

## The origin of Herbaceous hybrid Group peony cultivars of the M. M. Gryshko National Botanical Garden of NAS of Ukraine collection and the prospects for their use

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**Purpose.** To analyze the origin of the Herbaceous Hybrid Group peony cultivar collection of the M. M. Gryshko National Botanical Garden (NBG) National Academy of Sciences of Ukraine (NAS) and to determine the prospects for their use in breeding work and decorative horticulture. **Methods.** The object of research was peonies of the Herbaceous Hybrid Gp of the NBG peony collection. The plants are grown on sunny open experimental and exposition plots of the NBG. Cultivars studies and phenological observations of plants were carried out during 2012–2022. **Results.** Varietal diversity of Herbaceous Hybrid Gp peonies of the NBG collection was analyzed by origin. The analysis showed that 122 varieties were created by US breeders, of which the Saunders breeding is represented by the largest number of varieties in the collection. 38 varieties are of Ukrainian breeding and created in the NBG. The analysis of hybrids obtained by distant crosses made it possible to identify combinations that give fertile offspring and to create promising double and triple hybrids. For decorative horticulture, 165 varieties of world and domestic breeding are recommended. They were grouped into four groups by flower color and two groups by the beginning of flowering. Plants of the early group start flowering before May 22 ( $\pm 4$  days). The flowering of the late group of varieties occurs at the beginning of the flowering of the variety 'Red Charm' (May 22  $\pm 4$  days) and later. **Conclusions.** For more than 50 years of introductory work with peony Herbaceous Hybrid Gp, 133 varieties of world breeding were tested at NBG. The main number of varieties was included in the collection in the first years of the 21st century. A comparative study of new varieties showed that most of them are sterile. Varieties 'Dreamtime', 'Greenland', 'Quitzin', 'Lavender Whisper', 'Lemon Chiffon', 'Pastelegance', 'Pastelorama', 'Salmon Dream', 'Sunny Boy', 'Sunny Girl', 'Sunny Day', 'The Mackinac Grand', 'Vanilla Schnapps', 'Triphena Parkin', 'Pink Vanguard', 'Lavender Whisper', were fertile and can be successfully used in the hybridization process. It was revealed that the source of early flowering of varieties created in the NBG was introduced wild species of herbaceous peonies: *P. peregrina*, *P. wittmanniana*, *P. arietina*. Peonies with double or semi-double flowers can be obtained by using *P. officinalis* 'Rubra Plena' with double flowers as a maternal component, and *P. lactiflora* varieties ('President Taft', 'La Pionce', 'Lord Kitchener', 'Adolphe Rousseau', 'M-lle Janne Riviere') as paternal one also with terry flowers.

**Keywords:** interspecies hybridization; crossing; flowering.

### Introduction

The collection of peonies of the M. M. Gryshko National Botanical Garden (NBG) National Academy of Sciences is currently the largest in Ukraine and the richest in Eastern Europe. Having the status of a national treasure, the collection reflects a long period of historical development of the peony culture, which is a source of enormous genetic diversity and the

basis of domestic breeding [1–3]. The mobilized varieties serve as the basis for morphological and biological studies of plants, study of the rhythms of their growth and development, and features of adaptation under conditions of introduction [4, 5]. On the basis of the collected gene pool, methods of variety assessment and cultivation technologies are being developed. The collection is a standard for the State Variety Testing, a source of replenishment and expansion of the collections of regional botanical gardens and material for horticulture and greening. The collection also has scientific and educational value for breeders, amateurs, students of biological

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and agricultural specialties, and schoolchildren [2, 3].

Currently, the collection is a generic complex of *Paeonia* L., represented by three life forms and numbering 10 species, 650 varieties and 17 promising hybrid forms. It includes varieties of all garden peony groups:

Lactiflora Gp (varieties based on a single species *P. lactiflora* Pall.),

Herbaceous Hybrid Gp (varieties obtained by hybridization of herbaceous peonies of different species),

Lutea Hybrid Gp (*P. lutea* Delavay ex Franch. (*P. delavayi* Franch.) and *P. × suffruticosa* Andrews varieties were used to create cultivars),

Itoh Gp (obtained by crossing plants of different life forms),

Suffruticosa Gp (based on *P. × suffruticosa*) [1, 2].

Varieties of peonies of the Herbaceous Hybrid Gp are promising for the introduction and use. The group includes varieties created by hybridization of species of herbaceous peonies of diverse ecological and geographical origin: *P. officinalis* L. (South-Western and Eastern Europe, the Mediterranean), *P. lactiflora* (South-East Asia), *P. anomala* L. (South and Central Asia), *P. arietina* G. Anderson (Southeastern Europe, Caucasus), *P. officinalis* L. (Central and Southeastern Europe), *P. peregrina* Mill. (Southeastern Europe), *P. tenuifolia* L. (Balkan Peninsula, Caucasus, Crimea, Siberia), *P. daurica* subs. *wittmanniana* (Hartwiss ex. Lindl.) D.Y.Hong (Western Caucasus) and others [6, 7].

The species have different ploidy; therefore, most of the Herbaceous Hybrid Gp varieties were obtained by distant hybridization are tetraploids or triploids [8–10]. Such varieties are characterized by a wide range of morphological features, which increases their decorativeness and adapts well to new cultivation conditions. They differ from other groups in early flowering periods, originality of the coloring (bright red, coral pink, yellow flowers in the color of flowers) and flower shape (simple, semi-double and double) [11, 12].

