hypericum perforatum* L., *Symphytum officinale* L., *Teucrium chamaedrys* L., *T. polium* L. etc.);

– plants used in the treatment of rheumatic pain (*Centaurea cyanus* L., *Clematis vitalba* L., *Physalis alkekengi* L., *Urtica dioica* L. etc.).

– medicinal plants recommended in nervous system disorders (*Humulus lupulus* L., *Inula helenium* L., *Leonurus cardiaca* L., *Ononis spinosa* L., *Valeriana officinalis* L. etc.)

The number of medicinal shrubs (fig. 2) in the collection is in continuous growth: *Berberis vulgaris* L., *Hippophaë rhamnoides* L., *Viburnum opulus* L., etc.



Berberis vulgaris



Hippophaë rhamnoides



Viburnum opulus

Figure 2. Medicinal shrubs

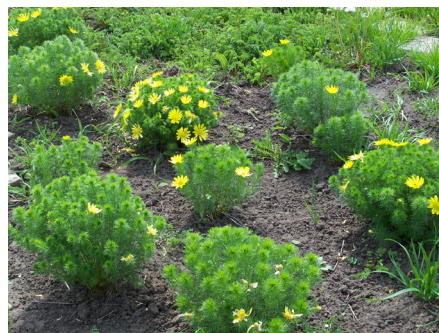
The toxic plants (fig. 3) that are used to produce drugs but which have toxic effects on the human body being consumed without medical supervision (*Adonis vernalis* L., *A. wolgensis* Stev., *Asarum europaeum* L., *Bryonia alba* L., *Convallaria majalis* L., *Digitalis lanata* L., *Scopolia carniolica* L., *Symphytum officinale* L., *Vinca minor* L. etc.) occupy an outermost position in the collection.



Asarum europaeum



Scopolia carniolica



Adonis vernalis

Figure 3. Toxic plants

A number of genera (*Phlomis*, *Verbascum*, *Teucrium*, *Lamium*, *Thymus*, *Artemisia*, *Potentilla* and *Salvia*)

have a large area of distribution in the flora of Republic of Moldova, but there is lack of information about their traditional applications. For example, *Teucrium polium* acts as a diuretic, tonic and antispasmodic drug. As a result of ethnobotanical studies, there was not found any information of its traditional use in Moldova. That makes obvious the need of supplementary ethnobotanical studies in order to collect all the knowledge about the use of these plants in folk medicine. In this line we can mention the species belonging to genera *Lamium* L., such as *L. amplexicaule* and *L. maculatum*, which possess significant therapeutic qualities due to biological substances, in particular to iridoid glycosides. In spite of this, they are almost not used by local people [7].

Experimental cultivation of several spontaneous medicinal plants (*Acorus calamus* L., *Ajuga reptans* L. (fig. 4), *Artemisia absinthium* L., *A. annua* L., *A. pontica* L., *Asparagus officinalis* L., *Helychrisum arenarium* (L.) Moench., *Inula helenium* L., *Leonurus cardiaca* L., *Nepeta cataria* L., *Origanum vulgare* L., *Phlomis pungens*

*Potentilla alba**Hypericum perforatum**Ajuga reptans*

Figure 4. Experimental cultivation of some wild medicinal plants

Willd., *Ph. tuberosa* L., *Physalis alkekengi* L., *Potentilla alba* L., *P. recta* L., *Primula veris* L., *Pyrethrum corymbosum* (L.) Scop., *Rumex confertus* Willd., *Salvia pratensis* L. (fig. 5), *S. nemorosa* L., *S. verticillata* L., *Stachys officinalis* (L.) Trev., *Scutellaria altissima* L., *Solidago virgaurea* L., *Symphytum officinale* L., *Tanacetum odessanum* (Klok.) Tzvel., *Teucrium chamaedrys* L., *T. polium* L., *Thymus marshallianus* Willd., etc.) on the experimental fields of the collection contributed to better understanding their agronomic requirements.

*Salvia pratensis**Pyrethrum corymbosum**Scutellaria altissima*

Figure 5. Experimental cultivation of some wild medicinal plants

Most of them showed high cultivation aptitude with positive agronomic results. It was revealed that under the condition of cultivation the rhythm of seasonal development of this species was generally the same as in natural habitats. They successfully passed all ontogenetic phases, as a result with the formation of viable seeds

The entire gene pool of spontaneous MAPs cultivated in the collection serves primarily as a basis for introduction and breeding research to improve assortment of medicinal plants used in the national economy. Thus, in recent years the research on biomorphological and ontogenetic peculiarities of the species of the genera: *Ajuga* L., *Lamium* L., *Origanum* L., *Nepeta* L., *Teucrium* L. and *Thymus* L. have been conducted. Good adaptation showed *Ajuga reptans* L., *Lamium album* L., *Nepeta cataria* L., *N. pannonica* L., *Phlomis pungens* Willd., *Ph. tuberosa* L., *Salvia nemorosa* L., *S. verticillata* L., *S. pratensis* L., *Teucrium chamaedrys* L., *T. polium* L., *Thymus marshallianus* Willd., etc. Some spontaneous species (*Epilobium parviflorum* Schreb., *Pimpinella saxifraga* L., *Solidago virgaurea* L., *Scorzonera hispanica* L.) were identified as difficult species for cultivation.

The research regarding chemical composition and biological activity of some economically important MAPs growing in the collection, in order to increase their practical use in national economy are also one of the main goals of this study. In the context of the optimal growth characteristics and phytochemical profile promising results were obtained for *Ajuga reptans* L., *A. genevensis* L., *Lamium album* L., *Nepeta cataria* L., *N. parviflora* Bieb., *Origanum vulgare*, *Teucrium polium* L., *T. chamaedrys* L., *Thymus marshallianus* Willd. [5, 8-10, 12, 23].

From a total number of native medicinal species cultivated in the collection 45 have different status of rarity, 22 of them (*Achillea ochroleuca* Ehrh., *Adonis wolgensis* Stev., *Allium guttatum* Stev., *Allium inaequale* Janka, *Allium montanum* F.W. Schmidt., *Centaurea thirkei* Sch. Bip., *Convolvulus cantabrica* L., *C. lineatus* L. (fig. 6), *Crambe tataria* Sebeók, *Digitalis lanata* Ehrh., *Dryopteris filix-mas* (L.) Schott, *Galanthus nivalis* L., *G. plicatus* Bieb., *Hepatica nobilis* Mill., *Herniaria glabra* L., *Leucojum aestivum* L., *Nepeta parviflora* Bieb., *Scopolia carniolica* Jacq., *Sempervivum ruthenicum* Schnittsp. et C.B. Lehm., *Sternbergia colchicifolia* Waldst. et Kit., *Valeriana tuberosa* L.) are included in the 3rd edition of the Red Book of Republic of Moldova [24]. Some of



Convolvulus lineatus



Digitalis lanata



Hepatica nobilis

Figure 6. Rare medicinal plants maintained on experimental fields

them, important from a therapeutic point of view became research subjects under various aspects: determining the coefficient of seed germination; establishing the optimal propagating methods in species *Allium guttatum*, *Nepeta parviflora*, *Aconitum lasiostomum* (fig. 7), *Achillea ochroleuca* and *Digitalis lanata* [1, 3]. For the *ex-situ* cultivation, the sectors were selected with conditions similar to those in nature and created experimental fields in several options. Most studied rare and endangered medicinal species (*Allium guttatum*, *Convolvulus lineatus*, *Digitalis lanata*, *Galanthus nivalis*, *G. plicatus*, *Hepatica nobilis*, *Leucojum aestivum*, *Valeriana tuberosa*, etc.) in culture conditions undergo a complete ontogenetic cycle, which demonstrates high adaptive potential and *ex-situ* conservation perspective [3, 13-17, 19, 20, 28]. Research program aimed at further identifying and studying other rare medicinal plants in danger of extinction in order to learn the multiplication features, their conservation

status and reintroduction in natural ecosystems.

The study suggests that *conservation-by-cultivation* is an effective way for protecting genetic resources of



Nepeta parviflora

Achillea ochroleuca

Aconitum lasiostomum

Figure 7. Rare medicinal plants maintained on experimental fields

spontaneous medicinal plants. The good indicators of growth and development of native MAPs under *ex situ* conditions are also very encouraging, demonstrating their suitability for cultivation on a large scale.

CONCLUSIONS

Currently, in the collection of medicinal plants are cultivated 114 species from the wild flora, belonging to the 43 families and 99 genera. During the last decade the comprehensive biological and phytochemical results have been obtained on species of the *Teucrium* L., *Artemisia* L., *Thymus* L., *Origanum* L. and *Ajuga* L. genera. The results of the study aimed at developing methods of propagation and ecological agro-technologies of *Ajuga reptans* L., *Artemisia pontica* L., *A. lerchiana* Web. ex Stehm., *Potentilla alba* L., *Pyrethrum corymbosum* (L.) Scop., *Salvia pratensis* L., *Scutellaria altissima* L., *Stachys officinalis* (L.) Trev., *Tanacetum odessanum* (Klok.) Tzvel., *Thymus marshalianus* Willd. were obtained. Investigations initiated in order to identify, research and conservation measures of medicinal plants with different category of rarity allow adding 45 rare or endangered species in the collection, among them 22 species being included in the 3rd edition of the Red Book of Republic of Moldova.

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ASPECTS OF THE TECHNOLOGY OF PRODUCING LAVENDER CUTTINGS OF THE SPECIES *LAVANDULA ANGUSTIFOLIA*, VARIETY “GARDEN LAVINIA”, WITH THE AIM OF CREATING INDUSTRIAL PLANTATIONS

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Abstract: The modern research on aromatic and medicinal plants, which have become very popular again, is a true source of health benefits. The cultivation of aromatic plants is favoured by the climatic conditions of our country, which by their diversity allow the development of a wide range of species. They are a source of plant material for the cosmetic, pharmaceutical and food industry. An important role in the growth of plant production is played by bio-morphological, ecological studies, the production of healthy planting material and the improvement of technologies for the cultivation of these plants. One of the most important aromatic species is lavender, which is cultivated for its inflorescences with pleasant, unique smell that exudes freshness. The essential oil, extracted by the distillation of fresh inflorescences, is the main product obtained from lavender and it is widely used in the perfumes, cosmetic products, pharmaceuticals, aromatherapy etc. The dry inflorescences, due to the essential oil and its components, are used in some teas with sedative, antiseptic, choleric, cholagogue, diuretic, carminative effects etc.

INTRODUCTION

The soil and climatic conditions of the Republic of Moldova are favourable for the cultivation of aromatic plants. The amount of rainfall, the abundant insolation and the rich soils are factors that positively influence the synthesis and accumulation of biologically active substances in larger quantities than in other areas.

Lavender is one of the numerous aromatic and medicinal plants, known and used for thousands of years, which is cultivated on relatively large areas. Among the species of the genus *Lavandula* L., *Lavandula angustifolia* Mill. is the most valuable and popular. Recently, the demand for organic, hypoallergenic and high-quality essential oils has increased on the pharmaceutical and perfume market in our country. Taking into account the



local market demands, we have chosen to work on the production of high-quality seedlings with the aim of creating industrial plantations of lavender. The use of pure biological material allows us to guarantee the production of high-quality raw material, the plants being vigorous and long living.

Lavender is a perennial subshrub, with lignified, thick and well-developed root, reaching 2.2-2.8 m deep in the soil. The stem branches from the base and forms a nearly globular bush, which grows 30-70 cm tall. The stems are square in cross-section, brown, with flaky bark. The leaves are opposite, linear-lanceolate, grey or greyish-green, tomentose on both sides, with branched, stellate (star-shaped) hairs. The flowers are labiate, strongly flavoured, grouped in spike inflorescences, which consist of 4-5 to 12 overlaid pseudo-whorls. The calyx of the flowers is tubular, hairy and glandular, of greyish-blue colour and the corolla is bluish-violet, sometimes blue and very rarely white. The fruits are small nutlets, brown, smooth

and shiny, situated at the base of the persistent calyx. The inflorescences with a pleasant smell, characteristic of this species, are harvested. The main product of this crop is the essential oil obtained by steam distillation from fresh inflorescences. Essential oil is used in perfumery, cosmetics, various sanitary and hygiene products [2, 5].

The process of expanding the areas cultivated with lavender or the diversification of this crop by adopting new varieties makes it necessary to identify new practical methods of producing planting material. The reason for producing planting material with our own resources is based not only on the idea of reducing the costs, but also on a better way of controlling the needs of development of this crop.

MATERIALS AND METHODS

The plant material used in this research comes from the mother plantation of lavender, the species *Lavandula angustifolia*, variety “Garden Lavinia”, obtained and certified in the Plant Resources Laboratory. The bushes are semi-globular, with strongly branched stem, 50-70 cm tall, producing spike inflorescences with 70-75 flowers arranged in 4 overlaid whorls. The fresh inflorescences contain 1.85 % essential oil, with 44 % linalool and 18.4 % linalyl acetate. The production of fresh inflorescences in the first years is 2-3 t/ha, and in the following years it can reach 6-7 t/ha. From one ton of fresh inflorescences, 12-15 kg of essential oil can be extracted. The evaluation of quantitative characteristics, the phenological research and the biometric measurements were carried out in accordance with the methods in force [1, 6, 9].

RESULTS AND DISCUSSIONS

Lavender can be propagated by four main methods: by seed, cutting, layering and division. The most recommended method is the production of rooted cuttings from lignified stems. The cuttings are taken in autumn (September-October) or in late winter-spring (February-March), in the dormant season. They should be taken from healthy, well-developed, 3- to 5-year-old plants, and should be herbaceous shoots, 7-8 cm long, with lignified base (1-year-old wood). They are cut with a sharp knife, below buds. Leaves are removed from the lower part with 2-3 buds, very carefully, so as not to damage the buds. The obtained cuttings, about 5-7 cm long, must be planted within 1-2 hours. If stored longer, but no more than one day, the cuttings are kept in pots with clean water.



Lavender cuttings are planted in cold frames. The land chosen for planting the cuttings must be cleaned of weeds, located near a water source, but without the danger of swamping, protected from wind. For the production of rooted cuttings, the field is ploughed to a depth of 20 cm and then harrowed

to break up and smooth its surface. After that, on this land, one should set the cold frames, in which a 4-5 cm thick layer of well-sifted river sand is laid. From the surface of the



sand until the top edge of the sidewalls of the cold frame, there must be no more than 6-8 cm. After smoothing out, watering and compacting the soil, the rows are marked at a distance of 10 cm. The prepared cuttings are planted at a depth of 4-5 cm, with a spacing of 4x4-6 cm. Immediately after planting, the cuttings are abundantly watered and the cold frames are covered with their lid. The planted lavender cuttings are checked daily to make sure that there is enough moisture and to remove the weeds. The irrigation of the cuttings is carried out very carefully, by fine spraying, and in summer, it is necessary to irrigate even twice a day. For a more successful and faster rooting, before planting, the cuttings are treated with growth stimulators. For this purpose, the "Lignohumate" growth stimulator was used. The cuttings are soaked in this solution on average for 9-12 hours. To accelerate this process, a slightly acidic solution is recommended, that is pH 5.5. Forest soil is preferred for use in cold frames.

Due to the fact that lavender is a very fast growing plant, the planted cuttings begin to root in 4 to 5 weeks, the roots grow fast, and flower-generating tips are trimmed to stimulate growth and development of roots until autumn (5-10 cm), making sure that most of them will survive in open ground. A month before the cuttings are removed from the cold frames, they are no longer watered. In October, once they have reached the necessary maturity, lavender cuttings will be removed from the ground. To avoid any damage or breakage, the soil in cold frames is well watered the day before. The cuttings are taken out of the ground manually. Further, the cuttings are counted, grouped and categorized according to the requirements. The new plants obtained from cuttings are ready to be transplanted to the permanent location, when they fulfill all the conditions necessary to develop well in the new place. The percentage of rooting of cuttings in cold frames is 80 %, and in open ground, at the creation of industrial plantations, it is 96 %.

The researched method is recommended for the propagation of lavender plants, for the production of rooted cuttings. The argument is simple: it is the most practical method, because the rooted cuttings inherit all the qualities of the mother plant, while the plants grown from seeds, according to some researches, may possibly become a little "wilder" and there is a risk that they will not have exactly the same qualities as the plant from which the seeds were harvested. Another reason to choose the propagation by cuttings is that these new plants grow faster than those obtained from seeds; studies have shown a significant difference in the branching of roots as well as shoots.

CONCLUSIONS

As a result of our research, rooted cuttings of lavender, *Lavandula angustifolia*, variety "Garden Lavinia", have been obtained; biologically pure and high-quality planting material has been produced in a relatively short time, for the purpose of creating industrial plantations for the production of essential oil; a sample plantation of lavender, *Lavandula angustifolia*, variety "Garden Lavinia", has been established on an area of 0.5 ha; some elements of organic farming have been used; the flowchart of producing rooted cuttings has been elaborated in order to use the technology of producing planting material of lavender by cuttings.

Some advantages of the production of rooted cuttings: the plants grow fast and are able to produce essential oil relatively early; blooming is relatively uniform; the new plants reproduce the characteristics and qualities of the parent plant relatively accurately; this method is less laborious and more cost-effective.

The above-mentioned method of obtaining cuttings of the variety "Garden Lavinia" is recommended as a guide for farmers, agricultural and forestry enterprises, as well as individual enterprises specialized in the cultivation of medicinal and aromatic plants.

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NUTRIENT ELEMENTS (P, K) IN TYPICAL FOREST BIOCENOSES OF RESERVE"CODRII"

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Abstract: This paper presents an analysis of the soil-plant relationships regarding the mobile forms of P and K in soil and their content in the herbaceous plant species (about 39 species belonging to 34 genera and 19 families) in 3 forest biocenoses of the European type from "Codrii" reserve. It was found that the studied soils, typical gray clay forest soils over clay-sandy loam and brown clay soils over deeply gleyed clay are secured with mobile P and exchangeable K, brown sandy loam soil over clay-sand shows lower values of P and optimum of K. Plants with a low P content ($\leq 1\%$, *Bromopsis benekenii*, *Dactylis glomerata*, *Galeobdolon luteum*) and high $> 4\%$ P (*Corydalis solida*, *Dentaria bulbifera*, etc.); with K values within 3-10 %, species with narrow accumulation limits (*Galium odorata*, *Convallaria majalis*, *Dentaria bulbifera* etc.) and broader accumulation spectrum (*Carex brevicollis*, *Carex pilosa*, *Melica uniflora*, *Dactylis glomerata*, *Euphorbia amigdaloides*, *Ficaria verna*, *Glechoma hirsuta*, *Viola hirta* etc.) were found.

Key words: phosphorus, potassium, forest biocenoses, forest soils, grasses.

INTRODUCTION

The research for several decades, starting with the studies conducted by G.F. Morozov (1886-1920), V.N. Sucaciov (1919-1967), has shown that forest ecosystems are more stable to environmental factors. Soil being a complex system, in turn, unifies the components of the ecosystem, being a media and a determinant of the existence of plants and animals. Soils and forest vegetation form forest types. Plant groups of herbaceous stratum are the concrete units that mirror the action of environmental factors [3] and can give indications of changes in disrupted systems.

The importance of phosphorus and of potassium for the growth and development of the living organism is indisputable, their research remains constantly up-to-date [1, 2, 5, 6]. Phosphorus is found in all plant organs, especially in seeds and growing tissues, it increases the resistance of plants during growth [1, 2]. K stimulates the ability of plants to synthesize organic substances, facilitates the transition of sugar into more active carbohydrates and plays an important role in the assimilation of nitrogen by plants [13].

In order to complete the information on the adsorption, accumulation and spatial distribution of the nutrients P and K and to specify the indicator character of the plants, we propose the results from 2001, obtained simultaneously in soil and plants during the spring, summer and autumn periods.

In this paper, we have highlighted the qualitative ranges of P and K and not the average values to reflect better the spatial variations of these elements as an index of soil-plant rapport changes according to the type of soil, the type of vegetation, the seasonal dynamics and the specific diversity of herbaceous stratum.

MATERIALS AND METHODS

The investigations were carried out in 3 European forest biocenoses from the "Codrii" Reserve, representing the common oak with hornbeam forest on typical gray clay forest soils over clay-sandy loam (A); durmast oak with linden and ash forest on brown clay soils over deeply gleyed clay (B); beech with durmast oak forest on brown sandy loam soil over clay-sand (C).

The common oak with hornbeam forest vegetation belongs to the *Quercetum* formation (*Quercus robur*), with two associations (900 m² of space for each forest type) *Carpineto-Quercetum* and *Fraxineto-Quercetum*. The vegetation of the durmast oak with linden and ash forest is also part of the *Quercetum* formation with a single *Fraxineto-Quercetum* association; The vegetation of the beech with durmast oak forest is part of the

Fagetum (*Fagus sylvatica*) formation comprising two plant associations – *Carpineto-Fagetum* and *Querceto-Fagetum*, characterized in the previous works [6, 7, 8, 9].

Samples were selected from a 1 m² sample area of 8 territorial repetitions from 1800 m² experimental areas. The investigations of P and K in plants, along with the full soil characteristics, were undertaken during the years 1995-2002 (2000-2002 thanks to the “Soros” Financial Support Scheme). Phosphorus and potassium in the soil were determined by the modified Ciricov method (GOST 26204-84), mathematical statistics – according to Dospehov V., Gorea S. [11, 14]. Plants (aerial part) were identified according to the T. Gheideman identifier [14] by G. Şabanov and T. Cojuhari. Plant mineralization was performed with sulfuric acid according to the Pinevich method, determination of P and K – Truog-Meier method (1987) [16]. Thanks for consultations Dr. Şabanov Galina, Dr. Filipciuc V. and the “Soros” Foundation for financial support.

RESULTS

Mobile phosphorus in the soil. It is known that soil is the sole source of P nutrition of plants, the mobile forms being accessible for plant nutrition.

The analyzed soils during this time period are characterized by P content from moderate to very high in the soils of the common oak with hornbeam forest (A) and durmast oak with linden and ash forest (B). The maximum values were found at the depth of the accumulation of the grass roots in the 0-20 cm layer within the range of 1.7-13.5 mg/100 g in typical gray clay forest soils over clay-sandy loam and in the range of 1.3-12.5 mg/100 g (0-30 cm) in brown clay soils over deeply gleyed clay, decreasing abruptly in the adjacent layers.

For the beech with durmast oak forest on brown sandy loam soil over clay-sand (C), the phosphorus values are low and very low, within the range of 0.2-1.9 mg/100 g, slowly spreading in depth. The summer period is characterized by a decrease of these values in all soil types, in the autumn compared to the summer, being at a higher level in (Table 1).

