PHENOLOGICAL DEVELOPMENT AND ORNAMENTAL ASSESSMENT OF *SYRINGA VULGARIS* L. CULTIVARS UNDER FOREST-STEPPE CONDITIONS OF UKRAINE

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The development of modern landscape architecture and urban greening is increasingly associated with the need for continuous optimization and expansion of the assortment of woody and shrub plant species. Contemporary urban environments are characterized by complex and often stressful conditions, including rapid urbanization, climate change, elevated levels of industrial emissions, soil degradation, and increased anthropogenic pressure. These factors significantly alter the ecological framework within which ornamental plants must function, necessitating the selection of species that combine high ornamental value with ecological resilience and adaptability to heterogeneous and often unfavorable growth conditions.

In this context, ornamental shrub species capable of maintaining stable декоративний ефект under variable environmental conditions are of particular importance. Among such species, *Syringa vulgaris* L. occupies a prominent position due to its high ornamental value, ecological plasticity, and relatively low maintenance requirements. This species is widely used in landscape design for parks, gardens, public spaces, and residential areas, where it performs both aesthetic and functional roles. Its tolerance to air pollution and urban stress factors has been noted in studies of urban woody vegetation (Nowak et al., 2006), while its adaptability to different soil conditions makes it suitable for a wide range of landscaping applications.

The genus *Syringa* L., belonging to the family Oleaceae, includes approximately 20–30 species naturally distributed mainly in mountainous regions of Southeastern Europe and Asia (Krüssmann, 1986; Dirr, 2009). Long-term cultivation and breeding have resulted in the development of more than 2000 cultivars, which differ in flowering time, inflorescence morphology, color range, fragrance intensity, and ecological adaptability. This diversity significantly expands the potential for the use of *S. vulgaris* in ornamental horticulture and landscape design and provides a valuable basis for phenological and ecological research.

Phenological development is one of the most informative indicators of plant adaptation to environmental conditions. The timing and sequence of phenological phases-such as bud break, leaf development, flowering, and fruiting-reflect the interaction between genetic traits and climatic factors (Schwartz, 2013). In woody plants, phenology is closely linked to temperature regimes, photoperiod, and water availability, which together regulate the processes of dormancy and active growth.

Under current climate change conditions, phenological studies have gained particular importance. Numerous studies indicate that rising temperatures and changing precipitation patterns lead to shifts in the timing of flowering and other developmental phases (Parmesan & Yohe, 2003; Cleland et al., 2007). Such changes may affect not only plant productivity but also the stability of декоративних насаджень and their ecological functions in urban environments.

For the Forest-Steppe zone of Ukraine, phenological research is especially relevant due to the transitional nature of this region and the variability of climatic conditions. Fluctuations in spring temperatures, late frosts, and uneven precipitation distribution may significantly influence the development of ornamental plants. Under such conditions, cultivar-specific responses become particularly important, as even small differences in biological characteristics can lead to substantial variation in flowering time, duration of декоративного ефекту, and overall plant performance.

Despite the widespread use of *S.vulgaris* in landscaping, the phenological behavior and adaptive capacity of its cultivars remain insufficiently studied at the regional level, particularly in the northeastern Forest-Steppe of Ukraine. Most existing studies focus on general biological or breeding aspects, whereas detailed field-based analyses under specific environmental conditions are limited. This highlights the need for comprehensive research aimed at clarifying seasonal development patterns, evaluating ornamental value, and determining the adaptive potential of S. vulgaris cultivars under local conditions.

The aim of this study is to investigate the peculiarities of the main phenological phases and to assess the ornamental value of *S. vulgaris* cultivars under the conditions of the Forest-Steppe zone of Ukraine.

To achieve this aim, the following objectives were defined:

– to generalize scientific literature on the biological and ornamental characteristics of species and cultivars of the genus *Syringa* L.;

– to conduct phenological observations of the main developmental phases of selected cultivars under regional climatic conditions;

– to analyze phenological and ornamental indicators and determine the prospects for the use of these cultivars in landscaping systems.

Materials and Methods. The research was conducted under the conditions of the northeastern Forest-Steppe zone of Ukraine, which is characterized by moderately continental climatic conditions with relatively warm summers and moderately cold winters. The regional climate is generally favorable for the cultivation of ornamental woody plants; however, fluctuations in temperature and irregular precipitation during the growing season may significantly influence the timing and duration of phenological phases.

The object of the study was *S. vulgaris* L., represented by two cultivars, including the typical species form and the ornamental cultivar 'Ludwig Spaeth'. These cultivars were selected due to their widespread use in landscaping and their distinct ornamental characteristics, which made it possible to assess variability in phenological development and decorative performance under local environmental conditions.

Phenological observations were carried out during the growing season in accordance with generally accepted methods of phenological research. The study focused on recording the timing and duration of the main developmental phases of plants, including bud swelling, bud break, leaf unfolding, formation of flower buds, onset and peak of flowering, end of flowering, and completion of vegetation. The onset of each phenological phase was determined visually based on clearly expressed morphological indicators, ensuring the consistency and reliability of observations.

Special attention was paid to the assessment of ornamental value, particularly during the flowering period, which represents the peak of decorative expression in *S. vulgaris*. The evaluation included the intensity and duration of flowering, color characteristics of inflorescences, uniformity of flowering, and the overall visual effect of plants in landscape compositions. The seasonal dynamics of ornamental attractiveness were analyzed in order to determine the periods of maximum decorative value and the stability of these characteristics under the conditions of the Forest-Steppe zone.

The collected data were subjected to office-based processing, systematization, and statistical analysis. Comparative evaluation of the studied cultivars was carried out to identify differences in phenological behavior and ornamental performance. The interpretation of results was performed taking into account both the biological characteristics of the cultivars and the influence of environmental factors typical for the northeastern Forest-Steppe of Ukraine.

Results. In Ukraine, ***S. vulgaris*** is represented by a considerable cultivar diversity; however, only 21 cultivars are officially included in the State Register of Plant Varieties Suitable for Dissemination in Ukraine, which are recommended for cultivation in different natural and climatic zones of the country (Belorusets et al., 1990; Mordan, Melnyk, 2025). This list includes cultivars of both domestic and foreign breeding, characterized by high ornamental value, adaptability to climatic conditions, stability of flowering, and suitability for various purposes, including ornamental use, landscaping, and cut-flower production (Table 1). At the same time, the actual assortment of *S. vulgaris* cultivars available for commercial and amateur horticulture is significantly broader.

