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**BIOLOGICAL AND ECOLOGICAL
CHARACTERISTICS OF
DENDROFLORA OF THE
PODILLIA BOTANICAL GARDEN
OF VINNYTSIA NATIONAL
AGRARIAN UNIVERSITY**

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*The article describes the role and significance of the Podillia Botanical Garden as a park and monument of landscape architecture of the national significance. The main periods of the establishment of the Botanical Garden are outlined. The taxonomic structure of the cultivated dendroflora of the Botanical Garden is presented. The biomorphological and systematic structure of the cultivated dendroflora of the Botanical Garden is presented. According to 58% of the garden territory is occupied by the woody plants and shrubs, the rest 42% is the area of open spaces (lawns, project sites, water basins, roads). Analysis of the territory distribution is carried out. The largest number of genera has been revealed in the families of Rosaceae – 24 genera, Betulaceae – 9 genera, Fabaceae – 9 genera and Fagaceae – 7 genera. The total collection of the cultivated dendroflora in the Podillia Botanical Garden is represented by 97 species, 6 forms, which belong to 2 groups, namely Pinophyta and Magnoliophyta. This indicates a great value of these plants and the need for their preservation and restoration. The prospects of the use of introduced plants of the Botanical Garden for the arrangement of green spaces in the city of Vinnytsia is analyzed. Having analyzed the species composition of the introduced plantations of the Podillia Botanical Garden, it has been established that the most common introduced species of plants that can be used for the landscaping of squares, parks, lanes and solitaire plantings in the city of Vinnytsia are as follows: *Acer platanoides*, *Ácer negúndo*, *rÁcer rúbrum*, *Robinia viscosa*, *Betula pendula*, *Tilia platyphyllos*. As for the shrub species that can be used, they are as follows: *Berberis thunbergii*, *Forsythia europaea*, *Buxus sempervirens*, *Kerria japonica*.*

Keywords: *introduced plant, prospects, analysis, arrangement of green spaces, park and monument.*

Tabl. 4. Lit. 8.

Introduction. Botanical gardens are the cultural and educational institutions and research establishments, where the collections of flora are accumulated for the purpose of its study, conservation, cultivation and acclimatization. Botanical gardens are the objects of the biodiversity maintenance, which are experiencing a constant search and selection of plants that are promising for green plantations and other types of activities [1-2].

One of the objects of the green ring of the city of Vinnytsia is the Podillia Botanical Garden, which is located on the territory of Vinnytsia National Agrarian

University. The Botanical Garden is a scientific and methodical base for the applied research conducted by the students and scientists of Vinnytsia National Agrarian University in the fields of Floriculture, Ornamental Horticulture, Forestry, Forest Reclamation, Plant Physiology, Ecology, etc.

At the same time, the Botanical Garden is the base for the development of regional programs for the arrangement of green spaces, study of the eco-landscapes of Podillia, monitoring of rare and endangered plants. Availability of such an object in the University structure enables to maintain close contacts with the protected areas of Vinnytsia region and botanical gardens of Ukraine, to conduct scientific and practical cooperation with the regional gardening station, the Institute of Horticulture of NAAS and some other institutions[3-5].

Analysis of recent publications. The botanical garden was established according to the decision of Vinnytsia Regional Council approved on August 20, 1965 as a scientific center for the study of various issues in Botany, Plant Growing, Fruit and Vegetable Growing, Ornamental Horticulture and Floriculture [2]. Prokopchuk V.M. [8] this object was founded on a voluntary basis under participation of the staff of the Pedagogical Institute, technical schools, schools, and forest organization according to the schematic plan. The family of Halyna and Anatolii Palamarchuk became the founders and people who made an invaluable contribution to the formation of plant groups, selection of collections, construction and further development of the Botanical Garden.

Since the Botanical Garden was intended, first of all, to reproduce the richness of the flora of Podillia, the planting material from the nurseries and forestry enterprises of Vinnytsia region was used for planting trees and shrubs.

Today, the Podillia Botanical Garden is a park and monument of landscape architecture of the national significance that reveals the beauty and uniqueness of the Podillia dendroflora. Along with a great variety of scientific goals, the botanical garden is the finished landscape construction, where an important role is played by the formation of landscape compositions both at the separate sites and the entire garden as a whole [3,6].