The first attempts to create interspecific peony hybrids were made in Europe in the middle of the 19th century. French breeder V. Lemoine first crossed *P. lactiflora* with *P. wittmanniana* and obtained hybrids ('Avant Garde', 'Le Printemps', 'Mai Fleuri', 'Russi Major') with an early flowering period. The German breeder G. Arends, crossing *P. peregrina* with *P. wittmanniana*, obtained hybrid forms with light yellow and pink flowers.

Three of his varieties are registered in the Peony Registry of the American Peony Society: 'Alpha', 'Mai Königin', 'Reine de Mai' [13]. In England, P. Barr was engaged in peony interspecific hybridization. Having done a lot of work on crossing *P. officinalis* and *P. arietina* and their breeding forms, he received a number of seedlings, among which he selected the variety 'Northern Glory'.

At the end of the XIX – beginning of the XX century American breeders A. Saunders, L. Glasscock, E. Auten crossed *P. lactiflora* and *P. officinalis* and obtained about a hundred interspecific hybrids. Also, from crossing *P. officinalis* and *P. tenuifolia*, L. Glascock obtained hybrid forms, one of which was registered as 'Laddie' variety. Professor A. Sanders made a particularly great contribution to the creation of new varieties. His work made it possible to extend the flowering period of peonies by two to three weeks compared with varieties based on *P. officinalis*, *P. tenuifolia* and interspecific hybrids obtained by W. Lemoine. He created new peony varieties with flowers of scarlet, red, light cherry, pale lilac, waxy hue with an interesting border of petals, as well as the color of bone and opal. But the greatest achievement was to obtain a pink color with orange-pink, coral, cherry shades, which were previously present only in Chinese bush peonies and never seen in herbaceous varieties [1, 13].

The success of distant hybridization has inspired many breeders to develop a whole group of early flowering varieties. So, W. Krekler created more than 400 varieties, including: 'A. Krekler', 'Abalone Pearl', 'Abalone Pink', 'All My Love', 'Allen Lewis' and others. W. Mains received now widely known varieties 'Buckeye Belle', 'Bill Krekler', 'Walter Mains', 'Goody'. W. Bockstoce made himself famous for varieties 'Henry Bockstoce', 'Diana Parcks', 'Carol', 'Bess Bockstoce'. Currently, 1127 varieties of Herbaceous Hybrid Gp are registered in the Peony Registry of the American Peony Society [13].

In Ukraine, varieties of the described peony group began to appear after the Second World War and are cultivated in the collections of botanical gardens, arboretums and amateur flower growers. Peony collection of the NBG is the most represented in terms of assortment.

*The purpose of the research* is to analyze the origin of the Herbaceous Hybrid Group peony varieties from the collection of the M. M. Gryshko National Botanical Garden of NAS of Ukraine (NBG) and to determine the prospects for their use in breeding work and ornamental horticulture.

## Materials and methods

Plants of peony varieties of the Herbaceous Hybrid Gp of the NBG peony collection were the object of research. Varieties of the Herbaceous Hybrid Gp were included to the collection by exchange and purchase of planting material (parts of rhizomes with three or four rudimentary shoots) with botanical institutions, amateur flower growers and garden centers in Ukraine and the world. The introduction forecast was carried out using the methods proposed by P. E. Bulakh [14], taking into account the varietal characteristics of the plants.

All available variety descriptions and variety descriptions from the Peony Registry of the American Peony Society were used for variety identification [13]. Plants of the peony collection are grown in the open sunny experimental and exposition areas of the NBG. The sites are located on the Pechersk slopes of the Kyiv Upland in the natural landmark "Zvirynets" (50°32' N and 30°33' E) in the southeastern part of Kyiv on the border of two physical and geographical zones: the forest zone of Polissia and Forest-Steppe zones. The climate is temperate continental. The average annual air temperature is 9.5 °C [15].

A comparative study of peonies of foreign breeding and varieties created in the NBG was carried out according to the method of V. M. Bylov [16] and the Method for conducting an examination of peony varieties (*Paeonia* L.) for Distinctness, *Uniformity and Stability* [17]. According to these methods, 6 plants of each variety were used for research [16, 17]. During 2012–2022 phenological observations of plants were carried out, the results were statistically processed [16, 18]. The most important indicators of the decorative variety value were singled out: the color of the flower and the beginning of flowering, according to which the varieties were grouped. Grouping varieties according to these parameters allows us to show the diversity of the peony assortment, which can be used in the selection of varieties for ornamental horticulture and breeding.

Although the weather conditions significantly shift the dates of the beginning of the variety flowering, however, the correlation between varieties regarding the timing of flowering is maintained: that is, the early-flowering variety always blooms earlier than the middle one, the middle one before the late one. Therefore, based on the determined timing of the beginning of each variety flowering, all varieties were divided into two groups relative to the beginning of flowering

of the medium-flowering variety 'Red Charm': group I – varieties blooming before the flowering of 'Red Charm', group II – after the beginning of its flowering [19]. Such a distribution of varieties into groups allows us to select varieties to expand the range of decorative flower arrangements. This distribution of varieties by groups makes it possible to choose varieties for expanding the range of flower arrangement decorativeness.

## Results and discussion

Peony introduction and breeding started at the beginning of the NBG construction and development. The formation of the collection fund began in 1947, when 30 first varieties were obtained through the German company "Lange". Later the collection was replenished with samples from other botanical gardens, experimental stations, scientific institutions and our own breeding.