Particularly valuable is the collection fund of the M.M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine, which currently represents one of the largest S. vulgaris collections in Europe. The collection includes 21 natural species out of approximately 28 known in the world flora, as well as more than 90 ornamental hybrids developed through the breeding program of the Botanical Garden (Kokhno, 2002). Such a representative gene pool provides extensive opportunities for breeding research, evaluation of cultivar adaptability under Forest-Steppe conditions, and the development of new promising cultivars. Owing to this, Ukrainian cultivars are regularly included in international catalogs and attract the attention of specialists in ornamental horticulture.

The cultivars of *S. vulgaris* recommended for Ukraine are distributed according to growing zones: Steppe, Forest-Steppe, and Polissia. This approach takes into account differences in temperature regimes, moisture availability, and plant resistance to critical climatic conditions, which allows for the proper selection of cultivar assortments for specific territories. A significant proportion of cultivars is characterized by ecological plasticity, enabling their cultivation in several natural zones due to their high frost resistance and ability to adapt to contrasting environmental conditions.

Table 1. List of *Syringa vulgaris* cultivars included in the State Register of Plant Varieties Suitable for Dissemination in Ukraine

Cultivar name *Syringa vulgaris*	Recommended zone	Direction of use*
′Bohdan Khmelnytskyi′	Forest-Steppe, Polissia	O, C, L
′Vohni Donetska′	Steppe, Forest-Steppe, Polissia	L, C.
′Vohni Donbasu′	Forest-Steppe, Polissia	O, C, L
′Hortensiia′	Forest-Steppe, Polissia	O, L, C
′Den Peremohy′	Forest-Steppe, Polissia	O, L, C
′Donetski Zori′	Steppe, Forest-Steppe, Polissia	L, C
′Donetskyi Suvenir′	Steppe, Forest-Steppe, Polissia	L, C
′Dochka Tamara	Forest-Steppe, Polissia	O, L, C
′Krasavytsia Moskvy′	Forest-Steppe, Polissia	O, L, C
′Lilova Piramida′	Forest-Steppe, Polissia	O, L, C
′Lesia Ukrainka′	Forest-Steppe, Polissia	O, C, L
′Mechta′	Forest-Steppe, Polissia	O, L, C
′Moskovskyi Universytet′	Forest-Steppe, Polissia	O, L, C
′Professor V.I. Chopyk′	Steppe	L.
′Professor M.L. Reva′	Steppe, Forest-Steppe, Polissia	L, C
′Professor O.L. Lypa′	Steppe, Forest-Steppe, Polissia	L., C.
′Reomor′	Forest-Steppe, Polissia	O, L, C
′Snizhnyi Kom′	Forest-Steppe, Polissia	O, L, C
′Taras Bulba′	Forest-Steppe, Polissia	O, C, L
′Charivnist′	Forest-Steppe, Steppe	L

Note: *Direction of use: Ornamental (O), Cut (C), Landscaping (L).*

The functional purpose of cultivars is also of considerable importance. Ornamental cultivars are used for the creation of accent compositions, solitary plantings, and collection displays. Cut-flower cultivars are distinguished by dense, large inflorescences and a pronounced fragrance, making them suitable for floral arrangements. Landscaping cultivars are characterized by increased resistance to urban conditions, including air pollution, soil compaction, and irregular moisture supply, which makes them particularly valuable for use in urban environments of Ukraine, including within the Forest-Steppe zone.

A detailed list of officially recommended cultivars of S. vulgaris is presented in Table 3.1, indicating the recommended natural zones of cultivation and directions of use. Among the most well-known and widely distributed cultivars are ′Bohdan Khmelnytskyi′, ′Den Peremohy′, ′Krasavytsia Moskvy′, ′Lesia Ukrainka′, ′Lilova Piramida′, ′Taras Bulba′, ′Moskovskyi Universytet′, ′Snizhnyi Kom′, ′Vohni Donbasu′, and ′Donetski Zori′. These cultivars are characterized by stable and abundant flowering, a wide range of color variations, and good establishment under moderately continental climatic conditions.

Thus, the cultivar diversity of *S. vulgaris* in Ukraine is extremely broad and includes officially registered, collection, and experimental cultivars. The combination of a rich gene pool, established breeding traditions, and the natural adaptability of the species provides a solid basis for studying the phenological characteristics of cultivars, their comparative ornamental value, and their resistance to the conditions of the Forest-Steppe zone, which is particularly important in the context of regional research.

Peculiarities of the Progression of the main phenological phases of *S. vulgaris*. The progression of phenological phases in common *S. vulgaris* is formed under the influence of numerous ecological and internal plant factors, which determine the rhythm of seasonal development, the timing of the onset of vegetation and flowering, the duration of generative processes, as well as the overall ornamental value of plants. The most significant factors include climatic conditions, cultivar characteristics, soil properties of the growing site, the condition of the root system, water regime, level of nutrient supply, and anthropogenic impact. All these factors act in a complex manner; therefore, the interaction of their effects often determines the individual phenological rhythm of each cultivar under specific environmental conditions.

Climatic conditions are the leading factor determining the timing of the main phenological phases. Temperature influences the rate of sap flow initiation, the timing of bud swelling, and the development of generative organs. A prolonged period of low temperatures in winter is necessary to complete physiological dormancy and to ensure the formation of fully developed buds. In the Forest-Steppe zone of Ukraine, the increase in spring temperatures usually stimulates an early onset of *S. vulgaris* vegetation; however, sharp drops in temperature or frosts during the budding period can suppress the development of inflorescences, deform panicles, or reduce the duration of flowering. The amount of effective temperatures (the sum of active

temperatures) determines the rate of development of phenological phases; therefore, in years with warmer springs, early cultivars begin flowering several days earlier than in years with slower warming. Air humidity and precipitation also significantly affect *S. vulgaris*: insufficient soil moisture or prolonged spring drought may lead to a reduction in inflorescence size, suppression of shoot growth, and shortening of the mass flowering phase.

Soil conditions determine the development of the root system and the overall physiological activity of plants. *S. vulgaris* grows best on structured, fertile, moderately moist soils with a pH close to neutral. Acidic soils slow down nutrient uptake and disrupt the synthesis of physiologically active substances, which reduces the quality of inflorescences and may shift flowering periods.

Excessive moisture and water stagnation in the root zone block root respiration and lead to metabolic disturbances, which negatively affect the development of generative organs. Conversely, optimal nutritional conditions, sufficient organic matter content, and favorable soil structure ensure active formation of flower buds and stability of phenological processes.

