

COLLECTION OF *PELARGONIUM* GENUS: HISTORY OF FORMATION AND DEVELOPMENT PROSPECTS

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Abstract

The paper considers some problems in collection formation of the most numerous representative from *Geraniaceae* (L.) family of *Pelargonium* L. Herit. genus, as well its importance, replenishment prospects and use. Natural distribution area of pelargonium is Cape region, located in subtropical zone, in the far south-west of Africa. Subtropical areas of Russia are the most northern subtropics in the globe. The amount of warmth here corresponds to the limit boundary of the world's subtropical areas, which allows to successfully introduce many valuable ornamental and fruit crops. At the same time, there is a number of adverse climatic features, which complicate the process of plants adaptation. More than 150 species, cultivars and garden hybrids of *Pelargonium* are cultivated in the collection of the garden-museum "Tree of Friendship" of the All-Russian Scientific and Research Institute of Floriculture and Subtropical Crops. The main groups are represented, among which the most numerous group of the following high-ornamental pelargoniums are: *P. zonale* L.Herit., *P. grandiflorum* Willd., *P. peltatum* (L.) Ait., *P. tomentosum* L'Herit., *P. capitatum* Ait., *P. cucullatum* Ait., *P. odoratissimum* (L.) L'Herit. ex Ait., *P. fragrans* Willd., *R. roseum* Willd. Ecological and biological characteristics of specific pelargoniums are studied. It is determined that fragrant and specific pelargoniums have a high adaptive capacity. It is also revealed that the most adapted group includes *Pelargonium crispum* Ait. and its hybrids. Collected samples are used to create highly ornamental hybrids with valuable economic features. New varieties of zonal and large-flowered pelargoniums are registered in the State Committee of the Russian Federation. In this work the prospects of using the most adapted species, cultivars and hybrids in urban landscaping of Black Sea coast were studied.

Key words: *Pelargonium*, *Geraniaceae*, collection, introduction, perspective species

Natural habitat of *Pelargonium* (L. Herit) distribution is Cape region located in the south- west of Africa. Aboriginal flora of this region is a rich source of ornamental plants, many of which have become a part of the global floriculture. These are the following: *Pelargonium*, *Amaryllis*, *Clivia*, *Freesia*, *Gerbera*, *Plumbago* etc., some of them are successfully cultivated in Russian subtropics (Alehin et al., 1961; Van der Walt, 1977).

Subtropical areas of Russia are the most northern subtropics in the globe. The climate here is warm and humid, with mild winters, hot summers, long cold spring and a long warm autumn. The average annual temperature ranges from 13 to 14 °C. Rainfall is from 1530 to 1250 mm, but it is unevenly distributed during the seasons. It mostly rains in winter; spring and summer are long drought periods. The amount of warmth corresponds to the limiting boundary in world subtropical areas, which allows the cultivation of many valuable ornamental and fruit crops successfully (Sapiev et al., 1997).

Analysis of the climatic characteristics in the humid subtropical zone of Russia suggests that there is a number of abiotic and biotic stress factors affecting the

introduced plant species. Among the abiotic stressors the following should be noted: low winter temperatures, high summer temperatures due to the lack of air and soil moisture, as well as the increased insolation. Among the biotic stressors, an important role is played by epiphytotics of diseases such as gray mold (*Botrytis cinerea* Pers.), black mold (*Pythium* sp.), powdery mildew (*Sphaerotheca pannosa* Lev. var. *rosae* Woron), as well as pests – cyclamen mite (*Tarsonemus pallidus* Banks), greenhouse whitefly (*Trialeurodes vaporariorum* Westw.) etc.

Plants usually adapt to the negative impact of unfavorable environmental factors through various anatomical and morphological mechanisms (pubescence of shoots and leaves, thickening of epithelial tissue and waxy surface on leaves, as well as protective cork layer on shoots). In addition, plants can use their physiological characteristics that contribute to the reduction of transpiration rate, accumulation of sugars and anthocyanins in cells. From this perspective, the representatives of *Pelargonium* species have a great potential for introduction into the Russian subtropics (Gutiyeva, 2007; Van der Walt and Vorster, 1981).