The first varieties of the Herbaceous Hybrids group were included in the collection in 1971–1976 (Fig. 1). These are A. Saunders varieties, created in the 30–40s: 'Carina', 'Cavatina', 'Early Daybreak', 'Legion of Honor', 'Reward', 'Rosy Cheek', 'Seraphim'; E. Auten varieties: 'Auten's Red', 'Early Scout'. Also 'Mahogany' (Glasscock, 1937), 'Ann Zahller' (Mains, 1956).

During the 80–90s of XX century 26 more varieties were introduced. The main number of varieties was included in the collection in the first years of the 21st century, which was due to the import of new varieties of world breeding to Ukraine and the need to test them in our conditions. In particular, during 2000–2019 the collection fund was enriched by 76 new varieties.

In total, over 50 years of introduction work with peony Herbaceous Hybrid Gp, 133 varieties of world breeding were tested in the NBG.

The analysis of the origin of the introduced varieties showed that 121 varieties were created by US breeders (Fig. 2). Of them, the collection of A. Saunders (33 varieties), E. Auten (13 varieties), L. Glasscock (10), and U. Bockstoe (7 varieties). The collection also includes varieties created and registered in Canada, Belgium, Sweden, Russia, the Netherlands, and France.

A. Saunders used a range of species as parental forms, crossing *P. lactiflora* with *P. officinalis*, *P. peregrina*, *P. anomala* subsp. *veitchii* (Lynch) D.Y.Hong & K.Y.Pan, *P. daurica* subsp. *mlokosewitschii*. To obtain early varieties, Sanders included *P. tenuifolia* and *P. macrophylla* (*P. daurica* subsp. *macrophylla*) in the breeding process.

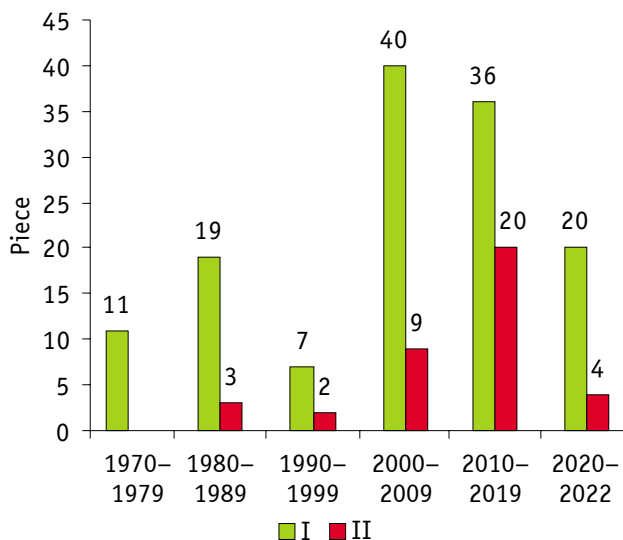


Fig. 1. The number of introduced varieties of world (I) and domestic breeding (II) in different years in the M. M. Gryshko National Botanical Garden of the NAS of Ukraine

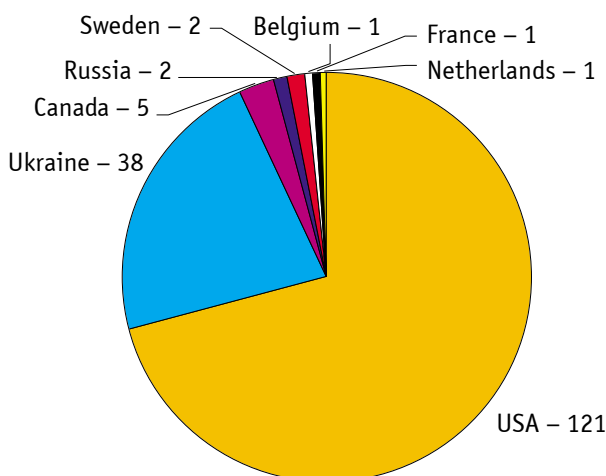


Fig. 2. Distribution of Herbaceous Hybrid Gp varieties of the peony collection of the M. M. Gryshko National Botanical Garden of the NAS of Ukraine by country of variety registration

The varieties of Auten, Glasscock and Bockstoe present in the collection owe their origin to *P. lactiflora* and *P. officinalis*.

It should be noted that the French cultivar 'Smoutii' (Smout / van Houtte, 1843) is the oldest one in the collection. The presence of *P. tenuifolia* genes in its genotype allows the variety to bloom already in the first decade of May.

From the data shown in Figures 1 and 2, it follows that 38 varieties of the Herbaceous Hybrid Gp collection are varieties of Ukrainian breeding created at the NBG. Breeding work with this group of cultivars was started at the NBG back in 1970 by V. F. Gorobets, Candidate of Biological Sciences, Leading Researcher of the Department of Flower and Ornamental

Plants. The priority direction of breeding work was the creation of varieties with early and very early flowering periods. Wild-growing species of herbaceous peonies were introduced into the NBG as a source of early flowering: *P. peregrina*, *P. wittmanniana*, *P. arietina*. The carriers of high decorativeness of the flower and high productivity of flowering were the varieties *P. lactiflora* and *P. officinalis* and their decorative subspecies and forms.

In the process of analyzing the results of our own breeding work, great form-building possibilities of distant hybridization were revealed, consisting not only in a combination of useful features of the original forms, but also in the appearance of many new ones that are not characteristic of the parental generation. Since in all combinations of crosses where wild-growing species were parental forms, the first generation was dominated by a negative trait – a single flower form, therefore the back-cross method, recurrent backcrossing, and crossing of terry *P. lactiflora* varieties with fertile interspecific hybrids  $F_1$  were applied.