Cultivar and genetic characteristics also play an important role. Different *S. vulgaris* cultivars exhibit distinct rhythms of seasonal development, which is manifested in the timing of bud swelling, the rate of bud opening, and the duration of budding and flowering. Plant responses to temperature fluctuations and drought are also genetically determined. Early cultivars are capable of activation at lower temperature sums, whereas late cultivars require longer spring warming. At the same time, the degree of sensitivity to spring frosts is cultivar-specific: some cultivars better preserve generative organs under stress conditions, while others respond by reducing or completely losing inflorescences.

Management practices and anthropogenic impact also significantly determine the seasonal development of plants. The presence of formative and sanitary pruning affects the number and vigor of annual shoots and, consequently, the formation of flower buds. Improper pruning, especially excessive removal of shoots in summer or autumn, may disrupt the annual development cycle and shift flowering phases to later periods or reduce their intensity. Adequate light conditions are a key prerequisite for the formation of fully developed generative structures: shading causes shoot elongation, reduces the number of inflorescences, and leads to shifts in phenological phases.

Biotic factors, such as disease infection and pest damage, affect the physiological state of plants and may alter the intensity of phenological phase progression. Leaf damage reduces photosynthetic productivity and limits the plant's ability to form flower buds. Diseases of the root system or trunk lead to delayed bud swelling, weak budding, and uneven flowering. Thus, the phenological development of *S. vulgaris* is the result of a complex interaction of external and internal factors.

Under the conditions of the Forest-Steppe zone of Ukraine, the most important factors are the temperature regime of the spring period, moisture availability, cultivar characteristics, and plant management practices. The study of the influence of these factors makes it possible to assess the prospects of individual cultivars and to form the most optimal assortment for ornamental landscaping and stable seasonal flowering.

Phenological observations of *S. vulgaris* plants (T-21) and the cultivar ′Ludwig Spaeth′ (T-19) made it possible to trace the patterns of seasonal development and to identify cultivar-specific differences that manifest at different stages of the vegetation cycle. The onset of vegetation in both plants was synchronous: the buds became lighter, increased in volume, and their surface lost the winter dullness and acquired a characteristic gloss (Fig. 1.A).

The described feature indicates the activation of cellular processes in the buds and the transition of the plant from a state of deep winter dormancy to pre-vegetative development.

Further development was accompanied by bud break; however, it was at this stage that the first differences in timing were observed. Plants of T-19 began the separation of protective bud scales earlier, which indicates either a faster accumulation of effective temperatures or a higher sensitivity to changes in photoperiod. T-21 entered this phase approximately five days later (Fig. 1.Б).

The photographs clearly demonstrate the exposure of the apical meristem and the initial growth of young tissues, which is characteristic of early spring differentiation.

At the budding stage, the situation changed: T-21 formed flower primordia earlier than T-19. Figure 1.B shows a fully opened bud with a visible generative primordium, which is a characteristic feature of the transition to intensive inflorescence development. At this time, T-19 still exhibited partial covering of the primordium by bud scales. This confirms cultivar-specific differences in the rate of development, which are likely associated with genetic characteristics and different responses to spring temperature fluctuations.

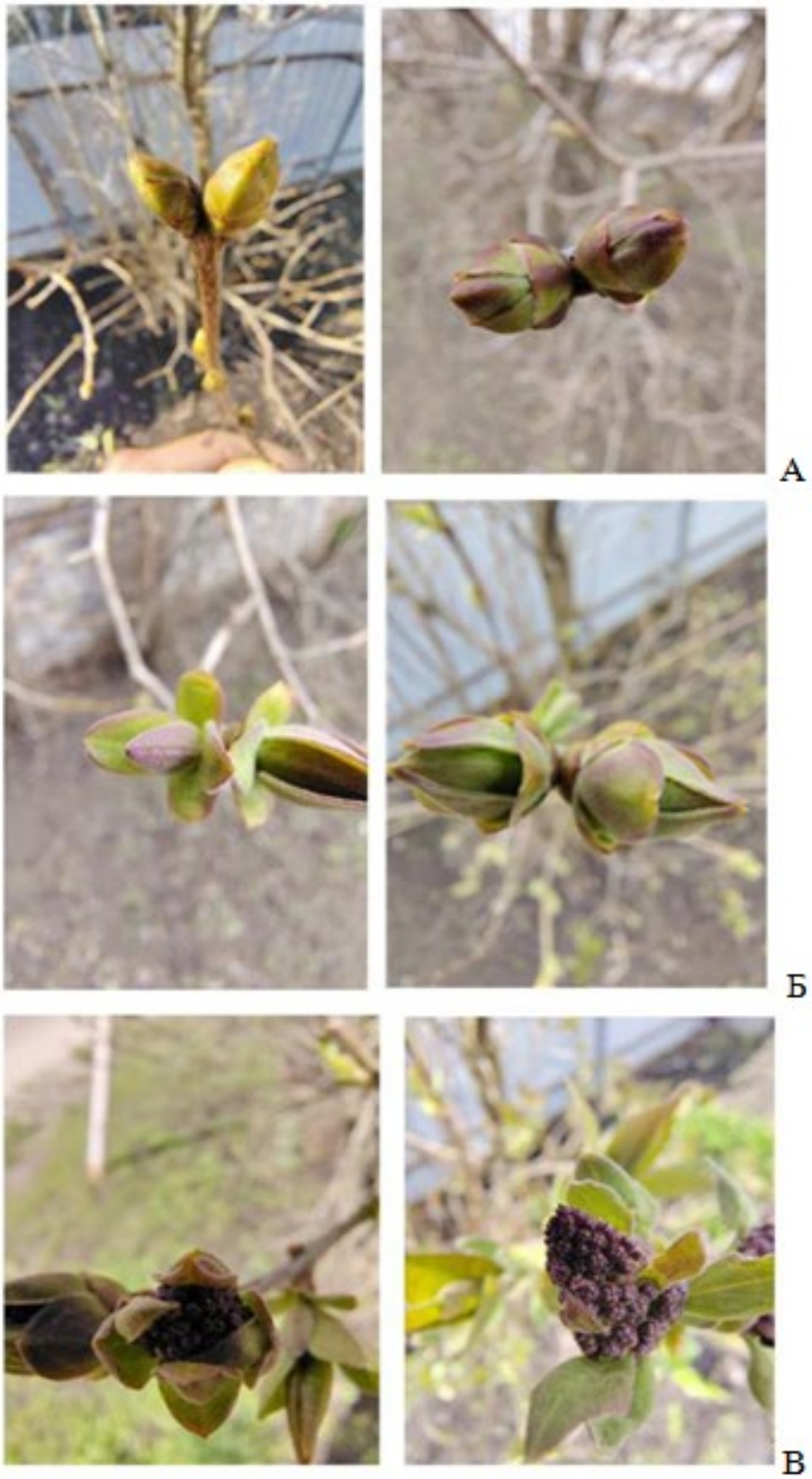

Figure 1. Main stages of early phenological development of Syringa vulgaris: A – Initial stage of bud swelling in T-19 and T-21 at the beginning of March; a lighter color and increased turgor are clearly observed; B – Beginning of the opening of protective bud scales in T-19 and bud break in T-21, occurring with a delay of approximately 5 days; C – Formation of flower buds in T-21: fully opened bud scales and appearance of floral primordia (photo by A. Mordan).

