COMPOSITIONAL APPROACHES OF HERBACEOUS PLANT COMMUNITIES IN A UNIVERSITY CAMPUS LANDSCAPE

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Abstract
The paper addresses compositional principles in the design of herbaceous beds and grass–herbaceous plant communities within a university campus environment. The aim of the study is to highlight the possibilities of using ornamental herbaceous plants in the formation of aesthetically valuable, functional, and ecologically stable vegetation elements in an academic setting. In the design of the planting beds, fundamental landscape architectural principles were applied, particularly composition, rhythm, colour harmony, plant height gradation, and seasonal dynamics of vegetation. Attention was also paid to the adaptability of the selected species to local site conditions, their ecological requirements, and maintenance demands. The selection of plant material focused on species and cultivars with high ornamental value throughout the growing season, while considering their phenology, growth habit, and mutual compatibility within the overall composition. The design also reflects the need to enhance biodiversity and support ecological functions of greenery within the urbanised environment of a university campus, and addresses mowing strategies. The outcome of the study is a design of compositionally balanced herbaceous plant communities that contribute to improving the visual quality of university space while creating opportunities for educational and research activities, including monitoring plant growth, development, and adaptation to specific site conditions.

Key words: herbaceous plant communities; planting design; landscape architecture; urban biodiversity; campus landscape

Introduction

Woody and herbaceous plants used in urban environments play a significant role in enhancing the resilience and adaptive capacity of cities to the impacts of climate change (Kuczman et al., 2024; Hus, Paganová, Raček, 2021), particularly through the mitigation of the urban heat island effect. At the same time, appropriately designed and managed green spaces represent a key tool for achieving sustainable development goals (Tóth, Slobodníková, 2025; Hus, Saková, 2025; Bellérová, Hus, 2025). In this context, there is an increasing need for new approaches to planning sustainable and ecologically functional urban spaces that integrate the use of trees, shrubs, and herbaceous plants. In Europe, herbaceous vegetation has long been considered an important element in enhancing the ecological stability of urban environments, including their resilience to climate change (Sjöman, Bellan, Hitchmough, 2015; Pomatto, 2023). At the same time, growing attention is being paid to the potential of meadow communities and perennial plantings, which enable a reduction in the maintenance costs of urban green spaces while providing positive environmental effects, including support for biodiversity (Caser, 2022; Hitchmough, 2009). The use of meadow flowers, including perennial species, in degraded urban areas also contributes to increased biodiversity and environmental awareness among residents (Jiang, Yuan, 2017). In addition to wildflower meadows, flower beds represent another preferred solution, significantly enhancing the aesthetic value of urban green spaces. Their advantage lies in their applicability even in smaller areas, such as roundabouts or vegetated strips along roads, where the use of meadow vegetation is less suitable. Under such conditions, Colombo et al. point out the risk that meadow vegetation may be perceived by the public as unmanaged and aesthetically less attractive, particularly after the completion of the life cycle of annual species. In contrast, flower beds combining ornamental and native perennials allow for the maintenance of continuous soil cover and, through variability in forms and colors, support pollinator presence (Hus, Saková, 2025; Hus, Pástorová, 2025). The use of perennial plantings in public spaces has become the subject of intensive professional discussion in recent years. Contemporary approaches to vegetation design primarily focus on economically efficient solutions with low maintenance requirements. A key aspect is the selection of species suitable for specific site conditions and the realistic consideration of long-term management and maintenance costs. This trend is closely linked to a period of stagnation or decline in

funding for public green spaces, which has motivated landscape architects and green space managers to seek cost-effective and sustainable approaches to creating dynamic, seasonally variable, and biologically valuable urban vegetation. In practice, this has led to a broader application of ecologically oriented plantings composed with regard to the ability of species to thrive under the natural conditions of a given site, rather than relying on traditional approaches based on intensive environmental modification to meet the requirements of selected species. Such an ecologically based approach enables a transition to less intensive management regimes, resulting in reduced maintenance costs and increased overall sustainability of vegetation elements in urban environments (Hitchmough, Woudstra, 1999). Despite these benefits, the implementation of flower plantings also has certain limitations. These include, in particular, the time required for project preparation and the selection of appropriate plant material, as only a thorough analysis of the growth characteristics of individual species and their interactions allows for the creation of stable and long-term functional vegetation compositions. After implementation, a time lag must be expected before achieving maximum ornamental effect, especially in the case of slow-growing species. Another limiting factor is that certain groups of perennials (e.g., bulbous and tuberous plants) exhibit only a short-term ornamental effect, which may be perceived negatively by users of public spaces. However, this drawback can be mitigated through appropriate species selection and compositional design (Korenkova, Shiryaeva, Naumkin, 2022). The present paper focuses on the presentation and analysis of compositional principles applied in the design of herbaceous planting beds and grass–herbaceous plant communities within a university campus environment (Porvazník, Bakay, Miklášová, 2025). The main objective of the study is to analyze and interpret the potential of ornamental herbaceous plants in creating aesthetically valuable, functional, and ecologically stable vegetation elements in an academic setting, with an emphasis on their application in the context of contemporary sustainability requirements and climate change adaptation.