The results of hybridization showed that the most decorative forms of peonies with double or semi-double flowers can be obtained using *P. officinalis* 'Rubra Plena' with double flowers as the maternal component, and *P. lactiflora* ('President Taft', 'La Pionce') as the paternal component, 'Lord Kitchener', 'Adolphe Rousseau', 'M-lle Janne Riviere') also with double flowers (Table 1). For example, variety 'Yuvilei Kyieva' was created by crossing *P. officinalis* 'Rubra Plena' with *P. lactiflora* 'Adolphe Rousseau', 'Benefis' variety – by crossing *P. officinalis* 'Rubra Plena' and *P. lactiflora* 'President Taft'. Sometimes it was possible to obtain double forms by crossing *P. officinalis* 'Rubra Plena' with varieties or breeding numbers of *P. lactiflora* that have single flowers. This is how the variety 'Chaklunka' was obtained.

Analysis of the hybrid stock obtained from distant crosses made it possible to identify combinations that give fertile offspring: ♀ *P. officinalis* 'Rubra Plena' × ♂ *P. peregrina*, ♀ *P. officinalis* 'Rubra Plena' × ♂ *P. humilis* (*P. officinalis* subsp. *microcarpa* Nyman), ♀ *P. officinalis* 'Rubra Plena' × ♂ *P. officinalis* var. *alba*, ♀ *P. officinalis* 'Rubra Plena' × ♂ *P. officinalis* var. *banatica*. The hybrids created as a result of such combinations turned out to be promising in further breeding work.

Most *P. lactiflora* cultivars were crossed with  $F_1$  distant hybrids (♀ *P. officinalis* 'Rubra Plena' × ♂ *P. peregrina*) and triple distant hybrids were obtained.

**The origin of the Herbaceous Hybrid Gp varieties of the the M. M. Gryshko National Botanical Garden of the NAS of Ukraine breeding**

	Variety	Year of registration and author of the variety	Combination of crossings
Double interspecific hybrids			
1	'Benefis'	2003 Gorobets	♀ <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. lactiflora</i> 'President Taft'
2	'Blondyn'	2013 Gorobets	♀ <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. lactiflora</i>
3	'Vesniane Defile'	2014 Gorobets	♀ <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. wittmanniana</i>
4	'Dzvony Mykhailivskoho'	2022* Gorobets	♀ <i>P. peregrina</i> × ♂ <i>P. lactiflora</i> 'Vesilna'
5	'Kozachok'	1981 Gorobets	♀ <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. lactiflora</i>
6	'Koketka'	2011 Gorobets	♀ <i>P. officinalis</i> var. <i>banatica</i> × ♂ <i>P. lactiflora</i> 'President Taft'
7	'Koryfei'	2003 Gorobets	♀ <i>P. peregrina</i> × ♂ <i>P. lactiflora</i> 'President Taft'
8	'Lehin Honorovyi'	2022* Gorobets, Shcherbakova	♀ <i>P. peregrina</i> × ♂ <i>P. lactiflora</i> 'Vesilna'
9	'Malynova Vatra'	2010 Gorobets	♀ <i>P. peregrina</i> × ♂ <i>P. lactiflora</i> 'La Pionce'
10	'Ofieliia'	1998 Gorobets	♀ <i>P. officinalis</i> var. <i>banatica</i> × ♂ <i>P. lactiflora</i> 'President Taft'
11	'Svitliachok'	2013 Gorobets	♀ <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. lactiflora</i>
12	'Travnevi Rosy'	2013 Gorobets	♀ <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. lactiflora</i>
13	'Favoryt'	2009 Gorobets	♀ <i>P. peregrina</i> × ♂ <i>P. lactiflora</i> 'President Taft'
14	'Khokhloma'	1986 Gorobets, Tyran	♀ <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. lactiflora</i>
15	'Chaklunka'	2003 Gorobets	♀ <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. lactiflora</i>
16	'Cheburashka'	2011 Gorobets	♀ <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. peregrina</i>
17	'Chervonyi Oksamyt'	1984 Gorobets, Tyran	♀ <i>P. peregrina</i> × ♂ <i>P. lactiflora</i> 'President Taft'
18	'Chervoni Vitryla'	1998 Gorobets	♀ <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. lactiflora</i>
19	'Chumatskyi Shliakh'	2010 Gorobets	♀ <i>P. lactiflora</i> 'Lord Kitchener' × ♂ <i>P. arietina</i>
20	'Yuvilei Kyieva'	2003 Gorobets	♀ <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. lactiflora</i> 'Adolphe Rousseau'
Triple interspecific hybrids			
21	'Vechornytsi Travnia'	2022 Gorobets	♀ <i>P. officinalis</i> × ♂ F <sub>1</sub> ( <i>P. officinalis</i> 'Rubra Plena' × <i>P. officinalis</i> var. <i>alba</i> )
22	'Dudaryk'	2022* Gorobets Shcherbakova	♀ <i>P. officinalis</i> × ♂ F <sub>1</sub> ( <i>P. officinalis</i> 'Rubra Plena' × <i>P. officinalis</i> var. <i>alba</i> )
23	'Herkules'	2010 Gorobets	♀ <i>P. lactiflora</i> 'Adolphe Rousseau' × ♂ ( <i>P. officinalis</i> 'Rubra Plena' × <i>P. peregrina</i> )
24	'Heroiam Nebesnoi Sotni'	2014 Gorobets	♀ <i>P. lactiflora</i> 'Lord Kitchener' × ♂ F <sub>1</sub> ( <i>P. officinalis</i> 'Rubra Plena' × <i>P. peregrina</i> )
25	'Irokez'	2007 Gorobets	♀ <i>P. lactiflora</i> 'Lord Kitchener' × ♂ F <sub>1</sub> ( <i>P. officinalis</i> 'Rubra Plena' × <i>P. officinalis</i> var. <i>banatica</i> )
26	'Kvazimodo'	2010 Gorobets	♀ <i>P. lactiflora</i> 'M-lle Janne Riviere' × ♂ F <sub>1</sub> ( <i>P. officinalis</i> 'Rubra Plena' × <i>P. peregrina</i> )
27	'Pysanka Kolomyi'	2010 Gorobets	♀ <i>P. lactiflora</i> 'Adolphe Rousseau' × ♂ F <sub>1</sub> ( <i>P. officinalis</i> 'Rubra Plena' × <i>P. peregrina</i> )

