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INVENTORY AND BIOECOLOGICAL ASSESSMENT OF DENDROLOGIC COLLECTION OF NIKITA BOTANICAL GARDENS

SUMMARY

Nikita Botanical Gardens is the principal centre of introduction and plant mobilization, including ornamental arboreal plants. A rich collection of arboreal ornamental plants was created due to work of several generations of researchers in Nikita Botanical Gardens. Arboretum of Nikita Botanical Gardens was and remains the most important object of planting and introduction testing of arboreal plants within South Coast of the Crimea. Dendrology investigations on Nikita Botanical Gardens territory are characterized by their integration: introduction, study of adaptation mechanisms and plant ecological plasticity, pest-, disease- and human influence-resistance of arboreal plants and shrubs. In recent decades fundamental works on introduction and bioecological study of new species and forms of ornamental plants have gained a great importance in Nikita Botanical Gardens. Based on rich empiric material it permits to assess introduction capacity of cultivated plants, improve selection system and work out recommendations for ornamental plants in development of landscape.

Key words: parks, ornamental plants, collection, inventory

INTRODUCTION

At present most parks of South Coast of the Crimea (SCC) are almost 200 years old. Therefore one of urgent problems is inventory with bioecological assessment of vital state and growth conditions of arboreal plants, the main structural element of landscape composition. Total area of SCC parks makes 2000 hectares. Nikita Botanical Gardens (NBG), founded in 1812, is the principal centre of introduction and plant mobilization, including ornamental arboreal plants.

Those objects which had been set at the beginning of NBG history, are still actual. First and foremost is to form the collection of ornamental and economically valuable plants, analyze their bioecological characteristics, reveal, select and propagate the most perspective plant species and sorts. As a result of long-term research work at mobilization and study of the world plant recourses, NBG has got collection fund of fruit, industrial, ornamental arboreal, shrub and flowering plants, which is one of the best in the world according to its species and forms. Nowadays urgent tasks are to maintain and increase the collection

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fund. That's why among first-priority directions are activation of ornamental horticulture development at NBG and deepen cooperation with leading botanical organizations from near-and-far-abroad countries.

In recent decades fundamental works on introduction and bioecological study of new species and forms of ornamental plants have gained a great importance in NBG. Based on rich empiric material it permits to assess introduction capacity of cultivated plants, improve selection system and work out recommendations on appliance of ornamental plants in landscape development (Plugatar and Klymenko, 2014; Plugatar *et al.*, 2014; Plugatar, 2015).

The aim of this study was to assess the current state of biological and ecological characteristics of dendrological collection at NBG.

MATERIAL AND METHODS

During inventory and making a list of plants the following symbols of life forms were used: deciduous breeds: 1 – tree, 2-shrub, 3-subshrub, 4-liana; evergreen: 5-coniferous, 6-foliage tree, 7-palm, 8-shrub, 9-subshrub, 10-low shrub, 11-branching rosellate tree (yucca), 12-bamboo, 13-liana, 14-half-evergreen shrub, 15-succulent cauline aphyllous shrub, 16-succulent rosellate plant (agave), 17-parasitic and half-parasitic shrubs, 18- coniferous and deciduous tree, 19-half-evergreen liana, 20-half-evergreen shrub, 21- redivive, 22-coniferous srub, 23-half-evergreen deciduous tree, 24-rambling subshrub.

According to drought-resistance all taxons are divided into 4 groups, resistant to summer drought (July-September) which is typical for subarid kind of Mediterranean climate: 0 – non-drought-resistant plants, suffering from air drought and lack of soil moisture even being irrigated regularly; 1 – plants being in need of soil moisture on South Coast of the Crimea, but rather air-drought-resistant; 2 – plants rather drought-resistant (air-drought-resistant and requiring soil moisture and irrigation in arid season; 3 – drought-resistant plants, growing without artificial irrigation in summer.

Frosting level was identified according to the following scale: 0 – shoots are not frosted over even in severe winter; 1 – tops of annual (last year`s) shoots freeze slightly, it concerns leaves of evergreen plants as well; 2 – annual shoots are destroyed by frost; 3 – biennial shoots are destroyed by frost; 4 – accretion of last 3 years is destroyed by frost, perennial branches of crown are considerably damaged; 5 – stem and branches till the snow level are completely destroyed (in case of lack of snow cover damages occur till the stem); 6 – a plant freeze slightly till cingulum but then renews completely; 7 – plant dies including root system (Kormilitsin, Golubeva, 1970).

