

Selection of herbaceous plant assortment for park ground cover using plants of natural phytocoenosis

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Abstract. The modern direction of landscape architecture to creation of ecological and naturalistic plant communities of perennial herbaceous species for the design of park walking routes in the style of “naturgarten” is highlighted in this paper. The principles of selection of herbaceous perennials developed by Russian scientists for planting in urban environments, as well as the principles of creating combinatorial plantings are given. The range of perennial herbaceous plants proposed to create a ground cover along the park walking route with an indication of their environmental requirements is presented in the Tables. The type and storey of plantings where these plants can be used, the flowering period and in the note the additional features of a particular species are indicated. This material can be further used in the design of structural modules of the ground cover according to the type of natural phytocoenoses for park areas with different environmental conditions.

1 Introduction

There is a tendency to create ecological gardens and parks in which biodiversity is maintained and expanded. A sustainable landscape is created in an urbanized environment and the use of water, energy resources and labor costs for agrotechnical care of such plantations are rationalized. All this is clearly seen at the present stage of development of the world landscape architecture.

In this regard, the study of decorative and ecological features of plants of the natural phytocoenosis is relevant at the present stage.

2 Research purpose

The substantiation of the range of herbaceous plants to create a park ground cover on the basis of the plants of the natural phytocoenosis.

3 Research tasks

1. Study of ecological requirements (relation to illumination, humidity, pH and soil fertility) of the plants of the natural phytocoenosis.
2. Evaluation of the flowering period and other decorative features of the plants of the natural phytocoenosis.

Scientific novelty lies in the analysis of ecological requirements and ornamental qualities of the plants of the natural phytocoenosis to justify the range of herbaceous plants with the aim of designing green ground cover in the style of Naturgarten preserving the decorativeness during the whole season.

4 Results

The study of ecological requirements and decorative features of the plants of the natural phytocoenosis allows to design a ground cover for open, closed and semi-open park spaces. As a result, the artistic value of the spaces adjacent to the walking route significantly increases.

Historically, in Russia, in urban landscaping, the flower beds were usually designed from annual flowering and decorative deciduous plants (with a very limited range) on a lawn background. Ornamental grasses and herbaceous perennials were not commonly used in the urban flower beds.

Modern ecological – naturalistic vision of the park flower beds and ground cover promotes the expansion of the range of herbaceous plants with the involvement of ornamental perennials and grasses close in their image to the plants of natural plant communities as well as the plants of the natural phytocoenosis that can grow together in the same area under the same environmental conditions.

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Table 1. The range of plants for greenbelt setting of open spaces (meadow phytocoenosis)