Table 1. Intervals of mobile P content (mg /100 g) in studied forest soils

Depth cm	Spring			Summer			Autumn		
	A	B	C	A	B	C	A	B	C
0-10	6.7-13.5	5.2-11.2	0.2-1.5	3.3-6.8	3.3-11.6	0.2-0.5	4.2-9.0	1.7-9.6	0.5-1.8
10-20	1.7-5.2	1.6-9.0	0.2-1.9	0.9-3.8	2.4-6.0	0.1-0.2	1.4-7.0	0.6-7.0	0.5-1.6
20-30	0.5-6.2	1.3-12.5	0.2-1.7	1.4-2.6	1.9-3.5	0.1	0.8-4.2	0.6-7.8	0.3-1.4
30-40	0.9-3.2	0.9-9.5	0.20-0.6	0.2-3.2	0.9-3.0	0.1	0.8-3.2	0.3-6.5	0.2-0.8
40-50	0.5-3.7	2.0-7.7	0.2-0.9						
50-60	0.8-2.7	1.8-15.0	0.2-0.5						

The spatial distribution of the mobile phosphorus in depth and horizontally, within the boundaries of each type of forest, denotes an unevenness of soil layer, largely determined by the spatial distribution of the plants. This is reflected in the specialty literature [15, 17]. The coefficient of variation (Table 2) of P for all soils in most cases exceeds 33 %.

Table 2. The coefficient of variation (%) of mobile P in the soils of forests A, B, C

Depth cm	Spring			Summer			Autumn		
	A	B	C	A	B	C	A	B	C
0-10	35.0	31.3	49.2	36.6	53.9	70.0	27.7	60.5	36.1
10-20	54.6	49.2	99.0	61.5	36.2	40.0	71.0	68.4	46.2
20-30	83.8	74.0	-	29.5	27.0	-	44.2	98.3	60.7
30-40	48.5	81.0	51.0	77.3	45.9	-	47.2	82.1	54.1
40-50	89.3	47.1	71.6						
50-60	59.2	80.6	43.4						

Deviations by depth (Table 3) are higher according to hydrological and physico-chemical characteristics of soil presented later [6, 8, 9]. Spatial variations of phosphorus in the soil of durmast oak with linden and ash forest are more uniform than other soils. Phosphorus variations by the type of vegetation are also high (Table 4).

Table 3. Mobile P variations in analyzed soil biocenoses, layer 0-60 cm

Forest type	March		June		September	
	Standard error	Coefficient of variation, %	Standard error	Coefficient of variation, %	Standard error	Coefficient of variation, %
Common oak with hornbeam	0.26	30.9	0.23	33.1	0.14	40.4
Durmast oak with linden and ash	0.17	35.4	0.31	39.4	0.18	67.1
Beech with durmast oak	0.07	60.0	0.09	50.9	0.06	30.0

Table 4. Spatial variations of P in soil according to forest type (ABC) by layers

Depth cm	March		June		September	
	Standard error	Coefficient of variation, %	Standard error	Coefficient of variation, %	Standard error	Coefficient of variation, %
0-10	0.97	79.6	0.97	84.4	0.59	73.3
10-20	0.61	90.2	0.49	81.2	0.38	89.9
20-30	0.71	98.0	0.32	68.5	0.34	91.2
30-40	0.93	98.0	0.38	95.6	0.31	91.7

Phosphorus in plants. The investigations proposed in this paper allowed us to assess more broadly the soil type-herbaceous species relationship, the results of which determined the variations of the phosphorus values, predominantly in rapport with the vegetation period. We also outlined groups of species with different accumulation limits of P. The species, which we managed to analyze in seasonal dynamics (*Aegopodium podagraria*, *Carex brevicolis*, *Carex pilosa*, *Corydalis marschalliana*, *Corydalis solida*, *Dentaria bulbifera*, *Melica uniflora*, *Mercurialis Perennis*, *Scila bifolia*, *Stellaria holostea*), mostly accumulate P in the first vegetation phases, in autumn the P values decrease considerably. The species *Bromopsis benekenii*, *Dactylis glomerata*, *Galeobdolon luteum*, *Pulmonaria officinalis*, *Viola hirta*, *Viola odorata* maintain the P content at the same level during the vegetation period. We note that the reflux in plants in the soils, which are poorer in P, is slower.

The highest amount of phosphorus, above 4.0 %, was established in the species *Corydalis solida*, *Dentaria bulbifera*, *Polygonatum latifolium*, *Scilla bifolia* and others. The smallest values ($\leq 1\%$) of P were found in *Bromopsis benekenii*, *Dactylis glomerata*, *Galeobdolon luteum* (Table 5). Most vernal species (*Corydalis marschalliana*, *Corydalis solida*, *Dentaria bulbifera* etc.), as well as some estival and autumn species (*Aegopodium podagraria*, *Mercurialis perennis*, *Stellaria holostea* and others) were placed within 2-4 %. The species *Convallaria majalis*, *Corydalis bulbosa*, *Euphorbia amigdaloides*, *Myosoton aquaticum*, *Pulmonaria officinalis*, *Symphitum tauricum*, *Viola hirta*, *V. odorata*, *V. reichenbachiana* have a low P content, 1-2 %. Reserves of nutrients in soil have contributed to the accumulation of organic mass. Species requirements for P in relation to the type of forest in this article have not been quantified because of the absence of plant material and financial resources.

Table 5. Phosphorus content (%) in the herbaceous species from studied biocenoses

Nr	Species		March		April		June		September	
		Fo-rest ty-pe	Inter- vals	CV%	Inter- vals	CV%	Inter- vals	CV%	Inter- vals	CV%
1	<i>Aegopodium podagraria</i> L	C	2.4-3.0	16.0	1.0-1.6	23.0	1.1-1.3	7.0	0.8	-
2	<i>Alliaria petiolata</i> (Bieb.) Cavara et Grande	B					1.4-1.5	5.0	1.2-1.5	12.0
3	<i>Anemonoides ranunculoides</i> L.	A	2.9-3.6	7.0	1.1-2.4	23.0				
		B	3.0-3.6	8.0	0.5-1.6	46.0				
		C	2.9-3.4	7.0	0.7-1.2	25.0				
4	<i>Asarum europaeum</i> L.	A			1.8-3.3	26.0	1.2-1.4	10.0	0.7-0.8	6.0
		C			1.8-2.1	7.0	1.8	-	1.1	-
5	<i>Ballota nigra</i> L.	B					1.2			
6	<i>Bromopsis benekenii</i> (Lange) Holub.	B			1.0	-	1.1	-	0.8-1.1	13.0
7	<i>Campanula rapunculoides</i> L.	A			2.7	-	1.0-1.3	20.0		
8	<i>Carex brevicolis</i> L.	A	2.3-3.3	14.0	1.4-1.9	12.0	0.9-1.4	21.0	0.6-0.9	16.0
		B	2.5-3.4	21.0	1.1	-	0.9-1.4	28.0	0.5-0.9	31.0
		C							0.6	-
9	<i>Carex pilosa</i> (senil) Scop.	A	2.8-3.2	9.0	1.9	-	1.1-1.4	14.0	0.6-0.9	11.0
		B							0.4	-
		C	1.7-2.8	25.0	1.-1.4	13.0	0.9-1.2	14.0	0.3-0.9	37.0
10	<i>Convallaria majalis</i> L.	B			1.1-1.4	17.0	0.9	-		
11	<i>Corydalis bulbosa</i> (cava) L.	A			1.1-1.3	5.0				
		C			1.1-1.3	12.0				
12	<i>Corydalis marschalliana</i> Pers.	A			1.3-2.1	21.0				
		B	3.4		1.1-1.4	8.0				

13	<i>Corydalis solida</i> (L.) Clairv.	A	3.0-3.6	7.0	1.3-1.9	13.0				
		B	3.0-4.2	11.0	1.1-1.3	8.0				
		C	3.7-4.1	7.0	1.4	-				
14	<i>Dactylis glomerata</i> L.	B					0.5-0.7	20.0	0.9	-
15	<i>Dentaria bulbifera</i> L.	A	3.3	-	0.8-1.9	29.0				
		B	2.0-4.2	21.0	0.8-1.0	10.0				
		C	3.6-4.3	7.0	1.-1.9	26.0				
16	<i>Euphorbia amigdaloides</i> L.	A			1.2	-	1.3	-		
		B							1.0-1.3	20.0
17	<i>Ficaria verna</i> Huds.	A			1.75	-				
		B			0.7	-				
		C	3.2	-	1.1	-				
18	<i>Gagea lutea</i> (L.) Ker.-Gawl.	A	2.9	-						
		B	1.8-2.5	15.0						
19	<i>Galeobdolon luteum</i> Huds.	C	2.3	-	0.9-1.1	18.0	1.3-1.7	16.0	0.8	6.0
20	<i>Galium odorata</i> (L.) Scop.	A							0.9	-
		C			1.1-1.5	0.1	0.9-1.2	15.0	0.7	2.0
21	<i>Geum urbanum</i> L.	A							0.9	-
		B							1.0	-
22	<i>Glechoma hirsuta</i> Waldst. et Kit.	A			1.5-2.1	24.0	0.9-1.1	15.0	0.6-0.7	7.0
		B	2.6	-	0.9-1.5	24.0	1.2	4.0	0.9	-
		C			1.9	-				
23	<i>Isopyrum thalictroides</i> L.	A	3.2							
24	<i>Lamium maculatum</i> (L.) L.	B	3.0	-	1.3	-				
25	<i>Lunaria rediviva</i> L.	B					1.4	-	1.5	-
26	<i>Melica uniflora</i> Redz.	A					0.4			
		B			0.9-1.2	20.0	0.8-1.4	34.0	0.4	-
27	<i>Mercurialis perennis</i> L.	A	3.6	-	1.8	-	0.7	-		
		B	3.9	-						
		C			1.1-1.3	12.0	0.7	-		
28	<i>Myosoton aquaticum</i> (L.) Moench.	B			0.9-1.8	36.0				
29	<i>Polygonatum latifolium</i> Desf.	A			0.8-2.3	36.0	1.2-1.6	12.0		
		B	4.1-4.4	4.0	0.9-1.5	20.0	0.9-1.1	6.0		
		C			1.2-1.6	15.0	0.8	-		

30	<i>Pulmonaria officinalis</i> L.	A			1.7	-	1.3-1.8	23.0		
		B			1.4	5.0	1.3	-		
		C					1.4	-	0.3-1.2	69.0
31	<i>Roegneria canina</i> (L.) Nevski (<i>Elymus caninus</i> (L.) L.)	B							1.0	-
32	<i>Scila bifolia</i> L.	A	2.9-4.1	12.0	1.6-2.5	31.0				
		B	2.3-3.7	14.0	1.1-2.3	28.0				
		C	3.0-3.5	10.0						
33	<i>Scutellaria altissima</i> L.	B					1.0	-		
34	<i>Stachys sylvatica</i> L.	C					1.7	-	1.1	-
35	<i>Stellaria holostea</i> L.	A	3.2	-	1.3-1.9	18.0	1.3-1.4	6.0	0.6-0.9	17.0
		B	2.3-3.3	15.0	1.0-1.9	23.0	1.2-1.4	9.0	0.8-1.1	11.0
36	<i>Symphytum tauricum</i> Willd.	B					1.9	-	0.5-1.4	48.0
37	<i>Viola hirta</i> L.	A			1.0-1.3	16.0	1.0-1.6	33.0	0.7-1.0	13.0
		B					0.8-1.2	30.0	0.8-1.7	39.0
38	<i>Viola odorata</i> Bieb.	A			1.4-1.7	7.4	1.3			
		B					0.8-1.2	30.0	0.8-1.7	39.0
		C					1.6	-		
39	<i>Viola reichenbachiana</i> Jord. ex Boreau	A					1.4	-		
		C					1.1	-		

Exchangeable Potassium. The studied soils are rich in reserves of **K**. The results of the researches revealed that the values of the exchangeable potassium vary depending on the type of soil, the type of vegetation and the depth, as well as the vegetation period, from low to very high. In spring and autumn compared to the summer period, the exchangeable potassium has lower values in the soils of all types of forest (Table 6).

Table 6. Intervals of exchangeable K content (mg/100 g) in the analyzed soils.

Depth, cm	Spring			Summer			Autumn		
	Forest A	Forest B	Forest C	Forest A	Forest B	Forest C	Forest A	Forest B	Forest C
0-10	45.5-97.5	21.8-55.0	11.0-20.5	62.5-100.0	45.0-92.5	22.5-37.5	22.5-67.5	13.8-70.0	7.5-21.3
10-20	19.3-59.3	7.5-34.3	3.8-9.8	35.0-77.5	20.0-57.5	15.0-20.0	15.0-26.3	8.8-42.5	6.0-11.3
20-30	11.0-43.0	6.3-27.5	3.8-12.3	22.5-45.0	17.5-40.0	12.5-20.0	10.0-25.0	7.5-26.3	7.5-10.0
30-40	9.8-25.0	5.0-18.0	5.0-11.0	20.35.0	15.0-32.5	10.0-20.0	8.8-17.5	7.5-20.5	7.5-15.0
40-50	9.8-19.3	5.0-15.5	6.3-11.0						
50-60	12.3-18.0	5.0-15.5	6.3-14.3						

The studied soils manifested a large interval of K values in fertile layers 0-10 cm, 10-20 cm; 15.3-97.5 mg/100 g for the typical gray clay forest soils over clay-sandy loam, being higher than in other soils in all research periods; 7.5-55.0 mg/100 g for the brown clay soils over deeply gleyed clay; 3.8-37.5 mg/kg for

the brown sandy loam soil over clay-sand (Table 6). In the adjacent layers, the K values are smaller and their boundaries in each type of forest are narrower.

Table 7. Coefficient of variation of K (%) in the soils of forests A, B, C

Depth, cm	Spring			Summer			Autumn		
	A	B	C	A	B	C	A	B	C
0-10	34.0	38.2	22.1	22.7	33.8	20.8	36.6	66.6	26.1
10-20	55.2	58.9	33.0	40.3	47.8	16.5	44.2	69.3	18.1
20-30	61.4	54.2	39.6	30.3	42.6	24.0	34.3	52.5	10.0
30-40	36.8	44.7	30.2	22.2	35.1	27.2	26.5	39.2	24.9

In the vegetation period, the variations are smaller for the 0-20 cm layers (Table 7) in the adjacent ones increases considerably. The coefficient of variation, which characterizes the layer 0-60 cm (Table 8), indicates higher values for the common oak with hornbeam forest and durmast oak with linden and ash forest and the lower for the beech with durmast oak forest. Spatial variations of K according to the type of forest are high for all layers, decreasing in the summer period (Table 9)

Table 8. Variations of K in the soil of analyzed forests, layer 0-60 cm

Forest type	March		June		September	
	Standard error	Coefficient of variation, %	Standard error	Coefficient of variation, %	Standard error	Coefficient of variation, %
Common oak with hornbeam (A)	0.80	36.2	0.90	27.8	0.38	45.8
Durmast oak with linden and ash (B)	0.32	42.0	0.95	38.5	0.42	59.3
Beech with durmast oak (C)	0.18	23.2	0.47	17.6	0.16	14.9

Table 9. Spatial variations of K in soil by forest type (ABC)

Depth cm	March		June		September	
	Standard error	Coefficient of variation, %	Standard error	Coefficient of variation, %	Standard error	Coefficient of variation, %
0-10	5.10	67.2	7.16	42.8	3.47	62.0
10-20	3.00	85.4	4.80	48.1	2.19	66.2
20-30	2.09	74.7	2.69	37.2	1.15	44.1
30-40	1.21	52.4	2.31	36.5	0.75	31.8

Potassium in herbaceous plants. The importance of K in plants as an element necessary for their growth and development, especially as a moderator for the synthesis of organic substances, is well known. In the absence of potassium, yellow spots appear on the leaves, the edges become brown and start to twist [13]. K values in the analyzed species were in the 3-10 % range, with the exception of *Myosoton aquaticum* species 11-19 %, which at present can be qualified as a K-type species. For a clearer emphasis on the mode of accumulation and distribution of K in the studied plants, we tried to group the species with narrow and broader accumulation

limits as follows:

- species with narrow accumulation limits:

4-10 % - 4-5 % *Galium odorata*; 5-7 % *Convallaria majalis*, *Dentaria bulbifera*, *Polygonatum latifolium*; 6-7 % *Alliaria petiolata*, *Lunaria rediviva*, *Stachys sylvatic*; 6-8 % *Corydalis bulbosa*; 7-8 % *Mercurialis perennis*; 7-9 % *Corydalis marsalliana*; 8-9 % *Campanula rapunculoides*, *Symphitum tauricum*;

- species that accumulate K in broader ranges:

3-7 % - 3-6 % *Carex brevicolis*, *Carex pilosa*; 3-7 % *Melica uniflora*; 4-7 % *Dactylis glomerata*, *Euphorbia amygdaloides*;

4-9 % - 4-8 % *Ficaria verna*; 4-9 % *Glechoma hirsuta*, *Viola hirta*; 5-8 % *Bromopsis benekenii*, *Galeobdolon luteum*; 5-9 % of *Aegopodium podagraria*, *Anemonoides ranunculoides*, *Corydalis solida*; 6-9 % *Asarum europaeum*, *Lamium maculatum*, *Scilla bifolia*, *Viola odorata*;

4-10 % *Gagea lutea*, *Stellaria holostea*

7-10 % *Pulmonaria officinalis*;

It is important to note for the species of vegetation in all forest types, a direct dependence on the soil reserves in the respective periods: a higher accumulation of **K** in March, the increase in the number of species and the organic mass in April.

CONCLUSIONS

1. Changes in the mobile **P** and exchangeable **K** values in soil are primarily due to pedogenetic processes. The soils of the common oak with hornbeam forest and durmast oak with linden and ash forest are characterized by a mobile **P** content from moderate to very high with accumulations in the humiferous layer. The brown sandy loam soil over clay-sand of beech with durmast oak forest achieves the lowest values, within the limits of 0.2-1.9 mg/100 g, evenly distributed in depth. The seasonal changes of the mobile **P** are evident for all soil types, largely as a result of plant growth, development and their reflux.
2. Spatial variations of phosphorus in brown clay soils over deeply gleyed clay are less pronounced compared to other soils. The largest cumulative variations (vertically and horizontally) are found for brown sandy loam soil over clay-sand of beech with durmast oak forest.
3. Most plants accumulate **P** in the early stages of vegetation. Species with low phosphorus (≤ 1 % *Bromopsis benekenii*, *Dactylis glomerata*, *Galeobdolon luteum*) and more than 4 % (*Corydalis solida*, *Dentaria bulbifera*, *Polygonatum latifolium*, *Scilla bifolia* and others) have been identified. **P** content in species *Corydalis solida*, *Dentaria bulbifera*, *Polygonatum latifolium*, *Scilla bifolia* and others varies insignificantly during vegetation.
4. Exchangeable potassium values vary according to soil type, vegetation type and depth (*max* in the forest soil **A** and *min* – in **B**), being characterized by a large range of values in fertile layers 0-10 cm and 10-20 cm, and dependence on the vegetation period (spring and autumn have lower values).
5. Variations of **K** in the 0-20 cm layers are smaller compared to adjacent ones; values of coefficient of variation by depth (0-60 cm layer) are high in common oak with hornbeam forest (27.8 % - 45.8 %) and durmast oak with linden and ash forest (38.5 % - 59.3 %), small and medium (14.9 % - 23.2 %) in the beech with durmast oak forest. Spatial variations of **K** according to the type of forest are high for all layers, with decrease in the summer period.
6. Species with **K** values were found within 3-10 %, species with narrow and wider boundaries. The first, starting with 6 %, do not exceed 2 units, are more sensitive to edaphotopic conditions. Species with a broader spectrum (between 3-4 units) can be better accommodated to the substrate.

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HIGHLIGHTING THE STRUCTURE OF DOWNY OAK STANDS (*QUERCUS PUBESCENS* WILLD.) ACCORDING TO THE HEIGHT OF THE TREES

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Abstract. The structure of downy oak forests (*Quercus pubescens* Willd.) according to tree height has been highlighted in this article. The structure of forest stands in relation to the total height of the trees is described by the specific distribution with asymmetry to the right, which has ecological explanation and indicates that trees, competing for light, tend to grow taller, but thinner. We have concluded that downy oak stands are characterized by relative ecological stability, suggesting that a state of normality could be reached as a result of applying appropriate silvicultural interventions.

Keywords: *Quercus pubescens*, stands, height, theoretical distribution, experimental distribution.

INTRODUCTION

The structure of the stands involves both the constituent elements and the connections, the spatial and temporal relationships between the component elements, which determines how the forest is organized. The structure expresses that system of interactions between elements that, although subject to change, provide the whole consistency and a certain ability to function. The forest is characterized by a complex and diversified structure of the species of trees and shrubs, but it also involves the numerical and spatial relations between them. Therefore, the unity between their element their links is the functional structure of a tree that can be modified in order to optimize it as an ecological system [8].

In order to highlight and know the structure of the stands in the specialty literature, scientific methodologies have been described which, given the biometric processing of primary materials, offer the possibility of interpreting the results based on the knowledge of the theory of probability theory. The approaches suggested that as a result of the use of mathematical statistics methods, the main dendrometric characteristics of the trees in a population sample can be highlighted and described the correlations between the values of the analyzed indices are established [4].

MATERIAL AND METHODS

The selection of valuable stands of downy oak (*Quercus pubescens* Willd.) on the field was made on the basis of the preliminary analysis of the materials of the forestry arrangement, whose forests are located in the south of the Republic of Moldova. Therefore, in the office were selected a row of stands that were characterized by the third and higher production class. Subsequently, measurements were performed on the field to check the dendrometric indices of the trees in order to establish the actual match of the production class with that indicated in the arrangements. As a result, six reached the age of exploitability age forests were select, such as those grown on the Nisporeni, Zloti, Carpineni, Talmaz, Baius and Baimaclia forests district. Representative areas of the oaks were placed in experimental areas the stands were described according to the method developed by Gh. Postolache [7].

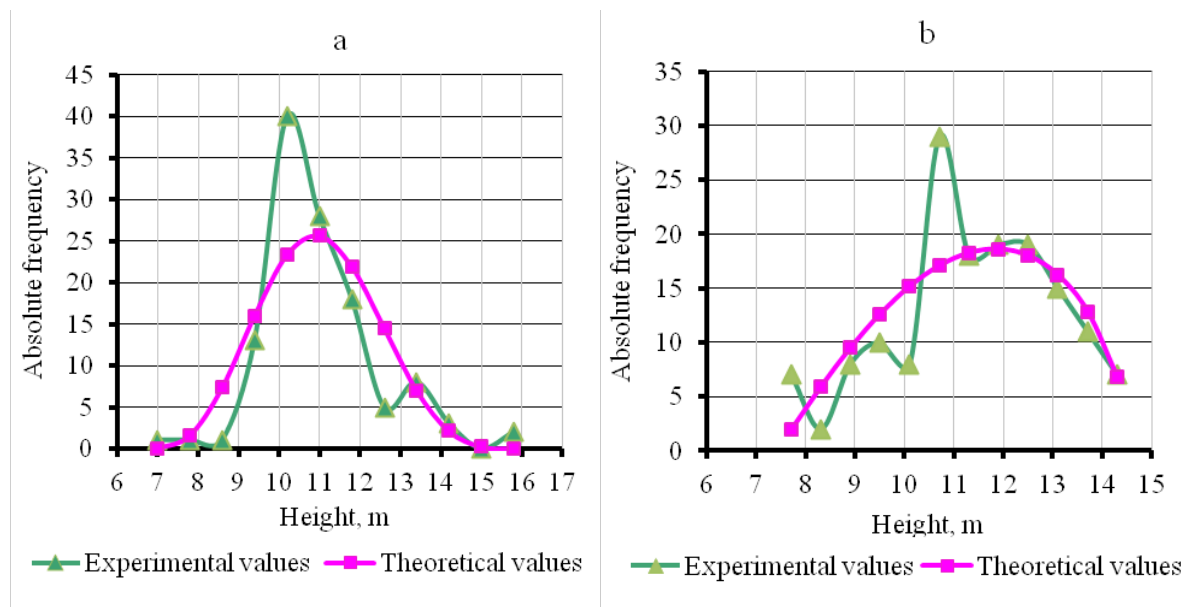
The processing of primary data from the 6 experimental surfaces was as follows. The values of the variational (numerical) strings of the total tree height were grouped into classes. In grouping the initial data into classes for us it was important to correctly set the number of classes to be formed. The correct training of the number of classes depends on the precision of the initial data processing and the subsequent accurate

interpretation of the results. The number of classes is found in relation to the number of observations and this correspondence is shown in the mathematical statistics manuals [4, 10].

