Analysis of the Prospects of Perennial Herbaceous Plants in Urban Landscaping for Creating Sustainable Floral Compositions

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Abstract. The authors of the article considered a relevant problem of using perennial plants in landscaping Russian cities in connection with their unique climatic conditions, existing traditions in landscaping and bad environmental conditions. For the natural and climatic conditions of the forest-steppe zone of the Russian Federation, a selection of perennial flowering plants that are resistant to the urban environment according to the criteria of low maintenance, shade tolerance, drought resistance and undemanding soil fertility has been carried out. When choosing perennial plants, the preference was given to the representatives of the local flora, large in height and stable for a long time in decorativeness. In this case it is possible to use the developed assortment when creating sustainable floral compositions in cities, meeting modern requirements of aesthetics, environmental friendliness and economy of the landscape objects. The design projects developed by the authors provide with the creation of modular flower beds of round, triangular, square shapes in the form of mixborders combined of large-sized flowering plants that easily fit into any configuration of the existing flower garden and are assembled by rhythmic repetition of the modules or their combination.

1. Introduction
Modern urban landscaping is aimed at reducing economic costs and labor intensity and, as a result, making the elements of landscaping more sustainable. In the foreign world, the use of perennials in urban landscaping has long been expanding, European landscape architects are conducting relevant research and experiments using certain groups of plants, soils, types of mulch and types of tillage[1,2,3]. In Russia this landscaping technique is just beginning to gain popularity used in the public space landscaping of the cities [4]. In addition, urbanization processes lead to significant changes in the insolation regime, as well as wind and humidity regimes of the urban areas, which additionally limits the range of crops suitable for use in the urban environments.

The advantages of using perennial herbaceous plants in the urban landscaping are their aesthetics, environmental friendliness and economy, namely, plant life and the ability to self-seeding and growth, resistance of perennials to unfavorable conditions - gas pollution, drought, soil fertility, the ability to compete with weeds, aesthetic dynamism, that is change during the growing season, which is especially important in the places of constant population transit - driveways and walkways in residential areas, roadsides and dividing strips in the main directions of public transport, district squares and parks[5,6].
The disadvantages of using perennials, first of all, include the duration of the preparation of projects for flower beds and the selection of an assortment as only a careful analysis of the characteristics of the growth and development of each plant separately and of the floral compositions as a whole will make it possible to create a truly stable landscape object [7]. Also, after planting, they need some time to show maximum decorative effect, especially for long-growing plants. More than that, one of the negative properties of the perennials is that some of them (bulbous, bulbotuberiferous plants) are not stably decorative, that is, they have a short decorative effect, but this can be eliminated by choosing the right assortment [8,9]. In Russia with its unique climatic conditions, existing traditions in the urban landscaping and bad environmental conditions, the problem of using perennial plants in the urban conditions requires careful study and development of recommendations.

In this regard, the analysis of the range of the perennial flowing plants and the development of design recommendations for the sustainable urban floral compositions are relevant.

The aim of the research is to analyze a promising assortment of the perennial flowing plants for the natural and climatic conditions of the forest-steppe zone of Russia on the example of the city of Orel and to develop design projects for the sustainable urban floral compositions.

2. Materials and methods
The selection of perennial plants was carried out to create low-maintenance floral compositions, shade tolerant compositions, drought resistant and undemanding to soil fertility, suitable for growing in the climatic conditions of the forest-steppe zone and urbanization conditions. When choosing perennial plants, the preference was given to the representatives of the local flora, large in height and stable for a long time in decorativeness [10, 11]. The design projects are developed in the form of mixborders in which plants are recommended to be planted not in 1-2 specimen, but in groups, "fillings" of 20 or more pieces, creating one-caller surfaces, perceived not only at the level of human eyes, but also from the windows of the nearby buildings.

3. Results and discussion
The flower beds on the landscape objects of the landscaping system of the city of Orel are typical as in most cities of Russia and are represented by the areas of regular or irregular geometric shapes from annual flower crops in a regular style - flower beds, borders, ridges [12]. This determined the use of a modular design solution when creating flower arrangements, which makes it possible to implement projects in almost any spatial conditions of the urban area.

The developed design projects provide for the creation of modular flower beds of round, triangular, square shapes in the form of mixborders from large-sized flowering plants that easily fit into any configuration of the existing flower garden and are assembled by rhythmic repetition of the modules or their combination. As a decorative component, inactive materials as well as stony areas or separation with decorative tiles can be introduced into the flower garden.