Landscape compositions of the garden reveal the most interesting natural components of the surrounding landscape, resolve the architectural and planning interrelations on its territory in the best way, and they also highlight ornamental as well as artistic and aesthetic properties of plants [7].

The purpose of the work is to conduct taxonomic, biomorphological and systematic analysis of the studied dendroflora of the Botanical Garden and to analyze the prospects of the use of introduced species of the Botanical Garden for landscaping of the city of Vinnytsia.

Results and discussion. The Podillia Botanical Garden includes such divisions as arboretum; typological department of the Podillia forests; pomological department (fruit and berry crops); systematic department of herbaceous plants; department of ornamental plants; nursery of decorative and wild fruit and berry crops; department

of natural science and nature protection; a winter garden with a collection of subtropical plants that are unique for Podillia.

According to 58% of the garden territory is occupied by the woody plants and shrubs, the rest 42% is the area of open spaces (lawns, project sites, water basins, roads) (Tabl. 1).

Table 1

Balance of the territory of the Podillia Botanical Garden

№ п/п	Name of the area	Area, ha	%
1	Under green plantations	41,13	57,85
2	Under lawns	15,38	21,5
3	Under flowered shrubs	0,35	0,5
4	Under roads	7,55	10,5
5	Under project sites	0,96	1,35
6	Under water basins	4,15	5,8
7	Under buildings	1,78	2,5
	Total	71,25	100

Source: formed on the basis of own research results

In addition to the main compositional centers such as a pond, a central alley, park areas, a parterre and clearings located on the main route, the Botanical Garden also includes a rosarium, a syringarium, an arboretum, research sites of the Faculty of Agronomy and Forestry, greenhouses, a fruit nursery, a biostationary, a hothouse and an exhibition site of flower-ornamental plants.

One of the first objects founded in 2015 is the biostationary of woody plants and shrubs. The area of this site is over 0,35 hectares, and the collection includes more than 100 species of woody plants and shrubs and more than 20 species of herbaceous plants. Among them, there are over 25 varieties of Chinese aster and about 50 varieties of the hybrid tea rose.

At present, the biostationary includes the collection species of woody plants and shrubs in the amount of 411 pieces. Life forms of plants include 89 trees (21%), 322 shrubs (79%). As for the educational process, the nursery is the main object for gaining knowledge and practical training.

Under the guidance of Faculty members, the students are engaged in growing the seedlings of rare species of ornamental plants and vegetable crops, grafting of ornamental forms of boxwood and other coniferous plants in the greenhouse located on the territory of the Botanical Garden.

In order to replant and sell the planting material, the department regularly replenishes and improves the fruit and berry nursery. The nursery includes collections of strawberries, woody and repair raspberries, grapes, blackberries, currants, mother clonal wildings of apple-trees and pear-trees.

The Hunter's Corner, which was established so long ago, is used to broaden theoretical knowledge of students in specialty "Forestry and Landscape Management".

In April 2017, an expositional site of flowers and ornamental plants was established on the territory of the Botanical Garden. According to the plan, the site is divided into a parterre and a part of the flowers and ornamental plant species

The parterre part is a lawn with a logo of VNAU placed in the center, planted from annual Tagétes. The lawn is hedged with *Spiraea japonica* and *Ligustrum vulgare*, which emphasizes the English classical style of the predominant dwarf regularly mowed grasses of the lawn.

A part of the site with flowers and ornamental plant species is formed in the form of an ornament of embroidery, according to the project, which was created by the students in parterre specialty "Landscape Management". The central elements are octagonal stars within which *Canna indica* and *Salvia officinalis* having bright red flowers are planted. In addition, bright colors are added by such annual flowers and ornamental plant species as *Centaurea jacea*, *Tagetes*, *Zinnia élegans*, *Antirrhinum majus*, *allistephus chinensis*(L.) Nees, *Eschscholzia californica*. Among perennials there are *Iris barbata*, *Aster*, *Lilium*, *Dahlia* and others.

Topiary figures make the exposition site especially beautiful. At the moment these are only the elephant and the cactus, but this summer it is planned to replenish the exposition site with new topiary collections and create interesting landscaping compositions using sculptures and elements of vertical gardening.

