

Development of hostas in the forest-steppe zone of the Novosibirsk region

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Abstract. This is research of biological features of the growth and development rhythm of 10 *Hosta* species and 7 varieties in the conditions of forest-steppe zone of Western Siberia. A comparative analysis of shoot formation in the species *Hosta albo-marginata*, *H. crispula*, *H. fortunei*, *H. decorata*, *H. kikutii*, *H. lancifolia*, *H. rectifolia*, *H. sieboldiana*, *H. undulata*, *H. ventricosa* was carried out. The peculiarities of the formation of underground shoots are noted. Dense-vertical-rhizomatous and loose-horizontal-rhizomatous biomorphs were identified. The description of underground and aboveground shoots is given. The leaf surface area was determined for species and varieties Golden Tiara, France, Night before Christmas, Pacific Blue, Stiletto, White Beauty, Wide Brim in *ex situ* conditions. It is concluded that the hostas are stable, promising and durable in the urban environment of the Novosibirsk region.

1 Introduction

When cultivating *ex situ* hostas, biomorphological criteria for their adaptation are of great importance. They are different from the natural places of existence of the host. The stability of the plant's life form has a great influence on their viability [1 – 2]. Representatives of the genus *Hosta* Tratt. (*hosta*, *funkia*), *Hostaceae* B. Mathew are perennial polycarpic herbaceous rhizomatous plants of the East Asian flora. The purpose of the study was to study shoot formation, growth and development of species and varieties of the genus *Hosta* in the conditions of the forest-steppe zone of Western Siberia.

2 Material and methods

The research is performed in the Central Siberian botanic garden of the Siberian Branch of the Russian Academy of Science (Novosibirsk). As objects of research served plants of 10 species: *Hosta decorata* Bailey, *H. sieboldiana* (Hook.) Engl., *H. lancifolia* (Thunb.) Engl., *H. albomarginata* (Hook.) Hyl., *H. crispula* F. Maekawa, *H. kikutii* F. Maekawa, *H. fortunei* (Baker) Bailey, *H. rectifolia* Nakai, *H. undulata* (Otto et Dietr.) Bailey, *H. ventricosa* Stearn and 7 varieties: Golden Tiara, France, Night before Christmas, Pacific Blue, Stiletto, White Beauty, Wide Brim [3–5]. During the preparation for the publishing

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there were used materials of the CSBS Siberian Branch of the Russian Academy of Science bioresource scientific collection "Collections of live plants on the field and glass-covered ground", UNU № USU 440534.

3 Results and discussion

It has been established that during the generative period, the rhizome and adventitious roots grow annually in the apical part of the plants. As plants age, the stems and roots in their older areas die off. The replacement buds of renewal are removed from the apical part of the underground shoot of the plant in a vertical, obliquely vertical, or horizontal direction. Thus, there is a constant renewal of individuals. This contributes to the high ecological plasticity of representatives of this genus.

When *H. lancifolia* plants are cultivated in the forest-steppe zone, a dense horizontal rhizomatous biomorph with underground formation of shoots is formed. Plants of the species *H. decorata* and *H. sieboldiana* belong to the fleshy-vertical-rhizomatous biomorphs. Their perennial stem part is represented by a fleshy rhizome. It is densely covered with adventitious roots and adventitious buds. During the growing season, several generations of lateral shoots develop on the plant. The daughter buds of the summer generation bloom in the axils of the green rosette leaves of the mother plant, forming new vegetative rosettes. The growth of new sections of the rhizome is associated with the development of new adventitious numerous and cord-like roots.

It was noted that *H. albo-marginata* and *H. undulata* form obliquely vertical rhizomes. They rise above the soil and move to a horizontal position. At the apical end of the shoot, replacement buds of renewal are formed. Thus, when cultivating hostas, the development of underground shoot systems with different life forms was noted. Dense-vertical-rhizomatous biomorphs (*H. decorata*, *H. sieboldiana*), oblique-vertical-loose-rhizomatous (*H. undulata*, *H. albo-marginata*), loose-horizontal-rhizomatous (*H. rectifolia*) and dense-horizontal-rhizomatous biomorphs are formed. (*H. lancifolia*) clones with underground shoot formation (fig. 1). However, in *H. decorata*, *H. sieboldiana*, orthotropic shoots are formed, and in *H. lancifolia*, *H. undulata*, *H. albo-marginata*, plagiotropic shoots are formed, on which adventitious buds and adventitious roots are formed. Under ex situ conditions, vegetatively mobile specialized disintegration increases, which is clearly visible in *H. undulata*, *H. rectifolia* and the varieties Stiletto and Golden Tiara. This enhances the vegetative and reproductive ability of hostas and the possibility of their long-term cultivation in flower beds of various types in an urban environment.