Materials and method

The conventional approach to the design of public spaces is based on long-established principles and practices that primarily emphasize aesthetic qualities and adherence to traditional compositional rules. However, this approach often overlooks broader ecological contexts and sustainability principles, which are currently regarded as essential in shaping urban environments. Over the past decade, several landscape architectural interventions have been implemented within the campus of the Slovak University of Agriculture in Nitra, with a particular emphasis on the application of herbaceous plantings. These interventions represent practical examples of a shift from traditional approaches towards vegetation-oriented solutions that reflect contemporary requirements for ecological stability and functional diversity of urban green spaces. At the same time, they serve as a means of presenting effective adaptation measures to the general public, particularly in the context of flood risk reduction and the mitigation of the adverse effects of climate change through planting design—specifically, through diverse, species-rich herbaceous compositions. The campus of the Slovak University of Agriculture in Nitra was subjected to a systematic analysis, on the basis of which selected vegetation modifications dominated by perennial plantings were identified and typologically classified. Different types of herbaceous communities were distinguished according to site conditions, species composition, and spatial arrangement.

Results

Within the area of the Slovak University of Agriculture in Nitra, several types of perennial planting beds were identified, which are characterized by different internal arrangements and variable species composition, which reflects differences in spatial location and site-specific conditions affecting their growth and development.

A/ Representative planting beds in front of the main building

In 2019, representative perennial planting beds with a total area of approximately 900 m² were established within the lawn areas of the representative space in front of the assembly hall of the Slovak University of Agriculture in Nitra. Linear planting beds were designed within the university parterre as a vegetation element accompanying users as they transition from the street space towards the assembly hall. The individual bed segments are complementary in form and sufficiently spacious to allow the plant community, composed of species used in the mixture, to function sustainably and provide year-round visual interest within this type of space.

year of establishment: 2019

site conditions: sunny exposure

plant community: a xerophytic plant assemblage providing year-round effect, with a pronounced spring aspect created by bulbous species and early spring perennials: (*Allium* 'Purple Sensation', *Helleborus niger*)

B/ Group understory planting beds located between the pavilions of the main building
In 2023, extensive lawn areas located between the blocks of the main building of the Slovak University of Agriculture in Nitra were transformed into perennial plantings established beneath the understory of existing mature trees, as well as under conditions of pronounced shading caused by the surrounding built environment enclosing the site on three sides. The locality is additionally characterized by a rain shadow effect, resulting in a significant reduction in incident precipitation. Within stands of deciduous broadleaved woody species, vertical differentiation of root systems between woody plants and herbaceous species occurs, enabling their coexistence across different soil horizons. However, a limiting factor for the persistence of understory herbaceous communities, particularly in dense tree groupings, is insufficient light availability. During the leafless period, approximately 50% of solar radiation reaches the soil surface, creating favorable conditions for the development of early spring ephemeroids. A key phenological feature of these communities is the spring aspect, characterized by intensive flowering of species prior to canopy leaf-out, such as *Corydalis cava*. Conversely, another group of species is adapted to reduced light conditions during the growing season following canopy closure, forming the so-called summer aspect of the herbaceous understory.
year of establishment: 2023
site conditions: shading from surrounding buildings; tree understory
plant community: species adapted to long-term shade and periodic soil desiccation (so-called "dry shade" conditions)