In order to highlight the structure of the downy oak stands according to the height of the trees, the Beta distribution function was used, which was applied to the description and interpretation of the frequencies of a string of dendrometric characters of wood species proved to be relevant and true [4]. Initially, the absolute frequencies of the experimental distribution of the tree height were calculated. To this purpose, for all experimental surfaces, class interval indices were calculated and the initial data of the investigated character was grouped into classes. Next, within the limits of each class, the numerical values of the data were calculated so that absolute frequencies were obtained. The calculation of the theoretical frequencies of tree height of the experimental surfaces was based on the Beta distribution function, which was presented in a previous paper [3]. The comparison of the experimental distributions of the theoretical ones of the total height of the trees was made on the basis of conformity tests χ^2 and Kolmagorov-Smirnov [10].

RESULTS AND DISCUSSIONS

In our researches the tree structure was emphasized by establishing the distribution of the number of trees by height categories for the studied stands as a result of the total inventory of downy oak trees from the experimental surfaces and the processing of accumulated data. From the analysis of the experimental and theoretical frequency curves referring to the distribution of the trees according to the total height, presented on the graphs of figure 1, it is observed that regardless of the experimental area from which the data were taken, the highest frequency is the trees that are remarking through medium heights. In fact, under the conditions of intrapopulation competition at the level of the crowns and root systems, downy oak stands become more heterogeneous in terms of combining trees of different sizes.



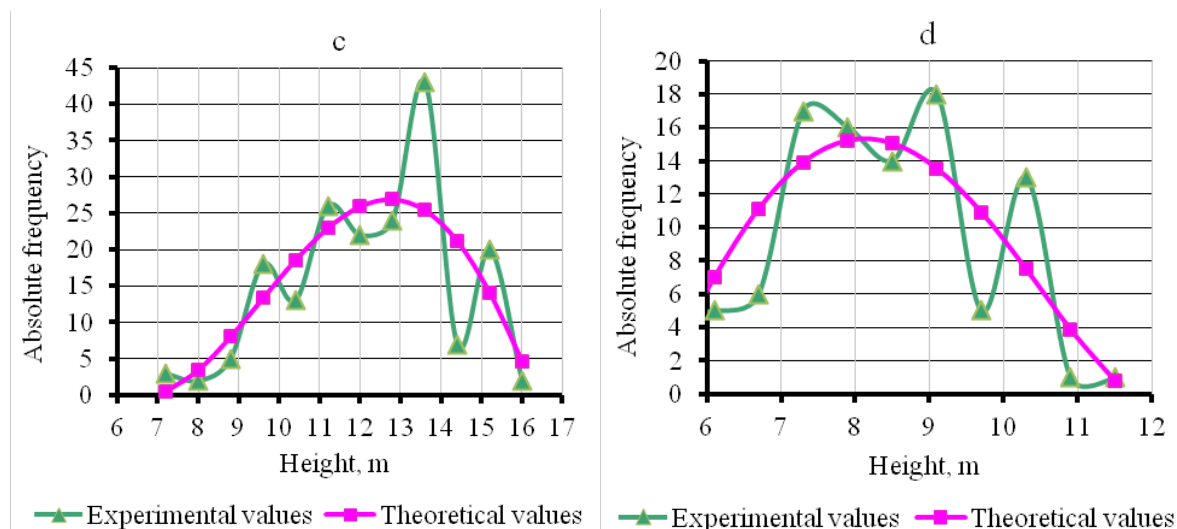
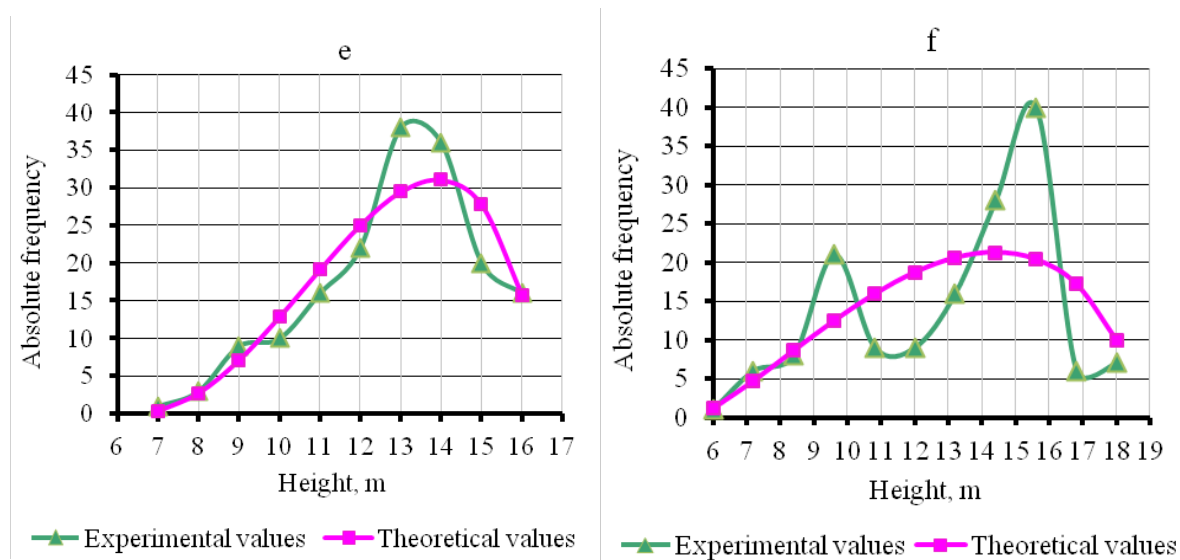


Figure 1. Comparison of the experimental distribution of the number of downy oak trees by height



classes and the distribution of theoretical distribution β in 6 experimental areas, such as: a – Nisporeni; b – Carpineni; c – Zloti; d – Talmază; e – Baius; f – Baimaclia

There is a higher oak agglomeration of the upper floor, due to the competition of specimens for light at the crown. In ruthless competition the trees strive to occupy the most favorable spaces to the light, accelerating their growth of height at the expense of increasing from diameter, which contributes to the fact that in such a tree there are more thin oaks than thick oaks, but higher. In these conditions starting from the competition

of light trees at the level of the crowns, the lengthening of the branch of the left side of the frequency curve has ecological explanations. This phenomenon is evident in the structure of the stands located in the Carpineni, Zloti, Baius and Baimaclia forest stands, which is explained by the fact that the theoretical and experimental distributions of the number of trees by height categories for these surfaces recorded a negative asymmetry on the right, characteristic of natural tree structures (see Figure 1 and Table 1).

Table 1. The main statistical and mathematical indices of the experimental distribution of the number of trees by height categories

Statistics indices	The experimental surface					
	Nisporeni	Carpineni	Zloti	Talmazza	Baius	Baimaclia
Minimum, m	7,0	7,7	7,2	5,5	7,0	6,0
Maximum, m	15,8	14,3	16,0	11,5	16,0	18,0
Amplitude, m	8,8	6,6	8,8	6,0	9,0	12,0
Media, m	11,0	11,4	12,3	8,3	12,9	13,2
Variance, m ²	1,95	2,71	3,71	1,86	3,97	8,54
Standard deviation	1,40	1,65	1,93	1,36	1,99	2,92
The coefficient of variability, %	12,7	14,5	15,7	16,5	15,5	22,2
Average standard deviation, m	0,13	0,13	0,14	0,14	0,15	0,24
Asymmetry coefficient, A	0,89	– 0,31	– 0,36	– 0,07	– 0,56	– 0,51
Excess coefficient, E	1,73	– 0,45	– 0,45	– 0,58	– 0,17	– 0,84

The asymmetric coefficients indicated values ranging from $A = -0,07$, as recorded in the experimental surface Talmazza, to $A = -0,56$, in the surface of Baius. We believe that the height structure of the stands is dictated by the competition processes that flow between downy oak specimens for crown light, water, and soil nutrients. At the same time, considering that some of the studied stands are part of the category of state-protected natural areas (from the Carpineni, Baius, Baimaclia forest areas) and have not been subjected for many years to the silvicultural interventions in the care cuts, they have formed structures is characterized by distributions close to natural ones.

It is necessary to mention that the experimental distribution curve of the number of trees by height category of the experimental surface Nisporeni is characterized by positive left, asymmetry ($A = 0,89$) and the excess curve coefficient is leptokurtic ($E = 1,73$) (Table 1). We believe that such a distribution of the specimens in the studied tree is due to the execution of the care and hygiene cuts, which have reduced the number of trees in the upper ceiling or competition between the specimens for light. This shows the lower coefficient of height variability in the analyzed tree ($C = 12,7\%$) compared to the other stands, which is the result of the selective extraction of specimens in the upper ceiling as a result of top cutting and cutting of hygiene (a string of crows was dispersed on the soil of the stands, which proves the application of cuttings in the past). It turns out that the structure of the respective stand in relation to the height was changed into the desired direction of the forester.

In the context of what has been discussed, it is known that in a natural equine or relative equine tree, a continuous process of passing trees from a lower, or higher, cenotic class into another proxima occurs, in relation to age. [5] In general, there is a shift from upper to lower, creating conditions for the natural selection process that manifests itself with a high intensity in the lower cenotic classes [6].

When selective upsets is execute from above, conditions are create for some trees of medium-sized cenotics to gradually pass to higher positional classes, which leads to unequal participation of trees in the growth of tree growth. Hence the need to know the combination of trees of different sizes of the tree structure. The dimensional shift in the trees occurs both because of the differences between the individual genetic potential and the action of the environment (air and soil). The structural differentiation in the stands is therefore a consequence of

the integrity state and ultimately leads to the natural elimination of the trees, respecting the self-regulation characteristic of the biological systems and the principle of optimization [9].

A certain scientific interest is the characterization of the variability of tree height of local (statistical) populations of downy oak. From the data included in Table 1 it appears that in the spreading territory of the forest periphery and in the South Plain the height of the trees in the populations had the variability limit of 6 to 18 meters. The lowest average height of 8,3 m was reported in the Talmazza population, the largest were characteristic for Baimaclia population ($\bar{x} = 13,2$ m). The comparison of downy oak populations, according to the height index, highlighted the fact that the youngest, crooked and diseased trees were identified within the experimental surface Talmazza. The best preserved stands with the slightest and highest specimens are those from the population samples Baius and Baimaclia. Given the high phenotypic value of the trees in the populations of investigation, they must be proposed as a tree-seed source.

Comparative population surveys by the level of variability of metric indices provide a low degree of scientific information [12, 13]. Therefore, as a measure of variability within the population, the variability coefficient index, which presents itself as an integrative indicator for comparing the different characters, was used. Table 1 presents the values of the tree height variability coefficients. It is observed that the researched populations are close to each other according to the level of individual variability. According to the scale of the variability level, developed by C. A. Mamaev [13], the degree of variability is estimated to be average ($C = 12,7-16,5\%$) for the majority of the investigated populations. Only the population of Baimaclia is distinguished, which is characterized by a high degree of variability of the total height of the trees ($C = 22,2\%$).

In accordance with the scientific results of V. B. Lukyanets [11], who, investigating a range of natural populations of pedunculate oak in Russia, determined that in oaks differing in origin and age classes the height of trees had amplitude of reduced variability. Considering what has been said and the results obtained by us, we conclude that with the populations of different species of oak, which grow in particular geographic regions under the edapho-climatic aspect, there are different tendencies in terms of the individual variability of the total tree height.

It is important to know if the experimental distribution of trees by height classes follows the law of the Beta theoretical distribution and if this function can express itself quite well, according to the specificity of the object under investigation, through an asymmetric frequency curve. The data presented in Table 2 shows that the modeling of the experimental distributions of the number of trees by height categories, based on the data of the six experimental surfaces, has a good adjustment to the Beta theoretical distribution function.

Table 2. Conformity tests of the distribution of the experimental values of the number of trees by the height classes with the theoretical ones of type β

The experimental surface	Statistical test							
	Absolute deviation		Absolute weighted deviation		χ^2		Kolmogorov -Smirnov	
	The experimental value	Theoretical value (p = 5%)	The experimental value	Theoretical value (p = 5%)	The experimental value	Theoretical value (p = 5%)	The experimental value	Theoretical value (p = 5%)
Nisporeni	47,573	***	6,504	***	3,718	18,307	0,083	0,376
Carpineni	37,059	***	3,056	***	1,633	18,307	0,033	0,376
Zloti	67,367	***	6,973	***	3,539	18,307	0,059	0,376
Talmazza	33,898	***	3,216	***	1,418	16,919	0,030	0,390
Baius	33,418	***	4,742	***	1,102	15,507	0,044	0,405
Baimaclia	72,271	***	8,398	***	5,310	16,919	0,093	0,390

A good adjustment of the experimental frequencies of the theoretical function used is demonstrated by the application of two statistical tests, such as: χ^2 and Kolmogorov-Smirnov, which showed that for all the analyzed stands the experimental value is less than the theoretical value.

Finally, it is necessary to note that the downy oak forests have been managed by the use of cutting cuts and regeneration of the stands was left from the shoots of the crows, which led to their structural and functional degradation. In view of the precarious state of downy oak forests, it is now necessary to establish optimal patterns of tree structure that would meet the conditions and meet socio-economic, environmental and other societal objectives. In this context, practically, modern technologies related to the natural regeneration of downy oak forests should be developed and exploited, considering that the species is heliophyte so that the seedlings significantly reduced their height increase as a result of their shading by the mature tree [2]. The creation of downy oak forest crops must be done with great discernment, especially in the context of the association with downy oak with rapidly growing species (downy oak being a slowly growing species in youth). It is important to note in the context of the topics discussed that the regeneration and installation of downy oak forest crops should take into account the genetic-population structure of the species and are oriented towards the rational use of forest reproductive materials by using strictly proven forestry in the forestry culture local. Such an approach to the problem will allow to model optimal structures of perspective stands, oriented towards ecological stability and maximum functional efficiency of downy oak forests.

CONCLUSIONS

1. Structure of downy oak populations after tree height is described by right-angled frequency curves, which indicates that in competition for light trees tends to grow more strongly in height than in diameter. Although downy oak stands are characterized by relative ecological stability, they may reach a normal state following the application of appropriate silvicultural interventions.
2. The total height of the trees in downy oak populations are characterized by an average degree of variability ($C = 12,7-16,5\%$). The results obtained but also the previous ones regarding the tree trunk variability in the populations [1, 3], which correlate with the climatic conditions of the resorts [1], show that the dendrometric dimensions of the trees change depending on the specific bioreceptivity offered to the populations by the conditions resort environment.

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MORPHOLOGICAL CHARACTERS OF THE SPECIES OF THE GENUS *OCIMUM* L.

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Abstract: The parameters of the morphological characters of the vegetative and generative organs of the species *Ocimum gratissimum* L., *Ocimum canum* Sims., *Ocimum basilicum* L. of the genus *Ocimum* L. and of the main varieties of *O. basilicum* L., from the collection of aromatic and spice plants of the Botanical Garden, have been established. The comparative-morphological analysis of the studied species and varieties allowed determining the main morphological differences between them and establishing the concrete characters for their identification.

INTRODUCTION

The cultivation of the new aromatic plant species requires the study of their biological peculiarities. The morphological characters of the introduced plants allow highlighting and appreciating their reactions of adaptation and their possibilities of acclimatization. It is known that as a result of the changes in the climatic-pedological conditions, the growth and development rate of some species also changes, while others are more conservative. Some researchers have determined that the height, size and shape of leaves, inflorescences and the phytomass productivity of introduced species increase under the influence of the cultivation conditions [2]. Data on the morphology of organs of the plants grown in different climatic regions reveal the possibilities of intraspecific variability and species lability.

Currently, in the Collection of Medicinal, Aromatic and Forage Plants of the Botanical Garden, there are 4 species of *Ocimum* L.: *O. basilicum*, *O. gratissimum*, *O. canum*, *O. americanum* and about 20 varieties of *O. basilicum*, 4 of which (*Purpurium*, *Opal mini*, *Frunză verde*, *Crețșor*) are local cultivars [6].

The studied species, *Ocimum gratissimum* (clove basil), *Ocimum canum* (hoary basil) and varieties of *Ocimum basilicum* (great basil), are precious as spice-aromatic and medicinal plants. Their green mass contains many biologically active substances and the volatile oil is a source of eugenol, used in food, pharmaceutical, cosmetic and other industries.

The description of the systematic characters of the species *Ocimum* L. is insufficient and the interspecific differences have not been determined yet. The fragmentary characterization is not sufficient for the identification of the species of *Ocimum* L. and the varieties of *Ocimum basilicum* L., which is also complicated by the use of synonyms. The vague description of morphological characters leads to the difficult determination of species even at the generative stage of development, which creates difficulties during the introduction works. There is some inadequacy in identifying the plants received by Delectus, with the name of the species indicated on the seeds. The interspecific and intraspecific hybridization of species, the high degree of polymorphism, which has increased the variability of the morphological organs of basil, creates impediments in solving problems with systematics and classification of the genus *Ocimum* L.

The identification of morphological characters would ease the systematic determination of newly introduced species and varieties of *Ocimum* L., would simplify the practical work with the available material in the collection and would allow the determination of hybrids and new varieties obtained by direct or free hybridization between the varieties used as starting material and the morphological parameters of which are known.

MATERIALS AND METHODS

The following species: *Ocimum gratissimum* L., *Ocimum canum* Sims. and the varieties of *Ocimum basilicum* L.: var. *difforme* (Frunză verde, Crețîșor), *Ocimum basilicum* var. *purpurescens* (Purpuriu and Opal mini), *Ocimum basilicum* var. *minimum* and *Ocimum basilicum* var. *chamaeleonicum* served as research subjects. The experiments were carried out in the greenhouse of the collection of medicinal and aromatic plants in 2015.

The plants were grown from seedlings, the seeds of the varieties of *Ocimum basilicum* L. being obtained in our country and the seeds of *Ocimum gratissimum* L. (Chilia, Odessa Oblast, Ukraine) and *Ocimum canum* Sims. (Helsinki, Finland) obtained by seed exchange. Ten plants of each studied species and variety were planted and they were subjected to morphometric measurements in the flowering stage of lateral shoots. We measured the height and the diameter of the plants, the length and the width of the leaf blade (the first pair of leaves below the central inflorescence on the main stem), the length of the petiole and the length of the inflorescence (Table 1). While studying the morphological characters of *O. basilicum* L. and their variability, the methods of Borodkin A., Ghirenko M. and Ivanova K. were taken into account [1, 4, 5]. The terminology proposed in the atlases of descriptive morphology was used when describing the morphological characters of the plants [7, 8, 9, 10].

The following parameters of the flowers of the species of the genus *Ocimum* L. were studied: the length and width of the lower and upper lips (labia) of the calyx and corolla. The carpological description of the nutlets was done according to the proposals of Ivanova I. and Dudik N. [3]. The morphological analysis of the freshly harvested seeds, which went through the complete cycle of development, took place according to the following indices: length, width, thickness of a seed and the mass of 1000 seeds. For the description of the inflorescences of the species *O. basilicum* L., *O. gratissimum* L. and *O. canum* Sims., we used the principles and the terminology of the universal scheme of the structure of floral stalks from the atlas of descriptive morphology of higher plants [9].

RESULTS AND DISCUSSIONS

For the varieties of *O. basilicum* L. the following characters and parameters were identified:

O. basilicum var. *minimum* Mansf. is characterized by height and diameter of bushes up to 30 and 25 cm, respectively, the lateral shoots forming an angle of less than 30° with the main shoot, strongly branched (40-60



Figure 1. *O. basilicum* var. *minimum* Mansf.



Figure 2. *O. basilicum* var. *chamaeleonicum* Alef

shoots), with ordinary shoots. Small leaves, 3.0 cm long and 1.4 cm wide, bright green, elliptical, with short petiole – 0.70 cm, with smooth surface and margin and lateral shoots, the length of an inflorescence is 8.0 cm, the length and the width of the upper lip of the calyx – 0.40 and 0.40 cm, the length and the width of the lower lip of the corolla – 0.56 and 0.45 cm, respectively. Anthocyanin pigmentation is missing. White flowers (Fig.1).

O. basilicum var. *chamaeleonicum* Alef. – dwarf plants (20-30 cm), compact, strongly branched, with short shoots. The leaves are very small (1.0-1.5 x 0.5-1.0 cm), ovate, short petiolate, with smooth surface, with entire or sparsely toothed margin, green or with anthocyanin pigmentation. The flowers are white or light violet (Fig.2).

O. basilicum var. *difforme* Benth. is a group of medium-sized plants with glabrous and dense shoots. The leaves are large or medium, broad-ovate, convex or blistered-undulate, with entire or lobed-toothed margin, the length and the width of the leaf blade is up to 7.0 and 5.5 cm, respectively, the petiole is 1.5-2.0 cm long. There are 4 thyrses on the main shoot, the calyx is often pubescent, the length of the upper lip of the calyx – 0.70 cm, the length of the lower lip of the calyx is also 0.70 cm, the length and the width of the upper lip of the corolla – 0.80 and 0.70 cm, the length and the width of the lower lip of the corolla – 0.70 and 0.30 cm. Anthocyanin pigmentation is missing.

Representatives: the variety *Frunză verde*, characterized by tall stem (77-79 cm), with up to 10 glabrous



Figure 3. *O. basilicum* var. *difforme* cv. Crețșor



Figure 4. *O. basilicum* var. *difforme* cv. Frunză verde

shoots. The leaves are green, ovate, large, blistered and convex, with a slightly toothed margin. The inflorescence is long (22.3 cm), with white flowers (Fig.4). The variety *Crețșor* is a large round bush (67-70 cm) with up to 10 leafy ramifications. The large, green-yellow leaves with short petioles are embossed, with lobed-toothed margin. The inflorescence (18.6 cm), with white flowers, has short internodes (Fig.3).

O. basilicum var. *purpurescens* Benth is characterised by the height and diameter of the plant of 55-60 cm and 30-35 cm, respectively, and erect, glabrous shoots. The leaves are large, broad-ovate, with toothed margin, smooth or slightly blistered, dark violet or reddish-violet, or green with violet tint on the abaxial surface and violet on the adaxial surface, the petiole is 1.5-2.5 cm long. The inflorescences are 15-20 cm long, dark violet, by 4-5 on the main shoot, the corolla is violet or lilac. The length of the upper lip of the calyx is 0.55-0.65 cm, the length of the lower lip of the calyx – up to 0.70 cm, the length of the upper lip of the corolla is up to 0.80 cm and the length and width of the lower lip of the corolla – up to 0.90 and 0.30 cm.



