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ASSESSMENT OF THE SUCCESS OF THE INTRODUCTION AND PERSPECTIVES OF THE USE OF *AESCULUS PAVIA* IN THE CONDITIONS OF VINNITSA

M.V. MATUSYAK, *Candidate of Agricultural Sciences, Associate Professor of the Department of Forestry and Horticulture, VNAU*
O.I. VRADII, *Candidate of Agricultural Sciences, Associate Professor of the Department of Ecology and Environmental Protection, VNAU*

The study considered the issue of inventory and assessment of the state of Aesculus pavia plantations in urban conditions using the example of the city of Vinnytsia, which is an important stage for the development of recommendations for improving the phytosanitary condition of green areas and the selection of sustainable species for landscaping. The inventory of plantations was carried out during the growing season of 2024, with the recording of 18 instances of Aesculus pavia, mostly concentrated in the Vyshensky District. The majority of trees are located along transport routes and are under 25 years old (56.5%), while trees aged 41–50 years account for only 8.9%. The assessment of the state of life using the visual analysis method, taking into account the condition of the leaves, the presence of mechanical damage, dry branches and pests, showed that a significant proportion of the trees are in good condition (64.5%). At the same time, trees near roads suffer from "burns" of leaves due to overheating of the soil, insufficient watering and technogenic stress.

Special attention in the study is devoted to frost resistance and drought resistance of the Aesculus pavia, which are key to the survival and effective use of the species in the urban environment. Research conducted in the agrochemical laboratory proved that the Aesculus pavia is able to withstand frosts up to -25 °C, while the greatest damage is observed in the buds. Studies of drought resistance based on water retention coefficients in different areas of the city have shown that the man-made load leads to an increase in water deficit. In the most polluted areas, the coefficient of water retention and drought resistance decreases, which impairs the viability and decorativeness of trees. The results of the study indicate a high perspective of the introduction of Aesculus pavia in urban conditions, in particular in Vinnytsia. This species retains decorativeness, and is also resistant to frost and partially resistant to man-made stress, which makes it a valuable element of landscaping, able to integrate into the cultural landscape of the city and contribute to the creation of natural fragments in the urban environment.

Keywords: *Aesculus pavia, introduction, perspective, decorativeness, landscaping.*
Tabl. 4. Fig. 4. Lit. 20.

Statement of the problem. In the city of Vinnytsia, population growth and the expansion of industry have led to an increase in the density of buildings, which has a negative impact on the city's ecological condition. Growing attention to landscaping is an important feature of modern urban development. Successful greening of urban and rural areas largely depends on the correct selection of tree and shrub species. Many plants introduced to Ukraine have not yet been sufficiently studied, which limits their use in landscaping. One of the promising species is the *Aesculus pavia*, capable of expanding the range of ornamental trees.

Basic information about the morphological features of this species is contained in the works of foreign researchers, who provide some data on ecological characteristics and the specifics of vegetative reproduction. However, detailed studies of phenology, reproduction and resistance to stresses in urban conditions have not yet been conducted. The study of the biological and ecological features of the *Aesculus pavia* will contribute to the assessment of its potential for greening the city of Vinnytsia.

Analysis of research and publications. A number of domestic and foreign scientists dealt with the issue of expanding the species composition due to the introduction of new species of the genus *Aesculus L.* and their use in landscaping. In particular, in the scientific work of Sarnenko I.I. highlights the peculiarities of the selection of bioindication methods for determining the resistance to environmental pollution of species of the genus *Aesculus L.* in the conditions of the city of Kherson [17]. O.K. Doroshenko and T.V. Didenko were actively involved in the study of the perspective of using species of the genus *Aesculus L.*, who focused the main attention of their own scientific research on the study of the passage of phenological phases in the studied plants depending on the influence of limiting factors [8]. In the work Shavanov K.E., Starodub M.F., Taran M.V., Marchenko O.A. studied the issue of photoinduction of chlorophyll fluorescence to determine the functional state of the photosynthetic apparatus of *Aesculus hippocastanum L.* and *Aesculus pavia L.* in three ecological zones of Kyiv [20]. A significant contribution to the study of species of the genus *Aesculus L.* was made by Yu. V. Yevtushenko [9], in whose scientific works the features of the introduction and prospects of the use of certain species in the conditions of Kyiv were highlighted, the author studied the features of drought resistance and frost resistance of species of the genus *Aesculus L.* In the scientific works of Calic D., Gilman E., Marincovic N. [1-3] reveal the issue of reproduction and use in gardening of representatives of the genus *Aesculus L.*

Research material and methods. The inventory of plantations was carried out in accordance with point 1.2 "Instructions for the technical inventory of green plantations in cities and towns of the urban type of Ukraine" [15]. For each tree, morphometric indicators were determined by performing the following measurements: height (m), trunk diameter at a height of 1.3 m (cm), approximate age (years) and crown projection.