Further elongation and formation of inflorescences proceeded in a regular manner. In the control plants, long, upright inflorescences reaching up to 30 cm were observed, with two or three pairs of racemose branches; in T-21, the inflorescences were more compact, up to 20 cm in length, but distinctly conical in shape. Differences between the plants were also manifested in flower size: T-19 had larger flowers of a purplish-red coloration, whereas the cultivar plants were characterized by smaller, *S. vulgaris* – violet flowers, which corresponds to the typical characteristics of the cultivar ′Ludwig Spaeth′.

Flowering first occurred in T-21, and approximately five days later T-19 also entered the flowering phase. Figure 2 illustrates this stage, demonstrating the higher early spring activity of the cultivar.

Figure 2. Full flowering phase (peak flowering stage) (photo by A. Mordan).

Following the completion of flowering, plants transitioned to the fruiting stage.

Both variants formed glossy, elongated, ovate capsules, which gradually matured over an extended period. The photographs show their initial green stage as well as their subsequent drying at the end of summer. Both plants completed fruiting almost simultaneously, at the end of August (Fig. 3).

After the full opening of the capsules, the plants gradually entered the stage of vegetation decline. In autumn, differences in leaf coloration became evident. In T-19, the leaves acquired a dark green or purplish-red оттенок, retained crown density, and exhibited resistance to premature leaf fall. In contrast, T-21 was characterized by a light yellow coloration, sometimes with purple shades, and a more sparse crown structure. Differences in the nature of autumn coloration and the rate of leaf fall are shown in Figure 4.

Figure 3. Completion of the fruiting stage (photo by A. Mordan).

Figure 4. Characteristic features of autumn coloration and the rate of leaf fall (photo by A. Mordan).

At the beginning of November, T-21 had almost completely shed its leaves, whereas T-19 still partially retained them, which indicates a longer duration of active physiological processes (Fig. 5).

By the end of November, both plants had completely lost their leaves, and the buds had acquired a darker coloration and became more compact, as shown in Figure 6.

In mid-December, the plants were in a state of complete dormancy, which represents the natural completion of the annual development cycle. This is confirmed by the photographs in Figure 7, where dense, dark buds fully adapted to winter conditions can be observed.

Figure 5. Completion of the leaf fall stage in the studied samples (photo by A. Mordan).

Figure 6. Preparation for winter dormancy: leaf shedding and bud compaction (photo by A. Mordan).

A comparison of the phenological phases of T-19 and T-21 revealed a number of significant cultivar differences that have practical importance for ornamental horticulture, landscape design, and further breeding research.

The onset of vegetation in both plants was synchronous, indicating a similar response to spring climatic conditions. However, at the stage of bud break, T-19 exhibited a faster response to thermal stimuli, whereas generative processes, on the contrary, intensified earlier in T-21. This indicates a differentiation in the rates of development of vegetative and generative organs depending on cultivar characteristics. The earlier budding and flowering of T-21 confirm literature data that the cultivar ′Ludwig Spaeth′ is characterized by high stability of flowering onset and moderate sensitivity to weather fluctuations.

Figure 7. Plants in a state of complete dormancy (photo by A. Mordan).

The characteristics of inflorescences also differed significantly between the variants. The control plants formed larger and more spreading inflorescences, which is a typical feature of wild-type *S. vulgaris*, whereas the cultivar plants produced more compact but brighter panicles, which enhances their ornamental value in urban plantings and private gardens. Differences in flower size indicate biological characteristics of the cultivar and are likely associated with genetically determined differences in the size of the perianth.

The fruiting phases in T-19 and T-21 coincided, demonstrating a leveling of developmental rates under conditions of a stable summer photoperiod and sufficient thermal resources. The autumn phase of vegetation revealed significant differences in leaf coloration, the rate of leaf senescence, and the timing of leaf fall. T-21 transitioned to the autumn state more rapidly, which may be associated with its cultivar-specific nature, implying a shorter period of active growth. In contrast, T-19 retained green foliage for a longer time, indicating a longer duration of physiological activity.

After the completion of field phenological observations, all obtained data were systematized and recorded in a generalized table. The timing of the main phenological phases was determined in accordance with the methodology for the examination of varieties of ornamental, medicinal, and aromatic plants [18, 20]. The obtained results are presented in the table.

In Table 3.2, clear differences in the timing of the main phenological phases between *S. vulgaris* variants T-21 and T-19 can be observed. For variant T-21, the onset of vegetation was recorded on March 9, bud break on March 25, the budding phase lasted from April 9 to April 23, flowering occurred from April 23 to May 22, fruiting from April 25 to August 26, and the completion of vegetation on December 12.

The T-19 variant was characterized by a different dynamic of phenological phase progression: the onset of vegetation also occurred on March 9; however, bud break was observed earlier, on March 21. The budding phase lasted from April 12 to April 28, flowering from April 28 to May 27, fruiting from May 30 to August 26, and the completion of vegetation coincided with that of T-21 and also occurred on December 12.

The identified differences in the rate of plant development indicate cultivar-specific and individual features of the response of *S. vulgaris* to environmental conditions, which determine different rates of progression of individual stages of organogenesis. For better visualization of the dynamics of phenological development, a calendar chart of the progression of phenological phases was constructed (Fig. 8), which allows a clear comparison of the duration and sequence of developmental phases in variants T-21 and T-19.