Activities on the ornamental sites are not limited to work related to the formation of collections and excursions for a wide range of visitors. Active cooperation with domestic institutions such as the garden centers "Etis", "Amitis", "Sun-garden", "Tetiana's garden", "Vinnytsiazelenbud" is organized to exchange seeds and seedlings.

Recently, 260 ornamental shrubs were presented by the former student of VNAU and nowadays the director of the company "Decoplant" in order to form a collection of ornamental shrubs on the basis of the exposition site of the Department. Among them there are 160 shrubs of roses and ornamental bushes (*Hydránga*, *Cornus alba*, *Ligústrum*, *Forsythia*, *Spiraea*, *Deutzia* and others).

The botanical collections of the biostationary and the exhibition site perform a cognitive function, expand the outlook supplementing the excursions to nature, which promotes formation of a broader understanding of the variability of the life forms of flora, which is especially important for future experts in Forestry and Horticulture.

The biostationary and the exhibition site are a reliable scientific base for the research on the biological and morphological characteristics of plants, reproduction and establishment of certain patterns of interspecific interactions between different species of ornamental plants.

The taxonomic structure of the cultivated denroflora of the Botanical Garden reflects the internal structure and specific features of plant groups in the Podillia Botanical Garden (Table 2). An important and researched indicator is the number of taxons of different rank.

Table 2

Taxonomic structure of the cultivated denroflora of the Podillia Botanical Garden

No	Name of the group	Systematic units					
		classes	orders	families	genera	types	forms
1	Pinophyta	1	7	12	7	7	1
2	Magnoliophyta	1	85	102	95	90	5
Total		2	92	114	102	97	6

Source: formed on the basis of own research results

The results of taxonomic studies of the cultivated dendroflora of the Podillia Botanical Garden indicate that woody plants and shrubs are presented by 97 species, 6 forms, which are referred to 2 groups – Pinophyta and Magnoliophyta, 92 orders, 114 families, and 104 genera.

The main feature of plant adaptation to new environmental factors is a certain life form of plants. The use of plants of a certain biological type plays an important role in the creation of composition park landscapes [1].

Most authors define the life form as the adaptability to certain conditions of growth. I. G. Serebriakov described a more complete classification of life forms of plants as a particular group of plants, the specifics of which are expressed in their seasonal development, the ways of annual growth and restoration, originality of ornamental qualities that historically arose in certain soil-and-climatic as well as phytocoenic conditions reproducing adaptation of plants to these conditions [1, 3].

According to O. A. Kalinichenko, the life form is the appearance of plants, which reflects their adaptability to the environment in the process of phylogeny. Woody plants are defined as perennial plants with wooden stems and root systems. By the features of the stem structure, size regarding the conditions of growth, the woody plants are divided into such groups as trees, bushes, shrubs, semishrubs, lianas, plants-pillows. Each group of woody plants is distinguished by its ornamental capacity, which determines its use in the garden and park construction [4].

As for the life forms of the dendroflora in the Podillia Botanical Garden, the trees are dominating – 70 species (61%), there are also 38 species (34%) of bushes and 6 species (5%) of lianas (Table 3).

Table 3

Biomorphological structure of the cultivated dendroflora of Podillia Botanical Garden

No	Name of genus	Life form		
		tree	shrub	liana
1	2	3	4	5
The group of Pinophyta				
1	Pinaceae	7	-	1
2	Cupressaceae	3	-	-
3	Taxaceae			
4	Ginkgoaceae			

continuation of tabl.3

The group of Magnoliophyta				
5	Adoxaceae -	3	-	6
6	Araliaceae	-	-	1
7	Betulaceae	9	-	-
8	Fabaceae	6	3	-
9	Fagaceae	7	-	-
10	Berberidaceae	-	4	-
11	Celastraceae	1	-	-
12	Bignoniaceae	1	-	-
13	Salicaceae	3	-	-
14	Ericaceae	-	2	-
15	Vitaceae	-	-	2
16	Juglandaceae	2	-	-
17	Hydrangeaceae	-	5	-
18	Caprifoliaceae	-	3	-
19	Ranunculaceae	-	-	2
20	Tiliaceae	2	-	-
21	Kolkwítzia	-	1	-
22	Magnoliaceae	3	-	-
24	Oleaceae	5	-	-
25	Platanaceae	1	-	-
26	Rosaceae	9	18	-
27	Rutaceae	1	-	-
28	Buxaceae	-	1	-
29	Sapindaceae	4	-	-
30	Moraceae	1	-	-
Total		70	38	6

Source: formed on the basis of own research results

Conservation and restoration of the variability of the cultivated dendroflora on the territories of the Podillia Botanical Garden require a comprehensive analysis, allocation of systematic units for research and comparison.

