Received: 18.11.2022 Revised: 28.02.2023; Accepted: 26.04.2023

UKRAINIAN JOURNAL OF FOREST AND WOOD SCIENCE

Journal homepage: https://forestscience.com.ua/en
Ukrainian Journal of Forest and Wood Science, 14(2)

UDC 630*26(477.5)
DOI: 10.31548/forest/2.2023.53

The current state of windbreaks in the Left Bank Forest-Steppe of Ukraine

Volodymyr Maliuha*

Doctor of Agricultural Sciences, Professor
Education and Research Institute of Forestry and Landscape-Park Management
National University of Life and Environmental Sciences of Ukraine
03041, 19 Horikhuvatskyi Shliakh Str., Kyiv, Ukraine
https://orcid.org/0000-0002-9786-0239

Oleksandr Sovakov

PhD in Agricultural Sciences, Associated Professor
Education and Research Institute of Forestry and Landscape-Park Management
National University of Life and Environmental Sciences of Ukraine
03041, 19 Horikhuvatskyi Shliakh Str., Kyiv, Ukraine
https://orcid.org/0000-0003-4586-0410

Sergii Dudarets

PhD in Agricultural Sciences, Associated Professor
Education and Research Institute of Forestry and Landscape-Park Management
National University of Life and Environmental Sciences of Ukraine
03041, 19 Horikhuvatskyi Shliakh Str., Kyiv, Ukraine
https://orcid.org/0000-0002-9449-3023

Abstract. The relevance of the study is related to the need to determine the current state of windbreaks as a component of the forest-agrarian landscape of a particular region. The purpose of the study is to conduct a comprehensive assessment of windbreaks. During the study, data from remote sensing of the Earth using satellite imagery was utilised, which allowed for determining field parameters, the placement of the windbreak system, and their characteristics. Forest inventory works were conducted using commonly accepted methods in forest mensuration, with adjustments made specifically for windbreaks. The quality class of windbreaks was determined based on the percentage of healthy trees out of the total number, and the sanitary condition index was calculated according to established categories. The analysis of the obtained data clearly shows

Suggested Citation:

Maliuha, V., Sovakov, O., & Dudarets, S. (2023). The current state of windbreaks in the Left Bank Forest-Steppe of Ukraine. *Ukrainian Journal of Forest and Wood Science*, 14(2), 53-66 . doi: 10.31548/forest/2.2023.53.

**Corresponding author*

a decline in the quality sequence of common oak from 9 to 3 units within the plantations. The windbreaks were created using the method of oak nest planting, with oak nests placed at a spacing of 5.0×3.0 m and a total windbreak width of 15.0 m. Two additional rows of companion trees were introduced in the wide 5-metre alleys, and companion and shrub species were added within the nest rows. The analysis of the characteristics of windbreaks showed that they have protective heights ranging from 19.6 m to 23.4 m and provide reliable protection for adjacent agricultural fields. Based on the range of effective protective effects of windbreaks, it can be noted that the calculated indicators provide protection with a reliable safety margin of up to 17%. If there is a need to create new windbreaks using the nest planting method in the future, a more efficient scheme is proposed, which involves placing companion tree species in the outer rows to prevent the crowns of the inner rows from spreading towards the field. As a result of the obtained findings, it became possible to conduct a comprehensive expert assessment of the state of windbreaks according to the following criteria: forestry and inventory parameters, meliorative properties, and the sanitary condition index

Keywords: plant composition; mixing schemes; design; protective effect; Condition Index; quality class

Introduction

The relevance of the chosen subject lies in the need to establish the existing parameters of windbreaks (WBs), ensure their effectiveness in protecting agricultural fields, and determine the sanitary condition of the plantations, which to some extent complements the current characterisation of the agroforestry landscape. The issue of ecological balance in the structure of land use in agrolandscapes, establishing an optimal ratio of arable land, pastureland, forests, and water resources, requires mandatory resolution. Global warming is irreversible, so the conservation, preservation, and restoration of WB systems, which play a key role in the complex adaptation of modern agriculture to changing climatic conditions, are of paramount importance. O. Tkachuk & N. Viter (2022) determined that windbreaks play a multifunctional role, supported by observations, research, and practical activities. To establish fast-growing and multifunctional plantations, I.V. Solomakha *et al.* (2022) proposed the use of multifunctional plant species that not only fulfil the functions of wind, water, and dust retention but also perform other economic tasks.