RESULTS AND DISCUSSION

In the first half of the XX century the largest replenishment of Arboretum specific composition was carried out (1927-1937). In 1937, year of the 125th anniversary of NBG, collection of ornamental plants in the open ground included 1057 species and garden forms of trees and bushes. Evergreen deciduous and

coniferous plants made 1/3 of total species and form variety of garden dendrologic collection. In this period representatives of South and Central Japan, Central and South China were widely exposed on the territory of Arboretum 221 species, or 30% from total amount of species presented there. The second position was occupied by the representatives of flora from Mediterranean region - 90 species, or 12% of total amount (Fig. 1).



Figure 1. *Cupressus sempervirens* L., Mediterranean

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Concerning floristic and geographical regions plants from East Asia (45%) were exposed with the largest number of taxons (Fig. 2). Dominants plants among them were deciduous shrubs (39%) and trees (20%). Evergreen plants were mainly represented by shrubs (20%), less arboreal plants – 7%. Almost all bamboos and more than a half of liana species (54%) of Arboretum collection were introduced from this floral and geographical region. Plants of Mediterranean flora made 29%; they were presented in almost equal parts by deciduous (25%) and evergreen (23,3%) trees; deciduous shrubs made 22% while evergreen and half-evergreen shrubs – just 12%.



Figure 2. *Trachycarpus fortunei* (Hook.) H. Wendl., East Asia

The most detailed inventory list of NBG dendrologic collection with biometrical and bioecological characteristics of plants was published in 1970 (Plugatar, Klymenko, 2014). By that time 1228 species, 327 hybrids and garden forms (1555 names in total) which belonged to 90 families and 299 genera had grown on the territory of Arboretum. Deciduous cultivars made 59% of the total amount of arboretum plants, evergreen – ap. 41%.

NBG collection was mainly formed due to arboreal and shrub plants. In 1970 a number of taxons of arboreal plants in Arboretum parks made 656 units or 42,2% of total amount of ornamental plants, shrub taxons – 737 units (47,4%). That period liana collection was quite impressive – 128 taxons (8,2%). Subshrubs and shrubs were not numerous – 23 taxons (1,5%). Bamboos were presented by 11 taxons (0,7%) (Fig. 3).

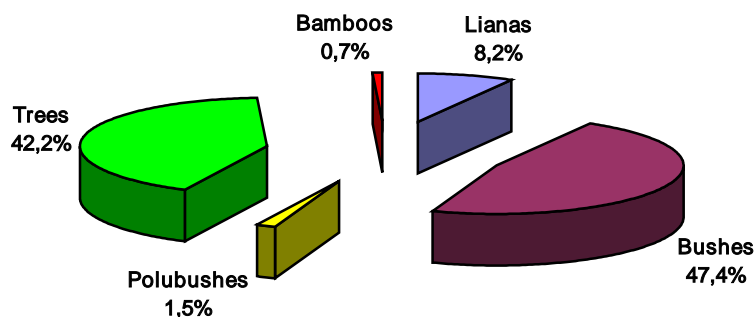


Figure. 3. Life form distribution of NBG Arboretum taxa in 1970

Species from North American occupied 19% of the total amount of arboreal plants, deciduous trees were dominant in that group – 28%; deciduous shrubs – 21%, evergreen and coniferous trees – 18%. All species of yucca and cactus (except of one cactus species) were delivered into NBG from North America (Fig. 4). Plants from Eurosiberian region and countries of southern hemisphere are not presented abundantly – 3%, mainly deciduous species (88%) in the first case and in the second case by evergreen plants – 72,5%.



Figure 4. *Yucca recurvifolia* Salisb., North America

Previous catalogue of dendrologic collection of NBG Arboretum was published in 1993 (Galushko *et al.*, 1993). It contained brief information about natural habitat, biological description according to winter- and drought-resistance, locality and a number of specimens of definite cultivars and forms within Arboretum territory. In accordance with catalogue data in early 90th of XX century total number of taxons in arboreal plant collection of Arboretum made 1797 taxons which in turn belong to 116 families.

In recent 20 years dendrologic collection undergo some changes (number of cultivars, specimens of diverse flora-geographical regions). Plants from East Asia were marked with the highest increase of cultivars (34 units more), which totally makes 592 units. Deciduous shrubs prevailed as well as in 1970 – 258 units, trees – 99 units. Evergreen plants are mostly presented by shrubs (92 units), less by trees – 8 units. Considerable reduction of the Mediterranean specimens occurred, either arboreal or shrubby plants. In 1970 total number made 353 cultivars, in 1990 it lowered till 252 units (Fig. 5).

