Modern Collection Fund of the Laboratory of Ornamental Plants of the Main Botanical Garden of the Russian Academy of Sciences as a Source of Genetic Resources for Breeding

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***Abstract*—The current policy of forming the collection fund of the laboratory of ornamental plants of the MBG RAS is aimed at creating not only large, but also unique collections that can be in demand in various aspects of research work. Thus one of the most actual and obvious basic directions of use of resources of a collection fund is the organization on its basis of selection work. So, it can be used as a source of formation of working collections for realization of two most often applied principles of selection of pairs for crosses: ecological and geographical and on a complex of economic and biological signs. The aim of the work is to create varieties of ornamental plants based on the use of genetic resources of the collection background of MBG RAS.**

Representatives of 4 generic complexes from the collection fund of the laboratory of ornamental plants of MBG RAS: *Astilbe, Dahlia, Iris* and *Phlox* were used as model objects. The creation of populations for selection is carried out using artificial inter-port and interspecific hybridization, as well as free and limited-free pollination. In the selection of parent pairs and the selection of maternal forms (with free pollination), the concept of the trait is mainly applied. Selection is carried out mainly from populations of F_1 hybrids. The method of selection is individual, according to the complex of decorative and economically valuable features. Currently, 6 breeding numbers have been prepared for transfer to the state selection test: 4 representatives of the genus *Dahlia* and 2 representatives of the genus *Astilbe*.

Keywords—MBG RAS, collection fund, herbaceous perennials, selection process, working collections, prospective breeding numbers

I. INTRODUCTION

In the modern conditions of globalization, the functions of Botanical gardens are constantly expanding. This led to the formation of a steady trend of consolidation and multivariate use of their collections.

Currently, created on the basis of three classical methods of introduction (ecological-geographical, phytocenotic and method of generic complexes), the collection fund of the laboratory of ornamental plants (LOP) of MBG RAS has 1055 species and varieties, as well as 4995 varieties and garden forms. The current policy of its formation is aimed at creating not only large, but also unique collections that can be in demand in various aspects of research work [1].

Creation of varieties of ornamental plants based on the use of genetic resources of the collection fund of MBG RAS.

II. EXPERIMENTAL

Representatives of 4 generic complexes from the collection fund of the laboratory of ornamental plants MBG RAS were used as model objects: *Astilbe* Buch.-Ham., *Iris* L., *Dahlia* Cav. and *Phlox* L.

The creation of populations for selection is carried out using artificial inter-port and interspecific hybridization, as well as free and limited-free pollination. In the selection of parent pairs and the selection of maternal forms (with free pollination), the concept of the trait is mainly applied. Selection of the best genotypes is carried out mainly from populations of F1 hybrids. The method of selection is individual, according to the complex of decorative and economically valuable features [2-4].

III. RESULTS AND DISCUSSION

In the modern world-trends in exploitation of genetic resources scientific collections of Botanic gardens can be used for the purposes of plant breeding as a source of the formation of working collections – a key element of the classical scheme of the selection process and subsequent implementation on the basis of their two most frequently used principles of selection of pairs for mating [2, 4].

Ecological and geographical principle. One of the General conditions of its application is the presence of large-scale field genetic banks. And in the process of

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introduction studies, the use of the method of generic complexes allows to effectively form large collections. On its basis in LOP created monocellate such herbaceous perennials as *Paeonia* L. (6 species, 480 varieties), *Phlox* (8 species, 185 varieties), *Tulipa* L. (33 species, 316 varieties), *Lilium* L. (5 species, 241 varieties), *Astilbe* (8 species, 132 сорта), *Hemerocallis* (10 species, 201 varieties), *Hosta* Tratt. (8 species, 91 varieties), *Narcissus* L. (1 species, 345 varieties), *Dahlia* (2 species, 151 varieties), *Dendranthema* Des Moul. (107 varieties), *Iris* (12 species, 204 varieties). In this case the model object for the implementation of this principle on the basis of the above condition is a meeting of representatives of the genus *Dahlia*. The main difficulty for the implementation of directed hybridization of this culture is belonging to the group of trimonoceic plants [5]. Therefore, the method of free pollination is used in MBG RAS.

The selection of promising genotypes is carried out on several main grounds: the type of inflorescence (mainly double forms); early and abundant flowering; stability during winter storage; stunting; decorative leaves (mainly due to the colored leaves).

Currently, 35 of the most promising samples have been selected. 4 cultivars have been prepared for transfer to the state agricultural testing.