V.M. Maurer & A.P. Pinchuk (2019), considering the experience of European Union countries, explored the prospects of agroforestry development in Ukraine. It provides an opportunity to transition to landscape-ecological principles in agriculture and ensure maximum protective effects.

V.M. Malyuga (2020) concluded that it is necessary to consider the proper management of existing windbreaks (WBs) with a meliorative focus (cultivation, protection, conservation, utilisation), including a portion of forests that perform protective functions, such as field-edge forests, ravine forests, baulk forests, riparian forests, and other forested areas. The meliorative role of forest plantations is manifested in the genesis of eroded soils. Since the establishment of erosion-control plantations, these soils gradually undergo positive changes in agrophysical, agrochemical, and biological properties.

The WB system should be viewed as an integral part of agro-landscapes. Therefore, the optimisation of the WB system should be conducted based on physiographic principles, utilising the latest forest melioration zoning of Ukraine. S. Wehling & M. Diekmann (2009), G. Decocq *et al.* (2016) emphasised the importance and value of such systems in fulfilling the functions of ecological corridors, which contribute to biodiversity. According to the findings of D.V. Dubyna *et al.* (2023), while performing biotope functions, WBs create an optimal environment for the natural flora and fauna, facilitating the development of evolutionary processes. Over time, some of these plantations acquire characteristics of natural ecosystems, providing habitats and migration routes for biodiversity within anthropogenically modified landscapes.

Strip-shaped WBs, like large-scale plantations, directly influence forest cover and, consequently, the carbon balance of small-scale agricultural areas. Such plantings are capable of accumulating atmospheric carbon depending on the characteristics of their aboveground phytomass (Khodash, 2010; Ziegler *et al.*, 2016). S. Maksimtsev *et al.* (2021) noted that in addition to these factors, windbreaks, especially roadside windbreaks, play a crucial role in protecting adjacent areas from the spread of heavy metals generated by traffic emissions. These plantations serve a dual function: on one hand, they protect transportation routes from adverse natural and climatic factors and the dispersion of harmful emissions from vehicles, and on the other hand, they provide protection for adjacent agricultural fields.

To maintain the sustainability of agricultural landscapes, it is necessary to implement systematic anti-erosion and land reclamation measures on field land. Windbreaks (WBs) ensure the long-term, reliable, and safe functioning of agro-landscapes while enhancing natural biodiversity. Therefore, the purpose of the study is to conduct a comprehensive expert assessment of the state of windbreaks based on defined criteria: forestry and inventory parameters, meliorative properties, and the sanitary condition index.

Materials and Methods

The current state of windbreaks in the Left-Bank Forest-Steppe of Ukraine was investigated using the example of the municipal enterprise (ME) “Pyriatyn-Agrolis” located in the Lubny district of the Poltava region. According to physiographic zoning, the territory of the enterprise is situated in the north-western part of the Poltava region within the forest-steppe zone of the Prydniprovskyi Lowland. The research was conducted during October-November 2022.

During the study, land survey data from satellite imagery were used. The use of remote sensing provided an opportunity to determine field parameters, the arrangement of the windbreak system, and establish their characteristics (length, width in crown projection, etc.). A similar method is found in the study by X. Yang *et al.* (2017). Additionally, the WBs lengths were determined using a rangefinder.