№	Latin name	Family	Planting type*	Storey of planting**	Ecological conditions			Flowering period	Notes
					Illumination***	Humidity**	pH and soil fertility		
	<i>Calamagrostis acutiflora</i>	Grasses (Poaceae)	Mono plantings, matrix, mixed	Upper, 150–200 cm	Sun	Drainage	Any soils	VII	The leaves are golden – yellow in autumn. Aggressive
	<i>Phalaris arundinacea</i>	Grasses (Poaceae)	Mono plantings, matrix, mixed	Upper, 100–150 cm	Sun	Excessive but the plant is drought resistant	Any soils, pH: 6.0-8.1	VI	Aggressive
	<i>Glyceria maxima</i>	Grasses (Poaceae)	Mono plantings, matrix, mixed	Medium, 50–60 cm	Sun, semishade	Excessive	Light loam and peat soils, pH: 6.0–6.5	VI–VIII	Leaves in autumn turn a reddish tone
	<i>Miscanthus sinensis</i>	Grasses (Poaceae)	Mono plantings, matrix, mixed, single	Upper, 20–250 cm	Sun, semishade	Sufficient	Light loam and peat soil, pH: 6.1–7.8	VII–VIII	Leaves in autumn turn yellow
	<i>Deschampsia cespitosa</i>	Grasses (Poaceae)	Mono plantings, matrix, mixed	Medium and upper, 30–100 cm	Sun, semishade	Sufficient	Any soils, pH: 3.7–8.0	V–VII	–
	<i>Carex hirta</i>	Sedge family (Cyperaceae)	Mono plantings, matrix, mixed, blocks	Bottom and medium, 10–60 cm	Sun, semishade	Sufficient	From wet clay to dry, sandy	IV–VI	Aggressive
	<i>Carex acuta</i>	Sedge family – Cyperaceae	Mono plantings, matrix, mixed, blocks	Medium, 40–100 cm	Sun, semishade	Excessive. Riparial plant	Any soils, but better muddy	VI	Aggressive
	<i>Primula veris</i>	Primrose (Primulaceae)	Mixed, blocks	Bottom, 30 cm	Semishade	Sufficient	Light soil	V–VI Yellow color	
	<i>Ranunculus ficaria</i>	Crowfoot family (Ranunculaceae)	Mixed, blocks	Bottom, 5–30 cm	Sun	Sufficient	Loam, pH: 6.5	IV–V Yellow color	In June, the aerial part of the plant dies
	<i>Anemone nemorosa</i>	Crowfoot family – (Ranunculaceae)	Mixed, block	Bottom, 25 cm	Semishade, shade	Sufficient	Light loam, pH: 6.5	IV–V White color	Ephemeroïd – the leaves are dying by mid-summer
	<i>Alchemilla vulgaris</i>	Rose family – Rosaceae	Mono plantings, mixed, blocks	Bottom, 30 cm	Sun, semishade	Sufficient	Loam, pH: 6.0	V–IX Green and yellow color	Decorative effect is preserved throughout the season
	<i>Pulmonaria obscura</i>	Borage family – Boraginaceae	Mixed, block	Bottom, 30 cm	Semishade, shade	Sufficient	Light loam, pH: 6.1–7.8	IV–V red-lilac-blue color	
	<i>Polygonum bistorta</i>	Buckwheat family – Polygonaceae	Mono plantings, blocks	Upper, 100 cm	Sun	Excessive	Any soil, but better fertile, peaty	V–VII Pale pink color	
	<i>Thalictrum aquilegifolium</i>	Crowfoot family – Ranunculaceae	Matrix, mixed	Upper, 150 cm	Sun, semishade	Sufficient	Light loam, pH: 6.5	VI–VII White, purple color	

Table 1. Ending

Campanula latifolia	Bell-flower family- Campanulaceae	Temporary plantings, mixed	Upper, 70–150 cm	Sun, semishade	Sufficient	Light loam, pH: 6.5–7.0	VI–VII White, purple, blue color	
Leucanthemum vulgare	Aster family –Asteraceae	Temporary plantings, mixed	Medium, 45 cm	Sun	Sufficient	Any soils	VI White color	
Tanacetum vulgare	Aster family –Asteraceae	Temporary plantings, mixed	Upper, 80–120 cm	Sun	Sufficient	Any soils	VII–X Yellow color	Undemanding plant
Geranium pratense	Geranium family – Geranium	Temporary plantings, mixed	Medium, 60 cm	Sun	Sufficient	Light loam	VI–IX Pink color	Undemanding plant
Lythrum salicaria	Lythrum family- Lythraceae	Temporary plantings, mixed	Upper, 80–120 cm	Sun, semishade	Sufficient	Any soil	VI–IX Purplepink color	Tolerates stagnant over-wetting
Salvia pratensis	Deadnettle family- Lamiaceae	Temporary plantings, mixed, blocks	Medium, 50–70 cm	Sun, semishade	Sufficient	Any soils, pH: 6.5	VI–IX Pink blue-violet color	Volatile oil plant
Veronica spicata	Snapdragon family – Scrophulariaceae	Temporary plantings, mixed, blocks	Medium, 70 cm	Sun	Sufficient	Light loam, pH: 6.5–7.0	VI bright blue, blue color	
Verbascum phlomoides	Snapdragon family – Scrophulariaceae	Temporary plantings, mixed, blocks	Upper, 80–200 cm	Sun	Sufficient	Light soils	VI–X Yellow color	Biennial plant, environmentally plastic, high reproduction rate
Nepeta × faassenii	Deadnettle family – Lamiaceae	Temporary plantings, mixed, blocks	Medium, 30–60 cm	Sun	Sufficient	Light loam, pH: 6.1–7.8	VI–IX Lavender color	Pruning of withered blossoms to encourage reflowering
Tulipa acuminata	Lily family Liliaceae	Temporary plantings, mixed, blocks	Medium, 40 cm	Sun	Sufficient	Sabulous clay and light loam	V Yellow with red stripes	Ephemeroïd – leaves are dying by mid-summer

Notes:* Planting type: mono plantings, matrix, temporary plantings, blocks, mixed, single.