The main principle in the development of the low-maintenance flower beds was to reduce the care of plants to a minimum level with planting single-species plants in large areas (sometimes with separate accent blotches of other species) [13, 14]. This principle is especially relevant for the conditions of the city, as it determines the increase in the efficiency of the landscape project by reducing the cost for planting maintenance. To create low-maintenance floral compositions in the climatic conditions of the city of Orel, we recommend to use the following plants: Aquilegia vulgaris L., Aster x frikartii “Wonder of Stata”, Boltonia asteroides L., Centaurea macrocephala Muss.Puschk. ex Wild., Heliopsis helianthoides L., Helenium hybridum, Hemerocallis hybridum, Leucanthemum-Superbum, Sedum telephium L. “Matrona”, Rudbeckia fulgida Aiton “Goldsturm”, Stachys byzantine K. Koch & Scheele.

When creating floral compositions, the general appearance of an individual plant is valued - its shape and stable decorativeness, therefore, their varieties are recommended for some species [15, 16].

The developed design project of a low-maintenance floral composition was carried out taking into account the preservation of long-term decorativeness and dynamics of plant height (Figure 1, Table 1).
Figure 1. Design project of the low-maintenance floral composition (planting plan).

Table 1. Planting list of a modular square-shaped flower bed.

| №  | Name                                     | Crop area, m² | Planting scheme, pcs./m² | Number of plants, container/pcs. |
|----|------------------------------------------|---------------|--------------------------|---------------------------------|
| 1  | *Sedum telephium* L. “Matrona”           | 3.04          | 25x25                    | 48                              |
| 2  | *Aquilegia vulgaris* L.                  | 3.84          | 35x35                    | 46                              |
| 3  | *Aster x frikartii* “Wonder of Stata”    | 2.88          | 40x40                    | 12                              |
| 4  | *Leucanthemum* -Superbum                 | 2.24          | 30x30                    | 20                              |
| 5  | *Heliopsis helianthoides* L.             | 2.68          | 45x45                    | 11                              |
| 6  | *Helenium hybridum*                     | 0.68          | 40x40                    | 2                               |

In the urban environment among dense buildings with a predominance of multistoried buildings, most of the surfaces are in conditions of partial or complete shading. The selection of shade-loving perennials made it possible to create sustainable flower arrangements for the limited growth conditions in terms of lighting. These are *Lysimachia clethroides* Duby, *Aruncus dioicus* (Walter) Fernald, *Geranium phaeum* L., *Digitalis purpurea* L., *Campanula lactiflora* M. Bieb., *Aconitum napellus* L., *Astrilbe Arendseii*, *Astrantia major* L., *Hosta hybridum*.

The design project of a floral composition for shady growth conditions, in addition to the dynamics of plant height, provides with a harmonious multi-tone color scheme in combination with a neutral color (Figure 2, Table 2).
**Figure 2.** Design project of a shady floral composition (planting plan).

**Table 2.** Planting list of a modular round-shaped flower bed.

| №  | Name                                      | Crop area, m² | Planting scheme, pcs./m² | Number of plants, container/pcs. |
|----|-------------------------------------------|---------------|--------------------------|----------------------------------|
| 1  | *Aruncus dioicus* (Walter) Fernald        | 4.12          | 70x70                    | 6                                |
| 2  | *Campanula lactiflora* M. Bieb. «Loddon Anna» | 4.36          | 50x50                    | 17                               |
| 3  | *Aconitum napellus* L.                    | 2.52          | 30x30                    | 23                               |
| 4  | *Digitalis purpurea* L.                   | 1.72          | 35x35                    | 15                               |
| 5  | *Astrantia major* L.                      | 1.24          | 40x40                    | 5                                |
| 6  | *Lysimachia clethroides* Duby             | 1.88          | 30x30                    | 16                               |
| 7  | *Hosta hybridum* «Abiqua Drinking Gourd»  | 0.4           | 40x40                    | 2                                |
| 8  | *Astilbe Arendsii* «Fanal»                | 0.8           | 50x50                    | 3                                |

Drought-resistant and undemanding to the soil plants, adapted to poor urban soils and lack of moisture, are of particular relevance for urban landscaping. They do not require regular watering and take root well [17]. Among the species of plants of this group, one can recommend many bright and spectacular decorative flowers that can delight with lush unique flowering throughout the season: *Eremurus stenophyllus* var. *bungei* (Baker) O.Fedtsch., *Perovskia abrotanoides* Kar., *Verbascum densiflorum* Bertol. “Costworld Queen”, *Lysimachia punctate* L., *Knautia macedonica* Griseb., *Campanula cespitosa* Scop., *Sedum telephium* L. “Herbstfreude”, *Centranthus ruber* L., *Iris germanica*
L. *Solidago hibrida*, *Thymus serpylum* L.

The design project of the floral composition combined of drought-resistant and undemanding plants was also developed in the form of a mixborder (Figure 3, Table 3).