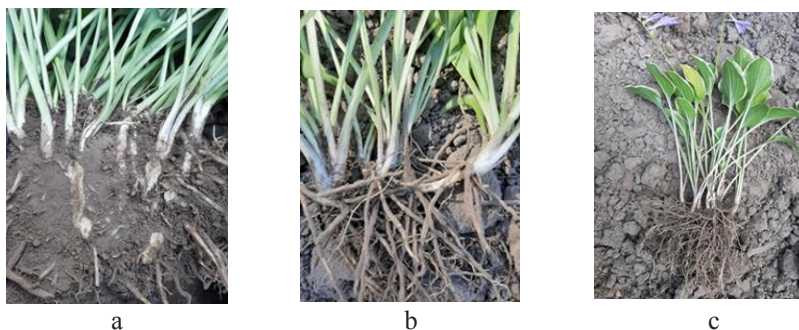


Fig. 1. Dense-vertical-rhizomatous biomorph in *H. decorata* (a), loose-horizontal rhizomatous in *H. rectifolia* (b), variety Golden Tiara (c)

As for aboveground vegetative shoots, in all studied hosta species and varieties they are of the rosette type. Throughout the growing season, above-ground vegetative shoots are formed in the internodes of the shortened rhizome. The expansion of each leaf is accompanied by the growth of a new section of the rhizome. It has been established that leaf sizes differ significantly between species and varieties. The leaf surface contributes to the high transpiration capacity of the hosta. This allows hostas to be identified as promising ornamental leafy crops for urban environments with different lighting conditions. It was noted that the leaf surface area of one leaf ranged from 25.07 (*H. kikutii*) to 123.29 cm² (*H. siboldiana*) in species, from 15.92 (Golden Tiara) to 96.28 cm² (Wide Brim) in varieties. In a two-year clone, depending on the species and variety, from 14 to 34 pieces are formed. rosette leaves. The two-year bush in species had 35–50 cm in diameter (*H. albo-marginata*, *H. rectifolia*, *H. siboldiana*, *H. decorata*) and 20–30 cm in diameter in varieties (*H. kikutu*, *H. crispula*, *H. ventricosa*). The height of the generative shoot of the varieties (from minimum to maximum value) was 17–85 cm. The diameter of two-year vegetative ramets of the varieties was: Golden Tiara 25–27 cm, France 43–45 cm Night before Christmas 56–60 cm, Pacific Blue 27–40 cm, Stiletto 11–16 cm, White Beauty 30–31 cm, Wide Brim 50–54 cm (fig. 2). The varieties were distinguished by their stability and decorativeness. After winter periods of dormancy, no attacks were observed in species and varieties. Aboveground stems in the form of leafless generative shoots were observed in species (*H. decorata*, *H. sieboldiana*, *H. ventricosa*). Leafy generative shoots with alternate leaf arrangement are observed in *H. albo-marginata*, *H. undulata*, *H. fortunei*, and *H. lancifolia*. Thus, hosta generative shoots can be rosette or semi-rosette. The duration of the small life cycle of a monocarpic (generative) shoot in a hosta (intrabud-underground, extra-bud-aboveground, flowering, fruiting, dying) is 15–24 months. The development of a monocarpic shoot occurs according to the dicyclic type. However, vegetative shoots, the buds of which are laid and develop during the growing season, are classified as monocyclic shoots. During the generative period of life of individuals, sympodial shoot growth was observed in all species and varieties.