Figure 5. *O. basilicum* var. *purpurescens* cv. *Purpuriu*



Figure 6. *O. basilicum* var. *purpurescens* cv. *Opal-mini*

Representatives: the variety *Purpuriu* has medium stem (56-58 cm), glabrous, with fewer shoots (14-18). The leaves are medium-sized (4.5 x 2.5 cm), reddish-violet, smooth and with prominently toothed margin. The inflorescences are long (19.5 cm), dark violet, have pink-lilac flowers (Fig.5). The variety *Opal mini* (fig. 16) has pleasant clove-like smell, the bush is medium-sized (53-55 cm), spherical, compact, with anthocyanin pigmentation on the whole surface. The leaves are small, elliptical (3.5 x 1.5 cm), violet-green, have a slightly toothed edge and are numerous on the plant. The inflorescence is of medium length (14.2 cm), with short internodes, has pink flowers. It has a decorative look (Fig.6).

For other species of the genus *Ocimum* L., the following parameters were identified.

Ocimum canum Sims. – the height and the width of the plant reach up to 60 and 55 cm, the length and the width of the leaf – up to 7 and 5 cm, the length of the petiole – up to 1.5 cm. The number of inflorescences on the main and the lateral shoots – up to 3 and 50. The length of the inflorescence – up to 18.5 cm, the length and the width of the upper lip of the calyx – 0.55 and 0.30 cm, the length of the lower lip of the calyx – 0.60 cm, the width of the upper lip of the corolla – 0.50 cm, the width of the lower lip of the corolla – 0.20 cm (Fig.7).

Ocimum gratissimum L. – the height and the width of the plant reach up to 90 and 60 cm, the length and the width of the leaf – up to 12 and 6 cm, the petiole – up to 3 cm long, the number of inflorescences on the main and the lateral shoots – up to 6 and 40, the width of the upper lip of the calyx – 0.2 cm, the length and the width of the upper lip of the corolla – 0.2 and 0.5 cm, the width of the lower lip of the corolla – 0.25 cm (Fig.8).

The comparative morphological analysis of species of the genus *Ocimum* L. has been carried out and the concrete characters for their identification have been established. Thus, among the varieties of *O. basilicum* L., var. *difforme* and especially var. *minimum* and var. *chamaeleonicum* differ substantially from var. *purpurescens* in the studied parameters. At the interspecific comparison of organ parameters, the species *Ocimum gratissimum* L. differs most from *O. basilicum* L.

The main characters that distinguish *O. canum* Sims. and *O. gratissimum* L. from *O. basilicum* L. are: the size of the plant, the shape, the lack or the presence of the slight anthocyanic colouring of the leaf margin; the increased pubescence of plant organs as compared with *O. basilicum* L., the toothed leaf margin (*O. canum* Sims. and *O. gratissimum* L.); in *O. basilicum* L., the more or less toothed leaf margin is characteristic of var. *purpurescens*, the veins of the leaf immersed in the mesophyll (*O. canum* Sims. and *O. gratissimum* L.), small flowers, longer pedicels, closed calyx after flowering of *O. gratissimum* L. The plants of *O. basilicum* subsp. *basilicum* L., except var. *minimum* and var. *chamaeleonicum* are of medium height or tall. The small plants,

O. basilicum var. *minimum*, var. *chamaeleonicum*, *O. canum* Sims., and the tall plants, *O. gratissimum* L., are characterized by spreading shoots, at an angle of 45-60°.

The parameters of the leaf blade of the studied species of *Ocimum* L. vary depending on their position: the largest of them are located in the middle part, more rarely – in the upper part. *O. basilicum* L., *O. canum* Sims. and *O. gratissimum* L. are characterized by large or medium leaf blade, and the varieties *minimum* and *chamaeleonicum* – by small leaf blade.

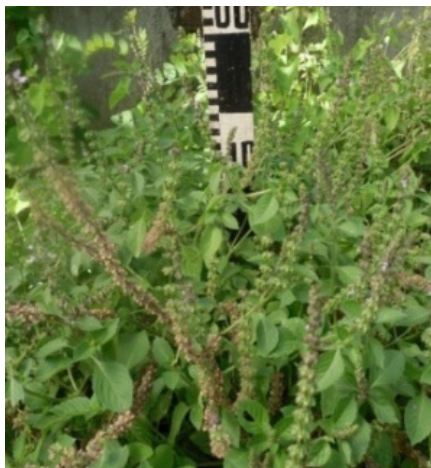


Figure 7. *Ocimum canum* Sims.



Figure 8. *Ocimum gratissimum* L.

The inflorescence of *O. basilicum* L., *O. gratissimum* L. and *O. canum* Sims. is a simple dichasium or composed of spiciform monothyrse. The thyrses are formed of two pairs of cymoids, opposite on the floral axis. In cymoids, the central flower blooms first, then the lateral ones. The peculiarities of the inflorescences of the species of *Ocimum* L. are the cause of the prolonged flowering and the uneven seed maturation. The knowledge of the process of formation of inflorescences in the studied species makes it possible to follow the dynamics of seed maturation in thyrses and to collect qualitative seeds under the conditions of their incomplete ripening under the action of the early autumn frosts.

According to the parameters of flowers, *O. canum* Sims. occupies an intermediate position between *O. basilicum* L. and *O. gratissimum* L., which is considerably inferior in size. The flowers of the varieties of *O. basilicum* L. have monotypic character, their parameters, except var. *minimum* and var. *chamaeleonicum*, do not differ significantly. All three species are the most similar in the width of the lower lip of the corolla, whereas the width of the upper lip of the calyx can be considered as an interspecific diagnostic character.

The fruits of the studied species – nutlets – are inferior to the species *O. basilicum* L. in most parameters. Among the varieties of *O. basilicum* L., var. *minimum* and var. *chamaeleonicum* are slightly rounded, small and the mass of 1000 seeds is smaller as compared with other varieties.

CONCLUSIONS

The main characters of the vegetative organs, which distinguish *O. canum* Sims. and *O. gratissimum* L. from *O. basilicum* L. are: size, pigmentation, pubescence and shape of the leaf blade.

In comparison with other species of the genus *Ocimum* L., the plants of *O. basilicum* L. are characterized by the polymorphism of the organs by parameters, pigmentation and shape, size and surface of the leaf blade.

The inflorescence of *O. basilicum* L., *O. gratissimum* L. and *O. canum* Sims. is a simple dichasium or

composed of spiciform monothyrse. They differ in the parameters of flowers, the length of pedicels and the type of calyx. The flower of the varieties of *O. basilicum* L. has monotypic character, the differences between varieties being only in size.

The nutlets of the studied species differ in most parameters from *O. basilicum* L.

The definite differences in the biometric parameters of the flower (length, width of the calyx and corolla) and the nutlet (length, width of the seed), which are individual for each of the three species, can be used as additional diagnostic indices for their identification.

The obtained results will simplify the systematic determination of the species and new introduced varieties of *Ocimum* L. and the practical work with the specimens available in the collection and would allow the identification of new hybrids and varieties obtained by direct or free hybridization between the varieties used as starting material. The visual appreciation of the valuable forms will be confirmed by biometric measurements of their characters, which, as compared with the parameters of the varieties available in the collection, would demonstrate the reasonability of selecting them.

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Tables

Morphometric indices of the characters of the species of the genus *Ocimum* L. Table No. 1

Code character	Variety <i>Ocimum basilicum</i>						O. gratissimum	O. canum
	var. <i>purpurescens</i> Purpuriu	var. <i>purpurescens</i> Opal-mini	var. <i>difforme</i> Frunză verde	var. <i>difforme</i> Crețioșor	var. minimum	var. chamaeleoni- cum		
	Indices of the characters							
A	57,9±1,0	54.5±1,0	78,1±1,1	69,5±2,4	28,6±1,4	26,6±2,6	86,9±5,7	55,9±3,9
B	34,8±0,6	33,5±0,7	47,7±2,1	39,1±4,6	24,1±1,0	27,6±3,1	57,0±7,5	52,4±3,0
C	4,4±0,3	3,4±0,7	5,6±0,2	7,1±1,3	3,0±0,3	1,1±0,2	11,8±1,6	6,9 ±1,3
D	2,3±0,3	1.3±0,3	5,2±0,4	5,7±1,0	1,4±0,2	0,8±0,2	5,5±0,7	4,7±0,6
E	2,4±0,3	1,8±0,3	2,0±0,2	1,7±0,1	0,7±0,2	0,9±0,2	2,9±0,2	1,5±0,4
F	19,5±0,7	14,2±0,9	22,3±1,1	18,6±3,6	8,2±0,8	6,2±0,8	13,9±0,4	18,5±2,7
G	0,57±0,03	0,65±0,02	0,67±0,03	0,68±0,07	0,40±0,01	0, 43±0,03	0,15±0,02	0,55±0,06
H	0,63±0,02	0,61±0,02	0,69±0,02	0,70±0,03	0,40±0,02	0,42±0,02	0,20±0,02	0,31±0,04
I	0,69±0,02	0,74±0,02	0,73±0,02	0,72±0,04	0,36±0,02	0,52±0,02	0,30±0,03	0,60±0,05
J	0,80±0,02	0,77±0,02	0,79±0,02	0,79±0,02	0,56±0,02	0,67±0,02	0,21±0,03	0,50±0,05
K	0,60±0,01	0,52±0,02	0,67±0,02	0,68±0,03	0,45±0,02	0,48±0,02	0,50±0,02	0,50±0,04
L	0,87±0,02	0,85±0,01	0,70±0,02	0,71±0,02	0,37±0,01	0,71±0,02	0,30±0,02	0,70±0,05
M	0,30±0,01	0,23±0,01	0,29±0,01	0,30±0,02	0,27±0,02	0,29±0,01	0,25±0,02	0,20±0,04
N	1,03±0,02	1,01±0,02	0,92±0,02	0,94±0,02	0,85±0,02	0,95±0,01	0,50±0,02	1,02±0,04
O	0,94±0,01	0,93±0,02	0,92±0,02	0,93±0,02	0,90±0,03	0,89±0,02	0,50±0,02	0,65±0,06
P	2,4±0,1	1,9±0,0	2,0±0,0	2,0±0,0	2,0±0,0	2,0±0,0	1,0±0,0	1,9±0,0
Q	1,4±0,0	1,1±0,0	1,2±0,0	1,2±0,0	1,1±0,0	1,1±0,0	1,0±0,0	1,1±0,0
R	1,1±0,0	1,0±0,0	1,1±0,0	1,0±0,0	1,1±0,0	1,0±0,0	0,9±0,0	1,1±0,0

Note: A- height of the bush, cm; B- diameter of the bush, cm; C- length of the leaf, cm; D- width of the leaf, cm; E- length of the petiole, cm; F- length of the inflorescence, cm; G and H- length and width of the upper lip of the calyx, cm; I- length of the lower lip of the calyx, cm; J and K- length and width of the upper lip of the corolla, cm; L and M- length and width of the lower lip of the corolla, cm; N – length of the pistil, cm; O – length of the stamen, cm; P – length of the seed, mm; Q – width of the seed, mm; R – thickness of the seed, mm.

PECULIARITIES OF REPRODUCTION OF THE SPECIES *STRANVAESIA DAVIDIANA* DECNE IN THE REPUBLIC OF MOLDOVA

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Abstract: The peculiarities of growth, development and reproduction of the introduced species *Stranvaesia davidiana* Decne in the Republic of Moldova were described in the present paper. The optimal methods of reproduction of the species were layering and lignified stem cuttings, treated with 0.01% IBA solution, during the 16-hour exposure.

Keywords: *Stranvaesia*, vegetative propagation, 0.01 % IBA solution.

INTRODUCTION

The main strategy of botanists is and will be the intensification and mobilization of new plants from spontaneous and exotic floras. World dendroflora provides us many woody plants of interest for various branches of the national economy. In this context, we consider *Stranvaesia davidiana* a precious and promising shrub for our country. The genus *Stranvaesia* Lindl. belongs to the subfamily *Maloideae*, fam. *Rosaceae*, which includes 5 species of evergreen trees and shrubs, widespread in China and the Himalaya mountains. The common name is *Chinese photinia*. In the native country, it grows well on the slopes and in mountain areas up to the altitude of 2300 m, reaches about 8 m in height. The present species has been grown in ex-USSR since 1917. The shrub was cultivated on the Black Sea coast during the 1929-1930 years. Currently, there are *Stranvaesia davidiana* shrubs in Nikita Botanical Garden, Yalta and in parks of Sochi, Sukhumi, Batumi etc. [1, 3]. In the Republic Moldova, it is grown in the nursery of the Botanical Garden (Institute) of ASM and only by some amateurs [1, 2].

MATERIALS AND METHODS

The plants of *Stranvaesia davidiana* Decne., from which yearly cuttings were collected in two periods: March-April and June-July, served as subjects of study. The semi-lignified cuttings were prepared in June-July, when intensive growth of shoots occurred and they were less lignified. This process also depends, every year, on the climatic conditions, under which the yearly shoots develop. The treated and untreated cuttings were planted in cold greenhouses. The cuttings were treated with 0.01 % solution of KMnO₄ and 0.01 % IBA growth regulator, with the exposure of 16 and 24 hours, according to the methodology [4, 5]. Distilled water served as control. The treated and untreated cuttings were planted in cold frames, using two types of substrates: sand and sand + peat with minimal 24 % artificial fogging. The cuttings developed roots after 30-45 days and grew, under such conditions, until the next year after taking cuttings. The phenological observations of the growing mother-plants of *Stranvaesia davidiana* Decne cuttings were performed according to the methodology [3]. After a year, the cuttings were planted in containers or in open ground.

RESULTS AND DISCUSSIONS

The pedoclimatic conditions of the Republic of Moldova are favourable to the introduction and cultivation of *Stranvaesia davidiana* Decne. and will make an essential contribution to the enrichment of the diversity of valuable and precious plants. In the Botanical Garden (Institute) of ASM, *Stranvaesia davidiana* Decne. has

been cultivated since the spring of 1985. The studied species, under the conditions of the Republic of Moldova, is an evergreen shrub and reaches the height of up to 2(3) m. In the first 4-5 years of development, in cold winters, the young plants froze to the snow level, beginning the new growing season by developing new shoots. On the base of phenological observations, it was found that the young shoots, at the beginning of the growing season are serpent-hairy and later become glabrous. The leaves are glabrous, green, oblong or oblong-lanceolate, acuminate, cuneate, entire on the edges, of 6-11 cm in length. The petiole is of red colour, reaches 2 cm in length. Blooms in May – June. The flowers are white, reach the diameter of 8 mm; the stamens are of red colour, equal in length with the petals. The flowers are grouped in umbeliform cluster inflorescences, of 7-10 cm in width. The fruits ripen at the end of October. The fruit is a pome, of red-dark colour, laevigate, subrounded, of the size of a pea, up to 8 mm in diameter. The shrub grows well in semi-shadow, prefers temperate climate, rich and moist soils. The species possess the “A” grade for decorative qualities, due to the persistent foliage and red fruits, which adorn the plant during the winter. The present species is recommended for parks, gardens and sheltered, semi-shady habitats, in central and southern districts of the Republic of Moldova. The growth of plants during the growing season is approx. 20 cm.

In the dry years, it is necessary to loosen and irrigate the soil. During the summer, it is necessary to add some chernozem at the root and to apply mineral or organic fertilizers. The species is characterized by rapid growth of the cuttings in June-July. At the end of August, the growth rate decreases. The plantlets obtained from germinated seeds have well-developed roots. The seedlings obtained in the first 2-3 years require protection during the winter. The root system of cuttings is less developed than that of the plants obtained by division, because of the roots received by dividing the bushes, which can be 15-20 cm long.

The advantage of the propagation by cuttings is justified by the fact that the obtained plants are healthy and vigorous, because the plants from which cuttings are taken are also healthy and vigorous. The plantlets in cold frames, obtained from lignified cuttings (winter cuttings) and green stem cuttings (summer cuttings), require a well-processed substrate, loose to the depth of 40 cm, with ventilation and abundant humidity. The harvesting of the cuttings was carried out in February and March, until the beginning of the growing season. The cuttings were preserved in sand and sawdust to avoid the danger of the frosts at the soil surface and then were planted in cold frames. When cuttings are put in the substrate, a better adherence of the seedling with the particles of the substrate needs to be realized, that is why, its good preparation and loosening is necessary, with the purpose of avoiding injuries of seedlings. The cuttings are put in the substrate vertically, with the buds upwards and at 1-2 cm below the substrate surface, to avoid the drying of the apex of the cuttings. The harvesting of the branches for cuttings was done from special cultures of mother plants. One-year-old branches were harvested, from which cuttings were taken with a sharp knife. The cuttings must be straight, well formed, having at least two buds, without any mechanical injuries. The length of cuttings must be minimum 15-20 cm and the thickness – 8-20 mm at the upper end.

After that, the cuttings are treated with KMnO_4 solution, then immediately fixed in the sand, in vertical position or slightly inclined, leaving the top end with 1 cm above the sand. Then, they are placed in the greenhouse or in the cold frame, where they are provided with a humid atmosphere, free oxygen access at the bottom of the cuttings and an optimal thermal and light regime. These conditions are achieved thanks to the correct construction of the cold frame, by fixing the cuttings in the sand at a depth of 0.5-1.0 cm, by moderate and gradual watering of the sand and by ensuring a constant temperature of 20-26 °C.

Before cutting the shrubs, the sand is abundantly wetted with boiling water and with solution of KMnO_4 . The optimal distance between rows is 6-10 cm and 4-5 cm between cuttings in a row. Immediately after preparing the cuttings, a fine spraying is applied and the cold frame is covered completely. The cold frames are shaded in such manner that only diffused light gets in (loosely woven mats or wooden sticks, which occupy one third of the frame surface, are used for this purpose). The cuttings are sprinkled two or three times on sunny days and one or two times on cloudy days, in the evening, weeds are plucked and blackened cuttings are removed. The prepared semi-lignified cuttings are usually 12-15 cm long with 2-3 knots. The leaf blade is shortened by 1/3 or

1/2 to reduce transpiration.

A higher percentage of rooting of the cuttings (by 10-12 %) was obtained from those that were treated, during 16 hours, with 0.01 % solution of IBA and thrust in the substratum at the depth of 2-3 cm, in comparison with untreated cuttings. In the first 3-4 weeks, they are watered 2-3 times per day, later once a day and then 1-2 times per week. The rooting percentage of the cuttings varied between 15-25 %. The cuttings were sampled from the sunny side of the plant, i.e. from the middle of the shoots.

The propagation by cutting is due to the phenomenon of polarity of the plant, phenomenon that manifests itself by the development of shoots in the upper part and of the roots in the lower part. The polarity of the plant is generated by nutrients and hormones, which circulate through the bark, from top to bottom, stimulating the place of accumulation, the formation of callus and roots.

The polarity decreases as the plant gets older, that is why, the cuttings are harvested only from young, annual shoots. The rooting capacity of cuttings depends on the biological peculiarities of each studied species, soil conditions and special interventions for the stimulation of cuttings. The success of cutting crops depends on the quantity of nutritive substances, which is contained by them and the conditions provided during their planting – well-prepared, loose, well-aerated soil and sufficient humidity. The roots of the cuttings derive from radicular rudiments, which are groups of meristematic cells, located at the point of contact of medullary rays with the generating cambium.

Radicular rudiments are formed over the axis of the stalk, with bigger concentration at the base of the layer, in the area of axillary buds. After the section done at the bottom by taking the cutting from the harvested shoot, a primarily parenchymal tissue is formed, named callus, playing a healing role for the wounds and which, later, forms a cambium with adventitious buds, from which the roots develop. Until the root formation, the cutting consumes the nutritive substances from its own reserves.

After rooting, the cold frames are open gradually, for the seedlings to get used to the new environment, and then, they are open definitively, watering the cuttings until October. The cuttings that, until October, have formed good roots are removed from the cold frames and are pricked out in the nursery, are watered and are shaded in the hot days. In our conditions, we practiced more often the planting of rooted cuttings of *Stranvaesia davidiana* Decne. in containers. The length of the radicles of the first order, obtained from semi-lignified cuttings, from summer until spring, achieved 2.0-5.0 cm (Fig. 1).



Fig.1. *Stranvaesia davidiana* Decne after vegetative pots



Fig.2. *Stranvaesia davidiana* Decne in the second growing season

As a result of scientific investigations, it has been found that for obtaining a bigger rooting percentage of *Stranvaesia davidiana* Decne. cuttings, it is necessary to select shoots from young plants, initially obtained also by vegetative method. It is very important to take cuttings correctly and to comply strictly with the technology. It was established that the optimal substrate for vegetative propagation of *Stranvaesia davidiana* Decne. species

shall be composed of peat and sand, in the correlation of 1 : 1 (Fig.2). During the process of studying the impact of rhizogenesis stimulators, concerning the rooting of semi-lignified cuttings of the species *Stranvaesia davidiana* Decne., it was found that the 0.01 % IBA stimulator proved to be optimal. It was established that the plantlets obtained from cuttings and from seeds were very sensitive to low temperatures in early spring in the first years of development and they needed to be covered with leaves.

CONCLUSIONS

Stranvaesia davidiana Decne. is propagated generatively and vegetatively, by stem cuttings, by division and by layering.

As a result of the process of propagation by lignified and semi-lignified cuttings, it can be obtained genetically uniform planting material, healthy and vigorous plantlets, which possess the same peculiarities and qualities as the mother plants. The process of rooting of the cuttings depends on several factors – the quality of the cuttings and of the substrate, the growth and development conditions of mother plants and brachiblasts before the cuttings are taken, the compliance with the optimal periods for taking cuttings and with the technology of preparing cuttings, as well as the density of cuttings in the nurseries.

On the base of scientific research, it has been found that for obtaining a bigger percentage of rooting of the cuttings of *Stranvaesia davidiana* Decne., it is necessary to select vigorous shoots from young plants, also obtained by vegetative method. An important role in the process of rhizogenesis consists in the correct sampling of cuttings, the strict compliance with the technology, as well as the observance of the necessary hydro- and thermal regimes. It has also been established that the optimal substrate for vegetative propagation of the species *Stranvaesia davidiana* Decne. shall be composed of peat and sand, in the correlation of 1 : 1.

During the process of studying the impact of rhizogenesis stimulators, concerning the rooting of semi-lignified cuttings of *Stranvaesia davidiana* Decne. species, it was found that the 0.01 % IBA solution proved to be optimal. It has been established that the plantlets obtained from cuttings and from seeds are very sensitive to low temperatures in early spring, so, in the first years of development, they need to be covered with leaves.

The present species, *Stranvaesia davidiana* Decne., is recommended for parks, gardens and sheltered, semi-shady habitats, in central and southern districts of the Republic of Moldova, being decorative all year round.