An assessment of the general condition of trees was also included in the inventory information, which was determined on a five-point scale based on the condition of tree plants in street plantings, developed by S.I. Kuznetsov, F.M. Levon, Yu.O. Klymenkom, V.F. Pylypchuk and M.I. Shumyk (Table 1) [10].

A comprehensive assessment of decorative characteristics was carried out according to the method of O.G. and O.V. Khoroshikh [18], which takes into account the decorativeness of such elements as the architecture of the crown and trunk, leaves, flowers and fruits (Table 2). Each of these morphological indicators is described in detail and evaluated on a scale: 1 point – low decorativeness, 2 points –

Table 1

Scale for assessing the general condition of trees

Evaluation, points	Explanation
5	trees without stunted growth with full leaf surface
4	trees with a growth that generally meets the norm and has approx 20-25% of the inactive surface
3	trees with weakened growth, which have about 50% inactive leaf surface
2	trees with stunted growth, the increase in current growth is almost absent; have about 75-80% of the inactive leaf surface
1	dead and dying, no current tree growth with 100% dead leaf surface

Notes: *Source: [10]*

medium, 3 points – high. According to the evaluation scale, woody plants are classified into three groups: highly decorative (29-42 points), medium decorative (15-28 points) and low decorative (up to 14 points).

Evaluation of frost resistance was carried out by the method of direct laboratory freezing of one-year-old shoots. Experimental studies were carried out in the

Table 2

The scale of comprehensive assessment of decorative features of woody plants

Signs of decorativeness	Details of signs	Evaluation, points		
		High (3)	Average (2)	Low (1)
Trunk architecture	Form	–	–	–
	Density	–	–	–
Crown architecture	Invoice	–	–	–
	Bark color	–	–	–
	Color of the branches	–	–	–
Total score		15	10	5
Leaves	Shape and size	–	–	–
	Color change	–	–	–
	Leaf cover time	–	–	–
	Color	–	–	–
Total score		12	8	4
Flowers	Shape, size, color	–	–	–
	Scent	–	–	–
	Time and duration of flowering	–	–	–
Total score		9	6	3
Fruits	Shape and size	–	–	–
	Color, abundance, duration of stay on the plant	–	–	–
Total score		6	4	2
General assessment of decorativeness		42	28	14

Notes: *Source: [18]*

agrochemical laboratory of VNAU.

The success of the introduction of *Aesculus pavia* was evaluated by the method of integral numerical assessment of the viability and perspective of the introduction of trees and shrubs based on visual observations, developed by P.I. Lapinim and S.V. Sidneva and reflected in the scientific work of Laptev O.O. [11]. The method involves the assessment of seven main indicators: degree of annual maturation of shoots, winter hardiness, preservation of habit, ability to form shoots, regularity of growth of shoots, ability to generative development, as well as methods of reproduction of the studied plants in conditions of introduction. Each of the indicators is evaluated according to the point system.

The total score of the introduction is the sum of points for all indicators, where the maximum value is 100 points. Depending on the general assessment, it is possible to determine the perspective of the introduction of both young and adult plants on a special scale (Table 3).

Table 3

Assessment scale for the introduction of woody plants

Index	Perspective of introduction	Total points	
		Adult plants	Young plants
I	Quite promising	91-100	56-68
II	Promising	76-90	46-55
III	Less promising	61-75	36-45
IV	Not very promising	41-60	26-35
V	Not promising	21-40	16-25
V	Completely unsuitable	5-20	5-15

Notes: *Source: [11]*

Research results and their discussion. The inventory of plantations and assessment of their condition in the urban environment can become the basis for developing recommendations for improving the phytosanitary characteristics of trees and bushes, improving the system of care for green plantations, as well as for the selection of plant species that are promising for greening cities and settlements with an increased level of stress factors. The inventory of plantations was carried out during the growing season of 2024. During field survey, 18 specimens of *Aesculus pavia* were recorded growing in the territory of Vyshensky and Zamostyansky districts.