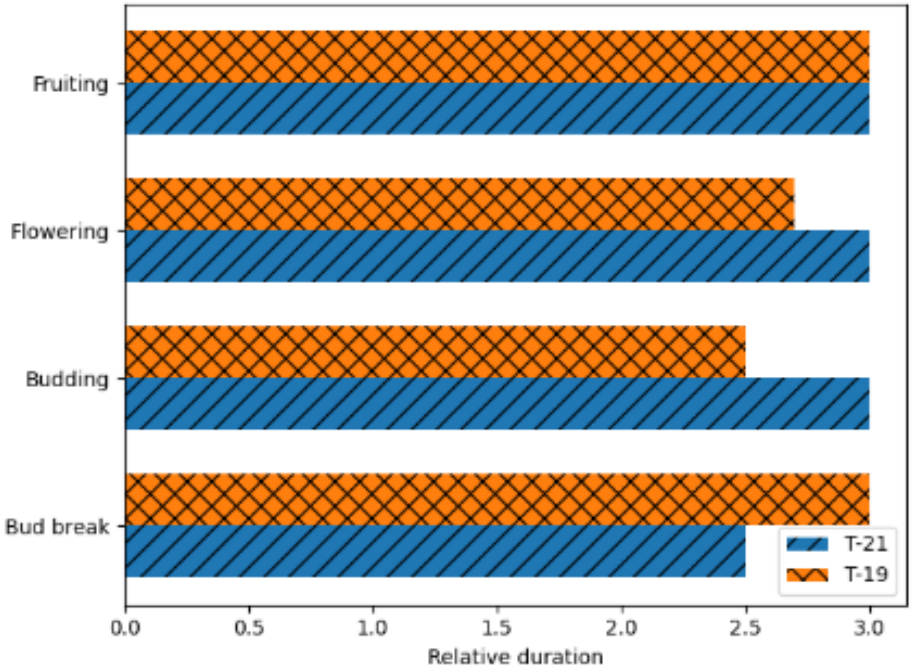

Figure 8. Comparison of the rate of progression of phenological phases in the studied samples of S. vulgaris.

In general, graphical and tabular comparison indicates that T-21 is an early-flowering variant with a more intensive generative phase, whereas T-19 demonstrates a more stable and prolonged vegetation period. Such differences are important for the selection of cultivars in ornamental plantings: T-21 is advisable for use where early and ярке flowering is required, whereas T-19 ensures a longer decorative effect in park-type green spaces.

Evaluation of the Ornamental Value of *Syringa vulgaris.* The ornamental value of *S. vulgaris* is assessed comprehensively, taking into account morphological, phenological, physiological, and landscape-decorative parameters that determine the visual expressiveness of the plant throughout the growing season. The analysis of ornamental value involves the study of crown characteristics, leaves, shoots, inflorescences, and the overall compositional role of the cultivar in the landscape environment.

One of the key criteria is the shape and architectonics of the crown, since the silhouette of *S. vulgaris* in both leafless and foliated states determines its decorative expressiveness throughout the year. Parameters such as plant height, crown diameter, symmetry, density, and the ability to maintain a stable shape under pruning are evaluated. The leaf apparatus is assessed according to size, shape, intensity of coloration, leaf density on shoots, resistance to sunburn, and resistance to premature drying. An important indicator is also leaf resistance to biotic stresses, including fungal and bacterial diseases, which may reduce the overall ornamental value of the plant (M.M. Gryshko…, 2020; Potapskyi et al., 2021).

The most important group of criteria determining the ornamental value of *S. vulgaris* consists of flowering characteristics. These include the timing of budding, duration of flowering, uniformity of flower opening within the inflorescence, and synchronization of flowering among different plants of the same cultivar. The number of inflorescences per shoot and per plant, their length, width, density, shape, as well as the direction and degree of branching are also determined. Special attention is paid to flower coloration, which may change at different stages of development - from bud to full bloom and to the end of flowering. Color saturation, uniformity, presence of gradients, contrast between the outer and inner sides of petals, and resistance of coloration to solar radiation are analyzed. The texture of flowers is also taken into account, as simple, double, and semi-double forms have different decorative potential in park compositions.

A separate indicator of ornamental value is flower fragrance, since *S. vulgaris* is distinguished by a wide range of aromatic profiles. The intensity, persistence, and qualitative characteristics of the fragrance are important when using cultivars in areas of mass visitation. In landscape practice, resistance of S. vulgaris to

urban environmental conditions is of great importance, including tolerance to air pollution, dust resistance, resistance to compacted soils, and the ability to withstand periods of temporary drought. These indicators directly affect ornamental value, since physiological stress is often reflected in leaf quality, the number of inflorescences, and the duration of flowering.

The phenological analysis of ornamental value includes the study of seasonal dynamics. The timing of leaf emergence, the beginning and end of budding, flowering phases, fruit formation, and the completion of vegetation are recorded. It is important to assess their stability over years, which makes it possible to determine the level of cultivar adaptability to climatic conditions. A comprehensive evaluation of ornamental value is supplemented by morphometric measurements, which allow comparison of cultivars and their ranking. Such indicators include inflorescence length, flower diameter, number of flowers per inflorescence, average number of inflorescences per shoot, and other quantitative criteria.

The final stage of ornamental analysis is the evaluation of the compositional role of the cultivar. The ability of *S. vulgaris* to create accent points in space, the harmony of combinations with other woody and herbaceous plants, the suitability of the cultivar for specific landscaping styles, and the seasonal expressiveness of compositions are taken into account. Based on the collected data, an integral scoring assessment of ornamental value is carried out, which makes it possible to identify the most promising cultivars for use in landscaping public spaces, squares, parks, and private areas.

The ornamental value of *S. vulgaris* has long been the subject of scientific interest in Ukraine and European countries, as this species belongs to the most widespread and highly valued ornamental shrubs in green plantings. In modern research, ornamental qualities are considered in close connection with morphological, phenological, breeding, and physiological-biological characteristics, as well as with plant adaptability to various urban environmental conditions.

Ukrainian researchers, particularly scientists of the M.M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine, pay special attention to the comprehensive evaluation of S. vulgaris cultivars. In the publications of Volodymyr Horb, morphometric approaches to the study of ornamental characteristics are described, including crown shape and density, branching intensity, leaf coloration and texture, as well as the structure, size, and architecture of inflorescences. The author emphasizes the necessity of evaluating new hybrids and cultivars in comparison with reference collections, which allows determination of their true ornamental value and compliance with modern landscaping requirements.

At the M.M. Gryshko National Botanical Garden, one of the largest *S. vulgaris* collections in Europe has been established, containing dozens of cultivars and hybrids of both Ukrainian and international breeding. This creates a unique basis for studying the variability of ornamental traits, flowering timing, resistance to adverse conditions, and the potential use of different cultivars in urban landscaping.

significant contribution to the study of ornamental qualities of *S. vulgaris* has also been made in the dendrological park “Oleksandriia” of the National Academy of Sciences of Ukraine, where a comprehensive inventory and optimization of the “Syringarium” exposition has recently been carried out. These studies focus on the age structure of plantings, soil condition, plant vitality, **the prospects of individual cultivars**, and the need to restore the collection to enhance its decorative effect. Such research demonstrates the importance of a systematic approach that combines morphological observations with the analysis of growing conditions.

