Anatomical and Morphological Characters of *Dianthus Barbatus*

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**Abstract.** The study of the anatomical and morphological characters of varieties and hybrids of *Dianthus barbatus* L plants and the identification of decorative characteristics by the color of flowers and their decorativeness is relevant in the technology of their cultivation. We studied the height of the shoots and the size of the bush, the diameter and doubleness of the inflorescence, to maintain constant characters in cross-pollinated species, since these characters vary greatly and are not constant within the variety and hybrid. *Dianthus barbatus* L plants have several biological characteristics that give them advantages over other flowering species. The high potential for the formation of many seeds is accompanied by reliable methods of their reproduction, due to the seeds preserved in the soil. *Dianthus barbatus* L represent a combination of different shades in one inflorescence - from white to maroon. The impact of numerous, both natural and anthropogenic, unfavorable environmental factors can lead to a decrease in plant productivity, therefore we carried out a comprehensive assessment of resistance based on anatomical and morphological characters and ecological methods of influencing the physiological characteristics of *Dianthus barbatus* L.

**1. Introduction**

The range of flower species is expanding every year due to the introduction and creation of new hybrids and varieties. Today, about 6,000 species of perennials are cultivated in the open field and are used for landscaping courtyards and in the private sector [1, 2, 3]. Floriculture in the territory of the Russian Federation is based on domestic varieties and foreign hybrids.

*Dianthus barbatus* L. is a biennial ornamental plant, distinguished by its colour range, beautiful, large spherical inflorescences [4, 5]. The flower has a delicate, pleasant, spicy aroma. There is a need for hybrids with a more graceful flower shape and an abundance of colours, as the trend towards gardening has increased significantly [6, 7, 8].

**2. Research methodology**

We studied two varieties, Mix of colors, Terry and a hybrid of Macarena F2 of the *Dianthus barbatus* L plants.

The experiments were carried out on sandy loam soils in terms of texture. Sandy loam soils are characterized by low fertility, a small thickness of the humus (arable) horizon of about 22 cm, an acidic reaction of the soil solution (pH 5.1) and a low content of nutrients mobile for plants: $P_2O_5$ - 8.2 mg/100g and $K_2O$ – 10.8 mg/100g3.
3. Discussion and results

The available varieties of *Dianthus barbatus* L. are well adapted to the soil and climatic conditions of the Novgorod region. This species requires minimal care for growth and development during the entire growing season, while variegated inflorescences with abundant flowering are observed. With the help of this species, it is possible to choose a color scheme for joint plantings on beds, flower beds, as a ground cover plant with good decorative qualities and a long flowering period [9, 10].

The value of *Dianthus barbatus* L lies in its long flowering, as it occurs during the period from June 15 to August 20, when the flowering of annual species is just beginning, and other perennials have already faded. However, most promising, and scarce hybrids of *Dianthus barbatus* L are characterized by low adaptive properties to the soil and climatic conditions of the Northwest region, which leads to poor survival, changes in morphological characters and, accordingly, their decorativeness.

The purpose of the research is to study anatomical and morphological signs and conduct biometric measurements and phenological observations of *Dianthus barbatus* L plants.

The study of the characteristics of the growth and development of plants of *Dianthus barbatus* L. is necessary for the correct combination with other ornamental species in the planning of flower beds and for the development of recommendations for their care. *Dianthus barbatus* L. was grown in seedlings, seeds for seedlings were sown in March. With this method of cultivation, *Dianthus barbatus* L received forty-five-day old seedlings, the plants were strong, healthy and in the year of sowing all the studied hybrids bloomed intensively. Caring for the plants of *Dianthus barbatus* L consisted in maintaining soil moisture, weeding weeds. After weeding the plants, the land around the bushes was loosened to provide oxygen in the arable horizon and after precipitation. Such soil accumulates moisture well in the root layer and promotes the movement of nutrients from the soil to plants. To protect against weeds and dry out the soil, mulching was carried out with freshly cut chopped grass. In autumn, the soil was mulched with hay to protect it from temperature extremes and to increase its resistance to unfavorable wintering conditions.

In the first year of life, the plants *Dianthus barbatus* L. formed densely growing bushes, which consisted of bright green rosettes and basal foliage and formed erect peduncles. In the second year of life, the bushes had erect peduncles and bloomed profusely. In the year of sowing, only faded inflorescences were pruned to preserve their decorative appearance. Pruning stimulated re-flowering of *Dianthus barbatus* L plants in August and in the second decade of September.

During the period of plant development, the peculiarities of the formation of bushes were studied, their foliage was determined, which influenced the formation of inflorescences and seeds in them. In the second year of the growing season of *Dianthus barbatus* L plants, the dates of the beginning of spring regrowth, budding, the beginning of flowering and flowering of the inflorescence were noted (table 1).

|                      | Regrowth | Budding | Beginning of flowering | Loss of decorativeness | Flowering duration, days. |
|----------------------|----------|---------|-----------------------|------------------------|---------------------------|
| Mix of colors        | 27.04    | 28.05   | 07.06                 | 05.09                  | 88                        |
| Macarena F₂          | 22.04    | 23.05   | 02.06                 | 14.08                  | 73                        |
| Terry                | 03.05    | 16.06   | 22.06                 | 25.09                  | 94                        |

We found that for two years of research, the beginning of spring regrowth was noted in the third decade of April, except for the Terry variety. In the studied hybrids and varieties, the formation of stems, inflorescences, the beginning of flowering, occurred unevenly. All the studied hybrids and varieties, a month later, entered the budding phase in the third decade of May. Macarena F₂ hybrid is characterized by fast growth, early inflorescence formation and, accordingly, flowering. A slow regrowth of shoots
was noted in the variety Mix of colors, in the second decade of June, the formation of inflorescences began, and a week later the flowering phase began.