The location of these plantations is mostly observed along transport routes in street plantings, and they are less common in parks and squares. The maximum concentration of plants was found in the Vyshenskyi district (67%), while in Zamostyanskyi their share is 33%. *Aesculus pavia* is most often used in single and group plantings; at the same time, in group plantings, it is mainly represented by monoplants or in combination with common bitter chestnut, without plantations with other tree and shrub species.

The age structure is dominated by trees up to 25 years old (56.5%), trees aged 31-40 years make up 34.6%, and the share of trees aged 41-50 years is 8.9%. Figure 1 shows the age distribution of the studied trees in percentage terms.

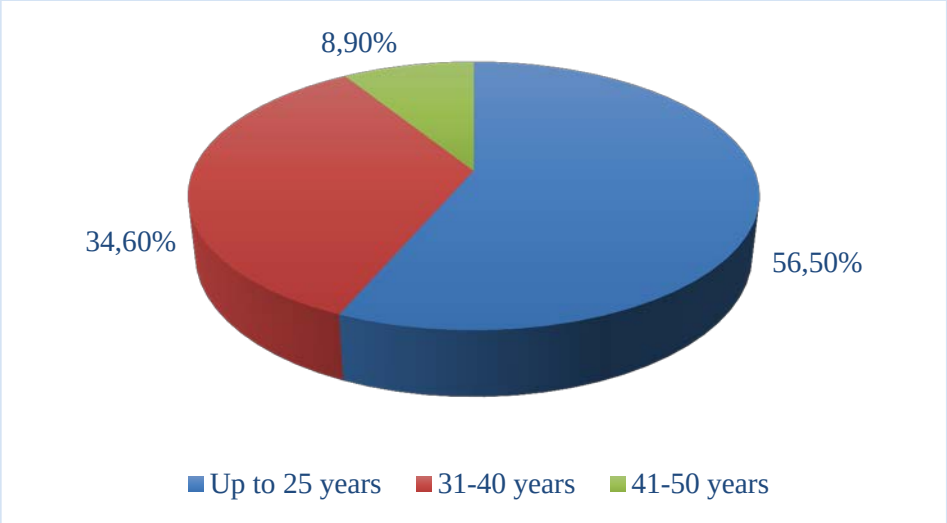

Fig. 1. Age structure of the studied plants
Source: formed on the basis of own research

On the basis of a field survey of plantations in Vinnytsia, the places where *Aesculus pavia* grows, as well as the types of plantations where this species is common, were determined. Mostly *Aesculus pavia* is found in the form of solitary trees and row plantings. Most of the trees are young specimens about 20 years old, while there are relatively few mature trees (40-50 years old).

The assessment of the vital state of trees was carried out using a visual analysis, taking into account the state of the assimilation apparatus, the presence of mechanical damage, dry branches, pathogens and harmful insects. The survey was conducted in two stages – in spring and autumn.

The highest percentage of trees in good health was recorded in botanical gardens and parks. In the first days of August, some *Aesculus pavia* trees growing near highways with heavy traffic began to show signs of "scald" leaves. Such cases were noted on Andrii Pervozvany street in Vinnytsia. The causes of this common physiological disorder are unfavorable soil conditions, insufficient or absent irrigation, soil compaction, extreme temperature changes and, most of all, the significant amount of heat that is reflected from the asphalt and received from traffic. As a result, the leaves curl, which worsens the appearance of the trees. When unfavorable conditions worsen, the leaves may even fall off.

In the spring, frostbite cracks on the bark were found on some trees – deep, elongated damages caused by prolonged cooling during severe frosts, especially with sharp fluctuations in temperature during the day. The bark near the cracks often peels off, which increases the area of the wound. Under favorable conditions, a callus forms on the cracks, thanks to which the wounds gradually heal, and over time only inconspicuous scars remain. However, before healing, there is a risk of infection of

the affected tissues with pathogens. Dry branches are noted on a small number of trees, on average they make up 20-30% of the total mass of the crown. Pruning of dry branches is recommended annually during the growing season, however, as observations show, these rules are not always followed.