C-11-25 (♀ 'Mariska Hiska'). 2011 selection. Group nymphaeum. Inflorescence of unusual shape as a result of reduction of reed flowers; color-green. The leaves are large, dark green, with an anthocyanin tinge. Bush compact, erect, with dark colored shoots, height of about 140 cm. Preliminary name – 'Himera'.

C -08-01 (♀ 'Alstergrus'). 2008 selection. Group semi-cactus. Inflorescences with a diameter of 12–14 cm, mostly directed upwards. Lingual flowers elongated (5–7 x 2 cm) with twisted 1/3 tips; pink with yellow streaks and a spot at the base, the reverse side is lighter. Terry more than 50. Flowering is abundant. Bush spreading, height of about 110 cm. Preliminary name – 'Prima Balerina'.

C-12-93 (♀ 'Yellow Star'). 2012 selection. Group decorative. Inflorescences diameter of 18 centimeters, directed the upper hand and a bit in side, Peduncles robust, light painted, – 40 see Uvular flowers broad 7cm's 3cm, slightly twisted have founding. The color is pink, with a yellow spot at the base, the reverse side is lighter. Terry more than 50. The leaves are large, 3-5 lobed with rarely sawn edges. Bush spreading, height 100 cm Flowering abundant, from early August to frost. Preliminary title – 'Vera'.

C-13-32 (♀ 'Staphania'). 2013 selection. Group decorative. Inflorescences directed upwards, 18–20 cm in diameter on strong peduncles 30 cm long. Lingual flowers elongated 7–8 cm x 2.5 cm, slightly twisted at the base. The color is light orange, darker on the reverse side. Terry more than 40. The leaves are dark green, large, 3–5 lobed, rarely with serrated edges. The Bush is compact, 130 cm high. Flowering is abundant, from the III decade of July to frost. Preliminary title – 'Zarnica'.

One of the modifications of the use of the ecological and geographical principle is the involvement in the selection process of collections, on the basis of which the preservation of the maximum possible number of varieties that make up the world assortment of culture is effectively realized in the field Bank. As part of the modern collection fund of LDP a collection of representatives of the genus *Astilbe*, comprising about 50% of the world assortment of this crop (132 varieties) [6]. In this direction, the present collection is an uncontested model object for selection work.

In the LOP 3 models of a grade are accepted: 1.compact plant size, early flowering, broad paniculate inflorescence; 2. the average size of the plant, the bright color of the leaves, the absence or strong reduction of petals; 3. large plants with abundant and early flowering.

The use of genetic resources of natural flora is a new direction of Astilbe breeding in the LOP of MBG RAS. For the study and evaluation involved 2 species – *Astilbe microphylla* Knoll and *A. biternata* (Vent.) Britt., previously practically not used in selection work. Both taxa differ not typical for most natural species shape and texture of the leaf. In addition, *A. biternata* is characterized by early flowering periods.

Currently, 2 breeding numbers have been prepared for transfer to the state variety testing.

A–10-11 (preliminary title – 'Olen'ka'). 2011 selection, from free pollination varieties 'Gloria'.

Tall 95-100 cm Leaves up to 40 cm Inflorescence large, 34 – 35 cm long, slightly drooping. The aroma is moderate. The petals are narrow (length – 0.7 cm, width – 0.1 cm) with an elongated apex. The General color of the inflorescence is light purple (77 D, according to the encoding RHS Colour Chart); the Central axis at the bottom is light yellowish-green, at the top almost white (with a slight pink tinge). The color of the petals is light purple (77 D), the calyx is large, white with a pink tinge (36 D). Anthers gray, staminate filaments light purple; pistil-light pink. Characterized by a long flowering period (The first ten days of July - first decade of August). Aroma is moderate.

A–05-16 (preliminary title – ‘Lyudmila’). 2018 selection, from the population from free pollination As-2014.

The inflorescence is paniculate. The General color of the inflorescence is light lilac-pink. Petals are large enough with a narrow base, expand to the top and acquire an oval shape, length – 0.5–0.6 cm, width-0.1–0.2 cm, white color – 155 A. Calyx light yellow-white – 4 D. Anthers are blue with a gray tinge. The stamens are light purple-pink. The pattern is characterized by a very interesting from a decorative point of view contrast between the color of the petals and stamens. The pistil is yellowish-white. The leaves are dark green. The color of the Central axis at the base is light green, closer to the top-white, the axis of the second order-white. The scent is faint.