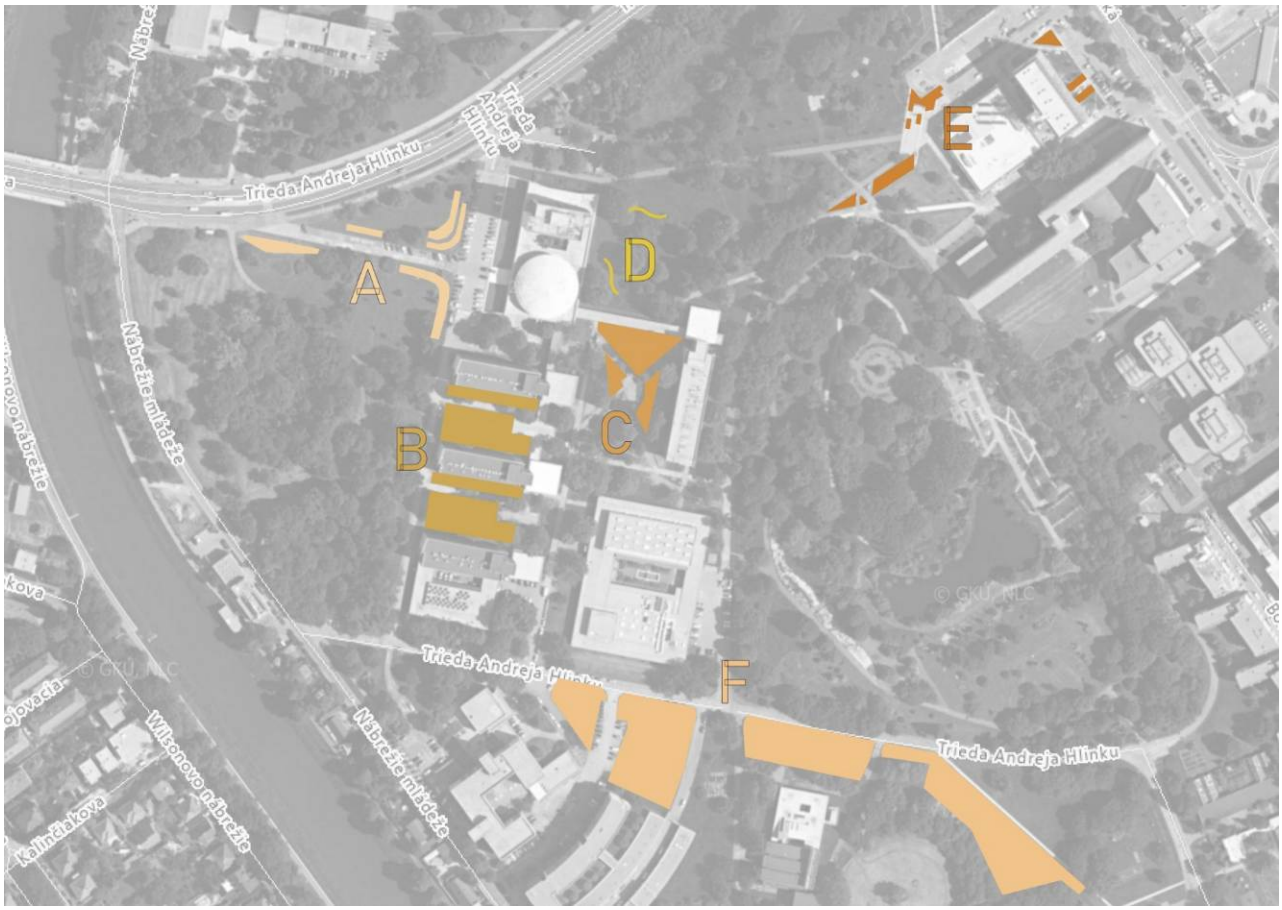

Fig. 1: Map of the campus of the Slovak University of Agriculture in Nitra indicating areas where perennial herbaceous planting elements were implemented (Hus, 2026).

C/ Perennial planting beds within the inner courtyard of the main building
A semi-enclosed space between Pavilion CH, the connecting corridor, and Pavilions A, Z, and T was transformed into a relaxation area complemented by urban furniture and a network of pathways. At the

same time, the original lawn areas were replaced with perennial planting beds covering a total area of 2800 m^2. The site, which includes these perennial plantings, is exposed to high visitor intensity.
The designed herbaceous community, intended for areas with partial light as well as shading caused by trees or surrounding buildings, consists of drought-tolerant species. The site is not equipped with automatic irrigation, and the plants are subjected to water deficit, particularly during the summer period.
year of establishment: 2023
site conditions: shading from surrounding buildings; tree understory; sunny exposure
plant community: species adapted to long-term shade and periodic soil desiccation (so-called “dry shade” conditions)