The soil and vegetation cover of the studied area is largely influenced by a moderate continental climate and near-optimal moisture conditions. Such circumstances led to the formation of chernozem and podzolic soils in this area, which was a consequence of the influence of forest and steppe vegetation. The Lubny district is characterised as a region with low forest cover and a deficit of forests.

The studied objects consisted of eight windbreaks located within the territory of the mentioned enterprise (Fig. 1). The current state of the windbreaks was assessed based on forestry and meliorative characteristics, and sanitary indicators.

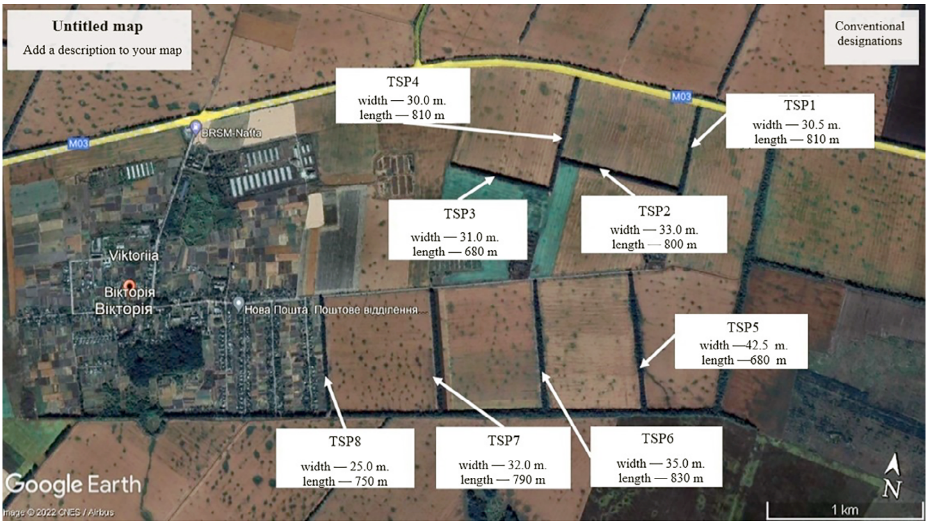

Figure 1. Location of temporary sample plots (TSP) in the windbreaks of the "Pyriatyn-Agrolis" ME

The forest inventory work was performed in accordance with the "Instructional Requirements for the Forest Melioration of Windbreaks" with clarifications provided in the "Guidelines for the Forest Melioration of Linear-Type Windbreaks" (Pylypenko, 2004; Yukhnovsky, 2013). The windbreaks were differentiated based on their construction, composition, mixing scheme, age, and protective height.

Considering the distance of the protective effect of the windbreaks depending on the existing structures in the mentioned farms, the average protective influence of 1 hectare of windbreak on adjacent fields was analysed. Based on the distance of influence of the windbreaks, their width, and protective height, the area of the field within the effective zone of influence of 1 hectare of windbreak was calculated using the formula (1) (Furdychko & Stadnyk, 2012):

$$S = 10000/A \cdot B, \quad (1)$$

where S – the area of the field within the protective influence zone of 1 hectare of the windbreak, ha; B – range of protective action (30 N for windward effect, where N is the protective height, m); A – width of the windbreak, m.

The quality class of the windbreaks was determined based on the scale of assessing their condition according to the percentage of healthy trees from the total number of trees (Pylypenko, 2004). The sanitary condition index was determined based on the obtained list of trees and their distribution into six categories: I – healthy, II – weakened, III – severely weakened, IV – dying, V – fresh dead, VI – dead from previous years (On the approval ..., 1995). Based on their ratio, the general index of the sanitary condition of plantings was calculated (Formula 2):

$$I = \frac{n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5 + 6n_6}{n_1 + n_2 + n_3 + n_4 + n_5 + n_6}, \quad (2)$$

where I – index of sanitary condition; (n_1.... n_6) – number of trees within the category, digits 1....6 – status category numbers.