** Planting storey: bottom (10–30 cm), medium (30–70 cm), upper (70–140 cm)

*** Illumination: shade, semi-shade, sun

**** Humidity: insufficient, sufficient, excessive

Tulipa acuminata, which is not typical for the natural phytocoenosis of the Non-Chernozem zone, was introduced into the proposed range to give more colorfulness to plantings in spring, especially since its appearance does not stand out from the general context.

One of the main tasks of a landscape designer working on the creation of park sceneries is the development of the original exclusive design providing the change of impressions. One of the possibilities to achieve this effect when creating pictures and landscapes in the style of "naturgarten" for different functional areas of the object (parade, walking, quiet recreation area), is to create compositions based on natural or more cultivated and even exquisite image of the same species of plants, but obtained as a result of selection [1, 2].

In this article, the criterion for plants selection was their natural appearance and high winter hardiness. Such plants can be used to create a ground cover in the walking area of the park in accordance with the natural light conditions [3].

In the master's dissertation of N.K. Borisova it is shown that currently, to create a sustainable vegetation cover, especially in the urban conditions, the principles of combinatorial planting developed by P. Udolf have been introduced into the practice of the landscape design [4]. In particular, in accordance with the technology of the "New wave", which contributes to the creation of a natural way of planting, the following types of plantings of herbaceous perennial plants were proposed: **mono plantings** (single and blocks), which consist of one species or plant variety, and **combinatorial plantings** (blocks, matrix and mixed) that are a collection of the perennial plants of various species that form a stable vegetation cover with a high decorative effect in these specific conditions [5].

Table 2. The range of plants for greenbelt setting of closed and semi-open spaces (forest phytocoenosis)

№	Latin name	Family	Planting type*	Storey of planting**	Ecological condition			Flowe-ring period	Notes
					Illumination**	Humidity**	pH and soil fertility		
1	<i>Molinia caerulea</i>	Poaceae	Mono plantings, matrix, mixed	Medium – 70 cm	Sun, semishade	Sufficient	Any soils, pH: 6.0–8.0	VIII–IX	
2	<i>Luzula sylvatica</i>	Juncaceae	Mono plantings, matrix, mixed	Bottom, medium, 20–70 cm	Semishade, shade	Sufficient	Light soil, loam and peat soil, pH: 5.1–9.0	V–VI	Grows early in spring
4	<i>Sagina subulata</i>	Caryophyllaceae	Mono plantings	Bottom 5–10 cm	Sun	Sufficient	Sandy loam, loamy soils	VI–IX	Looks like moss
5	<i>Poa pratensis</i>	Poaceae	Mono plantings, matrix	Bottom, 20–70 cm	Sun, semishade	Sufficient	Any soil except boggy	VI	
6	<i>Milium effusum</i>	Poaceae	Matrix, mixed	Upper, 100 cm	Shade, semishade	Sufficient	Light soils, loam, pH: 6.5	VI–VII	
7	<i>Corydalis solida</i>	Fumarioideae	Mixed, blocks	Bottom, 30 cm	Sun, semi-shade	Sufficient	Light soils, loam, H: 6.1–7.8	IV–V Pink color	Epheme-roid
8	<i>Hepatica nobilis</i>	Ranunculaceae	“Excipients”, mixed, blocks	Bottom, 15 cm	Shade, semishade	Sufficient	Light soils, loam, pH: 7.5–8.0	IV Blue, white, pink color	
9	<i>Gera-nium macrorhizum</i>	Geranium	Mono plantings, matrix, mixed	Bottom, 20–25 cm	Sun, semishade	Sufficient	Light soils, pH: 6.5	VI White, pink color	
10	<i>Campanula latifolia</i>	Campanulaceae	Temporary plantings, mixed	Upper, 70–150 cm	Sun, semishade	Sufficient	Light loam, pH: 6.5–7.0	VI–VII White, purple, blue color	
12	<i>Polygonatum multiflorum</i>	Liliaceae	Mono plantings, mixed	Medium, 30–90 cm	Shade, semishade	Sufficient	Light soils, pH: 6.5	V–VI White color	
14	<i>Aster alpinus</i>	Asteraceae	Mono plantings, mixed	Bottom, 25–30 cm	Sun, semishade	Sufficient	Light soils, loam	V–VI White, purple color	Grows well in a pine forest
15	<i>Dryopteris filixmas</i>	Dryopteridaceae	Mono plantings, mixed	Upper, 120 cm	Shade	Sufficient	Loam, pH: 5.1–6.5	–	Grows well in a spruce forest
16	<i>Matteuccia struthiopteris</i>	Woodsiaceae	Mono plantings, mixed	Upper, 150 cm	Sun, semishade	Sufficient	Peat soils, loam, pH: 5.6–6.0	–	
17	<i>Rodgersia aesculifolia</i>	Saxifragaceae	Mono plantings, mixed	Upper, 150 cm	Shade, semishade	Sufficient	Light soils	VI White color	When blooming leaves are purple-bronze, later green
18	<i>Podophyllum peltatum</i>	Berberidaceae	Mono plantings, temporary plantings, blocks	Medium, 30–50 cm	Sun, semishade	Sufficient	Loam, pH: 4.0–7.0, but the optimal slightly acidic	V–VI White color	
19	<i>Asarum europeum</i>	Aristolochiaceae	Mono plantings, mixed	Bottom, 30 cm	Shade, semishade	Sufficient	Light soils, pH: 6.5–7.5	Flowering a little noticeable	Winter-green plant