D/ Linear plantings of bulbous and tuberous species established within lawn areas
Bulb planting strips were established within lawn areas in the vicinity of the assembly hall of the Slovak University of Agriculture in Nitra. From a compositional perspective, they were designed in organic forms, creating a contrast with the rational and geometric character of the surrounding architecture. The spring aspect of the plantings is composed of two genera of bulbous plants – Narcissus and Crocus. Flowering occurs from March to the first half of April. Following flowering and the senescence of the above-ground plant parts, the area is subsequently incorporated into the standard lawn mowing regime.
year of establishment: 2021
site conditions: sunny exposure, semi-shaded conditions under tree canopies
plant community: bulbous and tuberous plant species flowering in March and April: *Narcissus*, *Crocus*

E/ Representative perennial planting beds in the university campus in front of the dormitory with a pronounced spring effect
The planting composition is complemented by woody species, specifically Amelanchier spp. and a shrubby form of Acer campestre, which contribute to the spatial structure and functional diversity of the design. The planting scheme is conceived as open and loosely arranged, with the use of dominant species forming the structural framework of the plant community. A pronounced spring aspect is ensured by the inclusion of bulbous plants of the genus Narcissus, which, when planted at high density, create a visually continuous, nearly monodominant effect during the period from March to April.
year of establishment: 2024
site conditions: sunny exposure
plant community: light-demanding xerophytic species

F/ Biodiverse grass–herbaceous communities
A project focused on the application of grass–herbaceous communities in an urban environment was implemented. As part of the project, 18 original flowering meadow mixtures were established over an area of approximately 1.5 ha. These stands serve as both demonstration and experimental plots. The project enables the monitoring of establishment processes, management practices, and the development of meadow communities under intra-urban conditions, while also facilitating the identification of limitations and risks associated with their implementation. The mixtures consist of species capable of adapting to urban environmental conditions and exhibiting resilience to periods of drought.
year of establishment: 2024
site conditions: sunny exposure
plant community: grass–herbaceous communities, annual and perennial herbaceous species

Conclusion
The study confirms that herbaceous plant communities, when designed with respect to compositional principles and site-specific conditions, represent an effective tool for enhancing the ecological, functional, and aesthetic quality of university campus environments. The use of perennial and grass–herbaceous plantings contributes to increased biodiversity, improved microclimatic conditions, and reduced maintenance demands. The case of the Slovak University of Agriculture in Nitra demonstrates the potential of university campuses as model spaces for the application of sustainable and ecologically oriented planting strategies that also support education and research activities. However, successful implementation requires careful species selection, detailed planning, and consideration of long-term management. Herbaceous planting design can thus be regarded as a progressive approach contributing to the development of resilient and sustainable urban landscapes.

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Souhrn
Článek se zabývá kompozičními principy při navrhování trvalkových záhonů a travnatě-trvalkových společenstev v prostředí univerzitního kampusu. Cílem studie je poukázat na možnosti využití okrasných trvalkových rostlin při vytváření esteticky hodnotných, funkčních a ekologicky stabilních vegetačních prvků v akademickém prostředí. Při navrhování výsadbových záhonů byly uplatněny základní principy krajinářské architektury, zejména kompozice, rytmus, barevná harmonie, gradace výšky rostlin a sezónní dynamika vegetace. Pozornost byla věnována také přizpůsobivosti vybraných druhů místním podmínkám, jejich ekologickým požadavkům a nárokům na údržbu. Výběr rostlinného materiálu se zaměřil na druhy a kultivary s vysokou okrasnou hodnotou po celou vegetační dobu, přičemž byla zohledněna jejich fenologie, růstový habitus a vzájemná kompatibilita v rámci celkové kompozice. Návrh také odráží potřebu posílit biologickou rozmanitost a podpořit ekologické funkce zeleně v urbanizovaném prostředí univerzitního kampusu a zabývá se strategiemi sečení. Výsledkem studie je návrh kompozičně vyvážených společenstev bylin, která přispívají ke zlepšení vizuální kvality

univerzitního prostoru a zároveň vytvářejí příležitosti pro vzdělávací a výzkumné aktivity, včetně sledování růstu, vývoje a adaptace rostlin na specifické podmínky daného místa.

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