The forestry and inventory parameters of the plantations were established with a focus on achieving the protective height. The distances of effective protective influence and the area of protected farmland were calculated, considering the structural features of the plantations. The assessment of plantings was conducted according to the index of their sanitary condition.

Results and Discussion

The summarised forestry and inventory characteristics of the plantations are presented in Table 1. As can be seen from the data provided, the main tree species is the common oak (*Quercus robur* L.). This species is characterised by frost and drought resistance, and low sensitivity to air humidity. Due to its high protective properties, longevity, and ability to regenerate through coppicing, the common oak is considered one of the effective species for protective afforestation. Another main species represented is the common ash (*Fraxinus excelsior* Michx.), which is light-demanding and thrives in fertile and moist soil conditions, often in combination with other tree species. The accompanying species include the Norway maple (*Acer platanoides* L.) and the European white elm (*Ulmus laevis* L.).

Table 1. Summarised forestry and inventory characteristics of the plantations

TSP	Composition of plantings	Tree species	Medium		Number of trees, pcs./ha	Density, m^2/ha	Bonitet class	Stock, m^3/ha
			height, m	Diameter, cm				
1	7CO3CA	CO	19.9	39.8	430	53.4	II	516
		CE	18.5	33.2	283	24.4		208
Total stock								724
2	5CA5CO	CO	20.3	45.2	303	48.6	I	452
		CA	23.4	30.8	573	42.8		498
Total stock								950
3	5SLM3CO2CE+ +CA	SLM	18.8	29.5	474	32.3	II	292
		CO	18.9	39.7	186	22.9		212
		CE	17.2	30.6	154	11.3		86
		CA	18.9	28.9	29	1.9		29
Total stock								619
4	6CA4CO+ VZ, SLM	CA	22.1	30.4	372	37.5	I	495
		CO	21.6	43.3	255	27.1		407
		CE	18.7	34.6	26	0.2		22
		SLM	19.4	9.8	23	2.4		2
Total stock								926
5	9CO1CA	CO	21.1	36.6	555	58.2	II	569
		CA	19.1	23.7	108	4.8		50
Total stock								619
6	5CO5CA	CO	18.6	36.8	250	26.6	II	233
		CA	19.0	47.8	132	24.7		235
Total stock								468
7	6CO4CA+CA	CO	21.2	40.1	431	54.4	II	541
		CA	20.8	33.7	271	24.2		338
		CE	18.2	26.2	64	3.5		28

Table 1, Continued

TSP	Composition of plantings	Tree species	Medium		Number of trees, pcs./ha	Density, m^2/ha	Bonitet class	Stock, m^3/ha
			height, m	Diameter, cm				
Total stock								907
8	8CO2CA+CE	CO	18.9	46.0	222	36.9	II	332
		CA	18.6	28.1	114	7.1		78
		CE	17.5	32.0	19	1.5		12
Total stock								422

Note: CO – common oak, CE – common elm, CA – common ash, SLM – sharp-leaved maple
Source: compiled by the authors

Experimental plantings are of the same age (71 years) and grow in the conditions of fresh oak forests (D_2), which is confirmed by corresponding indicators of the living understory cover. During the research period, the proportion of common oak in the plantations varied from 3 (TSP 3) to 9 (TSP 5) units in plantings. From the provided list of inventory indicators for protective windbreaks, the main factor determining their protective effect is the average height. The study showed that the current composition of the plantations is not always the result of a successful selection of tree species and timely forest management practices.