European scientific literature presents a wide range of studies aimed at evaluating the ornamental value of *S. vulgaris* based on phenological, biological, and genetic traits. In Poland, long-term studies of flowering phenology of various species of the genus *Syringa* have been conducted in botanical gardens in Poznań and Warsaw. In the works of M. Szwed and W. Antkowiak, the timing of budding, dynamics of flower opening, duration, and peaks of flowering are analyzed in detail, which makes it possible to determine the suitability of different cultivars for use in public spaces and urban green areas. These phenological indicators are considered integral criteria of ornamental value, as they ensure the harmony of seasonal perception of plantings (Laptiev, 2001).

An important direction of scientific research related to the preservation of ornamental qualities of cut inflorescences is represented by a group of Polish researchers studying post-harvest physiology of S. vulgaris flowers. Their results show that growing conditions, water regime, and the use of preservatives and antiseptic substances significantly affect the duration of decorative appearance of flowers in floral compositions. These studies emphasize that the ornamental value of *S. vulgaris* is important not only in landscaping but also in the floricultural sector.

In the countries of Northern Europe, attention is focused on historical, genetic, and morphological aspects of *S. vulgaris* ornamental value. In Finland, inventories of old cultivars of *S. vulgaris* planted in cultural landscapes of the 18th–19th centuries have been conducted. Studies by Lindén and Korpelainen show that

many old cultivars retain unique ornamental traits, such as complex structure of double flowers, rare petal shades, particularly strong fragrance, or prolonged flowering. Researchers use genetic profiling methods to identify old plants, determine their origin, and preserve valuable genotypes. The combination of morphological and molecular-genetic methods opens new opportunities for studying ornamental properties and restoring lost historical cultivars (Kyienko, Matus, Tkachyk, 2016)

In addition to European studies, significant contributions to the study of the genus *Syringa* have been made by Chinese researchers, who focus on species diversity, morphological traits, and phytochemical properties. Their review publications provide data on ecological growth conditions and the ornamental potential of many species, which may be useful for breeding programs and expanding the ornamental assortment.

The general analysis of scientific studies shows that the ornamental value of *S. vulgaris* is evaluated comprehensively, including crown architectonics, leaf quality, inflorescence characteristics, flower coloration and fragrance, duration and intensity of flowering, resistance to diseases, and adaptability to urban conditions. An important factor is phenological stability, which determines the predictability of decorative effect in different years. Modern studies increasingly combine classical dendrological methods with genetic analysis, phytopathological assessments, and approaches of urban landscape design.

Thus, scientific works of Ukrainian and European researchers form a broad theoretical and practical basis for analyzing the ornamental value of *S. vulgaris*. The generalization of these studies allows the formation of modern approaches to cultivar evaluation, substantiation of the selection of ornamental assortments for different types of green plantings, and determination of priority directions for breeding and introduction of this species.

During the phenological research, the ornamental value of plants was also assessed, as this indicator is one of the key criteria for the suitability of *S. vulgaris* for use in urban landscaping (Schwartz M.D., 2013). Under conditions of an urbanized environment, ornamental characteristics are an important factor in shaping an attractive urban landscape image, which necessitates a comprehensive evaluation of decorative traits throughout the entire growing season. Taking into account the gradual decline in ornamental value after flowering, a general assessment of decorative parameters at different stages of vegetation was carried out under the conditions of the Sumy region. The evaluation was conducted in accordance with the methodology for the examination of ornamental plant varieties for suitability for dissemination in Ukraine. Ornamental value was assessed using a four-point scale, while the degree of flowering and the level of foliage were evaluated using a five-point scale. The results of the assessment are presented in Table 3.

Table 2. Evaluation of the ornamental value of the studied *Syringa vulgaris* samples

Variant	Trait (score)	Foliage density	Flowering	Growth habit	Total score
S. vulgaris (control)	-	5	4	3	12
S. vulgaris 'Ludwig Spaeth' (T-19)	-	5	5	4	14

The analysis of the obtained data indicates that the cultivars differ in a complex of ornamental traits. The cultivar ‘Ludwig Spaeth’ (T-19) demonstrated the highest total ornamental score, which can be explained by more intensive and prolonged flowering, as well as a high level of foliage density. At the same time, the common *S. vulgaris* in the control variant was also characterized by sufficiently high ornamental properties, confirming its suitability for widespread use in urban landscaping.

For a more in-depth analysis, a decorative calendar was developed, integrating the results of phenological observations and the scoring evaluation of ornamental traits (Fig. 9). The obtained data make it possible to trace the seasonal dynamics of ornamental value and to assess the periods of maximum plant expressiveness.

The decorative calendar shows that *S. vulgaris* exhibits its maximum aesthetic qualities in the third month of spring, during the period of mass flowering. It is during this period that the plants reach the peak of ornamental value due to the abundant formation of inflorescences, the intense purple coloration (in the cultivar 'Ludwig Spaeth'), and the harmonious combination of flowers with bright green foliage.

After flowering, the ornamental value slightly decreases; however, *S. vulgaris* retains an attractive appearance due to its dense, compact, and well-foliated crown of dark green color. The leaves remain on the

plants until the second month of autumn, after which decreasing temperatures cause their gradual shedding. During the winter period, ornamental value decreases to a minimum level, although the crown structure retains a certain plastic expressiveness.

Thus, the results of the study confirm that *Syringa vulgaris* and its cultivar 'Ludwig Spaeth' are highly ornamental plants with pronounced seasonal dynamics. Despite the decline in ornamental value after the completion of flowering, during a long period of summer and until mid-autumn they remain important elements of urban landscaping due to their dense crown, stable foliage, and overall bioaesthetic attractiveness.