Over the past decades, the popularity of this culture has significantly increased in Russia. Thanks to nonproblematic reproduction and low requirements to growing conditions, zonal, large-flowered and ivy-leaved pelargoniums became one of the most popular flower-and-ornamental plants. However, the potential of native species and hybrids of *Pelargonium* genus is not over yet, since the diversity of its life forms is large. Among them there are trees and shrubs, evergreen and deciduous species. Some of them have a vertical growth pattern, while others are procumbent. These groups vary in size and texture, shape, colour, fragrance of leaves and flowers; they can be grown on different parts of the relief with well-drained soils. The basic biological requirements of these plants correspond to environmental factors in subtropical Black Sea coast that is why assortment replenishment of flowers and ornamental plants used in landscaping is relevant due to the diverse genus representatives.

The purpose of the study is to identify cultivars and forms of *Pelargonium* with high ornamental and economic characteristics and flexible biological properties, and which are adapted to the climatic conditions of the Russian subtropics from the existing global diversity of *Pelargonium* genus, as well as to preserve the gene pool for further use.

MATERIAL AND METHODS

The research objects are species and cultivars of *Pelargonium* genus. Selection of the cultivars for inclusion into the collection is conducted on the basis of comprehensive study of the experience of botanical gardens, as well as on the basis of getting acquainted with international and local catalogue. The majority of samples are received in the exchange. The plants are grown from seeds and stem cuttings. Lays of the experiments, as well as observation and evaluation of the cultivars are carried out by "Method of comparative evaluation of ornamental cultivars (Bulov, 1978). The cultivars are evaluated by a 100-point scale with a complex view of ornamental and economically useful features. The studies on the economic and biological features of the initial forms are conducted according to the methodological guidelines (Zinina, 1981; 1985). M. A. Odegova's scale is used to evaluate the introduction results (Odegova, 2008), which is modified for pelargonium.

Collection samples are cultivated in compliance with the basic agro technical measures for conservation and breeding. Updating of mother plants is performed at the age of 3-5 years.

RESULTS AND DISCUSSION

More than 150 species, cultivars and garden hybrids of *Pelargonium* L. Herit. are cultivated in the collection of the garden-museum "Tree of Friendship" of the State Research Institution All-Russian Scientific

and Research Institute of Floriculture and Subtropical Crops – Russian Academy of Agricultural Sciences. The main highly-ornamental groups are represented, among which there are the most numerous large-flowered pelargoniums (*P. grandiflorum* Willd.), zonal (*P. zonale* L'Her.), and ivy-leaved (*P. peltatum* (L.) Ait.), as well as species of *P. graveolens* (L'Her), *P. tomentosum* (L'Herit), *P. capitatum* (Ait.), *P. cucullatum* (Ait.), *P. odoratissimum* (L.) L'Herit. ex Ait), *P. × fragrans* (Willd.), *P. roseum* (Willd.) etc.

Formation of the collection was started in 2000. In the early stages it included mainly zonal pelargonium cultivars and to a less extent large-flowered and ivy-leaved (German breeding, PAC Elsner company). With the expansion of the assortment and emergence of new foreign selection products on the Russian market (English, Australian, American, French, etc.), the collection included cultivars and hybrids of angels and fragrant *Pelargonium* species. Currently 150 cultivar samples are divided into 9 groups (Table 1). The collection value is determined by the diversity of *Pelargonium* genus represented groups. It is especially important to have species, fragrant and succulent pelargoniums from rare sections of this genus (*Otidia*, *Reniformia*, *Ciconium* etc.).

It is well known that successful adaptation requires resistance of new species to adverse environmental factors, as well as seasonal rhythm of development and dynamics of growth processes, including peculiarities of reproduction in culture. As we included new samples into the introduction study, the following principles were foreground for us: their belonging to the different life forms; involvement of rare species and cultivars, which are rarely found in the collections as well as species that are not only ornamental, but also have useful properties (phytoncide and medicinal).