The problem of the mass distribution of the chestnut transient moth, which damages the common *Aesculus pavia*, leads not only to the loss of decorativeness of plants, but also to the inhibition of their life processes. During the examination of plantations in the city of Vinnytsia, no signs of damage to trees of the species *Aesculus pavia* by this pest were found. It is also known that the passing moth does not feed on the leaves of the *Aesculus pavia*.

Therefore, according to the results of the assessment of the vital condition of *Aesculus pavia* plants, the majority of trees belong to the "good" condition category (64.5%). 31.4% of trees correspond to the grade "4", and 4.1% to the grade "3" (Fig. 2).

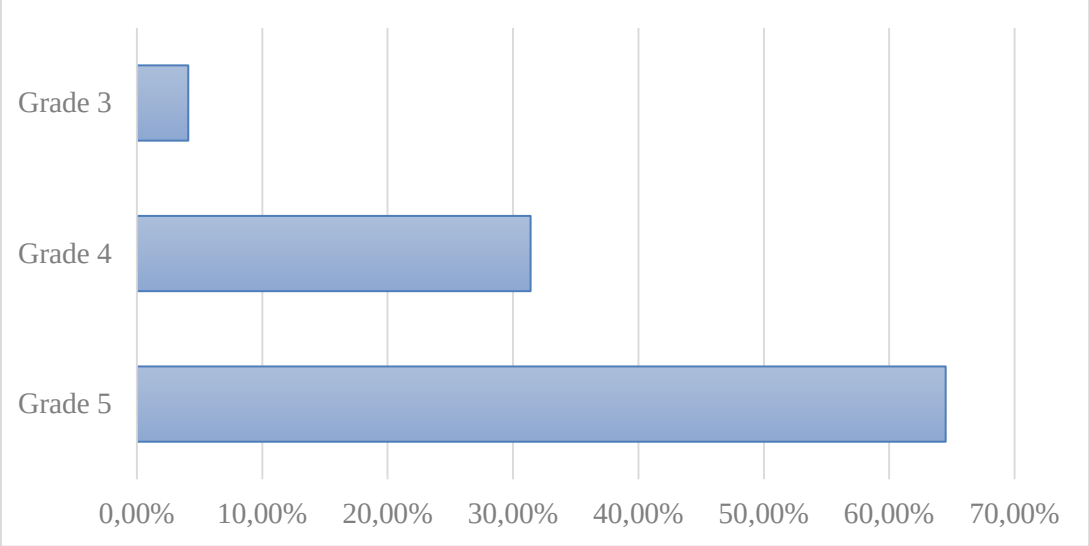

Fig. 2. Assessment of the vital state of Aesculus pavia plants in the plantation system of Vinnytsia
Source: formed on the basis of own research

The effectiveness of the introduction is closely related to the biological characteristics of the plants. This makes it necessary to study the adaptability of the introducer, among which are the issues of frost resistance and drought resistance, as well as the prospects of introduction, because its viability is aimed, first of all, at preserving it as a species and increasing the number of individuals.

Studies of potential frost resistance were carried out in the agrochemical laboratory of VNAU during the period of deep rest (second decade of January) at temperatures of -20 °C and -25 °C in 2024. The object of the study were one-year shoots of the species *Aesculus pavia* and *Aesculus hippocastanum* for comparison. For the analysis, two shoots were selected from the middle part of the crowns of 30-

year-old trees of the genus *Aesculus* growing on Andrii Pervozvany Street in Vinnytsia. As a result of the research, differences in the reaction of plant tissues of several species of the genus *Aesculus L.* to the effect of negative temperatures were established (Fig. 3).