Continue Table 1

	Variety	Year of registration and author of the variety	Combination of crossings
28	'Metelyk'	2009 Gorobets	♀ <i>P. lactiflora</i> 'Lord Kitchener' × ♂ F <sub>1</sub> ( <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. officinalis</i> var. <i>banatica</i> )
29	'Madiarochka'	2021 Gorobets	♀ <i>P. lactiflora</i> 'Lord Kitchener' × ♂ F <sub>1</sub> ( <i>P. officinalis</i> 'Rubra Plena' × <i>P. officinalis</i> var. <i>banatica</i> )
30	'Svitankova Poema'	2011 Gorobets	♀ <i>P. arietina</i> × ♂ F <sub>1</sub> (♀ <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. peregrina</i> )
31	'Sny Roksolany'	2021 Gorobets	♀ <i>P. lactiflora</i> 'Lord Kitchener' × ♂ <i>P. officinalis</i> var. <i>banatica</i>
32	'Stozhary'	2021 Gorobets	♀ <i>P. lactiflora</i> 'Lord Kitchener' × ♂ F <sub>1</sub> ( <i>P. officinalis</i> 'Rubra Plena' × <i>P. peregrina</i> )
33	'Strily Amura'	2021 Gorobets	♀ <i>P. lactiflora</i> 'Lord Kitchener' × ♂ F <sub>1</sub> (♀ <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. officinalis</i> var. <i>banatica</i> )
34	'Chempion'	2009 Gorobets	♀ <i>P. lactiflora</i> 'Adolphe Roussean' × ♂ F <sub>1</sub> ( <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. peregrina</i> )
35	'Chervona Vezha'	2009 Gorobets	♀ <i>P. lactiflora</i> 'Adolphe Roussean' × ♂ F <sub>1</sub> ( <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. peregrina</i> )
36	'Chornomor'	2013 Gorobets	♀ <i>P. lactiflora</i> 'Lord Kitchener' × ♂ F <sub>1</sub> ( <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. peregrina</i> )
37	'Filizhanka Koroliv'	2022* Gorobets	♀ <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. peregrina</i>
38	'Lunnaya doroga'	Gorobets	♀ <i>P. officinalis</i> 'Rubra Plena' × ♂ <i>P. wittmanniana</i>

\*year of filing an application for the State registration of a variety.

One of the most important decorative features of a peony flower, which is primarily taken into account by gardeners and landscape designers, is its color. We combined all the variety of peony colors and shades into four groups: red (light, dark red flowers, orange-red, purple-red, cherry, etc.), pink (light, dark pink flowers, salmon-pink, coral, coral pink, lilac pink, purplish pink), white (white, creamy white), yellow (light yellow petals, bright yellow, lemon yellow, creamy yellow) (Table 2).

The analysis of the variety origin have showed that those of early breeding in 20s-60s of the XX century mainly have a red flower color, inherited from *P. officinalis*, *P. tenuifolia*, and *P. peregrina*.

Varieties of light pink, pink, coral-pink color were obtained mainly in the second half of the 20th century, when various forms of *P. officinalis*, *P. arietina* and subspecies *P. daurica* and *P. anomala* were actively included into the breeding process.

At the end of the 20th and the beginning of the 21st centuries, a group of new varieties with bright yellow flower color appeared. The coloring was caused by genes that induce the synthesis of kaempferol glycosides of yellow color, obtained from the ancestral *P. daurica* subsp. *mlokosewitschii* [20]. New cultivars have been the result of a complex hybridization of early yellow-flowered cultivars: 'Moon-

rise', 'Nova', 'Rushlight', 'Ballerina', 'Elizabeth Cahn', 'Claire de Lune', 'Prairie Moon'.

Tests of new varieties in the conditions of Ukraine showed that the most promising of them were: 'Lemon Chiffon' – D. Reath's variety with a double shape and lemon-yellow color of the flower, yellow and cream-yellow K. Lanning varieties 'Sunny Boy' and 'Sunny Girl' (Fig. 3). Introduced in the NBG, the Swedish variety 'Quitzin' (author Prof. Harald Fawknner) has large bomb-shaped double flowers with creamy peach petals and bright yellow staminoids. It is characteristic that on one plant there are flowers, both single and of varying degrees of doubling. 'Quitzin' turned out to be quite promising for further breeding, resulting in its creamy pink variety 'Triphena Parkin' of 2009.