The largest number of genera has been revealed in the families of *Rosaceae* – 24 genera, *Betulaceae* – 9 genera, *Fabaceae* – 9 genera and *Fagaceae* – 7 genera (Table 4).

Conclusions and prospects for further research. The total collection of the cultivated dendroflora in the Podillia Botanical Garden is represented by 97 species, 6 forms, which belong to 2 groups, namely Pinophyta and Magnoliophyta. This indicates a great value of these plants and the need for their preservation and restoration. Having analyzed the species composition of the introduced plantations of the Podillia Botanical Garden, it has been established that the most common introduced species of plants that can be used for the landscaping of squares, parks, lanes and solitaire plantings in the city of Vinniytisa are as follows: *Acer platanoides*, *Ácer negúndo*, *rÁcer rúbrum*, *Robinia viscosa*, *Betula pendula*, *Tilia platyphyllos*. As for the shrub species that can be used, they are as follows: *Berberis thunbergii*,

Table 4

**Systematic structure of the cultivated denroflora of the Podillyia
Botanical Garden**

No	Name of genus	Systematic units		
		Number of genera	Number of species	Number of forms
1	2	3	4	5
The group of Pinophyta				
1	Pinaceae	3	3	1
2	Cupressaceae	2	2	-
3	Taxaceae	1	1	-
4	Ginkgoaceae	1	1	-
The group of Magnoliophyta				
5	Adoxaceae -	3	3	-
6	Araliaceae	1	1	1
7	Betulaceae	9	6	-
8	Fabaceae	9	9	-
9	Fagaceae	7	-	-
10	Berberidaceae	4	4	-
11	Celastraceae	1	1	-
12	Bignoniaceae	1	1	-
13	Salicaceae	3	3	-
14	Ericaceae	2	2	-
15	Vitaceae	2	1	2
16	Juglandaceae	2	2	-
17	Hydrangeaceae	5	4	-
18	Caprifoliaceae	3	3	-
19	Ranunculaceae	2	2	2
20	Cornaceae	2	2	-
21	Tiliaceae	1	1	-
22	Kolkwítzia	1	1	-
23	Magnoliaceae	3	3	-
24	Oleaceae	2	2	-
25	Platanaceae	1	1	-
26	Rosaceae	24	24	-
27	Rutaceae	1	1	-
28	Buxaceae	1	1	-
29	Sapindaceae	4	4	-
30	Moraceae	1	1	-
Total		102	97	6

Source: formed on the basis of own research results

Forsythia europaea, *Buxus sempervirens*, *Kerria japonica*. Analysis of the prospects of using introduced plants of the Botanical Garden has shown that selection of the most acclimatized species of deciduous introduced plants for their further growing for the arrangement of green spaces in the city of Vinnytsia is possible, but this issue requires a comprehensive study of their ecological and biological characteristics.

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АНОТАЦІЯ
БІОЛОГО-ЕКОЛОГІЧНІ ОСОБЛИВОСТІ ДЕНДРОФЛОРИ БОТАНІЧНОГО
САДУ «ПОДІЛЛЯ» ВІННИЦЬКОГО НАЦІОНАЛЬНОГО
АГРАРНОГО УНІВЕРСИТЕТУ