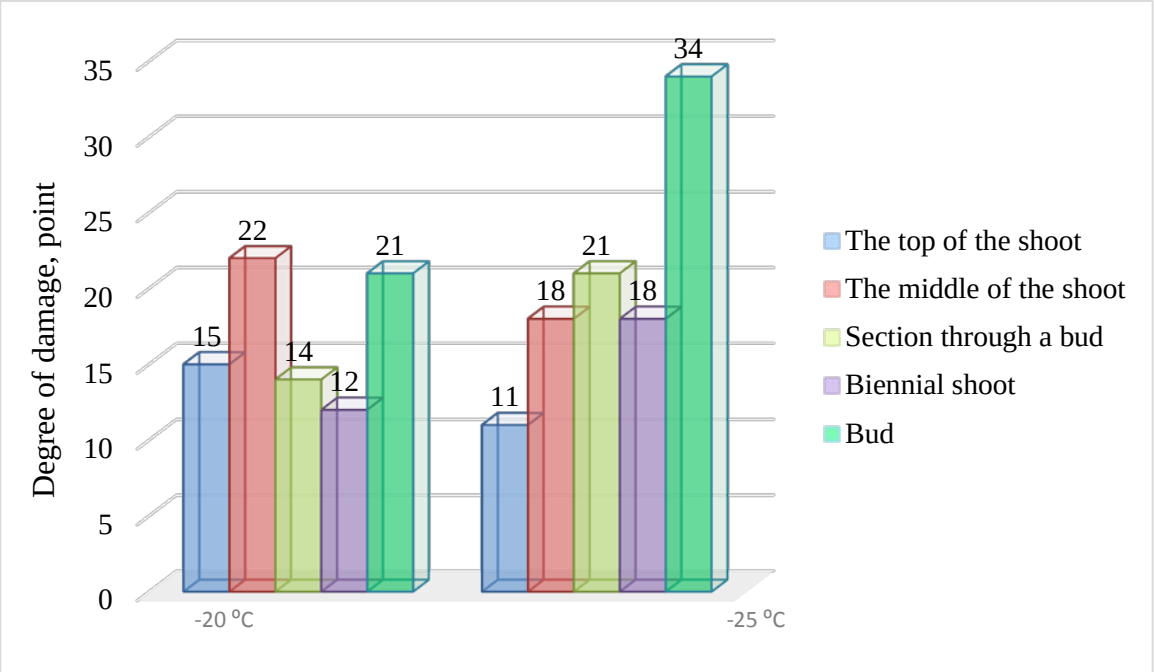

Fig. 3. Damage to various parts of shoots Aesculus pavia low temperatures
Source: formed on the basis of own research

As a result of the conducted research, we found that the *Aesculus pavia* is a rather frost-resistant species that can withstand temperature minimums at the level of -20-25 °C. We determined that the highest damage score due to artificial freezing was in the buds of the *Aesculus pavia* and was 21-34 points, and the lowest at the top of the shoot – 11-15 points, which generally corresponds to the parameters that were visually determined during the field survey.

The assessment of the level of drought resistance was carried out according to the integral ranking scale of the resistance of woody plant species to drought, which includes the assessment of plant viability, the calculation of the coefficients of water retention and drought resistance (Table 4).

In natural conditions, the water deficit is usually 10-20%. At high values of water deficit – 40-50%, plants begin to wither intensively and gradually die [14]. During the research, it was found that the growth of man-made load in the city leads to an increase in this indicator in all the studied plants. The lowest indicators of water deficit were recorded in plants growing in ecological zone №1. As a result of the research, it was determined that representatives of the genus *Aesculus* have different levels of drought resistance depending on the growth zone. The *Aesculus pavia* in the zones of strong anthropogenic load has a coefficient of drought resistance of 37.3%, while in the control it is 48.2, which is 10.9% lower. The coefficient of water retention in the zone of strong man-made load is 54.3%, while in the control – 62.4%.

Table 4

Coefficients of water retention and drought resistance of plants of some species of the genus *Aesculus*

View	Year	Place of growth	Coefficients, %	
			Кву	Кпс
Aesculus hippocastanum L.	2024	Zone №1 (Control)	72.5 ± 2.5	57.0 ± 2.35
		Zone №2 (Relative pollution)	69.2 ± 3.65	49.6 ± 2.53
		Zone №3 (Heavy pollution)	61.4 ± 4.0	44.7 ± 2.36
Aesculus pavia L.	2024	Zone №1 (Control)	62.4 ± 4.65	48.2 ± 3.2
		Zone №2 (Relative pollution)	58.2 ± 3.57	41.2 ± 2.34
		Zone №3 (Heavy pollution)	54.3 ± 3.89	37.3 ± 2.42

Source: formed on the basis of own research

This suggests that a decrease in the water-holding capacity of the assimilation apparatus of the plant and drought resistance in general will lead to a decrease in the biological stability and decorativeness of the studied species. Chestnuts occupy a significant place among the assortment of trees for landscaping. In the conditions of the city, these species can be an extremely important element of the cultural landscape, contribute to the integration of different groups of plants into a single composition and create fragments of wild nature.

The results of the evaluation of the decorative features of the *Aesculus pavia* on the territory of Vinnytsia, presented in fig. 4.