Obtaining varieties with cream-pink, pink-cream, pastel color of the flower has become one of the modern trends in the breeding of this peony group. Among them, Pastelegance (Seidl, 1989) and Pastelorama (Seidl / Bremer, 2013) turned out to be promising in our conditions. Both are the result of crossing pink and yellow Salmon Dream ('Paula Fay' × 'Moonrise') parental forms with 'Lemon Chiffon' and R. Anderson's hybrid, respectively.

In the NBG, *P. daurica* subs. *wittmanniana*, is included in the breeding work, which made it possible to obtain a light pink-cream variety 'Vesniane Defile'.





Comparative study of modern varieties showed that most of them are sterile and do not bear fruit. The sterility of varieties, which in most cases are triploids, is manifested due to the different fecundity of the original parental forms. However, we managed to find and select a number of fertile varieties: 'Dreamtime', 'Greenland', 'Quitzin', 'Lavender Whisper', 'Lemon Chiffon', 'Pastelegance', 'Pastelorama', 'Salmon Dream',

'Sunny Boy', 'Sunny Girl', 'Sunny Day', 'The Mackinac Grand', 'Vanilla Schnapps', 'Triphena Parkin', 'Pink Vanguard'. The selected varieties can be successfully used for hybridization in the breeding process.

The beginning of the peony flowering, as well as other ornamental plants, is one of the most significant indicators that allows choosing the right varieties for both cut and landscape compositions. The timing of the begin-





**Fig. 3. Flowers of modern peony varieties of Herbaceous Hybrid Gp of yellow, cream, cream-pink color promising for breeding work and decorative gardening:** 1. 'Lemon Chiffon' (Reath D. L., 1981), 2. 'Sunny Boy' (Laning, 1985), 3. 'Sunny Girl' (Laning, 1985), 4. 'Quitzin' (Fawkner, 2001), 5. 'Triphena Parkin' (Fawkner, 2009), 6. 'Pastelegance' (Seidl, 1989), 7. 'Pastelorama' (Seidl / Bremer, 2013), 8. 'Pink Vanguard' (Seidl / Hollingsworth, 2005), 9. 'Greenland' (Pehrson / Seidl, 1989), 10. 'Dreamtime' (Seidl / Bremer, 2013), 11. 'Vesniane Defile' (Gorobets, 2014), 12. 'Golden Wings' (Pehrson / Hollingsworth, 1994)

ning of flowering is a varietal characteristic, which strongly depends on the natural and climatic conditions of the region of introduction. However, the correlation between varie-

ties regarding the timing of flowering is maintained.

We divided the introduced Herbaceous Hybrid Gp cultivars into two groups relatively to



the beginning of flowering of the 'Red Charm' cultivar, which begins flowering on  $22.05 \pm 4$  days under NBG conditions. Under the conditions of the NBG, the varieties of the first

group bloom in the last days of April and until May 22. Varieties of the second group begin flowering on May 23 – the first days of June (Table 2).

Table 2

**Peony varieties of Herbaceous Hybrid Gp promising for decorative gardening**

Years of variety registration	Groups of varieties by flower color			
	Red	Pink	White	Yellow
Beginning of flowering < Red Charm				
Before 1939	'Jean E. Bockstoce' (Bockstoce, W. S.), 'Rosedale' (Auten), 'Smoutii' (Smout / van Houtte), 'Sunbright' (Glasscock)	'Cavatina' (Saunders)	'Chalice', 'Sera-phim' (Saunders)	
1940–1959	'Ann Zahler' (Mains), 'Auten's Red', 'Early Scout', 'Fiesta', 'Orange Glory' (Auten), 'Dad' (Glasscock / Krekler), 'Carina', 'Early-bird', 'Heritage', 'Reward' (Saunders), 'Illini Belle', 'Convoy', 'Red Charm' (Glasscock), 'Massasoit' (White / Wild & Son), 'Orleonok' (Fomocheva)	'Athena', 'Firelight', 'Laura Magnuson', 'May Lilac', 'Pico-tee', 'Winterthur' (Saunders)	'Ballerina', 'Garden Peace', 'Moonrise', 'Nova' (Saunders), 'Early Daybreak', 'Elizabeth Cahn', 'Starlight' (Saunders)	'Claire de Lune' (White / Wild & Son), 'Golden Wings' (Pehrson / Hollingsworth), 'Nova' (Saunders)
1960–1978	'America' (Rudolph), 'Burst of Joy', 'Red Romance' (Auten-Wild & Son), 'Tiny Tim' (origin unknown via Smirnow),	'Coral Fay' (Fay / Reath, D. L.), 'Novost' Altaya' (Luchnik), 'Paula Fay' (Fay), 'Rose Heart' (Bockstoce / Landis)		'Cream Delight' (Reath, D. L.), 'Roselette's Child' (Saunders)
1980–1999	'Merry Mayshine' (Saunders / Hollingsworth / Smetana), 'Chiervoni Vitryla' (Gorobets), 'Khokhloma' (Gorobets, Tyran)	'Lavender Whisper' (Klehm, R. G.), 'Lois Choice' (Laning), 'Kozachiok', 'Ofieliia' (Gorobets)	'Early Glow', 'Sunday Chimes' (Hollingsworth)	'Lemon Chiffon' (Reath, D. L.), 'Sunny Boy', 'Sunny Girl' (Laning), 'Lun-naya doroga' (Gorobets)
2000–2019	'Benefis', 'Cheburashka', 'Chervona Vezha', 'Heroiam Nebesnoi Sotni', 'Pysanka Kolomyi', 'Stozhary', 'Yuvilei Kyieva' (Gorobets)	'Blondyn', 'Chumatskyi Shliakh', 'Filizhanka Korativ', 'Koketka', 'Metelyk', 'Strily Amura', 'Svitankova Poema', 'Svitliachok', 'Travnevi Rosy', 'Vechornytsi Travnia', 'Vesniane Defile', 'Dudaryk' (Gorobets)		
Beginning of flowering $\geq$ 'Red Charm'				
1920–1939	'Chocolate Soldier' (Auten), 'Flame', 'Mahogany', 'Cherry Red' (Glasscock), 'Topeka' (Auten)			
1940–1959	'Alexander Woolcott', 'Ellen Cowley', 'Legion of Honor', 'Lustrous', 'Postilion', 'Scarlet Tanager' (Saunders), 'Angelo Cobb' (Freeborn), 'Buckeye Belle', 'Walter Mains' (Mains), 'Carol', 'Diana Parks', 'Henry Bockstoce', 'Howard R. Watkins' (Bockstoce, W. S.), 'Chief Justice', 'Dandy Dan', 'Favorita', 'Eldorado', 'Robert W. Auten' (Auten), 'Helen Matthews' (Saunders / Krekler)	'Bess Bockstoce' (Bockstoce, W. S.), 'Cytherea', 'Gillian', 'Lovely Rose', 'Ludovica', 'Rosy Cheek', 'Nadia' (Saunders), 'Eventide', 'Salmon Glow' (Glasscock), 'Goody' (Freeborn), 'Raspberry Rose' (Auten), 'Chalice Pink' (Saunders / Krekler)	'Requiem' (Saunders)	'Prairie Moon' (Fay)
1960–1979	'America' (Rudolph), 'Aristocrat' (Krekler), 'Blaze' (Fay / Reath, D. L.), 'Old Faithful' (Glasscock / Falk)	'Ann Berry Cousins' (Cousins / Klehm, R. G.), 'Coral Charm', 'Coral Supreme' (Wissing), 'Heavenly Pink' (Smirnow), 'Salmon Dream' (Reath, D. L.), 'Hi-Mabel' (Bockstoce)	'Colonel Owen Cousins' (Cousins / Klehm, R. G.)	