Based on the analysis of tabular data, a clear decline in the proportion of common oak in the plantations can be observed. The highest proportion of 9 units (approximately 90%) of oak is found in TSP 5, where it reached an average height of 21.1 m due to timely forest management and outperformed ash (19.1 m) in height. With a proportion of 8 units in TSP 8, oak reached a height of 18.9 m and slightly exceeded ash (18.6 m). With a proportion of 7 units in TSP 1, oak reached a height of 19.9 m due to the absence of competition from elm. With a proportion of 6 units of oak in TSP 7, it reached a height of 21.2 m and slightly outpaced the second dominant species, ash (20.8 m), in growth. In the latter case, oak achieved its height advantage through timely forest management practices. The same composition was found in TSP 2 and 6, where oak and ash both had a proportion of 5 units, but different height indicators (23.4 and 19.0 m, respectively). Ash exhibited particularly dominant growth in TSP 2, where the height difference with oak was 3.1 m. In TSP 4, oak accounted for only 4 units, and the second dominant species (ash) reached a height of 22.1 m, slightly surpassing oak in this indicator. With a proportion of 3 units in TSP 3, with maple dominating, both species reached nearly the same height (18.9 and 18.8 m, respectively). Common oak consistently grows according to bonitet class II, while common ash grows according to bonitet class I (TSP 2 and 4). Norway maple, which also grows according to bonitet class II, can compete with common oak under certain circumstances.

The studied protective windbreaks were established in the pattern of oak clumps, with oak clusters spaced at 5.0×3.0 m and a total windbreak width of 15.0 m (Fig. 2a). Two additional rows of companion trees were introduced in the wide 5-metre alleys, and companion and shrub species were added within the nest rows.

Along with determining the main taxonomic characteristics, calculations of the protective influence of PFSs were performed based on their structural features. Analysis of the forest meliorative characteristics of windbreaks (Table 2) revealed that the experimental windbreaks have protective heights ranging from 19.6 m (TSP 6) to 23.4 m (TSP 2) and provide reliable protection for agricultural crops (Table 2). According to the instructional requirements, the width of the fields in the main crop rotation is set at 600 m (Pylypenko, 2004). Considering the effective protective influence zone within a 30 H distance (H – protective height of the windbreak), the calculated values ranged from 588 to 702 m. Thus, practically all the studied windbreaks (except TSP 6) provide protection with a reliable overlap (safety margin) of up to 17%.

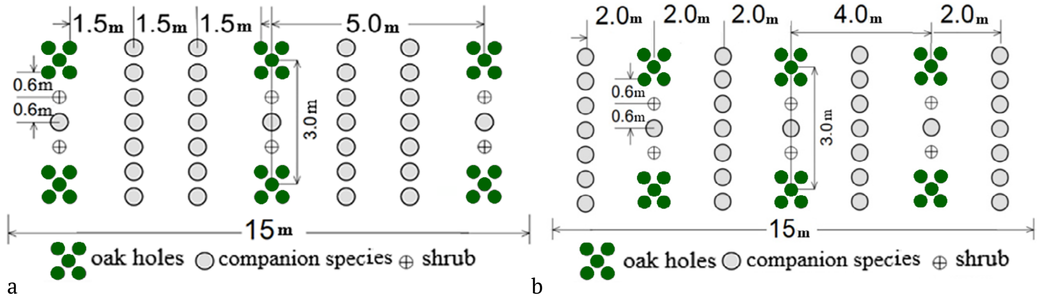

Figure 2. Mixing schemes for oak clump windbreaks
Notes: a – ready-created windbreaks; b – recommended modified version
Source: compiled by the authors

Table 2. Silvicultural characteristics of plantations

TSP	Composition of plantings	Protective height, m	Range of effective protective action of the windbreak, m	Protected area of field land 1 ha windbreak, ha	Protection of field land, % of the standard value
1	7CO3CA	21.7	651	43.4	108
2	5CA5CO	23.4	702	46.8	117
3	5SLM3CO2CE+CA	20.4	612	40.8	102
4	6CA4CO+ VZ, SLM	21.7	651	43.4	108
5	9CO1CA	22.3	669	44.6	112
6	5CO5CA	19.6	588	39.2	98
7	6CO4CA+CA	20.5	615	41.0	103
8	8CO2CA+CE	20.3	609	40.6	102

Note: CO – common oak, CE – common elm, CA – common ash, SLM – sharp-leaved maple
Source: compiled by the authors

In case of practical necessity for creating windbreaks using the nesting method (considering the drawbacks), it is advisable to use a modified scheme (Fig. 2b) for future use. Its features lie in the need to place accompanying tree species in the outer rows to prevent crown growth towards the field. Under such conditions, the crowns of the accompanying tree species can be easily pruned, or if necessary, these trees can be removed without disturbing the overall structure of the windbreak.