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CHARACTERISTICS OF GROWTH AND DEVELOPMENT OF *SPARTIUM JUNCEUM* L. IN THE REPUBLIC MOLDOVA

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Abstract: This article describes the characteristics of growth and development of the species *Spartium junceum* L. (weaver's broom, Spanish broom), which can be used in various branches of the national economy. The most effective method of propagation was sowing the seeds, which had been previously treated hydrothermally with hot water of 70 °C for 16 hours and with 0.01% gibberellin solution for 24 hours, in trenches, in spring – in April or May.

Keywords: generative propagation, *Spartium junceum* L.

INTRODUCTION

In relation to climate change, dangerous processes of vegetation degradation and worsening conditions for the development of woody plant species occur, making the continuous mobilization, conservation and rational use of biodiversity more necessary than ever. The *Fabaceae* Lindl. family include trees, shrubs, and subshrubs, perennial and annual grasses. Over 700 genera and 17 000 species, spread almost all over the globe, are part of this family. [4] The genus *Spartium* L. includes only one species. *Spartium junceum* L. (common names: weaver's broom, Spanish broom) was introduced in the Republic of Moldova in 1867 [1, 2]. Blast fibres extracted from this plant may be used as raw material for making thick fabrics and weaving baskets. This ornamental, melliferous shrub has been ranked “A” for its decorative qualities and can be cultivated in central and southern districts of Moldova, but, for unknown reasons, it is not widely used. In the north of the country, this species is affected by low temperatures. It is native to the Canary Islands and the Mediterranean Basin. That is why we decided to study the peculiarities of growth, development and reproduction of this species, in order to use it in various sectors of national economy.

MATERIAL AND METHODS

The 5-6-year-old plants that grew and developed in the collection of the Botanical Garden (Institute) of the ASM, Chisinau, served as research materials.

Phenological observations were carried out according to methodical indications [5], in 2013-2016. The seeds, collected in August and September, were stored differently, cleaned by various methods and treated according to the methodology [3]. Prior to the incorporation in fine loose soil, the seeds were treated with hot water of 70 °C for 30, 60 minutes and 16 hours, until the water chilled, and with 0.01 % and 0.03 % gibberellin solution – for 24 hours. The seeds were sown in two periods, in February-March, in boxes, in greenhouses, in a mixture of soil, sand and peat in a ratio of 2:1:1, and in April-May, depending on climatic conditions. The fruits and seeds collected during the years of research were analyzed, focusing on several morphological parameters, in the Dendrology Laboratory of the Botanical Garden (Institute) of the ASM.

RESULTS AND DISCUSSIONS

Spartium junceum L. is an evergreen shrub, which grows up to 2-3 m tall. Its stems are erect, cylindrical, light green, glabrous and leafless or with few leaves. The leaves are simple, narrow-lanceolate or lanceolate,

glabrous or sparsely hairy, ephemeral, blue-green, 1-2.5 cm long. The growing season started, in 2014-2016, 10-15 days earlier than the multiannual average. The leaves developed in April-May (Tab.1.). The stems remained green throughout the growing season until next spring. In the years of the research, the leaves fell in October.

The flowers are papilionaceous, yellow, fragrant, 2-2.5 cm across, in erect terminal racemes (Fig.1.).



Fig1. *Spartium junceum* L. in bloom



Fig2. *Spartium junceum* L. in the period of ripening

The calyx is bilabiate, the upper labium is double-toothed and the lower – undivided during flowering. The wings are longer than the keel (carina), the keel – acuminate or curved, the stamens – monadelphous, the anthers – hairy, the ovary – sessile, multiovulate, with linear style, slightly curved at the tip, elongated stigma. The fruits mature in August-September (Tab.1).

Table 1. Phenological stages of the species *Spartium junceum* L.

Year	Month														
	April			May			June			August			September		
	10-days period														
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
2013	X	-	-	//	//	//	//	//	//	#	#	#	#		
2014	X	-	-	//	//	//	//	//	//	#	#	#	#		
2015	X	-	-	-	//	//	//	//	//	#	#	#	#		
2016	X	-	-	//	//	//	//	//	//	#	#	#	#		

X - Initiation of vegetation

/// - Flowering

- - Budding

- Fructification

The abundance of flowering and fruiting is in close correlation with the air temperature and the amount of rainfall during the respective stages. The flowers develop on annual shoots. The fruits are polyspermous, linear pods, 4-8(10) cm long and 0.5-0.7 cm wide, at first villous, then glabrescent (Fig.2). Depending on the climatic conditions in the years of research, the percentage of fruiting ranged between 48 and 65 %. The temperature fluctuations had a negative impact on the process of ontomorphogenesis of seeds and only half of them were viable, the rest – sterile. The viable seeds differed from the sterile ones in colour, size and weight (Fig.3.).



Fig.3. *Spartium junceum* L., fruits and seeds

Fig.4. *Spartium junceum* L. after cutting

Spartium junceum L. is an evergreen shrub, very decorative in the flowering stage, with fragrant flowers, which contain essential oil. It flowers and bears fruit from the age of 3-4 years. *Spartium junceum* L. grows fast in the first 3-4 growing seasons and reaches a height of 2 m, is light tolerant, drought resistant, grows on arid soils and develops well on slopes exposed to the sun. In cold winters, a part of the plant may be affected, but it recovers by producing root sprouts. After pruning, the number of shoots increases and the flowering stage starts later than usual (Fig.4).

Hydrothermally treated seeds, sown in February-March in the greenhouse, germinated evenly in 15 days, while those sown in April-May germinated unevenly in 20-25 days. The germination of the seeds, treated with 0.01 % gibberellin solution for 24 hours and sown in trenches, was more even and by 10-15 % higher as compared with the untreated seeds. The 0.01 % gibberellin solution influenced positively the germination capacity of seeds and the germination percentage constituted 85-90 % in the years of research.

Before sowing, the seeds had been soaked in hot water for 16 hours, until the water cooled. Transplanting the 5-7 cm tall seedlings, obtained from the seeds sown in February-March, the expected results were not achieved. The seedlings obtained from seeds treated with hot water for 16 hours had a less developed root system as compared with those obtained from seeds treated with gibberellins. The seedlings obtained from seeds treated with 0.01 % gibberellins solution for 24 hours, sown in trenches, in April-May, reached a height of 30-35 cm, by the end of the growing season, and had a well-developed root system. These seedlings were planted in loose soil. The survival rate of seedlings was about 80-90 %, depending on climatic conditions and compliance with the technology in the years of research. The weight of 1000 fruits was 350-420 g and the weight of 1000 seeds ranged between 14 and 30 g.

Analysing the data from Table 2, we can conclude that the fluctuations in temperature and the amount of rainfall in the years of research, 2013-2014, had a negative impact on the morphological parameters of fruits: the percentage of fruiting, the share of seeds in the mass of fruits, the number of viable seeds in a fruit. The lowest percentage of fruiting was recorded in 2015.

The seeds were sown about 2 cm deep. The norm of pure and fertile seeds was 3-4 g per linear meter. Transplanting can be carried out in the first 2-3 growing seasons because the survival rate decreases by 40-50 % as the plants get older. The well-developed and deep root system hinders transplanting of mature plants in the field.

Table 2. Morphological characteristics of fruits of *Spartium junceum* L.

Morphobiological characteristics	2013	2014	2015	2016
Weight of 1000 fruits, g	350	420	400	380
Weight of 1000 seeds, g	14	30	18	22
Share of seeds in the mass of fruits, %	4,0	7,14	4,5	5,8
Seed diameter, mm	4,0	3,0	4,0	4,0
Number of seeds in a fruit, units	11	15	12	16
Fruiting percentage, %	60	65	48	50
Peduncle length, mm	6,0	8,0	7,0	8,0
Fruit length, mm	75	73	65	81

CONCLUSIONS

1. *Spartium junceum* L. is a heliophile, melliferous species, decorative in the flowering stage. It grows fast and is undemanding to soil, can be transplanted in the first 2-3 growing seasons.
2. The duration of the flowering stage of this shrub, the abundance of flowering and fruiting is in close correlation with the climatic conditions at that time.
3. The optimal method of propagation of *Spartium junceum* L. was sowing in spring, in April or May, seeds that have been previously treated hydrothermally with hot water of 70 °C for 16 hours and with 0.01 % gibberellin solution for 24 hours.
4. *Spartium junceum* L. can be used as an ornamental plant in landscape architecture, planted in groups with other, taller species or along small alleys.

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THEROPHYTES IN THE COLLECTIONS OF ORNAMENTAL PLANTS OF THE BOTANICAL GARDEN

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Abstract: The article elucidates the current state of the collection of the Floriculture Laboratory of the NBG (I). The taxonomic analysis points out the presence of 172 species and 297 cultivars, which are part of 31 families and 116 genera. The annual therophytes prevail; they constitute 96.8 %. Biennial therophytes make up 3.2 %. The inventory of the species planted in urban green spaces was made and new ideas and species were proposed to enrich these assortments.

Key words: therophytes, ex situ collection, ornamental plants.

INTRODUCTION

Annual and biennial ornamental plants are an essential component of rural and urban green spaces. Their decorative qualities and, especially, the long flowering season make them more preferable than perennial plants, which bloom over a shorter period. Botanical Gardens take the responsibility to maintain, conserve the plant world and to make use of its benefits, by managing various collections. Particular attention is devoted to therophytes, creating imposing generic collections. Thus, at the Tsytin Main Botanical Garden of the Academy of Sciences, Moscow, in the 1990s, there was a collection of annual plants, which included about 600 species and varieties [9]. The collection of the M. M. Hryshko National Botanical Garden, Kiev, currently includes 334 species and 505 varieties of therophytes. In the collection of Central Botanical Garden of the National Academy of Sciences of Belarus, Minsk, there are 667 specific taxa [3,12,13].

The collections of flowering plants include typical annual species (*Callistephus chinensis*, *Zinnia elegans*, *Eschscholtzia californiaca* etc.), which in *ex situ* behave in the same way as in natural habitats, and atypical species, which in the wild are perennials (*Begonia semperflorens*, *Verbena hybrida*, *Antherrhinum majus*, *Gaura lindheimeri*, *Petunia sp.*, *Salvia horminum*, *Salvia splendens* etc.), and in *ex situ* conditions are cultivated as annual plants [7].

The life cycle of these representatives of flora lasts one or two years, and they manage to vegetate, bloom and produce fruits during this time. The main method of propagation of annuals and biennials is the generative one. The seeds are gathered annually and stored in dry rooms, at constant temperature (+15-20 °C). Some species are sown directly in soil, but others need pre-cultivation in warm greenhouses. The seeds are sown in January-March. These species originate from various geographical areas. Usually, they are representatives of the South-American, African, Mediterranean or Australian flora: *Salvia splendens*, *Ageratum houstonianum*, *Begonia semperflorens*, *Portulaca grandiflora* etc.

MATERIALS AND METHODS

The studies were conducted in 2015-2017. The collection of annual and biennial flowering plants and landscape arrangements from Chisinau served as research subjects. The names of specific and generic taxa were used in accordance with the modern classifications [11]. The biomorphs were appreciated according to the system of life forms devised by Raunkiaer (1905).

RESULTS AND DISCUSSIONS

In the Botanical Garden (Institute) of Chisinau, there is an impressive collection of therophytes, which

could enrich the range of plants that are grown for decorative purposes in urban green spaces. In this paper, we will come up with new suggestions, species that we recommend for these purposes and which are not currently found in the green spaces of Chisinau.

Currently, the annual and biennial plants constitute 469 intraspecific taxa: 172 species and varieties, 297 cultivars (82 taxa which are currently being tested), which are part of 31 families and 116 genera of the phylum *Magnoliophyta* (tab. 1).

If we analyse the composition of collections in the 80s-90s of the past century, we see that the annuals made up, at that time, 343 species and 386 varieties, belonging to 167 genera and 48 families [5]. It is obvious that, quantitatively, the collection of annuals has halved, numerous varieties of China asters, marigolds, sage, phlox etc. have been lost. Nevertheless, there are still numerous varieties of annual plants.

The vascular flora of our country includes 459 annual and 157 biennial therophytes [2]. In the collections of the Botanical Garden, the native flora constitutes about 15 % of the total number of species. The following species have been attested: *Briza media*, *Campanula persicifolia*, *Cyanus segetum*, *Nigella damascena*, *Oenothera biennis*, *Digitalis lanata* etc.

Representative species: *Asteraceae* (246 taxa); *Cucurbitaceae* (45); *Solanaceae* (32); *Lamiaceae* (16); *Papaveraceae* (16) (fig. 1). The genera with the most numerous taxa in the collection: *Amaranthus* (9), *Callistephus* (90), *Capsicum* (23), *Cucurbita* (35), *Lagenaria* (5), *Ocimum* (10), *Phlox* (4), *Tagetes* (27) etc. The biennials in these collections do not impress with quantity – 15 species and cultivars, or 3.2 % of the total number of therophytes: *Lunaria annua*, *Campanula persicifolia*, *Alcea rosea*, *Ceiranthus cheiri*, *Brassica oleracea* var. *acephala*, *Bellis perennis*, *Viola x wittrockiana*, *Dianthus barbatus* etc. We plan to complete the collection of biennial plants with more valuable varieties.

Some genera constitute separate collections – *Callistephus* and *Tagetes*, which count about 160 species and varieties. The dwarf varieties of China asters are very popular, since they look great in borders, mixed borders, flower gardens etc. The varieties of the groups ‘Princess’, ‘Margarete’, ‘Meister’, ‘Victoria’, ‘Sferoidal’ etc. are used in landscape design, but more often as cut flowers.

The researchers of the Botanical Garden have also used its collections for plant breeding. The richness of the available gene pool has resulted in new varieties that are more resistant to the local conditions and possess very valuable decorative qualities. Thus several *Callistephus* varieties, which are in high demanded today, have been created: ‘Maria Bieșu’, ‘Codreanca’, ‘Piramida Albă’, ‘Piramida Violetă’, ‘Nuvela’ etc. [4]. The varieties have passed the necessary tests and have been patented, being included in the Catalogue of Plant Varieties of Moldova. Currently, there are three other varieties in the Catalogue: ‘Nuvela’, ‘Rozetti’ and ‘Speranța’.

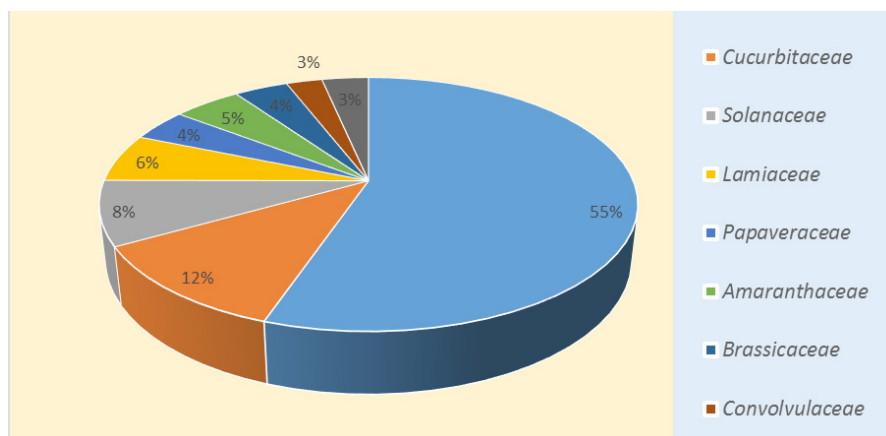


Figure 1. Share of the most representative families.

The flowerbeds in our city consist of annual, biennial or perennial plants, but cultivated under the new conditions as annuals. According to our investigations, in the last three years, the most common annual or biennial species used in landscape design in Chisinau are: *Ageratum houstonianum*, *Anterrhinum majus*, *Begonia semperflorens*, *Celozia argentea*, *Cineraria maritima*, *Irisine lindinei*, *Lobullaria maritima*, *Mirabilis jalapa*, *Petunia hybrida*, *Portulaca grandiflora*, *Salvia splendens*, *Tagetes patula*, *Verbena hybrida* etc. In total, about 30 species and their cultivars have been recorded. Biennial plants, which after flowering have to be removed from flowerbeds, are less common in the urban landscape. We recommend supplementing the available assortments with interesting and lesser known species. Recently, decorations with the use of *Capsicum* varieties, which impress with the multitude of colours, shapes and quantities of fruits, have appeared in street flowerbeds in Western European cities.

Table 1. Taxonomical composition of the collection of therophytes

No.	Families	Genera	Species	Cultivars
	<i>Amaranthaceae</i> Juss.	<i>Amaranthus</i> L. <i>Celosia</i> L. <i>Gomphrena</i> L. <i>Alternanthera</i> Forssk. <i>Irisine</i> P.Browne	12	7
	<i>Asteraceae</i> Bercht. & J.Presl	<i>Ageratum</i> L. <i>Amberboa</i> (Pers) Less. <i>Ammobium</i> R. Br. <i>Anacyclus</i> L. <i>Anthemis</i> L. <i>Arctotis</i> L. <i>Bellis</i> L. <i>Callendula</i> L. <i>Callisthephus</i> Cass. <i>Carthamus</i> L. <i>Cyanus</i> (= <i>Centaurea</i> L.) <i>Chrysanthemum</i> L. <i>Coreopsis</i> L. <i>Cosmos</i> Cav. <i>Crepis</i> L. <i>Dahlia</i> Cav. <i>Dimorphotheca</i> Moench. <i>Emillia</i> Cass. <i>Erigeron</i> L. <i>Gazania</i> Gaertn. <i>Helianthus</i> L. <i>Helichrysum</i> Mill. <i>Helipterum</i> DC. <i>Laya</i> Hook. <i>Lonas</i> Adans. <i>Madia</i> Molina <i>Matricaria</i> L. <i>Sanvitalia</i> Gualt. ex Lam. <i>Senecio</i> L. <i>Tagetes</i> L. <i>Thitonia</i> Desf. <i>Tolpis</i> Adans. <i>Venidium</i> Less. <i>Xeranthemum</i> L. <i>Zinnia</i> L.	52	163

	<i>Balsaminaceae</i> A. Rich.	<i>Impatiens</i> L.	2	6
	<i>Brassicaceae</i> Burnett	<i>Brassica</i> L. <i>Erysimum</i> L. <i>Iberis</i> L. <i>Lobularia</i> Desv. <i>Lunaria</i> L. <i>Matthiola</i> R. Br.	7	8
	<i>Campanulaceae</i> Juss. (<i>Lobelioideae</i>)	<i>Lobelia</i> L. <i>Campanula</i> L.	2	-
	<i>Capparaceae</i> Juss.	<i>Cleome</i> L.	2	2
	<i>Caryophyllaceae</i> Juss.	<i>Dianthus</i> L. <i>Gypsophila</i> L. <i>Vaccaria</i> Medic.	5	1
	<i>Convolvulaceae</i> Juss.	<i>Convolvulus</i> L. <i>Ipomea</i> L. <i>Pharbitis</i> Choisy <i>Quamoclit</i> Mill.	10	-
	<i>Cucurbitaceae</i> Juss.	<i>Cucumis</i> L. <i>Cucurbita</i> L. <i>Ecbalium</i> A. Rich. <i>Lagenaria</i> Ser. <i>Momordica</i> L.	8	37
	<i>Dipsacaceae</i> Juss. (<i>Dipsacoideae</i> Eaton in <i>Caprifoliaceae</i> Juss.)	<i>Scabiosa</i> L.	2	4
	<i>Euphorbiaceae</i> Juss.	<i>Euphorbia</i> L. <i>Ricinus</i> L.	2	2
	<i>Fabaceae</i> Lindl.	<i>Dolichos</i> L. <i>Phaseolus</i> L.	2	3
	<i>Hydrophyllaceae</i> R. Br.	<i>Phacelia</i> Juss.	3	-
	<i>Lamiaceae</i> Martinov	<i>Molucella</i> L. <i>Ocimum</i> L. <i>Perilla</i> L. <i>Salvia</i> L. <i>Thymus</i> L.	9	15
	<i>Linaceae</i> DC. ex Perleb	<i>Linum</i> L.	1	2
	<i>Loasaceae</i> Juss.	<i>Blumenbachia</i> Schrad. (syn. <i>Mentzelia</i> L.)	2	-
	<i>Lythraceae</i> Jaume	<i>Cuphea</i> Adans.	1	
	<i>Malvaceae</i> Juss.	<i>Alcea</i> L. <i>Malope</i> L. <i>Lavatera</i> L.	3	2
	<i>Martyniaceae</i> Horaninow	<i>Martynia</i> L. <i>Proboscidea</i> Schmidel.	2	-
	<i>Nyctaginaceae</i> Juss.	<i>Mirabilis</i> L.	2	4
	<i>Onagraceae</i> Juss.	<i>Clarkia</i> Pursh. <i>Godetia</i> Spach. <i>Oenothera</i> L. <i>Lopezia</i> Cav.	7	5

	<i>Papaveraceae</i> Juss.	<i>Argemone</i> L. <i>Eschscholzia</i> Cham. <i>Glaucium</i> Mill. <i>Papaver</i> L.	7	9
	<i>Poaceae</i> Barnhart	<i>Briza</i> L. <i>Coix</i> L. <i>Lamarckia</i> Moench. <i>Lagurus</i> L. <i>Panicum</i> L.	6	1
	<i>Polemoniaceae</i> Juss.	<i>Phlox</i> L.	1	3
	<i>Portulacaceae</i> Juss.	<i>Portulaca</i> L.	2	-
	<i>Ranunculaceae</i> Juss.	<i>Adonis</i> L. <i>Delphinium</i> L. <i>Nigella</i> L.	8	-
	<i>Rubiaceae</i> Juss.	<i>Asperula</i> L.	1	-
	<i>Scrophulariaceae</i> Juss.	<i>Antirrhinum</i> L. <i>Digitalis</i> L. <i>Linaria</i> L. <i>Nemesia</i> Vent.	5	3
	<i>Solanaceae</i> Juss.	<i>Capsicum</i> L. <i>Datura</i> L. <i>Lycopersicon</i> L. <i>Nicandra</i> Adans. <i>Nicotiana</i> L. <i>Petunia</i> Juss. <i>Salpiglossis</i> Ruiz et Pav. <i>Solanum</i> L.	14	18
	<i>Tropaeolaceae</i> Juss. ex DC.	<i>Tropaeolum</i> L.	1	-
	<i>Verbenaceae</i> J.St.-Hil	<i>Verbena</i> L. <i>Verbesina</i>	2	2
Total	31	116	172	297

We recommend using the cultivars of *Ocimum*, *Capsicum*, the species of *Lagurus*, *Gaura*, *Phlox*, *Dianthus*, *Brassica*, *Amaranthus*, *Panicum* etc. in urban landscaping.

Annuals are appreciated for their richness of colours, the various sizes of plants and their flowers, the diversity of leaves, the shape, which can be compact, erect, repent, twining, scandent etc. Some twining species are amazing and unusual, for example *Proboscidea louisianica*, *Dolichos lablab*, *Quamoclit coccinea*, *Cardiospermum halicacabum*, *Ecballium elateri* etc. Annual plants impress not only through flowers but also through their leaves, which are sometimes even bolder. Thus, the species *Kochia scoparia*, *Iresine lindenii*, *Perilla frutescens* etc. are very attractive especially due to their foliage.