Continue Table 2

Years of variety registration	Groups of varieties by flower color			
	Red	Pink	White	Yellow
1980–1999	'Command Performance' (Hollingsworth), 'Red Grace' (Glasscock-Klehm, R. G.), 'The Mackinac Grand' (Reath, D. L.), 'Christmas Velvet' (Anderson, R. F.), 'Chervonyi Oksamyt' (Gorobets, Tyran)	'Carnation Bouquet', 'Pastelegance' (Seidl), 'Coral Sunset' (Wissing), 'Coral n Gold', 'Etched Salmon' (Cousins / Klehm, R. G.), 'Lorelei' (Hollingsworth), 'Coral Magic', 'Pink Hawaiian Coral' (Klehm, R. G.), 'Salmon Chiffon' (Rudolph / Klehm, R. G.)	'Greenland' (Pehrson / Seidl)	'Golden Wings' (Pehrson / Hollingsworth)
2000–2019	'Chaklunka', 'Chempion', 'Chornomor', 'Favoryt', 'Herkules', 'Koryfei', 'Madiarochka', 'Malynova Vatra', 'Dzvony Mykhailivskoho', 'Lehin Honorovyi' (Gorobets)	'Dreamtime', 'Pastelorama' (Seidl / Bremer), 'Joker' (Bockstoce / Landis / Allan Rogers), 'Lavender Baby' (Warmerdam), 'Pink Vanguard' (Seidl / Hollingsworth), 'Triphena Parkin' (Fawkner), 'Roselette's Baby' (Adelman), 'Trokez', 'Kvasimodo', 'Sny Roksolany' (Gorobets)	'Vanilla Schnapps' (Seidl / Bremer)	'Quitzin' (Fawkner)

Varieties whose parent forms were early flowering species and their forms begin flowering earlier. Thus, 'Earlybird', one of the first varieties of Saunders, which blooms in the conditions of the NBG as early as April  $28 \pm 3$  days, was created on the basis of the hybridization of *P. woodwardi* and *P. tenuifolia*. Another early (May  $5 \pm 4$  days) Saunders variety 'Seraphim' was obtained by crossing *P. lactiflora* and *P. macrophylla*. 'Starlight' – a hybrid of *P. lactiflora*, *P. officinalis*, *P. macrophylla*, *P. daurica* subsp. *mlokosewitschii* blooms on May  $12 \pm 3$  days.

An early flowering period is also noted for variety 'Orlyonok' (V. F. Fomicheva), which blooms on May  $12 \pm 4$  days due to the presence of *P. tenuifolia* genes in its genotype. On May 11 'Tiny Tim' (Smirnov, 1975) begins its flowering, which is due to the early flowering of *P. tenuifolia* 'Rubra Plena'. Early flowering 'Novost Altaya' variety (Z. I. Luchnik) is due to the crossing of *P. lactiflora* with *P. anomala*.

Among the introduced cultivars, Autena cultivars are among the first to bloom: 'Early Scout' ( $15.05 \pm 5$  days) was created on the basis of *P. lactiflora* 'Richard Carvel' and *P. tenuifolia*; 'Favorita' ( $16.05 \pm 4$  days) is the result of hybridization between *P. lactiflora* and *P. officinalis*.

Varieties created in the NBG are marked by early flowering periods. Among them, 'Vesniiane Defile' and 'Stozhary' bloom on May  $12 \pm 2$  days, 'Strily Amura' – on May  $13 \pm 3$  days,

'Filizhanka Koraliv' – on May  $14 \pm 2$  days, and 'Blondyn' – on May 16.