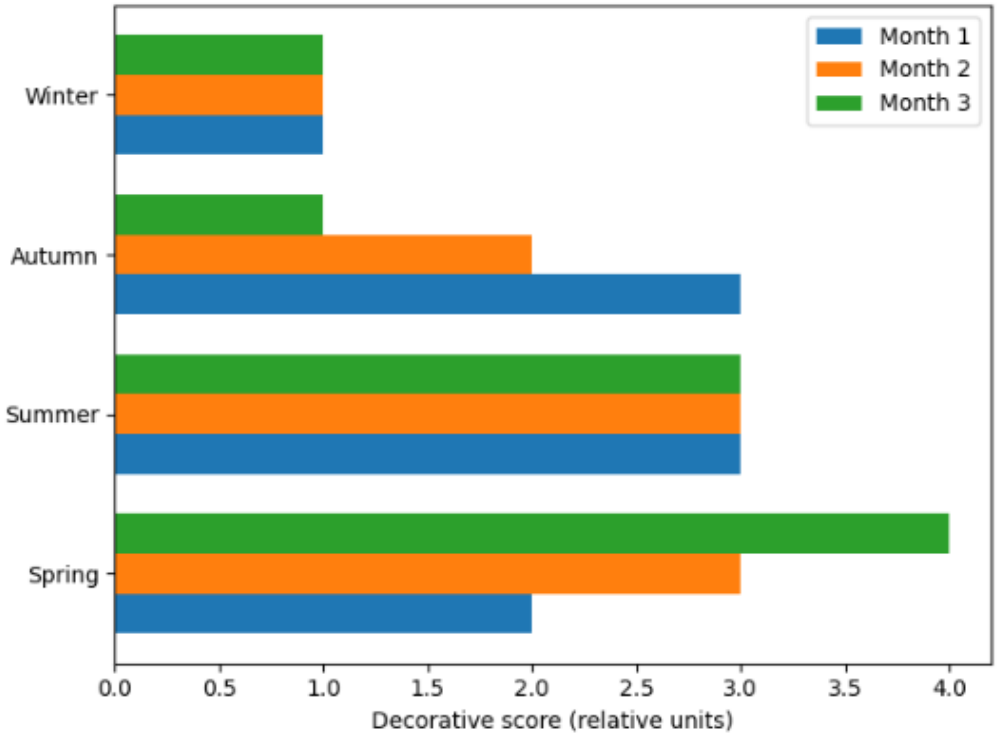

Figure 9. Ornamental value of the studied S. vulgaris samples across the seasons of the year.

Discussion. The obtained results confirm that the phenological development of ***S. vulgaris*** cultivars under the conditions of the Forest-Steppe zone of Ukraine is determined by a complex interaction of climatic factors and genetically determined cultivar characteristics. The synchronous onset of vegetation in both studied variants (T-19 and T-21) indicates a similar response of plants to the accumulation of effective temperatures at the end of the winter period, which is consistent with general patterns of phenological activation in temperate woody species.

At the same time, the revealed differences in the timing of subsequent phenological phases demonstrate the importance of genotype-specific regulation of developmental processes. In particular, the earlier bud break observed in T-19 suggests a higher sensitivity to thermal stimuli or a lower threshold of temperature accumulation required for growth activation. Conversely, the earlier initiation of budding and flowering in T-21 indicates a more rapid transition to the generative stage, which may be associated with cultivar-specific features of organogenesis and internal physiological regulation.

Such differentiation between vegetative and generative development rates confirms that the phenological behavior of *S. vulgaris* cultivars cannot be explained solely by external environmental factors. Instead, it reflects the interaction between climatic conditions and genetically determined adaptive strategies. This is particularly important for ornamental horticulture, where the timing and duration of flowering are key indicators of ornamental value.

The influence of climatic conditions, especially temperature fluctuations during the spring period, was clearly reflected in the dynamics of phenological phases. The observed shifts in the timing of bud break and flowering between cultivars correspond to established concepts regarding the role of accumulated heat units in regulating plant development. At the same time, the sensitivity of generative organs to spring frosts

highlights the vulnerability of flowering processes and emphasizes the importance of selecting cultivars with higher stress tolerance for urban and landscape plantings.

The results of the study also indicate that the duration of the flowering period and the stability of ornamental traits are closely related to cultivar characteristics. The cultivar ′Ludwig Spaethë demonstrated more intensive and expressive flowering, which directly influenced its higher ornamental score. This finding aligns with the general understanding that the ornamental value of S. vulgaris is primarily determined by the abundance, uniformity, and visual expressiveness of inflorescences.

An important aspect revealed in the study is the difference in the duration of the vegetation period. The longer retention of foliage in T-19 indicates a prolonged period of physiological activity, which may be associated with a more efficient photosynthetic apparatus and greater resistance to environmental stress factors. In contrast, the earlier transition of T-21 to autumn senescence suggests a shorter period of active growth, which may be advantageous under certain climatic conditions but reduces the duration of the ornamental effect outside the flowering phase.

The coincidence of fruiting phases in both cultivars suggests that under stable summer conditions, characterized by sufficient thermal resources and a relatively constant photoperiod, differences in developmental rates tend to level off. This indicates that environmental conditions during the summer period have a stabilizing effect on phenological processes.

The comprehensive assessment of ornamental value confirmed that both studied variants possess high ornamental potential, although with different patterns of seasonal expression. The cultivar ′Ludwig Spaeth′ is characterized by a more pronounced and prolonged decorative effect due to intensive flowering and stable foliage, whereas the control form of *S. vulgaris* demonstrates balanced characteristics and reliable adaptability.

From a practical perspective, the identified differences between cultivars have important implications for landscape design. The earlier flowering of T-21 makes it suitable for creating early-season accents in plant compositions, while the prolonged vegetation and stable ornamental performance of T-19 make it more appropriate for plantings where a long-lasting visual effect is required. The combination of such cultivars in landscaping schemes allows for the extension of the overall decorative period and increases the variability of visual effects in green spaces.

Thus, the results obtained not only expand the understanding of the phenological behavior of *S. vulgaris* cultivars under the conditions of the Forest-Steppe zone of Ukraine but also provide a scientific basis for their rational use in ornamental horticulture and urban landscaping.

Conclusions. 1. The cultivar diversity of *Syringa vulgaris* in Ukraine is extensive and scientifically substantiated. The State Register of Plant Varieties Suitable for Dissemination in Ukraine includes 21 cultivars recommended for cultivation in the Steppe, Forest-Steppe, and Polissia zones. The presence of a substantial collection fund, particularly in the M.M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine, where 21 species and more than 90 ornamental hybrids are maintained, provides a reliable genetic basis for further breeding and introduction studies, as well as for expanding the assortment of plants used in landscaping.

2. The phenological development of *Syringa vulgaris* under the conditions of the Forest-Steppe zone of Ukraine is characterized by pronounced cultivar-specific differences against the background of overall stability of the annual growth cycle. For both studied variants (T-19 and T-21), a synchronous onset of vegetation was observed; however, the timing of bud break, budding, and flowering differed significantly. The cultivar ′Ludwig Spaeth′ (T-19) is characterized by earlier and more intensive flowering, whereas T-21 demonstrates phenological phases that are slightly shifted in time but more balanced in duration. These results indicate differences in the rate of organogenesis under identical environmental conditions.