Notes:

* Planting type: mono plantings, matrix, temporary plantings, blocks, mixed, single plantings.

** Planting storey: bottom (10–30 cm), medium (30–70 cm), upper (70–140 cm)

*** Illumination: shade, semi-shade, sun

**** Humidity: insufficient, sufficient, excessive

In our research, we selected and analyzed the species of the plants of the natural phytocoenosis that could be used to create a ground park cover along the walking route passing through the open, semi-open and closed park spaces. In each case, there is a specific environmental situation in terms of the illumination of the areas, humidity, fertility and acidity of the soil. In addition, we took into account the seasonal changes in the decorativeness of the plants in order to ensure the aesthetic appeal of the surroundings of the route from spring to autumn.

Most often in the Non-Chernozem zone in the open areas, a meadow plant community is formed, which is dominated by perennial herbaceous plants (sedge and grass families), growing in conditions of sufficient or excessive moisture. A soddy type of soil formation is characteristic for meadows. Depending on the conditions of a particular place, the fertility and moisture content of these soils can be quite different.

The list of the plants for decoration of open areas that contribute to the image of meadow phytocoenosis is presented in Table 1 with the indication of their main environmental requirements, decorative period and planting place.

The forest phytocoenosis, which is developed within semi-open and closed park spaces, is a complex plant community consisting of woody, shrubby vegetation and a ground cover.

In comparison with the closed park spaces, semi-open spaces are lit better due to the sunrays penetrating them.

A characteristic feature of the forest phytocenoses is the formation of the forest litter from the leaf or coniferous litter, in which the root system of herbaceous perennials is located.

The selection of perennial herbaceous plants for the ground cover is recommended in accordance with the species composition of trees in the park.

Taking into account all above stated, the range of perennial grassy plants offered for the design of a ground cover of the closed and semi-open park spaces solved in the style of natural phytocenoses (1) is presented in Table 2.

In order to achieve the naturalism, the boundaries of artificially created plant communities should be smoothed. This goal may well be realistically, as most of the selected species of the plants have a pronounced plasticity relative to the environmental conditions of the area.

5 Conclusion

The proposed range of the herbaceous perennial plants can be used in the design of structural modules of the ground cover for park areas with different environmental conditions.

References

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