В статті описано роль та значення ботанічного саду «Поділля», як парку-пам'ятки садово-паркового мистецтва загальнодержавного значення. Висвітлено основні періоди створення ботанічного саду. Подано таксономічну структуру культивованої дендрофлори ботанічного саду. Наведено біоморфологічну та систематичну структуру культивованої дендрофлори ботанічного саду. Серед життєвих форм дендрофлори у ботанічному саду «Поділля» переважають дерева – 70 видів (61 %), 38 видів (34 %) із них кущів та 6 видів (5 %) ліан. Найбільшою кількістю родів представлено родини: Розові (*Rosaceae*) – 24 роди, Березові (*Betulaceae*) – 9 родів, Бобові – (*Fabaceae*) – 9 родів та Букові (*Fagaceae*) – 7 родів. Загальна колекція культивованої дендрофлори у ботанічному саду «Поділля» представлена 97 видами, 6-ма формами, які відносять до 2-х відділів - голонасінні (*Pinophyta*) та покритонасінні (*Magnoliophyta*). Що свідчить про велику цінність даних насаджень та необхідність їх збереження та відновлення. Проведено аналіз розподілу території. Проаналізовано перспективність використання інтродуцентів ботанічного саду для озеленення міста Вінниці. Проаналізувавши видовий склад інтродукованих насаджень ботанічного саду «Поділля» встановлено, що найбільш поширеними інтродукованими видами рослин які можна використовувати для озеленення скверів, парків, алей та солітерних посадок у м. Вінниця є: клен гостролистий (*Acer platanoides*), клен ясенolistий (*Acer negundo*), клен червонолистий (*Acer rubrum*), акація рожева (*Robinia viscosa*), береза повисла (*Betula pendula*), липа великолиста (*Tilia platyphyllos*). З кущових видів, які можна використати: барбарис тунберга (*Berberis thunbergii*), форзиція європейська (*Forsythia europaea*), самшит вічнозелений (*Buxus sempervirens*), керія японська (*Kerria japonica*).

Ключові слова: інтродуцент, перспективність, аналіз, озеленення, парк-пам'ятка, культивований

Табл. 4. Літ. 8.

АННОТАЦИЯ
БИОЛОГО-ЭКОЛОГИЧЕСКИЕ ОСОБЕННОСТИ ДЕНДРОФЛОРЫ
БОТАНИЧЕСКОГО САДА «ПОДОЛЬЕ» ВИННИЦКОГО
НАЦИОНАЛЬНОГО АГРАРНОГО УНИВЕРСИТЕТА

В статье описано роль и значение ботанического сада «Подолье», как парка-памятника садово-паркового искусства общегосударственного значения. Освещены основные периоды создания ботанического сада. Подано таксономическую структуру культивированной дендрофлоры ботанического сада. Среди жизненных форм дендрофлоры в ботаническом саду "Подолье" преобладают деревья – 70 видов (61%), 38 видов (34%) из них кустов и 6 видов

(5%) лиан. Наибольшим количеством родов представлены семьи: Розовые (*Rosaceae*) – 24 рода, Березовые (*Betulaceae*) – 9 родов, Бобовые (*Fabaceae*) – 9 родов и Буковые (*Fagaceae*) – 7 родов. Общая коллекция культивированной дендрофлоры в ботаническом саду "Подолье" представлена 97 видами, 6-ю формами, которые относят ко 2-х отделов - голосеменные (*Pinophyta*) и покрытосеменные (*Magnoliophyta*). Что свидетельствует о большой ценности данных насаждений и необходимости их сохранения и восстановления. Приведены биоморфологическая и систематическая структуры культивированной дендрофлоры ботанического сада. Проведен анализ распределения территории. Проанализированы перспективность использования интродуцентов ботанического сада для озеленения города Винницы. Проанализированы видовой состав интродуцированных насаждений ботанического сада "Подолье". Установлено, что наиболее распространенными интродуцированными видами растений которые можно использовать для озеленения скверов, парков, аллей и солитерных посадок в г.Винница являются: клен остролистный (*Acer platanoides*), клен ясенелистный (*Acer negundo*), клен краснолистный (*Acer rubrum*), акация розовая (*Robinia viscosa*), береза повислая (*Betula pendula*), липа крупнолистная (*Tilia platyphyllos*). С кустовых видов, которые можно использовать: барбарис тунберга (*Berberis thunbergii*), форзиция европейская (*Forsythia europaea*), самшит вечнозеленый (*Buxus sempervirens*), керия японская (*Kerria japonica*).

Ключевые слова: интродуцент, перспективность, анализ, озеленение, парк-памятник, культивируемый.

Табл. 4. Лим.8.

Інформація про автора

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