CONCLUSIONS

For the climate and soil conditions of our country, the therophytes grown outside the natural habitat are the most vulnerable. That is why the mobilization of these species requires a thorough analysis for a subsequent successful introduction. Obviously, to comply with the cultivation technologies is vital for these plants.

Currently, the collection of annual and biennial plants of the Floriculture Laboratory of GB (I) includes 172 species and 297 cultivars, belonging to 31 families and 116 genera of the phylum *Magnoliophyta*. Annual therophytes prevail, as they constitute 96.8 %. Biennial therophytes make up only 3.2 %.

In recent years, the gene pool has been completed with valuable species and cultivars that will complement the new assortments proposed for planting in green spaces. The long blooming season makes them the most popular among ornamental plants used in landscape design. Although some species require pre-cultivation in protected areas, their use has increased a lot in recent years.

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ANALYSIS OF THE PHENOLOGICAL SPECTRUM OF REPRESENTATIVES OF *SEDUM L* IN THE GREENHOUSE COLLECTION OF BOTANICAL GARDEN OF MOLDOVA

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Abstract: This article presents and analyzes the observations of the growth and development of the collection plants of the genus *Sedum L*, which were carried out for seven years from 2010 in the greenhouse of the Botanical Garden of the Republic of Moldova.

Key words: growth rhythms, growth forms, phenology, *Sedum*

INTRODUCTION

The introduction of the indoor plants of the genus *Sedum L* in Republic of Moldova started 1968-ies. According to Dvoryaninova, Shestak (1985) in the 70s the famous collection consisted of eight species and grew up to 23 species in mid 80s. Currently, there are 26 taxa in the collection. The collection increased mainly due to the receipt of live material from various botanical gardens of the former USSR. The success of the introduction of plants was generally determined by evaluated their ability to produce flowers and fruits in a new environment. And as fruiting is often linked to specific pollinators of plants, the main criteria is the stable, in other words, regular, at the same time observed, bloom.

MATERIAL AND METHOD

The objects of our study were the species of the genus *Sedum L* available in the greenhouse collections of the Botanical Garden (Institute) of Republic of Moldova. Currently, the genus *Sedum* is represented, in the greenhouse collections, by of 23 species samples and one hybrid. To assess the success of acclimatization, phenological observations were performed on the tested collectible plants for 7 years. The phenological observations technique is used as follows: the generative phase of plant development was observed every 10 days throughout the year: 1st, 10th and 20th of each month. We studied the following steps of generative development phases: the emergence of a visible bud, the growth inflorescences, the development of colored buds, opening of the first flower, mass flowering and end of flowering.

RESULTS AND DISCUSSIONS

The study yielded the following data: From the 24 studied species there are 9 not blooming species: *Sedum amecamecanum*, *Sedum burito*, *Sedum dasyphyllum*, *Sedum dendroideum ssp prealtum*, *Sedum lucidum*, *Sedum monregaliense*, *Sedum rubrotictum*, *Sedum rubrutictum cv. Aurora*, *Sedum stahlii*. Irregular blooming, i.e. plants do not produce flowers every year, was observed at 5 species. At two species single flowering was observed two times during the observation period. This is *Sedum compactum*, *Sedum nussbaumerianum*. Flowering was observed once during the observation period at species *Sedum furfuraceum*, *Sedum moranense ssp grandiflorum*, *Sedum sexangulare*. Regular and sustained flowering (in the same time frame) was observed at 8 species: *Sedum allantoides*, *Sedum chontalense*, *Sedum hulteni*, *Sedum morganianum*, *Sedum multiceps*, *Sedum pachyphyllum*, *Sedum palmeri*, *Sedum macdougalii*.

Table №1

Table №1

[illegible]

[illegible]

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CONCLUSIONS

The studied *Sedum* species showed the most stable and regular flowering (*Sedum allantoides*, *Sedum chontalense*, *Sedum hulteni*, *Sedum morganianum*, *Sedum multiceps*, *Sedum pachyphyllum*, *Sedum palmeri*, *Sedum macdougali*) can be considered the most adapted to the conditions maintained in the greenhouse collection of Botanical Garden of the Republic of Moldova

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NEW VARIETIES OF *CHRYSANTHEMUM INDICUM* L. IN THE COLLECTION OF “ALEXANDRU CIUBOTARU” NATIONAL BOTANICAL GARDEN (INSTITUTE)

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“Alexandru Ciubotaru” National Botanical Garden (Institute), Chişinău 2002, 18 Pădurii str.

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Abstract: This article presents the research on chrysanthemum breeding conducted in the “Alexandru Ciubotaru” National Botanical Garden (Institute), as a result of which, two new varieties of chrysanthemums were obtained, tested and characterized.

Key words: chrysanthemum, breeding, parent group, selection, new varieties.

INTRODUCTION

The chrysanthemums used in ornamental floriculture are varieties of two species: *Chrysanthemum morifolium* Ramat. – florist's daisy, or hardy garden mum, and *Chrysanthemum indicum* L. – Indian chrysanthemum, within the daisy family (*Asteraceae*) [1].

Indian chrysanthemum is one of the oldest flower crops, which not only has not lost its importance in our days, but also takes the second place in the world production of ornamental flowering plants. It is hard to find an ornamental plant so widespread and diversely used. Chrysanthemums, with their delicate foliage and diversity of colours, look perfectly in flowerbeds, mixed flowerbeds, borders, rockeries and alpine gardens. They are grown for cut flowers, in containers, in pots, in the form with tall stem, of bonsai and cascade. A lot of work on introduction, variety testing and breeding of local varieties of chrysanthemums has been carried out in the Botanical Gardens of different countries. The varieties of ornamental plants obtained as a result of breeding have great advantages in terms of decorativeness and their biological and economic features, in comparison with the introduced ones [2]. After centuries of breeding, a huge number of varieties of chrysanthemums have been created and they differ in the shape of the inflorescences, in their colour, in size and number, in the height of the bush and in the time of flowering. However, despite the diversity of modern varieties of chrysanthemums that can satisfy any taste, work on breeding new varieties is still carried out in many countries, since there are no universal varieties suitable for all geographic regions. Any variety is not stable and can significantly change when moved to other geographical and environmental conditions. Varieties that are highly decorative, vigorous, simple to cultivate, with high reproduction rate, resistant to diseases, pests and unfavourable climatic conditions of an area, can be obtained only under the given conditions. Therefore, the work on the creation of new varieties of chrysanthemums must be carried out in this region. The research on the creation of native varieties of chrysanthemums in the Botanical Garden (Institute) of the ASM began in 1959 under the leadership of N.L. Sharova. Since then, the overall environmental conditions have significantly changed and worsened, the arid periods have become longer and the air temperature has increased in the spring-summer months. The anomalous heat in Moldova (in May up to + 30 °C, and in June-July up to 40-45 °C and above), the small amount, and often the absence of rainfall during the vegetative and reproductive phases of development of chrysanthemums could not but affect the state of plants. Many varieties have died and some have simply become unsuitable for these conditions. Given the environmental aspects and due to the changes of trends in floriculture, there is a need to update the collection and to enrich it with new varieties, more decorative and sustainable under the conditions of urbanization. For this reason, the goal of our research was to obtain our own

varieties of chrysanthemums, highly decorative and hardy under the conditions of the Republic of Moldova.

MATERIALS AND METHODS

The research was conducted on the experimental plot of the Floriculture Laboratory and in the greenhouse of “Alexandru Ciubotaru” National Botanical Garden (Institute). The subjects of research were 12 varieties of Indian chrysanthemum, mostly early flowering (Zvezdopad, Vi Vili, Deniz, Meriyed Deo, Zolotoy dozhd, Belaya romashka, Superform, Enset Bella, Alba, Ditya solntsa, Smuglyanka, Măruntăle). The following methods were applied: the method of the State variety testing of agricultural crops (issue 6, the chapter of ornamental crops) (1968) and the methods of Yabrovaya-Kolakovskaya (1972), Dvoryaninova (1982).

RESULTS AND DISCUSSIONS

At present, the collection of chrysanthemums of “Alexandru Ciubotaru” National Botanical Garden (Institute) includes about 100 varieties and 35 selection forms, which are promising for obtaining new native varieties. In our collection, there are varieties flowering at different time – from September to January. The colour of inflorescences is also very diverse – from white to dark burgundy. There are lilac, yellow, pink, orange and greenish inflorescences of various shades, often of different colour on the outer and inner side of flowers. In terms of shape of inflorescences, there are representatives of nine classes, according to the classification developed by the Institute of Horticulture of GDR (Claus, 1960) and supplemented by Dvoryaninova.

Chrysanthemums, like many other ornamental herbaceous plants, reproduce by seeds and vegetatively. The main method of reproduction of chrysanthemums is vegetative, in which all the characteristics of the “mother” plant are inherited by the “child” plant. The reproduction by seeds is used to create new varieties and the main value of this method consists in the possibility to use it for selection. This method has several advantages over the vegetative one. It allows obtaining a large amount of diverse and clean (uninfected) planting material, as vegetative propagation inevitably transmits young plants fungal and viral infections from the infected mother plant. In addition, the plants obtained from seeds are characterized by longevity, have better-developed root system, better tolerate transplantation and are adapted to the climatic conditions of the given area. According to Yabrovaya-Kolakowskaya (1972), chrysanthemum breeding is carried out by artificial hybridization, free cross-pollination and vegetative reproduction of the emerging varieties. According to the data from literature [1, 3, 5, 7 etc.], the most diverse offspring of chrysanthemums is obtained by free cross-pollination. The study of the varieties from the collection of chrysanthemums growing in the open ground showed that the maturation of seeds occurs irregularly, but only in years with warm and long autumn.

Our work on breeding chrysanthemums has been done for two purposes: obtaining early flowering varieties with low, compact, abundantly flowering bushes, for use as living plants in outdoor landscaping and for cultivation in containers, as well as creating varieties to produce cut flowers, with tall bushes that do not collapse under their own weight, on which a large number of highly decorative inflorescences are formed. In our work, we did not apply artificial hybridization, but used free cross-pollination between the plants of the selected parental pairs. By applying the method of free cross-pollination of different groups of parental varieties in 2005-2012, we obtained mature seeds from which subsequently more than 2,000 seedlings were grown, with diverse shapes and colours of the inflorescences, structure of the bush, foliage and other features, which allowed an interesting selection.

In the first year, among the seedlings, the method of individual selection was used and it was based mainly on decorative features. Priority has been given to plants with original colours of inflorescences, compact bushes, abundant and lasting flowering. The final evaluation was carried out in the third year of cultivation.

From the first group of parent varieties – Ditya solntsa, Fuksiya feyri, Belaya romashka, Smuglyanka,

Meriyed deo and Superform – 1024 seedlings were obtained, but only 3 % of the total number of seedlings was selected. The homogeneity of the inflorescence and the daisy-like (simple) type prevailed; most bushes were prone to flattening. However, there were also highly decorative forms, three of which (Olguța, Raza soarelui, Gingășie) successfully passed the State Variety Testing. We used another group of parental varieties – Zvezdopad, Vi Vili, Deniz, Zolotoy dozhd, Superform, Enset Bella. The most diverse offspring has been obtained from the varieties of Zvezdopad and Vi Vili. From these varieties, varicoloured populations have been obtained, and a great diversity has been observed in the inheritance of the characteristics of the mother plant. This refers to the shape, colour and size of the inflorescence, the shape and size of the leaf, the height and habitus of the bush and the timing of flowering. This has led to the conclusion that this group of varieties are suitable for use as parent plants.

The research on the inheritance of characteristics of mother plants in chrysanthemums in the first generation has shown that a certain pattern is traced. Thus, for example, among the offspring of yellow varieties, seedlings with yellow flowers predominate – up to 45 %, pink-lilac – up to 25 % and red (of different shades) – 15 %. The plants with white inflorescences, after free cross-pollination, produce up to 40 % seedlings with white flowers, 20 % yellow and 35 % pink-lilac and a very small percentage of seedlings with red and purple flowers. The most dominant is the pink-lilac coloration, which produces up to 49 % seedlings of the same colour and 20 % of similar colour – purple. Thus, in the offspring obtained from seeds, the type of the mother plant predominates quantitatively.

The varieties of chrysanthemums obtained by us have been cultivated and adapted for several years on the experimental plots of the Floriculture Laboratory of “Alexandru Ciubotaru” National Botanical Garden (Institute). In the process of testing, many specimens died from an unsuccessful wintering or from unfavourable weather in the spring-summer period, or for some other reason. Stationary testing was carried out on a separate plot of the State Variety Testing department. As a result of selection and rejection of seedlings, which was carried out for several years, 35 selection forms have been chosen as promising for further research.

Since 2014, five selection forms of chrysanthemums have been identified (Zvezdopad 86/12, Zvezdopad 80/12, Zvezdopad 48/12, Zvezdopad 44/12 and Zvezdopad 34/12), as the most promising for obtaining new varieties. During the growing season, the plants underwent agrotechnical care, observations, fixation of phenological stages, biometric measurements, according to which they were characterized. Of the tested selection forms, two passed the State Variety Testing in 2016 and received certificates of new varieties, the rest are still being tested.

Characteristics of new varieties:

Zefir (Zvezdopad 80/12) – it has double, pale pink inflorescences, 4-5 cm in diameter. It blooms abundantly, there are up to 30 inflorescences on one flower-bearing shoot. The shoots are resistant to flattening. The bush grows up to 75 cm tall, it is pyramidal, compact, the foliage density – medium. The leaves are of medium size (5-6 cm long and 2-4 cm wide), dark green, dense, slightly pubescent on the lower surface and slightly tapering at the tips. Blooms from early September to November. It is resistant to diseases and pests, frost and drought and is very easy to reproduce (abundant root suckers). This variety is recommended to be grown for cut flowers or for planting in groups (Figure 1).



Fig. 1 Cultivar Zefir

winters well without shelter, is drought tolerant, resistant to diseases and pests. It is recommended for flower gardens of various types (borders, mixed borders, round flower beds) and for cultivation in container (Fig. 2).

Făclia (Zvezdopad 17/12) – the inflorescences are simple, daisy-like, 3-4 cm in diameter, red with a burgundy tinge, the petals (ray florets), on the outer side, are matte, with a silvery tinge and, on the inner side, are yellow with a greenish tinge at the base. The disk florets are bright yellow with a greenish tinge. The inflorescences are located throughout the whole perimeter of the crown. The bush is spherical, 25-30 cm tall, with dense foliage. The leaves are bright green, medium-sized, slightly pubescent on the upper surface, the leaf blade is dissected to 1/3, the tips are slightly pointed. Blooms from late September to mid-November. It



Fig.2 Cultivar Făclie

CONCLUSIONS

1. Our research confirms that the most diverse and viable offspring is obtained by free cross-pollination of parental varieties.
2. With a successful combination of parental varieties, a great diversity of shapes and colours of inflorescences, height and habitus of the bush, foliage and even blooming time characterize the obtained offspring.
3. The best mother plants of the studied varieties proved to be Zvezdopad, Vi Villi, Deniz, Superform, Belaya romashka and Smuglyanka.
4. New autochthonous varieties Zefir and Făclie are highly decorative, resistant to diseases, pests and unfavourable climatic conditions and are recommended for use in landscaping, for cultivation in

containers, for cut flowers.

5. The varieties are vigorous, with high reproduction rate, highly decorative, resistant to diseases, pests and unfavourable climatic conditions of Moldova and can be obtained only under such conditions.

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SCIENTIFIC CHRONIC

PROFESORUL ION COMANICI LA 85 DE ANI!

dr. A. Teleuță, dr. V. Bucațel



La 14 iulie 2018, profesorul universitar Ion Comanici împlinește 85 de ani. S-a născut într-o familie de țărani cu stare și cu harul muncii, din s. Colibași, Județul Cahul. După absolvirea colegiului pedagogic din Cahul, apoi a facultății de biologie și chimie a Institutului Pedagogic din Tiraspol, în 1958 se înscrie la doctorantură în cadrul Grădinii Botanice a A.Ș.M., având în calitate de conducător științific pe ilustratul savant acad. V. Ribin, discipol și colaborator al lui N.I. Vavilov.

În anul 1965 își susține teza de doctorat cu tema: „Înmulțirea vegetativă a nukului”, iar în 1983-teza de doctor habilitat în biologie. Comanici este promotorul noii ramuri în agricultura Republicii Moldova-cultura de soi a nukului, care a luat amploare și actualmente se dezvoltă vertiginos. S-a început de la aceea că la sfârșitul anilor 60 (secolul trecut) I. Comanici împreună cu V. Ribin au ridicat întrebarea despre altoirea nukului, lipsa căreia era dintotdeauna cauza principală pentru punerea culturii nukului pe

bază de soi, științifică (a se vedea „Moldova Socialistă” din 9 octombrie 1959; „Советская Молдавия” от 11 декабря 1959 г.; „Moldova Socialistă” din 16 martie 1960, nr.63). La început, I. Comanici a studiat minuțios particularitățile morfobiologice ce țin de activitatea cambială și procesele de concreștere a țesuturilor la altoire, precum și exigențele acestora față de temperatură și umiditate. În continuare a elaborat metode eficiente de altoire a nukului atât în spațiu protejat, în containere și în lăzi de stratificare, cât și în teren deschis, în pepinieră (Pomic., vitic. și vinific. Mold., 1959, nr 6, p. 90-91; Pomic., vitic. și vinific. Mold., 1962, nr. 3, p. 39-42; Садоводство, 1964 Nr. 10, c. 38-40). Aceste lucrări de pionierat, în Republica Moldova și în tot spațiul ex sovietic, au avut un larg ecou în comunitatea științifică, precum și în rândurile practicienilor, au fost puse la baza tehnologiilor de producere a materialului săditor, jucând astfel un rol important la crearea culturii de soi a nukului. Aceste lucrări trezită un viu interes și în republicile unionale, ca dovadă este faptul că în scurt timp au vizitat Republica Moldova, spre a lua cunoștință de metodele de altoire, specialiști din Crimeea, Kirgistan, Tadjikistan, Kiev, Voronej.

Prof. I. Comanici a efectuat vaste studii populaționale asupra variabilității nukului atât local cât și a celui din Centrul Genetic Primar contribuind la dezvoltarea mai profundă a potențialului genetic al acestei specii și pronosticarea unor forme valoroase. Pe baza acestor cercetări comparate dănsul a elaborat Concepția Existenței în Moldova a unui Focar al Centrului Genetic Secundar al Nukului, ca bază genetică pentru selecția de noi soiuri, a evidențiat mai multe forme de perspectivă, două dintre care au fost omologate ca soiuri sub denumirea „Codrene” și „Lunguițe”. În continuare a obținut încă 4 soiuri, care au fost omologate în 2016: „Dolna”, „De Vălcineț”, „Micleușene”, „Surpriz” și 2 soiuri „Nistrene” și „De Buicani”, omologate în 2017. A stabilit anumite legități la hibridarea distantă și a obținut mai mulți hibrizi interspecifici, inclusiv *J. nigra* x *J. regia* F₂ nr.6-2, *J. sieboldiana* x *J. regia* F₂ nr. 1-1 care îmbină reușit calitățile înalte ale formei de cultură (coața subțire, conținutul de miez până la 55%) și însușirile prețioase (rezistența la ger și boli) ale speciilor sălbatice.

În cadrul cercetărilor citologice a stabilit, pentru prima dată în literatură, numărul de cromozomi la trei specii: *Juglans sieboldiana* Max.; *J. major* (Torr.) A. Heller; *J. hindsii* Jeps. A stabilit de asemenea forma, dimensiunile și numărul de cromozomi la 9 specii (din 10) de *Juglans*, la 3 varietăți de *J. regia* L. (Бюлл. Гл. Бот. Сада. Вып. 125. С. 73-79) și 19 hibrizi distantă. La toate aceste specii și hibrizi s-a constatat numărul

de cromozomi $2n=32$, ceea ce determină, după părerea sa diversitatea specifică restrânsă a fam. *Juglandaceae* Lindl. cca. 60 specii. A descoperit mai multe delegări în desfășurarea meiozei la hibrizi distanți (nedisfuncția cromozomilor omologi în anafaza I, întârzierea (engl.-langging) anafazică în anafaza I sau II), ceea ce lămurește cauzele sterilității la F_1 .

A creat o bogată colecție de specii de juglandacee, soiuri și forme de nuc comun și hibrizi distanți de *Juglans* L. și, de asemenea, expoziția de *Carya pecan* la care a obținut prima reproducere moldovenească de pecan în număr de câteva sute de puieti, ca bază materială pentru lucrările de introducere în continuare.

În aspect aplicativ a implementat metoda de altoire a nukului în câteva gospodării, a realizat Proiectul de transfer tehnologic „Producerea materialului săditor de soiuri omologate de nuc” (I.S.S. Iargara). În I.S.S. Iargara a înființat o plantație de soiurile „Codrene” și „Lunguiete” cu suprafața de 16 ha intercalate cu alun. Se implementează soiurile omologate „Codrene” și „Lunguiete” în gospodăriile individuale și colective și a hibrizului *J. nigra* x *J. regia* F_2 nr. 6-1 în calitate de portaltoi.

Este autor a 130 lucrări științifice, inclusiv 8 monografii (4 în colaborare) și 6 broșuri și culegeri în problemele nukului comun și altor nucifere; conducător științific a 5 doctoranzi și consultant a 2 doctoranzi, membru al Consiliului Coordonator al Uniunii Asociațiilor Producătorilor de Culturi Nucifere din Republica Moldova, membru al Consiliului Științific al Grădinii Botanice a A.Ș.M.; președinte al Seminarului Științific de profil pentru Conferirea Titlului Științific de Doctor și Doctor Habilitat de pe lângă Grădina Botanică a A.Ș.M.; și membru al seminarului similar de pe lângă UAS din Moldova, membru al colegiului de redacție al publicației periodice „Revista Botanică”.

Este distins cu Diploma de Onoare a Președintelui Academiei de Științe a Republicii Moldova. D-lui I. Comanici i s-a conferit titlul onorific „Om emerit”; Medalia „Dimitrie Cantemir”; Ordinul „Gloria Muncii”.

ȘTEFAN TOPALĂ – OCTAGENAR

dr. Alexandru Teleuță, dr. Vasile Bucațel, dr. hab. Constantin Dadu,
dr. hab. Mihail Rapcea, cercet. șt. Daniela Ivasișin

Destinul neordinar al ilustrului savant, omului împătimit de vița de vie și maestru în hibridarea distantă a acestei plante biblice



Dr. habilitat, prof. Șt. Topală s-a născut la 22 martie 1938, s. Podgoreni, județul Orhei. După absolvirea școlii primare din satul natal și a școlii medii din s. Cuizăuca (r. Rezina) este student la Colegiul Agricol din Cucuruzenii de Sus, r. Orhei, pe care-l absolvește în 1958. În a. 1959 devine student, iar în anul 1964 absolvește facultatea de agronomie a Institutului Agricol din Chișinău cu Diplomă de Merit. În perioada 1964-1965 practică activitatea de agronom în s. Boșcana, r. Criuleni. Din anul 1965 își continuă studiile în doctoratură la Institutul de Botanică „V.L. Komarov”, (Sankt-Petersburg), în domeniul citologiei viței de vie sub ghidarea științifică a talentatului citolog cu renume mondial M.S. Navașin.