The results of fig. 4 show that the *Aesculus pavia* has high indicators of viability and is a very promising tree species that can be successfully used in the conditions of the city of Vinnytsia.

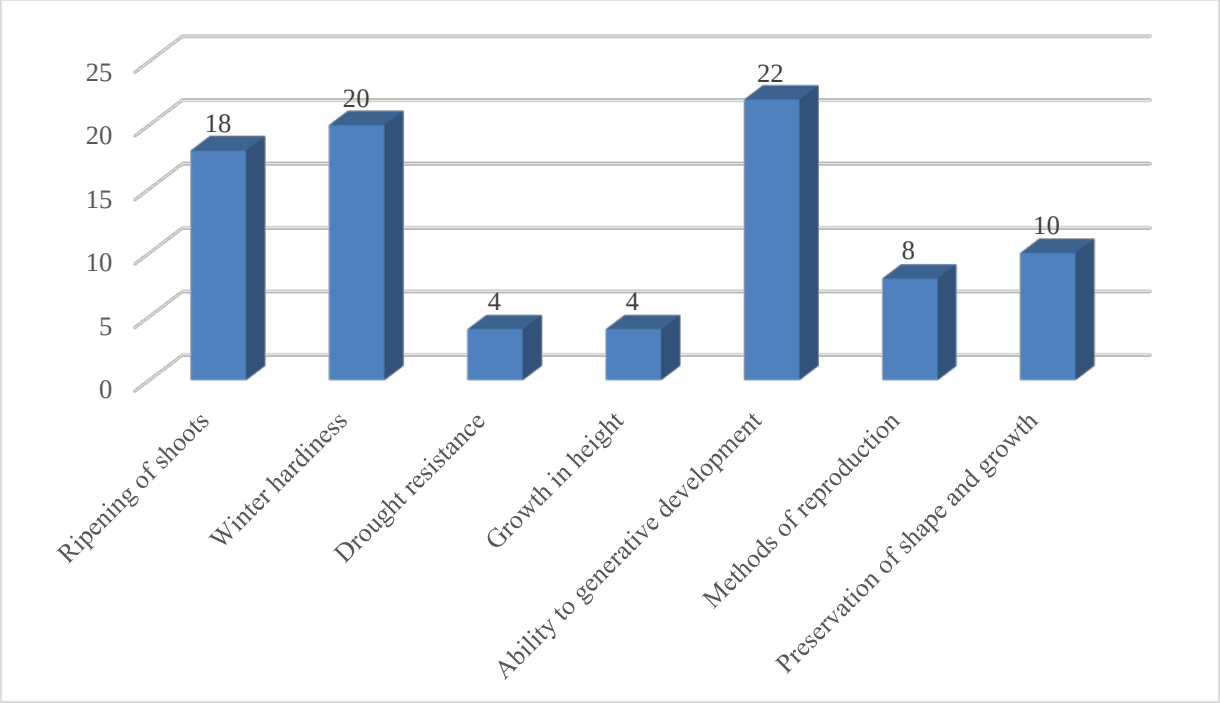

Fig. 4. Prospects of introduction of Aesculus pavia in the conditions of the city. Vinnytsia

Source: formed on the basis of own research

Conclusions. According to the research results, the following conclusions can be drawn: 1. Inventory and assessment of the condition of urban plantations makes it possible to develop recommendations for improving the phytosanitary condition of trees and bushes. It also promotes the selection of species that can tolerate stressful urban conditions. 2. During the survey of plantations in the Vyshensky and Zamostyansky districts of Vinnytsia, 18 specimens of *Aesculus pavia* were recorded, most of which grow along roads, in single or group plantings. 3. The age structure of trees showed a preference for young plantations: most trees are under 25 years old (56.5%), significantly fewer trees are between 31 and 40 years old (34.6%) and between 41 and 50 years old (8.9 %). 4. Studies of the vital condition of trees revealed that the best condition is shown by trees in botanical gardens and parks. At the same time, trees near the roads suffer from "burns" of leaves due to heat stress caused by heat reflection from the asphalt. 5. The *Aesculus pavia* showed resistance to frost, withstanding temperatures up to -20...-25 °C. Studies have confirmed that most of the damage is observed in tree buds at low temperatures, but the general frost resistance of the species is high. 6. The level of drought resistance of *Aesculus pavia* decreases in conditions of high man-made load. The coefficient of water retention and drought resistance is significantly reduced in heavily polluted areas, which can negatively affect the biological stability and decorativeness of this species.
7. *Aesculus pavia* is a promising species for urban landscaping, which has high viability and retains decorative qualities even under the conditions of stressful factors of the urban environment, as research in Vinnytsia shows.