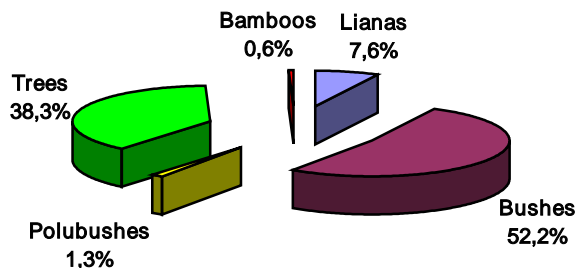


Figure 5. Life form distribution of NBG Arboretum taxons in 1990

A number of North American cultivars increased till 241 units: arboreal plants – 7 more units, shrubby – 3 more units, lianas – 1 more cultivar. A number of plants from Eurosiberian region and countries of southern hemisphere rose up to 64 and 44 units. A number of plants from Eurosiberian zone increased mostly due to arboreal deciduous plants.

According to analysis of plantation state and development in recent decades, collection of NBG Arboretum lost 157 taxons because of unfavorable factors during the period 1990-2014.

A number of shrubs decreased in a large measure – 88 taxons less or 58,4% of lost plants. A number of trees went down by 56 taxons or 35,7%. Loss of liana taxons (3,8% less), subshrubs and low shrubs (2,0% less) occurred as well.

The main reasons causing reduction of dendrological collection are extreme weather conditions: extremely dry period 1993-1994 and anomalously low

temperatures in March of 2006 and February 2012. Therefore it's important to reveal main limiting factors, which determine capacity of growth and development of introduced plants in dendrologic collection of NBG.

According to drought-resistance taxons, specimens of group №1 (plants, requiring soil moisture on SCC, but air drought-resistant) mainly reduced their number. The second place was taken by plants from group № 2 (33,8%) - plants rather drought-resistant, air-drought-resistant and requiring soil moisture and irrigation in arid season. Taxons of group № 0 (non-drought-resistant plants, suffering from air drought and lack of soil moisture even being irrigated regularly) made 8,9% of total lost plants. Plant group № 3 (drought-resistant plants, growing under conditions of SCC without artificial irrigation in summer) was characterized by minimal loss – 7,0%.

Therefore specimens of groups, diametrically opposite according to drought-resistance level, are characterized by approximately similar loss, what indicates that under conditions of NBG Arboretum moisture level isn't the main limiting factor which determines successful introduction of ornamental arboreal and shrubby plants.

Assessment of low temperature-resistance of lost taxons shows that destroyed by frost plants to a large degree are specimens of group № 2, characterized by frost-killing of annual shoots in previous years. Specimens of groups № 0 and 1 had close data of loss – 14,6% and 17,9%. So the main climatic factor limiting growth and development of ornamental plants in the parks of NBG Arboretum is temperature regime during winter and spring period.

Extension of dendrological collection due to new cultivars of arboreal and shrubby plants was considerably activated in the beginning of XXI century. During period 2007-2015 clumps of Arboretum were replenished by 98 new taxons-585 specimens. Currently the following genera are presented by maximum number of taxons: *Berberis* L., *Cotoneaster* Medic., *Cupressus* (Tourn.) L., *Forsythia* Vahl., *Laurocerasus* Roem., *Ligustrum* L., *Lonicera* L., *Nerium* L., *Philadelphus* L., *Pinus* L., *Pyracantha* Roem., *Quercus* L., *Spiraea* L., *Thuja* Tourn., *Viburnum* L., *Yucca* L.

CONCLUSIONS

Gardens and parks of SCC, particularly of nearshore, are of great architectural, art, scientific and practical values. Therefore one of urgent problems is inventory with bioecological assessment of vital state and growth conditions of arboreal plants - the main structural element of landscape composition. Dendrology investigations on NBG territory are characterized by their integration: introduction, study of adaptation mechanisms and plant ecological plasticity, pest-, disease- and human influence-resistance of arboreal plants and shrubs. In recent decades fundamental works on introduction and bioecological study of new species and forms of ornamental plants have gained a great importance in NBG. Assessment of low temperature-resistance of lost taxons shows that destroyed by frost plants to a large degree are specimens of group, characterized by frost-killing of annual shoots in previous years. So the

main climatic factor limiting growth and development of ornamental plants in the parks of NGB Arboretum is temperature regime during winter and spring period.

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