În anul 1972 susține teza de doctor în științe biologice, specialitatea citologia plantelor, la Institutul Unional de Fitotehnie în numele lui N.I. Vavilov, Sankt-Petersburg (Rusia) cu tema: „Спонтанная полиплоидия у *Vitis vinifera* L. и ее значение для селекции винограда”.

Începând cu anii șaptezeci ai sec. XX după susținerea tezei de doctor la sugestiile marelui botanist și academician P.M. Jukovski, originar din Chișinău, a lărgit considerabil spectru investigațiilor citologice și cariologice, incluzând în materialul de cercetare speciile spontane ale fam. *Vitaceae* Juss., genofondul mondial de soiuri al sp. *Vitis vinifera*, *V. labrusca*, *V. silvestris*, hibrizii distanți N.C.-6-15; DRX-55; DRX-58-5; DRX-60-24, clonele de *V. rotundifolia* N 1; N10 314, primite din Montpellier, Franța, dar și clonul spontan de *V. rotundifolia*, introdus în Rusia din SUA, de marele savant genetician și fitotehnician rus cu renume mondial N.I. Vavilov.

După susținerea tezei de doctor dl. Șt. Topală își continuă activitatea de cercetător științific în cadrul Grădinii Botanice (Institut) a AȘM, în calitate de cercetător științific inferior în Laboratorul „Citologia plantelor”, apoi „Flora plantelor de cultură” (1968-1977), cercetător științific superior în Laboratorul „Hibridare distantă a plantelor” (1977-1989).

În anul 1988 susține și teza de doctor habilitat în biologie, specialitatea botanica, cu tema: „Кариология, полиплоидия и отдаленная гибридизация винограда”.

În perioada anilor 1989-2001 este șef de laborator. Paralel îndeplinește funcția de Secretar științific al Consiliului Specializat pentru Conferirea Titlului Științific de Doctor și Doctor Habilitat de pe lângă Grădina Botanică a A.Ș.M. Din a. 2002 până în prezent activează în calitate de cercetător științific principal al Laboratorului Dendrologie.

Dlui Șt. Topală în anul 2004 i se conferă titlul științific de profesor cercetător.

Cercetările științifice ale dlui prof. Șt. Topală s-au axat pe specia de cultură *Vitis vinifera* L., și-au continuat cu investigațiile citologice asupra genofondului viței de vie cultivată, concentrat în cele mai mari colecții ampelografice din Europa, ce aparțin Institutului de Vinificație și Viticultură „Magaraci” (Ialta) și Institutului Național al Viei și Vinului (Chișinău), unde a determinat numărul de cromozomi somatici ai garniturii diploide ($2n=38$) la cca 2000 soiuri și colne de viță de vie. Concomitent a descoperit 10 forme tetraploide de viță de vie cu numărul dublu de cromozomi ($2n=76$) și 9 forme citochimere, care conțineau în conul de creștere celule diploide ($2n=38$) și celule tetraploide ($2n=76$) în diferite proporții.

Deasemenea, în colaborare fructuoasă comună și activitate științifică prodigioasă cu cercetătorii practicieni din Institutul de Vinificație și Viticultură „Magaraci” (Ialta) a elaborat metoda de diagnosticare vizuală a formelor tetraploide spontane de viță de vie, totodată a efectuat investigații cariologice la mai mult de 50 de specii ale fam. *Vitaceae* Juss. din flora spontană, colectate din zonele tropicale și subtropicale ale Terrei de botaniști floriști ai URSS, unde acestea cresc, iar actualmente vegetează în oranjierile de fond ale Grădinilor Botanice din Moscova, Ialta, Chișinău.

Rezultatele științifice ale dlui prof. Șt.Topală au fost prezentate și apreciate la justa valoare la diverse foruri științifice, atât naționale, cât și internaționale, fiind expuse în circa 350 de lucrări științifice, inclusiv trei monografii originale în limbile rusă și română.

Monografia „*Cariologia, poliploidia și hibridarea interspecifică a viței de vie*” constituie o sinteză a cunoștințelor referitoare la cariologia, sistematica, citologia, poliploidia, citogenetica și hibridarea interspecifică (distantă) a viței de vie. În lucrare sunt prezentate rezultatele cercetărilor citologice la circa 2000 soiuri și clone de viță de vie, inclusiv românești, care fac parte din speciile: *Vitis vinifera* L., *V. labrusca* L., *V. silvestris* Gmel., hibrizi interspecifici (distanți) de 5 generații, precum și la peste 50 de specii spontane din familia *Vitaceae* Juss.

În baza datelor din literatura de specialitate și rezultatelor proprii ale multelor cercetări citologice și cariologice, a elaborat și a propus clasificarea modernă, îmbunătățită a familiei *Vitaceae* Juss., clasificare bazată pe principii filogenetice, în care genurile sunt poziționate în conformitate cu timpul probabil de apariție al acestora. Schema de clasificare propusă, a fost acceptată și publicată în *Enciclopedia Viticulturii* și diferite manuale de specialitate și este în prezent larg utilizată în R. Moldova, țările CSI, Bulgaria. Actualmente, schema de clasificare a devenit ea înșiși bibliografie de referință, atât pentru cercetătorii din Țară, cât și celor de peste hotare.

Un alt merit deosebit al autorului constă în aceea că, pe bază de investigații cariologice și palinologice, a confirmat experimental, în premieră absolută, ipoteza originii monofiletice din diferite ecotipuri de *Vitis silvestris* Gmel. a speciei de cultură *Vitis vinifera* L., înaintată de C.Darwin (1859) și susținută de Vavilov (1928), Negruli (1946), Jukovskii (1971).

Chintesența studiilor citocariologice a dlui profesor Topală constă în cele două descoperiri importante în citogenetica speciei *Vitis vinifera* L. și anume:

1. Sinteza unui genom nou al viței de vie ($n=19$ și $2n=38$) din genomurile a două specii: *Vitis rotundifolia* Michx ($n=20$; $2n=40$) și *Vitis vinifera* L. ($n=19$; $2n=38$). Acest genom nou îmbină armonios calitatea și productivitatea speciei cultivate *Vitis vinifera* L., cu rezistența la boli și dăunători ale speciei spontane *Vitis rotundifolia* Michx.

2. O metodă originală de sterilizare a gametofiților, depistată la hibrizii interspecifici din generația F_3 .

Mai mult, autorul a obținut trei generații de hibrizi interspecifici indigeni, mulți dintre aceștia fiind autofertili. Printre hibrizii autofertili din F_5 , au fost identificate o serie de specii sintetice de viță de vie ca: *Vitis vinifolia*, *V. rotundifera*, *V. cruceștiana*, *V. nigra* și altele.

Noul genom creat de domnul profesor Ștefan Topală, poate fi considerat o nouă specie, similară cu vița de vie europeană cultivată pe rădăcini proprii până la apariția filoxerei în Europa (1868). Deosebirea esențială constă în faptul că noua specie, creată, are origine hibridă și posedă rezistență sporită la atacul filoxerei. Noua specie de viță de vie sintetizată constituie pentru viticultura mondială o extraordinară sursă genetică a caracterului „rezistența la filoxeră”, sursă care poate fi exploatată cu succes în programele de hibridare și ameliorare. Utilizarea exhaustivă a acestei valoroase surse genetice va permite crearea unui genofond cu posibilități reale de soluționare a celei mai spinoase probleme din viticultura mondială – sensibilitatea la filoxeră.

Analizând activitatea științifică în întregime, dar în special, mai profund și detaliat tratatul fundamental «*Cariologia, poliploidia și hibridarea distantă a viței de vie*» - operă științifică magistrală, ne exprimăm deplina diferență față de extraordinara contribuție științifică și deopotrivă practică a dlui prof. Șt. Topală și avem toată convingerea că aceasta va reprezenta o referință de o deosebită valoare în știința și practica viticolă.

Grație pregătirii profesionale înalte în școli de prestigiu, perseverenței, insistenței, muncii cu jertfire de

sine de zi cu zi, vocației de cercetător-inventator și abordării corecte și originale a problemelor dificile ale ameliorării plantelor, dl profesor a obținut în premieră absolută realizări importante de o mare rezonanță, benefică pentru știința și practica ameliorării genetice a viței de vie. De rând cu talentul de cercetător cu spirit inovativ, natura l-a mai înzestrat din plin pe dl profesor Ștefan Topală cu o gamă largă de calități umane ca bunătate, inteligență, modestie, rară cumsecădenie, săritor la nevoie, pedagog prin vocație, abilitate de a evalua valorile adevărate ale oamenilor de știință și al., care prezintă numai câteva din acele virtuți prin care efectiv s-a impus pe parcursul timpului printre citologi, botaniști, viticultori și alți colegi de breaslă din mediul academic moldovean și nu numai.

Dl. profesor, Șt. Topală este cu certitudine creatorul *genomului nou, hibrizilor distanți fertili, speciilor sintetice* de viță de vie, care a fundamentat teoretic și practic direcția de ameliorare genetică a viței de vie prin utilizarea amplă a metodei de hibridare distantă cu participarea speciei americane *Muscadinia rotundifolia* Small. și a inserat un aport valoros propriu în dezvoltarea continuă a acestui important domeniu.

Cu ocazia jubileului de 80 de ani - acestei onorabile aniversări felicităm autorul și exprimăm cele mai sincere sentimente de recunoștință pentru marele aport, contribuții incomensurabile în dezvoltarea citologiei, cariosistematicii, citogeneticii, poliploidiei, hibridării distanțe și ameliorării genetice a viței de vie și-i dorim dlui profesor cercetător Șt. Topală multă sănătate, prosperitate, perseverență, ani mulți de viață și noi realizări în știința viței de vie.

PROFESORUL, DR. HAB. GHEORGHE POSTOLACHE LA 75 DE ANI

dr. hab. Ion Comanici, dr. Ion Roșca, dr. Ștefan Lazu



Recent la Consiliul Științific al Grădinii Botanice Națională (Institut) "Alexandru Ciubotaru" GHEORGHE POSTOLACHE, Șeful laboratorului Geobotanică și Silvicultură, profesor cercetător, doctor habilitat în științe biologice a fost omagiat cu prilejul a 75 ani.

Gheorghe Postolache s-a născut la 2 mai 1943 în comuna Codreanca (Cobâlca), județul interbelic Orhei, azi raionul Strășeni. În anul 1959 a absolvit școala medie din satul natal. În anul 1964 a absolvit facultatea de biologie și geografie (specialitatea biologie și chimie) a Institutului Pedagogic din or. Tiraspol. În anul 1964 a lucrat un timp scurt profesor la școala medie din comuna Cuizăuca(r. Rezina), a urmat serviciul militar, iar în februarie anul 1966 a fost încadrat ca laborant în laboratorul de floră și geobotanică la Grădina Botanică a Academiei de Științe a Moldovei (AȘM). În anii 1967-1970 a urmat doctorantura la Academia de Științe a Moldovei unde sub conducerea membrului corespondent a AȘM, doctor habilitat, profesor Tatiana Geideman a elaborat iar în 1971 a susținut teza de doctor în științe biologice. În 1997 a susținut teza de doctor habilitat în științe biologice cu tema: „Vegetația Republicii Moldova”. După terminarea doctoranturii a fost angajat la Grădina Botanică în

calitate de colaborator științific. A lucrat o perioadă (1979-1981) director adjunct pe probleme de știință a Grădinii Botanice, iar din 1981 până în prezent lucrează șef al laboratorului de geobotanică și silvicultură. Din 1966 până în prezent Gh.Postolache a activat în domeniul geobotanicii, silviculturii și florei.

A fost conducător a 28 de proiecte științifice, dintre care 7 proiecte instituționale, 15 proiecte de grant și 6 proiecte editoriale.

În perioada anilor 1967-1974 a cercetat, litera în circuitul de substanțe și productivitatea biologică, probleme din cadrul Programul Omul și Biosfera. În aceste cercetări a elaborat conceptul litiera component a ecosistemelor forestiere, a emis definiția, clasificarea și a. a acestui component a ecosistemelor forestiere, care au fost reflectate în monografia „Лесная подстилка в круговороте веществ”, (1976). Această lucrare a fost apreciată cu Premiul tinerilor savanți din Moldova.

În perioada anilor 1972-1975 Gh.Postolache, a cercetat regenerarea naturală a stejarului pedunculat, mesteacănului și altor specii de arbori din Nordul Moldovei. În rezultatul cercetărilor a stabilit că stejarul pedunculat edificatorul pădurilor din Nordul Moldovei nu are capacitatea de a se regenera natural (prin semințe). Stejarul înfloarește aproape anual dar florile și fructele sunt afectate de vătămători și de temperaturile joase. Mesteacănul în aceste păduri creștea spontan forma multe semințe însă semințele nu germinau.

În anii 1980-1985 dr. Gh.Postolache a cercetat perdelele forestiere de protecție din Republica Moldova și a elaborat sortimentul de specii de arbori și arbuști pentru crearea perdelelor forestiere pe câmpurile agricole. Folosind conveierul de înflorire a plantelor pentru atragerea insectelor polenizatoare a elaborat *Recomandări de creare a perdelelor forestiere și oazelor biocenotice în livezi* (1985).

În anii 1986-1990 Gh.Postolache în cadrul proiectului instituțional a cercetat vegetația din văile râurilor. În rezultatul cercetărilor efectuate a evidențiat regularitățile de formare și de răspândire a comunităților vegetale din luncile râurilor. Este cunoscut faptul că în anii 1960-1975 sau efectuat lucrări hidrotehnice de adâncire și îndreptare a albiilor râurilor din Moldova. În aceste vremuri au fost desecate locurile băltoase din lunca Prutului, Nistrului, Răutului și multor râuri mici. Aceste lucrări sau efectuat fără o careva argumentare

științifică, de aceea a apărut necesitatea de a evidenția impactul acestor lucrări asupra vegetației. În rezultatul cercetărilor științifice Gh.Postolache a evidențiat, că prin adâncirea și îndreptarea albiilor râurilor au loc schimbări esențiale în regimul hidrologic în luncă și în compoziția și structura comunităților vegetale. Noile comunități vegetale sunt cu o productivitate și diversitate mai scăzută decât cele spontane. Ca rezultat are loc procesul de degradare a comunităților vegetale. În baza unor regularități de răspândire a comunităților vegetale a elaborat *Recomandări de împădurire a malurilor bazinelor acvatice*.

În noiembrie 2000 pădurile de la cele mai mari altitudini, în special din Podișul Nistrului au fost afectată de chiciură. În baza proiectului *Cercetarea impactului chiciurei asupra pădurilor în noiembrie 2000* a elaborat *Recomandări de ameliorare a stării pădurilor afectate de chiciură în noiembrie 2000*.

În anii 2003-2006 a elaborat proiectul „*Elaborarea procedeele tehnologice de reconstrucție și creare a perdelelor forestiere în scopul reducerii influenței negative a calamităților naturale asupra plantelor de cultură în stepa Bălți*” efectuată în cadrul Programului de Stat „*Principii și procedee tehnologice de diminuare a consecințelor naturale (seceta, înghețuri, etc.) asupra plantelor de cultură* (Coordonator al programului acad.S.Toma). În rezultatul cercetărilor efectuate a fost elaborată *Carcasa forestieră pentru Stepă Bălți* (raioanele Sângerei, Fălești, Râșcani, Drochia). Pentru a avea o situație mai bună a propus de plantat 23565,6 ha păduri și 4645,7 ha perdele forestiere de protecție, în Stepă Bălți. S-a elaborat sortimentul de specii de arbori, au fost evidențiate suprafețele necesare pentru fiecare localitate din acest spațiu. În prezent recomandările elaborate se implementează în Nordul și Sudul Moldovei de către Agenția de Stat Moldsilva. Rezultatele acestor cercetări au fost reflectate în monografia *Diminuarea impactului factorilor pedoclimatici extremali asupra plantelor de cultură* (2008).

La sfârșitul secolului trecut se simțea necesitatea unei sinteze despre vegetația Republicii Moldova. Pe parcursul anilor 1975-1995 Gh.Postolache a organizat expediții în toată Republica Moldova care au dat posibilitate de a efectua un mare număr de relevee a comunităților vegetale și de a culege un mare volum de informație despre vegetația Moldovei. În timpul acestor expediții a cercetat vegetația forestieră, de stepă, de luncă, vegetația acvatică și palustră. În baza acestei informații a evidențiat legitățile de formare și răspândire a asociațiilor vegetale care au fost oglindite în monografia *Vegetația Republicii Moldova* (1995). În baza informației colectate și legităților evidențiate a elaborat: clasificarea vegetației stepelor și luncilor Republicii Moldova (1995). A sistematizat, unificat și generalizat materialul colectat de autorii precedenți și datele personale despre asociațiile vegetale din Moldova și a elaborat *Prodromul Vegetației Moldovei* (1995). În baza materialului colectat Gh.Postolache a elaborat câteva hărți: *Harta vegetației Republicii Moldova* (1995, 2001, 2002, Scara 1:1500000); *Regionarea geobotanică a Republicii Moldova* (1994, 1995, 2002, Scara 1:4000000); *Harta. Plante rare*. (1999, 2002 Scara 1:1500000); *Harta. Plante medicinale* (2002); *Regionarea perdelelor forestiere din Republica Moldova* (1995) Primele 4 hărți au fost incluse în *Atlasul Republicii Moldova* (2002).

În anii 1995-2005 Gh.Postolache a fost Coordonator Național în Programul European EUFORGEN, iar din 2002 participant în Programul European PLANTA EUROPA. Fiind coordonator național în aceste programe Gh.Postolache a favorizat stagierea unor tineri cercetători și participarea la conferințe și simpozioane internaționale.

În anul 1997 Gh.Postolache a inițiat proiectul: „*Cercetarea resurselor genetice forestiere în pădurile de foioase din Sud-Estul Europei*”, care s-a îndeplinit pe parcursul anilor 1998-2001 împreună cu savanți din instituțiile de cercetări științifice din Bulgaria, România, Italia, Luxemburg și R. Moldova (proiect finansat de Guvernul Luxemburg). În cadrul acestui proiect au fost elaborate 2 monografii, au fost elaborate *Harta răspândirii fagului (Fagus sylvatica) în Sud-Estul Europei*; *Harta răspândirii gorunului (Quercus petraea) în Sud-Estul Europei*; *Harta răspândirii stejarului pedunculat (Quercus robur) în Sud-Estul Europei*.

În perioada 2009 – 2012, a elaborat împreună cu alți specialiști proiectul „*Fortificarea capacităților instituționale și a reprezentativității sistemului de arii protejate din Moldova*”, finanțat de Fondul Global de Mediu (UNDP/GEF), care a contribuit la revalidarea sistemului național de arii naturale protejate din Moldova. În anii 2014-2018, Prof. Dr.hab. Gheorghe Postolache este coordonator al proiectului editorial „*Editarea cărților “Ariile Naturale Protejate din Moldova”* - 4 volume. Până în prezent au fost editate volumele 1,2 și 4. Volumul

3 este prezentat la editură Știința.

În perioada anilor 1972-2018 pentru conservarea *ex situ* a celor mai reprezentative specii de plante vasculare și ecosisteme împreună cu alți colegi, a elaborat *Expoziția „Vegetația Moldovei”* din Grădina Botanică Națională „Alexandru Ciubotaru”, care include 12 microexpoziții forestiere, o micorexpoziție cu vegetație de stepă și una cu vegetație de luncă. A fost mobilizat genofondul a peste 500 specii de plante autohtone. Se realizează conservarea *ex situ* a 50 specii de plante vasculare rare. Rezultatele acestor lucrări au fost reflectate în monografia *Expoziția „Vegetația Moldovei” din Grădina Botanică AȘM*(2010).

Gh.Postolache a elaborat câteva metode noi de cercetare: Metoda de creare a perdelelor forestiere în livezi (1984, 1985, 1987); Metoda de amplasare a rețelei de suprafețe permanente în rezervații forestiere (1994); Metoda cercetării diversității floristice și fitocenotice în ariile protejate forestiere(2001). Metoda de cercetare a arboretelor(2008).

A elaborat recomandări: Noi arii protejate de către Stat (1987,1998); Recomandări de creare a perdelelor forestiere (1987, 1995) (Coautor); Recomandări de creare a plantațiilor forestiere în zona bazinelor acvatice(1987); Recomandări și îndrumări privind combaterea secetei(1995) (Coautor); Recomandări de conservare a resurselor genetice forestiere de gorun (*Quercus petraea*)(2000); Recomandări de efectuare a lucrărilor silvotecnice în pădurile afectate de polei în noiembrie 2000 (2001); Recomandări privind ameliorarea stării arborilor seculari din Moldova (2014).

În baza cercetărilor științifice a publicat peste 400 de lucrări științifice în diverse reviste, enciclopedii, culegeri, din țară și străinătate dintre care a elaborat 5 monografii de un singur autor („Лесная подстилка в крзоворотом вешество”(1976), „*Vegetația Republicii Moldova*”, (1995); „*Expoziția Vegetația Moldovei din Grădina Botanică AȘM*”(2010), „*Ariile naturale protejate din Moldova. vol. 2, Arborii seculari*” (2015), „*Rezervația „Pădurea Domnescă*”(2017), este coautor la 15 monografii. Profesorul Gh.Postolache este unul din autorii „*Cartea Roșie a Republicii Moldova*” (2015) ediția 3.

Gh.Postolache a participat cu rapoarte la conferințe și simpozioane științifice în țară și peste hotare (Austria, Belarusi, Bulgaria, Cehia, Elveția, Estonia, Franța, Germania, Norvegia, Portugalia, România, Rusia, Suedia, Ucraina, Ungaria și a.). A fost membru comisiei de experți din cadrul Comisiei Superioare de Atestare din Republica Moldova, Presedinte al Seminarului de profil „Botanica” și a câtorva Consiliului Specializate de susținere a tezelor de doctor habilitat în biologie (specialitatea 05 Botanica), Membrul Consiliului Științific a Grădinii Botanice, Membru Consiliului Tehnic al Agenției de Stat pentru Silvicultură” Moldsilva”. Gh.Postolache a participat la elaborarea Primului Raport Național, Strategiei Naționale și Planul de Acțiuni în Domeniul Conservării Diversității Biologice în Republica Moldova. A participat la elaborarea Strategiei Dezvoltării Durabile a Fondului Forestier Național.

Prof. Dr.hab. Gheorghe Postolache a îndrumat 7 discipoli pentru susținerea tezelor de doctor în biologie și un doctor habilitat în biologie,a fost conducător a multor lucrări de licență.

Gh.Postolache a activat în calitate de profesor la Universitatea Agricolă și Universitatea de Stat(prin cumul). Prof. Dr.hab. Gheorghe Postolache este laureat al „*Premiului tinerilor savanți în domeniul științei și tehnicii*”, iar pentru merite în dezvoltarea științei, i s-a conferit Titlul onorific de „*Om emerit*” și Medalia „Dimitrie Cantemir”.

Cu ocazia jubileului de 75 de ani din ziua nașterii și 52 ani de activitate științifică, a domnului Gheorghe Postolache, îi exprimăm felicitări, îi dorim urări de sănătate și noi realizări în domeniul de cercetare. La mulți ani Domnul Profesor!