To assess the introduction results M. A. Odegova's scale was used (Odegova, 2008). According to a five-point scale modified for pelargoniums, the following characteristics were evaluated: completeness of phenological stages; plants ability to vegetative and seed reproduction; phytoncidal properties; defectiveness by

Table 1. Composition of *Pelargonium* genus collection

№	Name of the group	Cultivars number,	
		piece	%
1.	Species	12	8
2.	Zonal	26	17
3.	Regal	47	
4.	Ivy-leaved	10	7
5.	Angels	14	9
6.	Scented-leaved	12	8
7.	Succulent	2	2
8.	Uniques	1	1
9.	Species hybrids	26	17

Table 2. Introductory evaluation of some *Pelargonium* species

Name of species	Point scoring assessment on indicators					
	1*	2	3	4	5	general point
<i>P. capitatum</i> (Ait.)	5	4	5	4	4	22
<i>P. × fragrans</i> (Willd.)	5	5	5	4	5	24
<i>P. crispum</i> (Ait.)	5	4	5	4	5	23
<i>P. roseum</i> (Willd.)	5	4	4	5	5	23
<i>P. denticulatum</i> (Jacq.)	5	4	5	4	5	23
<i>P. cucullatum</i> (Ait.)	5	5	4	4	4	22
<i>P. odoratissimum</i> (L.) (L'Herit. ex Ait.)	5	4	4	4	5	23
<i>P. vitifolium</i> (L'Herit.)	5	4	4	5	4	22
<i>P. tomentosum</i> (L'Herit.)	5	3	3	4	4	19
<i>P. quercifolium</i> (L'Herit.)	5	3	4	4	4	20
<i>P. limonium</i> × Sweet.	5	4	5	5	5	24
<i>P. inquiensis</i> (Ait.)	5	5	5	3	4	23

pests and diseases. After summing the scores (Table 2) by the indicators, we have selected *Pelargonium* species: promising (21 – 25 points), not very promising (16 – 20).

The completeness of phenological stages passed by plants is a significant indicator of plants adaptive capacity to introduction conditions. Flowering, fruit formation and seeds of full value mean high adaptive capacity. According to the indicator called “completeness of phenological stages”, pelargoniums had 5 points after completing the whole development cycle, including fruiting; 4 points were received by plants that blossom but give no fruits. There were not any nonflowering samples. After summing the points on indicators, there were identified promising – *P. capitatum* (Ait.), *P. × fragrans* (Willd.), *P. crispum* (Ait.), *P. roseum* (Willd.), *P. denticulatum* (Jacq.), *P. cucullatum* (Ait.), *P. odoratissimum* (L'Herit. ex Ait.), *P. vitifolium* (L'Herit.), *P. limonium* × Sweet., *P. inquiensis* (Ait.), and not very promising species of *P. tomentosum* (L'Herit.), *P. quercifolium* (L'Herit.).

During the process of selection studies we have established very complex heterozygous nature of pelargonium cultivars. This is confirmed by the fact that pollen of many cultivars of this culture is often not equalized and has a disturbed pollen shell that causes outpouring of pollen grain content (Tsatsenko et al., 2011). Genetic imbalances of such cultivars contribute to a large diversity of biological and morphological characters in the hybrid offspring. When selecting forms with preset attributes the work is complicated by the fact that hybrids may have unpredictable changes in the type of mutation during vegetative reproduction. Therefore, starting with the selection, it is necessary to clearly define the main expressed features in future cultivars, which ensure their high ornamental value.

It should be noted that selection of cultivars according to features controlled by polygenes on phenotype

does not necessarily lead to the desired result. Superficially similar forms may have different genetic structure of this character and, naturally, they transmit it to posterity in different ways.

Intervarietal hybridization analysis carried out during the years of selection research (Gutiyeva, 2011) in the given Institute allowed to identify some promising economically valuable recombinants and several productive families (high yield of ornamental and relatively stable forms; mono-colour flower; compact bush form). Some promising forms from these families, having positive qualities that have given the rise to new cultivars, which exceed parental forms in their flexibility and ornamental value were identified.

The collection of *Pelargonium* genus has been cultivated with the aim to maintain gene resources and identify valuable features in collection samples for new breeding programs. Use of the sources with known phenotypic structure in selection allows to select parental pairs purposefully and increases the likelihood to obtain the planned result.

Promising direction in breeding research is the creation of interspecific hybrids, which will provide a wide range of new formations in form, structure, colour etc. Including the methods of tissue culture to this work, in particular the culture of immature embryos will overcome the incompatibility problems, especially in cases of species crossings belonging to different sections of the genus.

Collectible Pelargoniums are widely used in various research and production programs. They are indispensable in creating ornamental compositions in gardens, parks, streets and on balconies.

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