![Figure 3. Design project of a floral composition of drought-resistant and undemanding plants (planting plan).](image)

**Table 3.** Planting list of a modular triangular-shaped flower bed.

| № | Name                               | Crop area, m² | Planting scheme, pcs./m² | Number of plants, container/pcs. |
|---|------------------------------------|---------------|--------------------------|----------------------------------|
| 1 | *Sedum telephium* L. “Herbstfreude” | 1.12          | 25x25                    | 18                               |
| 2 | *Verbascum densiflorum* Bertol. “Costworld Queen” | 1.48          | 40x40                    | 6                                |
| 3 | *Iris germanica* L. “Buttered Popcorn” | 0.92          | 40x40                    | 4                                |
| 4 | *Knautia macedonica* Griseb.       | 1.24          | 30x30                    | 11                               |
| 5 | *Perovskia abrotanoides* Kar.      | 1.8           | 60x60                    | 5                                |
| 6 | *Eremurus stenophyllus* var. *bungei* (Baker) O.Fedtsch. “Rosalind” | 2.96          | 40x40                    | 12                               |

It should be noted that the selection of plants that are promising for creating sustainable plantings in the urbanized areas can be continued quantitatively or distributed according to other criteria. The endemic species deserve special attention, as their use will expand the possibilities of using...
ornamental plantings in the most unfavorable conditions.

4. Conclusion
As a result of the study, a selection of an assortment of perennial flowering plants suitable for growing in the natural and climatic conditions of the forest-steppe zone of Russia was carried out. The following parameters were taken into account: adaptation to the urban environment, decorativeness, color, plant height, habit (bush shape), flowering time.

In the landscaping of cities in the forest-steppe zone of Russia, it is recommended to use the developed design projects of modular flower beds of round, triangular, square shapes, solitary or with rhythmic repetition of the modules or their combination.

The use of the developed sustainable floral compositions of the perennial plants in the flower decoration of the cities will make it possible to use the aesthetic potential of the flowering plants to a greater extent, reduce the cost of landscaping activities, increase the ecological sustainability of the urban environment, and improve the citizens’ mood.

5. References
[1] Stupakova O M, Aksyanova T Yu 2013 Compositions of perennial herbaceous, woody conifers and deciduous plants in urban landscaping Conifers of the boreal zone T 31 5-6 pp 41-44
[2] Gehl Jan and Gemzme Lars 2012 New city spaces (Moscow: KROST Publ.) 264
[3] Kuzmina N M, Ardasheva O A, Fedorov A V 2019 Characteristics of the species composition and the relevance of the use of perennial flowering plants in landscaping cities of Udmurtia Astrakhan Bulletin of Environmental Education 6(54) pp 187-192
[4] Morgunova E G, Bykova M A 2017 Experience of using perennial herbaceous plants in the urban environment Collection of final materials of the youth forum “The role of landscape architecture in the ecology of a modern city” (Orel: Publishing house Orel SAU) pp 30 -33
[5] Koisman T 2011 Flower gardens Design Project planning (M.: Publishing house Eksmo)
[6] Krasnoshchekova M N 2017 Used and promising plants for flower beds in the landscaping of the city of Maykop Actual problems of the forestry complex 47 pp 186-189
[7] Manhanov A D, Korsunova T M 2014 Prospects for the use of native perennial herbaceous plants in landscaping urbanized areas Bulletin of the Krasnoyarsk State University 9 pp 105-109
[8] Sidorenko M V 2016 Problems of modern approaches to the creation of landscape flower gardens in a modern urban environment on the example of Minsk Proceedings of BSTU I pp 211-215
[9] Shiryaeva N A 2017 Modern methods of flower decoration of the cities Collection of final materials of the youth forum “The role of landscape architecture in the ecology of a modern city” Publishing house: Orel SAU pp 38-40
[10] Semenenkova E V 2017 The methodology of examining the flower arrangement of various elements of the city planning structure Forestry bulletin T 21 2 pp 15-19
[11] Makoznak N A, Berezko O M 2013 The concept of a system of coloristic organization of elements of floral and decorative design of the spatial environment of Minsk Proceedings of BSTU. Forestry I pp 238-241
[12] Bogayskova A V, Korenkova E A 2019 Characteristics of the greening system in Orel Collection of materials of the national (all-Russian) scientific-practical student conference "Modern problems of the urban greening" (Novosibirsk: Publishing house of IC NSAU "Golden Spire") pp 20-23
[13] Sidorova M A 2008 Ecological and aesthetic approaches as base for designing landscape flower bed in small garden in the middle Russia region Collection of scientific works of the State Nikitsky Botanical Garden Vol 130 pp 187-192
[14] Selekhov A N, Khanbabaeva O E 2014 Comprehensive assessment of the flower arrangement of the city of Moscow Vestnik of landscape architecture 4 pp 67-71
[15] Hagen T, Borstel W 2009 Ideal plants for your garden (M. : “White City”)
[16] 2002 Flowers in the garden and landscape design (LLC “Adelat”) 494
[17] Naumkin V P, Shiryaeva N A 2020 Honey plants in floral decoration of the urban areas Beekeeping 2 pp 24-27