VALENTINA ȚÎMBALÎ – UN EXEMPLU DE REZISTENȚĂ

(la a 65-a aniversare)

Dr. Valentina Cantemir, dr. Tatiana Sârbu



Valentina Țîmbalî s-a născut în plină vară, la 15 iulie 1953, într-o familie de gospodari, pe nume Matrona și Iosif Șestac, din com. Olănești, Ștefan-Vodă. În 1970, a absolvit școala din satul natal și a continuat studiile la Institutul Pedagogic de Stat din Tiraspol, Facultatea de Biologie și Chimie, pe care l-a absolvit în 1977 cu diplomă roșie. În același an este angajată la Grădina Botanică (I) a AȘM, activând cu fidelitate până în prezent. În perioada 1979-1982 perfectează studiile la doctorat în cadrul instituției date. Teza de doctorat cu tema: „Биология развития и особенности выращивания бромелиевых, перспективных для озеленения интерьеров” a fost susținută cu succes în 1985. Ca rezultat al cercetărilor efectuate asupra biologiei dezvoltării și particularităților de creștere a speciilor de bromeliacee a fost creată o colecție de plante din familia *Bromeliaceae*, care în prezent cuprinde aproximativ 130 de taxoni. După obținerea doctoratului, ocupă

funcția de cercetător științific inferior în Laboratorul de Plante tropicale și subtropicale din cadrul Grădinii Botanice (Institut) a AȘM și, urcă în carieră până când devine șef al acestui laborator. Din 1991 până în prezent, ea ocupă funcția de șef al Laboratorului de plante tropicale și subtropicale al Grădinii Botanice (I) a AȘM. În calitate de manager, împreună cu membrii acestei subdiviziuni, a fondat colecția de plante tropicale și subtropicale, care constituie 2726 de taxoni, ce aparțin la 577 de genuri din 134 de familii. Reprezentanții acestor familii au constituit obiectul unor studii complexe din cadrul temelor instituționale de cercetare elaborate de dna Valentina Țîmbalî. Acest genofond de plante de teren protejat, excepțional prin diversitate și valoare, este etalat pe o suprafață de 2100 m² în cadrul a 7 complexe de seră, și anume: colecția de plante suculente (inclusiv cactuși, întrunește 1500 de taxoni, fiind printre cele mai numeroase din ex-URSS); colecția de plante tropicale (cca 450 taxoni); colecția de plante subtropicale (peste 600 taxoni).

Timp de 4 decenii de activitate științifică continuă în cadrul Grădinii Botanice (I) dna Țîmbalî V., o cunoscătoare de excepție a acestui fitogenofond acumulat, a contribuit și continuă să contribuie la dezvoltarea cercetărilor privind studiul, reproducerea și introducerea plantelor de teren protejat în Republica Moldova. În cadrul cercetărilor au fost evidențiate particularitățile de creștere și dezvoltare a speciilor de plante tropicale și subtropicale în condițiile Republicii Moldova; selectate speciile de perspectivă și elaborate asortimente pentru amenajarea interioarelor cu diverse destinații.

În acești ani a participat activ, promovând realizările laboratorului, la numeroase conferințe, seminare științifice naționale și internaționale. În cadrul expozițiilor tematice la Moscova, Kiev, Iași, Piatra-Neamț a fost menționată cu diplome, medalii, premii pentru colecțiile prezentate. Împreună cu echipa de cercetare este autoarea a numeroase proiecte de amenajare a interioarelor și de implementare a lor. Colaborează în continuare cu cercetătorii din București, Moscova, Kiev, Iași, Ialta, Odesa etc.

Rezultatele științifice ale cercetărilor, efectuate de dna Țîmbalî V., au fost publicate în peste 100 de lucrări științifice, inclusiv monografiile „Тропические и субтропические растения в оранжереях Ботанического сада АН МССР”, 1985; „Бромелиевые (биология, интродукция, агротехника)”, 1989, Cartea Roșie a R. Moldova, ed. 3, 2015 (coautor). În baza hotărârii Consiliului Național pentru Atestare și Acreditate din R. Moldova în a. 1999 i se conferă titlul de cercetător științific superior la specialitatea „Botanica”. Dna V. Țîmbalî este Laureat al Premiului AȘM „Boris Melnic” (2016), membru al AO Societății de Botanică din R. Moldova. În mod activ contribuie la formarea specialiștilor în domeniu, fiind conducător de doctorat, teze de master și licențe. Educația ecologică a populației, în special a tinerii generații, o realizează atât prin lecții, excursii la

colecțiile de plante tropicale, subtropicale, cât și emisiuni tematice la posturile naționale de radio și televiziune.

Pentru activitatea fructuoasă timp de 40 de ani în Grădina Botanică (I) a AȘM și rezultate științifice deosebite, obținute în cercetare, crearea și întreținerea unui genofond impresionant de plante exotice pentru teren protejat, dnei Valentina Țîmbali i se conferă titlul onorific „Om emerit”, diplome de merit ale Academiei de Științe a Moldovei și alte mențiuni.

Dna Valentina Țîmbali, numită, pe bună dreptate, de dna dr. Eugenia Cernei într-o dedicație, **Regina tropicală**, timp de 4 decenii de activitate științifică consacrată domeniului ales, a dat dovadă de competență, perseverență și rezistență pentru a acumula, gestiona și păstra un patrimoniu național vast și unic de plante tropicale și subtropicale pe teren protejat din cadrul Grădinii Botanice (I).

Cu ocazia jubileului de 65 ani de la naștere, dorim ca această **Regină tropicală**, pe nume **Valentina Țîmbali**, să reziste în timp tuturor provocărilor timpului iar noi, colegii de breaslă, îi spunem Mulți ani, Mulți ani trăiască!

IN MEMORIAM

PROFESORUL RUDENKO IVAN SERGHEI – 95 DE ANI DE LA NAȘTERE

(4.10.1922 – 14.02.2017)

*dr. hab., prof. Ion Comanici, dr. Vasile Bucățel****La 4 octombrie 2017, distinsul savant Rudenko Ivan Serghei, plecat dintre noi la 14 februarie 2017, ar fi împlinit 95 de ani.***

S-a născut la 4 octombrie 1922, în familie de țărani din satul Loboikovo, raionul Danilovka, regiunea Volgograd. În anii 1929-1937 învață în școala medie incompletă din satul natal, după terminarea căreia, își continuă studiile la Școala pedagogică din Mihailovka (1937-1941), apoi urmează cursurile la Școala militară de infanterie din Ordjonikidze (V.1941-XII.1941). La terminarea cursurilor este numit comandant al plutonului de pușcași și a companiei de pușcași în cadrul diviziei 136 de infanterie, în care activează până în august 1943, când a fost rănit. În august-septembrie 1943, se tratează în spitalul militar. În septembrie 1943-februarie 1944, este adjunct al șefului statului major al regimentului de gardă 44 pe serviciu de recunoaștere. În februarie 1944, este din nou rănit și se tratează în spitalul militar din Tbilisi până în iulie 1944. A luat parte la mai multe bătălii, inclusiv cele de la Stalingrad, Kursk-Oriol, Don ș.a. A fost decorat cu ordinele „Красное Знамя” (25.VI.1943), „Красной Звезды” (4.II.1943) și medaliile „За оборону Сталинграда”, „За победу над Германией” ș.a.

După război, în anii 1945-1950, își face studiile superioare la Institutul Agricol din Simferopol. În 1950-1951, lucrează în calitate de agronom la stația de mașini și tractoare Nr. 2 (SMT), șef al laboratorului agrochimic din Bahcisarai al SMT.

În 1951-1954, este doctorand la Filiala A.Ș.URSS din Crimeea, avându-l ca conducător științific pe prof. V.A. Ribin. În 1956, susține teza de doctor (candidat) în științe, pe tema „Studiu morfologo-anatomic privind inițierea și dezvoltarea mugurilor floriali la soiurile hibernante de măr”. În procesul studiilor citologice asupra mugurilor floriali a descoperit un fenomen neașteptat și anume, la temperatura aerului de -10 °C, în mugure se desfășoară procesul de diferențiere prin diviziuni celulare indirecte, prin mitoze.

În același an, 1956, vine la Grădina Botanică a AȘM, împreună cu prof. V.A. Ribin, unde lucrează până la pensionare. Într-un timp relativ scurt, dânsii creează la Grădina Botanică o colecție de hibrizi și forme poliploide de plante pomicele. Aici, I. Rudenko desfășoară o vastă activitate științifică în domeniul hibridării distante, filogenezei și poliploidiei plantelor pomicele. Efectuează cercetări morfologice și citologice asupra hibrizilor interspecifici și intergenerici, precum și asupra formelor poliploide, evidențiind forme foarte valoroase. Astfel, dânsul obține de la hibridul *Cydonia oblonga* x *Malus domestica* F₁ (obținut în Bulgaria, V. Panov ș.a., 1965), generațiile F₂ și F₃. Hibridul intergeneric *Cydonia* x *Malus* a fost numit de către I.S. Rudenko – *Cydolus*. *Cydolus* îmbină, în diferită măsură, caracterele fructului de gutui și măr. Fructele mari – 200 g, de culoare galbenă-limonie, gust dulce-acriu, aromat de măr. Posedă însușirea de a forma din muguri 1-2 flori (oligoflorie), ceea ce exclude periodicitatea fructificării, are perioada de înflorire extinsă pe 20-25 zile, evitând astfel pericolul înghețurilor de primăvară, prezintă interes ca portaltot universal pentru gutui, măr și păr.

Cydolus a fost predat, prin contract de colaborare, Institutului de Cercetări pentru Pomicultură din

Moldova și Secției de Stepă a Grădinii Botanice Nichita din Ialta, precum și multor pomicultori-amatori, în toate cazurile primind aprecieri înalte.

O altă descoperire științifică importantă a fost realizată în urma studierii hibridului intergeneric *Prunus besseyi* x *Armeniaca vulgaris*. Cercetările citologice au pus în evidență, pentru prima dată în știință, faptul că hibridii *Prunus besseyi* x *Armeniaca vulgaris* F₃ reproduc, după numărul de cromozomi, întreg șirul aloploid al genului *Prunus* Mill. – 2x; 3x; 4x; 5x; 6x (Руденко, 1978). Hibridii hexaploizi – 2n=6x=48 prezintă interes pentru sporirea rezistenței la geruri și secetă a prunului de cultură (*Prunus domestica* L., 2n=48) din contul genomului *Prunus besseyi* Bail.

Pe lângă activitatea intensă pur științifică, I. S. Rudenko participă activ la construcția „verde” a Grădinii Botanice.

I.S. Rudenko, inițial, deține funcția de cercetător științific inferior (1956-1961), apoi cercetător științific superior (1961-1964), secretar științific (1964-1966), cercetător științific superior (1966-1975). Apoi, este șeful laboratorului de Citologie și Embriologie al Secției de genetică (1975-1977). În 1977, se întoarce la Grădina Botanică în funcția de colaborator științific superior. 1982-1986 – șef al Laboratorului de hibridare distantă, 1986-1998 – cercetător științific principal.

La 23 mai 1980 i se conferă, prin Hotărârea Comisiei Superioare de Atestare de pe lângă Sovietul Miniștrilor al URSS (proces verbal nr. 17), titlul de doctor (habilitat) în științe. Tema disertației – „Morfologia și citogenetica hibridilor distanți și formelor poliploide”. Rezultatele lucrării au fost înalt apreciate de mai mulți specialiști din Uniunea Sovietică. În decursul anilor, i-a avut ca discipoli pe A. Hripunov, Galina Duducal (doctor în științe), Iu. Destreanschi și a. În 1991 i se acordă titlul de profesor universitar. În 1998 este pensionat. A publicat circa 200 de lucrări științifice, inclusiv 6 monografii (la două – coautor). Monografia sa „Отдаленная гибридизация и полиплоидия у плодовых растений” Кишинев „Штиинца”, 1978, 196 c., după aprecierea mai multor savanți, este o lucrare unică, de talia căreia nu s-a publicat mai înainte nici în țară, nici peste hotare. Autorul, aplicând metode citogenetice moderne, a obținut date noi, care au aprofundat și lărgit imaginația și înțelegerea existente în domeniul dat. Cartea servește drept model pentru tinerii cercetători de atitudine conștiincioasă, serioasă față de adevărul științific, față de experiment, de argumentarea faptelor și concluziilor științifice.

DOCTOR ÎN ȘTIINȚE BIOLOGICE VASILE CHIRTOACĂ

dr. hab. Gh. Postolache, dr. Șt. Lazu, cercet. șt. L. Talmaci



La 20 februarie 2018 doctorul în biologie Vasile Chirtoacă ar fi împlinit 80 ani. S-a născut la 20 februarie 1938 într-o familie de țărani răzeși din satul Lipetchi din raionul Kotovsk, regiunea Odessa (Ucraina). A fost elev a școlii medii din satul natal, apoi a absolvit școala de mecanizare, iar în anul 1958 a susținut examenele de admitere la facultatea de biologie și chimie de la Institutul Pedagogic din or. Tiraspol. De la primele cursuri studentul V. Chirtoacă era pasionat de lumea plantelor. Frecventa cercurile științifice studențești, unde a prezentat rapoarte și a început primele lucrări de cercetare. Sub conducerea profesorului Petru Tarhon a efectuat primele experiențe de cercetare științifică. Rezultate de cercetare V. Chirtoacă le-a publicat în lucrare științifică: *Date prealabile privitor la influența giberelinei asupra plantelor*. Lucrarea a fost publicată împreună cu profesorul P. Tarhon în revista Institutului din Tiraspol numită Учебные записки Тираспольского пединститута. Вып. 13, 1964. Кишинев, стр. 168-192.

După absolvirea Institutului din Tiraspol V. Chirtoacă a activat în funcție de asistent la catedra de Botanică a Institutului Pedagogic din or. Tiraspol.

În anul 1966 a susținut cu succes examenele și a devenit aspirant la Grădina Botanică a Academiei de Științe a Moldovei, conducător științific a fost doctorul habilitat în științe biologice, profesorul Tatiana Gheideman. În anul 1972 V. Chirtoacă a susținut teza de doctor în științe biologice (pe acele timpuri candidat în științe biologice): *Биологическая продуктивность дубрав из дуба скального в Центральной Молдавии* la Consiliul Științific de susținere a tezelor de doctor în științe de la Universitatea din or. Dnepropetrovsc. Problema la care a lucrat mai mulți ani Dl. Chirtoacă era actuală și se încadra în problema de cercetare globală „Omul și Biosfera”. La acest domeniu V. Chirtoacă a publicat 14 articole în reviste de specialitate și culegeri.

V. Chirtoacă mulți ani a activat cu pasiune în domeniul de cercetare a florei ferigilor și orhideelor. În anul 1968 a publicat prima lucrare științifică despre ferigi „*О распространении папоротников в Молдавии*”, iar în anul 1970 a publicat lucrarea „*Ужовник в Молдавии*”. În anul 1975 editează o lucrare generalizatoare despre ferigi „*Папоротники Молдавии*” în revista Охрана природы Молдавии împreună cu profesorul T. Gheideman.

Doctorul V. Chirtoacă a adus o mare contribuție la cercetarea *Orhideelor*. În anul 1979 apare articolul *Новые для флоры Молдавии виды рода Eripactis Zinn (Orchidaceae)*, care a fost publicat în Buletinul Academiei de Științe a Moldovei (Științe biologice și chimice). În același an a apărut o altă publicație „*Ятрышниковые (Orchidaceae) Молдавии*”.

V. Chirtoacă mulți ani a colaborat cu colegul de laborator Afanasie Istrati. Pe parcursul a mai multor ani împreună au efectuat cercetări floristice în Rezervația științifică „Plaiul Fagului”. Rezultatele acestor cercetări au fost publicate în mai multe reviste și culegeri. V. Chirtoacă și A. Istrati în anul 1987 au publicat teze la o conferință de la Moscova (Rusia) „*Орхидные Государственного заповедного лесохозяйственного хозяйства «Реденский лес» Молдавской ССР*”. În același an a mai publicat în revista Buletinul AȘM „*Новые виды папоротников в Молдавской ССР*”, în anul 1988 au publicat „*Редкие виды флоры Молдавии, произрастающие в Реденском лесу*”, iar în anul 1990 au publicat în aceeași revistă împreună articolul „*Телекия прекрасная – Telekia speciosa (Schreb.) Baumg. (Asteraceae) в Молдове*”.

Un anumit aport V. Chirtoacă a adus la cercetarea florei unor arii naturale protejate. Rezultatele cercetărilor floristice în rezervația științifică „Plaiul Fagului” au fost oglindite în 7 publicații. V. Chirtoacă este unul din autorii monografiei „*Natura Rezervației „Plaiul Fagului”*”, care a fost editată în anul 2005. Rezultatele

cercetărilor efectuate în rezervația "Codrii" au fost oglindite în 6 articole, iar cercetărilor efectuate în Rezervația științifică Iagorlâc au fost reflectate în 3 publicatii.

V. Chirtoacă împreună cu K. Vitko au cercetat flora ariei protejate "Cantemir". În baza cercetărilor efectuate au publicat articolul "*Растительный покров Кантемирского биологического заказника*". V. Chirtoacă împreună cu A. Istrati, Gh. Simonov au elaborat și în anul 1994 au expus la Congresul I al botaniștilor din Moldova raportul „*Contribuții floristice în lanșaflul natural Trebujeni*”. În acelaș an V. Chirtoacă împreună cu colegii de laborator A. Istrati, A. Negru, Gh. Popescu au prezentat la conferința botaniștilor lucrarea „*Flora rezervației „Iagorlic”*”. Împreună cu Șt. Lazu au cercetat ariile protejate din Ocolul silvic Ocnița. În baza cercetărilor efectuate în anul 2002 au elaborat lucrarea „*Ariile protejate din ocolul silvic Ocnița*”, care a fost expusă la conferința științifică "Dezvoltarea durabilă al sectorului forestier al Republicii Moldova".

V. Chirtoacă a adus un mare aport la construcția Grădinii Botanice din Chișinău. De la primele lucrări și până la sfârșitul vieții a activat la mai multe lucrări. O mare activitate a desfășurat la crearea Expoziției "Vegetația Moldovei". A participat activ la elaborarea microexpoziției de gorunet cu tei și frasin. A participat la lucrările de mobilizare a genofondului de plantare a arborilor, arbuștilor, ierburilor și a. Este autor și coautor a mai multe publicații științifice despre lucrările efectuate în această expoziție. Împreună cu N. Marcu în anul 1992 au publicat articolul „*Виды рода душистик Calamintha Mill. (Lamiaceae) в Молдове*”.

Generalizând cercetările floristice efectuate pe parcursul activității Dl. V. Chirtoacă pentru prima dată a evidențiat peste 20 specii noi pentru Republica Moldova, dintre care 8 specii de ferigi: limba șarpelui (*Ophioglossum vulgatum* L.), gymnocarpium ferigiform (*Gymnocarpium driopteris* (L.) Newm.), creasta cucoșului (*Polystichum aculeatum* (L.) Roth.), ferigă feminină (*Athyrium filix-femina* (L.) Roth.), ferigă cartuziană (*Dryopteris carthusiana* (Vill.) H. P. Fuchi), ferigă dilatată (*Dryopteris dilatata* = *Dryopteris austriaca* (Jacq.) Woyнар ex Schinz et Thell.), ferigă caucaziană (*Dryopteris caucasica* (A. Br.) Fraser-Jenkins et Corley). 3 specii de orhidee dumbrăviță (*Epipactis purpurata* Smith, *E. atrorubens* (Hoffm.) Bess.), poroinic-mascul (*Orhis mascula* (L.) subsp. *sygnifera* (Vest) Soó). De rând cu acestea au mai fost evidențiate prezența a două specii de Lamiacee – roiniță (*Melissa officinalis* L.) și izma-mentifolie (*Calamintha menthifolia* Host), Ciperacee – rogoz paniculat (*Carex paniculata* L.), Brassicacee – pana-zburătorului (*Lunaria annua* L.), Scrofulariacee – veronica jachini (*Veronica jacquinii* Baumg.), Ranunculacee – piciorul-cucoșului-auriu (*Ranunculus auricomus* L.), Onagracee – iarba-vrăjitoarei (*Circaea intermedia* Ehrh.) și din Asteracee – albăstrița-salonitană (*Centaurea salonitana* Vis.) și brustanul (*Telekia speciosa* (Schreb.) Baumg.). Din aceste 20 specii de plante găsite și popularizate de V. Chirtoacă 8 sânt incluse în Cartea Roșie a R.Moldova (toate polipodiofitele și câte o orchidacee (*Epipactis purpurata* Smit), cariofilacee (*Paronichia cephalotes* (Bieb.) Bess.), 3 specii sânt luate sub ocrotire de stat (*Telekia speciosa* (Schreb.) Baumg., *Carex paniculata* L., *Epipactis atrorubens* (Hoffm.) Bess.), iar 5 sunt declarate plante rare și nu sunt cuprins în lista speciilor luate sub ocrotire de stat. Patru specii sunt menționate ca prezente frecvent în flora locală.

V. Chirtoacă a participat activ la elaborarea colecției speciilor de plante rare autohtone din Grădina Botanică. În baza lucrărilor efectuate V. Chirtoacă împreună cu P. Pânzaru și A.Istrati au elaborat lucrarea „*Colecția de plante autohtone rare în Grădina Botanică din Chișinău*”, care a fost prezentată la conferința „*Bazele teoretice ale inverzirii și amenajării localităților rurale și urbane, 4-5 septembrie 1997*”. O altă colecție de plante autohtone V. Chirtoacă a organizat în Rezervația Codrii. Rezultatele de creare a acestei colecții de plante rare au fost publicate în lucrarea Chirtoacă V., Istrati A., Manic Șt. „*Plante rare în colecția rezervației „Codrii”*”. Aceste rezultate au fost relatate la conferința „*Rezervația naturală „Codrii” - 25 ani: Realizări, probleme, perspective*” în anul 1996.

V. Chirtoacă a fost conducător a lucrării de licență a studentei Balachina, unde a fost evidențiată componența floristică a microexpoziției de stepă din Grădina Botanică. În baza acestor cercetărilor în anul 2000 a fost publicată lucrarea „*Flora expoziției de stepă din Grădina Botanică din Chișinău*”, autori V. Chirtoacă, S. Balachin, Gh. Postolache.

V. Chirtoacă a adus aport și în alte domenii. A cercetat creșterea gorunului în condițiile tipului de pădure

gorunet cu scumpie. În baza cercetărilor efectuate în anul 1980 a elaborat lucrarea „Ход роста и ширина годовичного кольца деревьев в скумпиевой дубраве” care a fost publicată în Buletinul AŞM.

Pe parcursul activităţii ştiinţifice a elaborat 93 publicaţii, dintre care este coautor la 13 monografii. A participat activ la elaborarea lucrării Cartea Roşie a Republicii Moldova. Ediţia 2.

Din partea colegilor, colaboratorilor Grădinii Botanice şi celor care l-au cunoscut îi aducem celui care a fost modestul şi neobositul Vasile Chirtoacă acest omagiu cu prilejul a 80 ani de la naştere. Ne rugăm ca Domnul să-l odihnească în pace şi să-l aibă în pază, iar noi să-l pomenim ca pe un bun coleg şi un bun cunoscător a florei şi vegetaţiei Republicii Moldova.

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