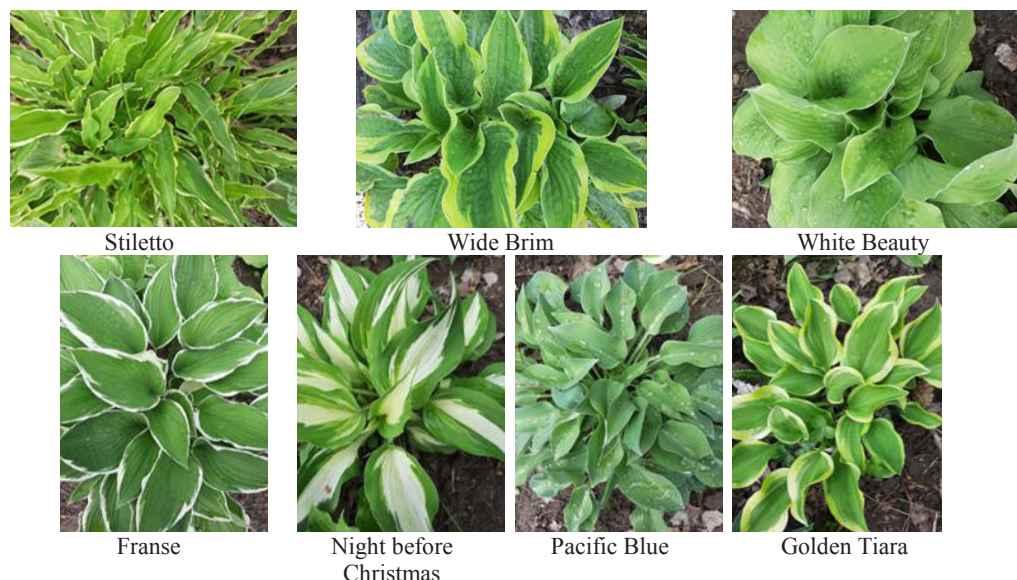


Fig. 2. Hosta varieties cultivated in the Central Siberian Botanical Garden

Hostas in Siberia reproduce vegetatively, which is characterized by a faster and more efficient method of forming ramets. The productivity of three-year-old individuals ranges from 35 to 75 pieces. vegetative divisions depending on the species; in varieties it is 2–3 times less. However, fruiting is observed in hostas, which is well expressed in *H. decorata*. The morphological structure of hosta leaves differed both in shape, from linear-oblong to rounded-ovate, and in color from light to dark green, from monochromatic to variegated, with different surface textures, from smooth to shiny waxy. Long-petioled species with a size from 19 to 38 cm were noted: (*H. fortunei*, *H. decorata*, *H. rectifolia*) and short-petioled species whose size ranged from 10 to 15 cm (*H. undulata*, *H. crispula*, *H. kikutii*, *H. lancifolia*). Interspecific and intervarietal differences in the leaf surface of hostas were revealed: smooth surface in *H. rectifolia*, *H. undulata*, *H. ventricosa*, *H. albo-marginata*, varieties Golden Tiara, White Beauty; shiny as if varnished in *H. lancifolia*, *H. fortunei*, *H. decorata*, *H. kikutii*, variety Pacific Blue; with a waxy tint especially pronounced on the underside of the leaf in *H. siboldina*, *H. kikutii*. Two tall (85–115 cm) species were identified – *H. decorata*, *H. rectifolia* and two varieties – France, Night before Christmas; five medium-sized (65–80 cm) species – *H. albo-marginata*, *H. crispula*, *H. fortunei*, *H. undulata*, *H. ventricosa* and three varieties – Pacific Blue, White Beauty, Wide Brim; three low-growing (35–60 cm) species – *H. kikutii*, *H. sieboldiana*, *H. lancifolia* and two varieties – Golden Tiara and Stiletto, the habit and color of which combine well in various landscape group plantings.

4 Conclusion

Biomorphological study of representatives of the genus *Hosta* in ex situ conditions provides a complete aspect of the adaptive capabilities of biomorphs and the strategy of their development. Obviously, the ecological and morphological transformation of the hosta shoot system occurred simultaneously in the mesophytic and xerophytic directions, which at the present stage of development ensured a stable xeromesophytic line of their existence with a wide cultigenic area. The biomorph adapts in the form of morphological variability of underground and aboveground vegetative shoots and enhances the vital state of the taxon. In general, hostas cultivated in the forest-steppe zone of Western Siberia have a long-growing, summer-autumn phenorhythm of development, with the duration of the growing season in different years being 98–120 days. Representatives of the genus *Hosta* are typical, both short- and long-rhizome, sympodially growing polycarpics with a dense or loose rhizomatous biomorph, with rosette or rosette-free erect generative shoots formed in the pre-winter period and rosette vegetative monocyclic shoots. *Hosta*, despite its origin in the monsoon climate, adapts well to urban green spaces in the Novosibirsk region and is resistant to positive temperatures. It is distinguished by its longevity (7–15 years or more) in plantings, shade-tolerant and light-loving. Low-growing species and varieties are used in flower beds as borders, medium-growing ones in mixed-type flower beds, tall ones forming powerful clumps of large variegated and plain leaves as tapeworms in various landscape groups against the backdrop of lawn, gravel, and stones. It has been established that in urban conditions, the hosta leaf surface accumulates 1.5–2 times more sulfur, nitrogen and ash substances compared [6–7] to representatives of such families as *Iridaceae* Juss., thereby exhibiting high phytoindicative ability.

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