Among the late varieties, we should note 'Colonel Owen Cousins', 'Coral n Gold', 'Henry Bockstoce', 'Lorelei', 'Old Faithful', 'Herkules', 'Koryfei', the beginning of flowering of which falls on May 27–31 and 'Dzvony Mykhailivskoho', 'Lehin Honorovyi' – on  $09.06 \pm 2$  days.

### Conclusions

For more than 50 years of introduction work with Herbaceous Hybrid Gp peonies, 133 varieties of world breeding were tested in the NBG. The main number of varieties was included in the collection in the first years of the 21st century, which was due to the introduction of new varieties of world breeding to Ukraine and the need to test them in our conditions.

Varieties created in the late XX – early XXI century with bright yellow, pastel, pink-cream, cream-pink flower color, proved to be promising for cultivation in Ukraine. Comparative study of new varieties showed that most of them are sterile. Fertile varieties were: 'Dreamtime', 'Greenland', 'Quitzin', 'Lavender Whisper', 'Lemon Chiffon', 'Pastelegance', 'Pastelorama', 'Salmon Dream', 'Sunny Boy', 'Sunny Girl', 'Sunny Day', 'The Mackinac Grand', 'Vanilla Schnapps', 'Triphena Parkin', 'Pink Vanguard', 'Lavender Whisper', which can be successfully used in the hybridization process.

Introduced wild species of herbaceous peonies are the source of early flowering cultivars created in the NBG: *P. peregrina*, *P. wittmanniana*, and *P. arietina*. Peonies with double or semi-double flowers can be obtained using both the maternal component of *P. officinalis* 'Rubra Plena' with double flowers, and the paternal of *P. lactiflora* varieties ('President Taft', 'La Pionce', 'Lord Kitchener', 'Adolphe Rousse', 'M-lle Janne Riviere') also with double flowers.

For ornamental horticulture, 165 varieties of world and domestic breeding, combined into four groups according to flower color and two groups according to the beginning of flowering are recommended, which makes it possible to select varieties to expand the range of decorative flower compositions.

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**Горобець В. Ф., Щербакова Т. О.\*** Походження сортів півоній Herbaceous hybrid Group колекції Національного ботанічного саду імені М. М. Гришка НАН України та перспективи їх використання. *Plant Varieties Studying and Protection*. 2022. Т. 18, № 2. С. 78–89. <https://doi.org/10.21498/2518-1017.18.2.2022.265175>

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**Мета.** Проаналізувати походження сортів півоній Herbaceous Hybrid Group колекції Національного ботанічного саду імені М. М. Гришка Національної академії наук України (НБС) та визначити перспективи їх застосування в селекційній роботі та декоративному садівництві. **Методи.** Об'єктом досліджень слугували рослини сортів півоній групи трав'янисті гібриди (Herbaceous Hybrid Gr) колекції півоній НБС. Рослини вирощуються на сонячних відкритих експериментальних та експозиційних ділянках НБС. Порівняльне вивчення сортів та фенологічні спостереження за рослинами проводили протягом 2012–2022 рр. **Результати.** Проаналізовано сортове різноманіття півоній Herbaceous Hybrid Gr колекції НБС за походженням. Аналіз показав, що 122 сорти створено селекціонерами США, з яких у колекції найбільшою кількістю представлена селекція Сандерса. 38 сортів – це сорти української селекції, створені в НБС. Аналіз гібридів, отриманих шляхом віддалених схрещувань, дав змогу виділити комбінації, які дають фертильне потомство, і створити перспективні подвійні та потрійні гібриди. Для декоративного садівництва рекомендовано 165 сортів світової та власної селекції, які об'єднали у чотири групи за забарвленням квітки та у дві групи за початком цвітіння. Рослини ранньої групи розпочинають цвітіння до 22 травня

(± 4 доби). Квітування пізньої групи сортів припадає на початок цвітіння сорту 'Red Charm' (22 травня ± 4 доби) та пізніше. **Висновки.** Більш як за 50 років інтродукційної роботи з півоніями Herbaceous Hybrid Gr в НБС було випробувано 133 сорти світової селекції. Основна кількість сортів була залучена до колекції в перші роки ХХІ ст. Порівняльне вивчення нових сортів показало, що більшість із них є стерильними. Фертильними виявилися 'Dreamtime', 'Greenland', 'Quitzin', 'Lavender Whisper', 'Lemon Chiffon', 'Pastelegance', 'Pastelorama', 'Salmon Dream', 'Sunny Boy', 'Sunny Girl', 'Sunny Day', 'The Mackinac Grand', 'Vanilla Schnapps', 'Triphena Parkin', 'Pink Vanguard', 'Lavender Whisper', які можуть успішно використовуватися в гібридаційному процесі. Установлено, що джерелом раннього цвітіння сортів, створених в НБС, були інтродуковані дикорослі види трав'янистих півоній: *P. peregrina*, *P. wittmanniana*, *P. arietina*. Півонії з махровими або напівмахровими квітками можна отримати, використовуючи як материнський компонент *P. officinalis* 'Rubra Plena' з махровими квітками, а як батьківський – сорти *P. lactiflora* ('President Taft', 'La Pionce', 'Lord Kitchener', 'Adolphe Rousseau', 'M-lle Janne Riviere') також з махровими квітками.

**Ключові слова:** міжвидова гібридизація; схрещування; цвітіння.

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