3. The ornamental characteristics of the studied *Syringa vulgaris* samples were evaluated as high, with a clear advantage of the cultivar ′Ludwig Spaeth′. According to the scoring assessment, this cultivar (T-19) achieved the highest total score (14 points) due to the combination of abundant, bright, and prolonged flowering, high foliage density, and a well-defined crown habit. The control variant of *S. vulgaris* also demonstrated high ornamental properties (12 points), confirming its suitability for widespread application in urban landscaping.

4. The decorative calendar revealed a pronounced seasonal dynamics of ornamental expression. The peak of ornamental value occurs during the period of mass flowering in late spring, when the combination of abundant inflorescences and dense foliage ensures the maximum visual effect. After the flowering period, plants retain a high level of ornamental value due to their dense, well-foliated crowns of dark green coloration, which maintain the aesthetic appeal of plantings until mid-autumn. This feature represents an important advantage for their use in urban green spaces.

5. The results obtained confirm the high potential of Syringa vulgaris and the cultivar ′Ludwig Spaeth′ for landscaping under the conditions of the Forest-Steppe zone of Ukraine. The combination of ecological adaptability, resistance to urban environmental factors, stability of phenological indicators, and high ornamental value provides a strong basis for recommending these forms for use in various types of green plantings, including parks, squares, alleys, and accent compositions, as well as for their further use in breeding and landscape-oriented research.

Acknowledgements. The authors express their sincere gratitude to Andrii Mordan, MSc student, for providing photographic materials used in this study.

REFERENCES

1. Agrarii Razom Information System, (n.d.) Description and characteristics of Syringa vulgaris. Available at: https://agrarii-razom.com.ua/plants/buzok-zvichayniy.
2. Agrarii Razom Information System, (n.d.) Lilac cultivation: features of growing and storage. Available at: https://agrarii-razom.com.ua/culture/buzok.
3. Belorusets E.Sh., Horb V.K., (1990) Lilac. Kyiv: Urozhai, 176 p.
4. Botanical Garden of Sumy State Pedagogical University named after A.S. Makarenko, (n.d.) Available at: https://pgf.sspu.edu.ua.
5. Cleland E.E., Chuine I., Menzel A., Mooney H.A., Schwartz M.D., (2007) Shifting plant phenology in response to global change. Trends in Ecology & Evolution, 22(7), 357–365.
6. Kokhno M.A. (Ed.), (2002) Dendroflora of Ukraine. Wild and cultivated trees and shrubs. Angiosperms. Part I. Kyiv: Vyshcha Shkola, 448 p.
7. Dolhova L.H., Zaitseva I.O., (n.d.) Phenorhythmic patterns of introduced woody plants of the genus Syringa. Bulletin of Dnipropetrovsk University. Biology, Ecology.
8. Dziuba I.M., Zhukovskyi A.I., Zhelezniak M.H., et al. (Eds.), (2016) Encyclopedia of Modern Ukraine. Kyiv: Institute of Encyclopedic Research of NAS of Ukraine. Available at: https://esu.com.ua/article-53581.
9. Horb V.K., (2018) Biological, morphometric and ornamental features of Syringa fauriei Lev. and methods of its use in landscaping. Plant Introduction, (4).
10. Horb V.K., (2002) Growth and development of generatively mature plants of the genus Syringa L. under the conditions of Kyiv. Plant Introduction, (2).
11. Horb V.K., (1989) Lilac in Ukraine. Kyiv: Naukova Dumka, 158 p.
12. Horb V.K., Klymenko Yu.O., Dovhaliuk N.I., (2020) Influence of crown management system on ornamental value and longevity of Syringa vulgaris cultivars. Scientific Bulletin of UNFU, 30(4).
13. Institute of Evolutionary Ecology of NAS of Ukraine, (n.d.) Common lilac. Available at: https://www.ieenas.org/p/buzok-zvichainii.
14. Krüssmann G., (1986) Manual of Cultivated Broad-Leaved Trees and Shrubs. Timber Press.
15. Kyienko Z.B., Matus V.M., Tkachyk S.O., (2016) Methodology for examination of plant varieties (ornamental, medicinal, essential oil and forest) for suitability for dissemination in Ukraine. Vinnytsia: Ukrainian Institute for Plant Variety Examination, 12 p.
16. Laptiev O.O., (2001) Introduction and acclimatization of plants with fundamentals of landscaping. Kyiv: Fitosotsiotsentr, 109 p.
17. M.M. Gryshko National Botanical Garden of NAS of Ukraine, (n.d.) Available at: http://www.nbg.kiev.ua/collections_expositions/index.php?SECTION_ID=192.
18. Ministry of Environmental Protection and Natural Resources of Ukraine, (2022) Environmental Passport of Sumy Region (as of 01.01.2022).
19. Mordan A.O., Melnyk T.I., (2025) Analysis of species and cultivar diversity of the genus Syringa L. in horticulture. In: Proceedings of the Scientific and Practical Conference of teachers, postgraduate students and students of Sumy NAU, April 14–18, 2025, 136–137.
20. Nowak D.J., Crane D.E., Stevens J.C., (2006) Air pollution removal by urban trees and shrubs in the United States. Urban Forestry & Urban Greening, 4, 115–123.
21. Parmesan C., Yohe G., (2003) A globally coherent fingerprint of climate change impacts across natural systems. Nature, 421, 37–42.
22. Peculiarities of cultivation and promising directions for the use of Syringa amurensis L. under the conditions of Podillia, (2021) 13 p.
23. Podieryahin S.O., (2021) Current state and prospects for the use of Meyer lilac under the conditions of SE “Vinnytsia Forestry”. Vinnytsia National Agrarian University, 45 p.
24. Potapskyi Yu.V., Bezvikonnyi P.V., Tarasiuk V.A., (n.d.) Decorative evaluation of species and cultivars of the genus Syringa L. Tavriiskyi Scientific Bulletin, 141(2), 38 p.
25. Schwartz M.D., (2013) Phenology: An Integrative Environmental Science. Springer.
26. Skrypak V.R., (2021) Analysis of taxonomic composition and spatial structure of the syringarium of the State Dendrological Park “Oleksandriia” of NAS of Ukraine and ways of its optimization, 6 p.
27. State Register of Plant Varieties Suitable for Dissemination in Ukraine, (2025) Available at: https://sops.gov.ua/ua/derzavnij-reestr.