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АНОТАЦІЯ

ОЦІНКА УСПІШНОСТІ ІНТРОДУКЦІЇ ТА ПЕРСПЕКТИВИ ВИКОРИСТАННЯ AESCULUS PAVIA В УМОВАХ М. ВІННИЦІ

У дослідженні розглянуто питання інвентаризації та оцінки стану насаджень гіркокаштана червоного (Aesculus pavia) у міських умовах на прикладі м. Вінниці, що є важливим етапом для

розробки рекомендацій з покращення фітосанітарного стану зелених насаджень та вибору стійких видів для озеленення. Інвентаризацію насаджень здійснено впродовж вегетаційного періоду 2024 року, з фіксацією 18 екземплярів гіркокаштана червоного, переважно зосереджених у Вишенському районі. Більшість дерев знаходяться вздовж транспортних шляхів і мають вік до 25 років (56,5 %), тоді як дерева віком 41–50 років становлять лише 8,9 %. Проведена оцінка життєвого стану за методикою візуального аналізу з урахуванням стану листя, наявності механічних пошкоджень, сухих гілок і шкідників показала, що значна частка дерев перебуває в доброму стані (64,5 %). Разом з тим, дерева поблизу доріг потерпають від «опіків» листя внаслідок перегріву ґрунту, недостатнього поливу та техногенного навантаження.

Окрему увагу в дослідженні присвячено морозостійкості та посухостійкості гіркокаштана червоного, що є ключовими для виживання та ефективного використання виду в міському середовищі. Проведені в агрохімічній лабораторії дослідження засвідчили, що гіркокаштан червоний здатний витримувати морози до -25 °С, при цьому найбільші ушкодження спостерігаються у бруньках. Дослідження посухостійкості на основі коефіцієнтів водоутримання в різних зонах міста показали, що техногенне навантаження призводить до підвищення водного дефіциту. У найбільш забруднених зонах коефіцієнт водоутримання та посухостійкості знижується, що погіршує життєздатність і декоративність дерев.

Результати дослідження свідчать про високу перспективність інтродукції гіркокаштана червоного в міських умовах, зокрема у Вінниці. Цей вид зберігає декоративність, а також є стійким до морозів і частково стійким до техногенного навантаження, що робить його цінним елементом озеленення, здатним інтегруватися в культурний ландшафт міста і сприяти створенню природних фрагментів у міському середовищі.

Ключові слова: *гіркокаштан червоний, інтродукція, перспективність, декоративність, озеленення.*

Табл. 4. Рис. 4. Літ. 20.

Інформація про авторів

Матусяк Михайло Васильович – кандидат сільськогосподарських наук, доцент, завідувач кафедри лісового та садово-паркового господарства факультету екології, лісівництва та садово-паркового господарства навчально-наукового інституту агротехнологій та природокористування Вінницького національного аграрного університету (21008, м. Вінниця, вул. Сонячна 3, e-mail: mikhailo1988@gmail.com).

Врадій Оксана Ігорівна – кандидат сільськогосподарських наук, доцент, доцент кафедри екології та охорони навколишнього середовища факультету екології, лісівництва та садово-паркового господарства навчально-наукового інституту агротехнологій та природокористування Вінницького національного аграрного університету (21008, м. Вінниця, вул. Сонячна 3).

Matusyak Mikhailo – Candidate of Agricultural Sciences, Associate Professor, Head of the Department of Forestry and Horticulture, Faculty of Ecology, Forestry and Horticulture, Educational and Scientific Institute of Agricultural Technologies and Nature Management of Vinnytsia National Agrarian University (21008, Vinnytsya, Soniachna st. 3. e-mail: mikhailo1988@gmail.com).

Vradii Oksana – Candidate of Agricultural Sciences, Associate Professor of the Department of Ecology and Environmental Protection, Faculty of Ecology, Forestry and Horticulture, Educational and Scientific Institute of Agricultural Technologies and Nature Management of Vinnytsia National Agrarian University (21008, Vinnytsia, 3, Soniachna St., e-mail: oksanavradii@gmail.com).