The duration of the budding phase in *Dianthus barbatus* L plants lasts from 5 to 8 days, and individual flowers bloom in inflorescences. We have found that the duration of flowering depends on the care of the plantings of *Dianthus barbatus* L, the content of nutrients and moisture in the soil. The duration of a blossoming flower of *Dianthus barbatus* L on an inflorescence lasts from 7 to 12 days, and its corolla falls off, then a neighboring flower blooms. In Novgorod region, the duration of flowering of *Dianthus barbatus* L plants ranged from 73 to 94 days in 2019 and two to three days shorter in 2020. A short flowering period of 73–74 days was observed in the Macarena F₂ hybrid. The Makhrovaya variety was distinguished by long flowering up to 94 days due to the formation of many additional inflorescences, which bloomed before the onset of autumn frosts.

Plant height is one of the most important indicators affecting the decorativeness of flowering species. In this regard, the change in morphological, quantitative traits and physiological properties is of undoubted interest. In the year of sowing, *Dianthus barbatus* L plants form a rosette of leaves of light green color and lanceolate shape. In the second year of life, low straight shoots up to 65 cm and a small number of nodes develop, which increase their resistance to lodging. On the generative shoots, dense corymbose inflorescences with a diameter of 8 to 10 cm were formed. Flowers in the varieties Mix of Colors and Terry are double, variegated color prevailed. The Macarena F₂ hybrid has simple and monochromatic flowers. Each of them has 4 bracts, along the edges with cilia. In the phase of intense flowering, from 20 to 30 flowers bloomed in the inflorescence.

With the growth of plants, new renewal buds, leaves and shoots were formed, respectively, and the height of the plants, the diameter and size of the shoots increased. The growing season of 2019 was characterized by a large amount of rainfall and a lack of heat, so all plants were stunted. In 2020, with moderate rainfall and high temperatures during the budding period, all plants were tall.

The maximum growth of shoots in *Dianthus barbatus* L. plants was observed in the budding phase and varied from 1.6 to 2.7 cm/day. Plant height depended on the length of the growing season; it was found that in late-ripening varieties the maximum shoot height was 92 cm in 2019 and 96 cm in 2020 (figure 1). The maximum growth of shoots of *Dianthus barbatus* L. plants was observed in the budding phase and varied from 0.6 to 1.7 cm day. We noted that when inflorescences are formed on generative shoots, their growth stops.

![Figure 1](image_url). Growth dynamics of plant shoots *Dianthus barbatus* L., cm.
We found that the strength of the attachment of flower corollas to the base of the calyx depended on the duration of inflorescence flowering. In the Macarena F$_2$ hybrid, weak attachment was noted, and a rapid shedding of the corolla occurred, which was reflected in the decorative effect in the rainy growing season of 2019. Based on the results of the research, we found that the characteristics of the bush determine the adaptive abilities and further use of the hybrid for gardening. In addition to the height of the shoots, the shape and diameter of the bush, the number of flowering stems, their strength and the percentage of foliage are of great importance for the decorativeness of *Dianthus barbatus* L. plants (table 2).

**Table 2.** Morphological characteristics of plants *Dianthus barbatus* L.

|                   | Number of stems, pcs. | Bush size cm |
|-------------------|------------------------|--------------|
|                   | blooming | not blooming | blooming | not blooming |
| Mix of colours    | 3        | 2            | 55       | 24           |
| Macarena F$_2$    | 5        | 4            | 35       | 37           |
| Terry             | 5        | 2            | 42       | 28           |

We found that the number of generative shoots (flowering), the loss of decorativeness and the duration of the flowering phase of *Dianthus barbatus* L. plants depended on the amount of precipitation and the sum of active temperatures during the growing seasons of growth and development. The sum of active temperatures and the onset of physical maturity of the soil influenced the spring regrowth of *Dianthus barbatus* L. plants, which in turn had a significant effect on the onset of budding and the duration of flowering of *Dianthus barbatus* L. plants.

4. **Conclusion**

Based on the results of the study of *Dianthus barbatus* L. plants, it was found that the beginning of the renewal of the growing season had an impact on the onset and duration of the flowering phase of *Dianthus barbatus* L. The weather conditions during the research years influenced the number of formed generative shoots, the size of the bush and the decorativeness of *Dianthus barbatus* L. plants.

According to the results of a comprehensive assessment of *Dianthus barbatus* L. plants for decorativeness and economically valuable traits, it was found that the Terry hybrid was characterized by an original flower color, large inflorescence, and high adaptability for landscaping settlements to the local climatic conditions of Novgorod region.

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