Another important condition for the implementation of the ecological and geographical principle of selection of pairs is a high degree of adaptation to local environmental conditions of at least one of the components of crossing. This makes it possible to effectively use the introduced varieties of domestic selection available in the collections of LOP. The formation of this part of the collection fund in the last decade is one of the strategic directions of research

work, as it contributes to the preservation of national breeding achievements. Therefore, the main principle of forming collections for such genera as *Dendranthema*, *Lilium*, *Phlox* and *Paeonia* is the maximum attraction of varieties of domestic selection. At the same time the most promising for the implementation of breeding work is the collection of the genus *Phlox* dominated by a representative sample of domestic varieties *Ph. paniculata* hort.

Selection of breeding material is carried out on the basis of several characteristics: Corolla color (mainly brightly colored and / or with the original color-rings, spots, color transitions), linear dimensions (small-flowered) and non-standard shape (stellate, rounded) Corolla, timing (early flowering) and flowering duration (more than 1–1.5 months), plant height (mainly stunted) and Bush shape (dense, compact, not lodging).

Currently 23 of the most promising samples have been selected from breeding nurseries of different years.

In recent years the collection of representatives of the genus has been significantly expanded *Aster* L. [7], which according to the inventory of 2019 has 7 natural species and 57 varieties. Since 2012, on its basis, the variety study of asters is carried out in order to select parent forms for the selection of culture for early flowering and compact habitus of the Bush. Now the working collection including 10 varietals is formed.

Selection of pairs according to the complex of economic and biological features, assuming complementarity of crossing components according to the selected features, can also be implemented on the basis of large collections or core collections. In some cases, retro varieties may be used as a source of genetic material.

The collections of LOP contain a set of retro varieties on such crops as: *Iris*, *Astilbe*, *Paeonia*, *Phlox*, *Hemerocallis*, *Dendranthema*, *Narcissus*. They can be used as a source of high adaptive potential, which probably determines the high stability of hybrids in culture. At the same time, the most promising for the creation of the selection process, in our opinion, are *Hemerocallis*, *Dendranthema* and *Narcissus*.

The collection of varieties in LOP *Iris x hybrida* hort., along with the collection of varieties *Astilbe*, it is typical in the aspect of implementation of the principle of creating a sample of cultivars representing the main stages of microevolutionary development of culture, which also allows the selection of pairs on the basis of a complex of economic and biological characteristics [8-9].

The model object in this direction is Iris x hybrida Thus selection work includes two directions: 1) hybridization of the grades belonging to one garden group and characterized by any unique or a little widespread signs (colouring of a flower, habitus of plants, morphological features of a perianth); 2) crossing of the most perspective grades belonging to different garden groups.

Currently selected 7 of the most promising breeding numbers of hybrid F_1.

At the stage of reproduction with the prospect of transfer to the state testing of varieties are 2 breeding numbers.

I 36-2012-2017, hybrid F_1 ('Honey Glazed' x hybrid from *I. aphylla*). Hybridization of 2012. Selection 2017. Selected mainly on the architectonics of the inflorescence and coloristic characteristics of the perianth.

Medium-sized, a group of Miniature tall Bearded irises – MTB (according to the classification of The American society of iris). Height 45–50 cm. Perianth orange-yellow medium tone, at the base of the perianth lobes - more intensely colored. Beard dark blue, large, contrasting.

I 68-2014-2018, hybrid F_1. ('Cimarron Rose' x 'No Contest'). Hybridization of 2014. Selection 2018. Selected based on color characteristics of the perianth.

Stunted, a group of Standard dwarf Bearded irises – SDB (according to the classification of The American society of iris). Height 32–35 cm. Perianth light brown-Burgundy with a yellowish tinge, in the center of the lower lobes-a small purple-Burgundy spot with indistinct edges. The beard is dull orange at the base, brown at the end. Under the beard a well-defined brown-yellow area with dark brown veins.

IV. Conclusion

Modern collection fund of LOP in MBG RAS is used as a base for breeding work. Thus as model objects 4 generic complexes are accepted: *Astilbe*, *Dahlia*, *Iris*, *Phlox*.

The formation of working collections is carried out taking into account the further implementation on their basis of the two most commonly used principles of selection of pairs for crosses: ecological and geographical and the complex of economic and biological characteristics.

6 breeding numbers have been prepared for transfer to the state testing of varieties: 4 representatives of the genus *Dahlia* and 2 – of the genius *Astilbe*.

Thus, in our opinion, in modern conditions genetic resources of collection fund of Botanical gardens can be used in selection of ornamental plants, first of all, as a base for formation of working collections and, accordingly, creation on their basis of populations for selection.

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