Regarding the structures, it is worth noting that all of them are dense, and therefore do not meet the conditions for effective protection of agricultural crops. The reason is that over the past 30 years, forest care measures concerning windbreaks have not been implemented. This has led to the proliferation of understory and vegetative shoots from self-felled trees, resulting in densification, especially in the lower layer of the plantation (Fig. 3). To increase the effectiveness of the protective influence of windbreaks, it is recommended to conduct thinning operations to create optimal airflow patterns. The current state of windbreaks is often unsatisfactory. This situation is especially prevalent in plantations that have not been transferred under the control of local territorial communities or municipal enterprises and sometimes suffer from unauthorised logging. Maintenance and restoration work are not conducted in these windbreaks, resulting in their degradation and loss of protective properties.

Figure 2. General view of PFS with a dense structure (TSP 1)

As a result of the thinning of windbreaks due to unauthorised logging, processes of soil compaction and erosion develop, accompanied by the growth of shrubs and woody vegetation, which weakens the plantations. As a result, the action of pathogens and forest pests is activated which negatively affect the sanitary condition of plantings. The results of the assessment of the sanitary condition of plantings are represented in Table 3. Tree weakening can also be caused by ice and snow loads (Stadnik, 2003).

Table 3. Sanitary condition of windbreaks

TSP	Composition of plantings	Condition index	Condition	Healthy, %	Quality class	Number of trees, pcs./ ha
1	7CO3CA	1.85	weakened	72.3	2	289
2	5CA5CO	1.50	healthy	76.4	1	263
3	5SLM3CO2CE+CA	1.65	weakened	65.4	2	295
4	6CA4CO+ VZ, SLM	1.46	healthy	70.4	2	318
5	9CO1CA	2.62	very weakened	49.2	3	325
6	5CO5CA	3.08	very weakened	41.7	3	362
7	6CO4CA+CA	1.93	weakened	60.2	2	359
8	8CO2CA+CE	2.37	weakened	59.0	2	217

Note: CO – common oak, CE – common elm, CA – common ash, SLM – sharp-leaved maple
Source: compiled by the authors

Analysis of the results of the assessment of the sanitary condition of eight windbreaks showed the following results: two healthy ones with a sanitary condition index of 1.50 and 1.46, respectively (TSP 2 and 4); four weakened ones (with an indicator from 1.65 to 2.37, TSP 1, 3, 7, 8); two very weakened ones (2.62 and 3.08, respectively, TSP 5 and 6). By quality class, the distribution turned out to be somewhat different. The first quality class in the presence of 76.4% of healthy tree species was found at TSP 2, and the third quality class was found at TSP 5 and 6, where the number of healthy plants is 49.2 and 41.7%, respectively. The second quality class is the remaining plantings with an indicator of healthy plants from 59.0 to 72.3% (TSP 1, 3, 4, 7, 8).

Similar objects (PFSs) have been considered in a number of papers over the past period. In particular, the impact of global climate change on the current state and biological stability of PFS is indicated in paper O. Tkachuk & N. Viter (2023). The authors note that these climate changes may have a negative impact on the functioning of windbreaks within the Vinnytsia region. This can result in the suppression of certain tree species that are vulnerable to drought, high temperatures, pests, and diseases, especially those with shallow root systems. Special suppression will occur in species with shallow root systems. Such tree species mentioned by the authors include common oak, Scots pine, European fir, European beech, silver birch, and grey alder. Such suppression can considerably affect the environmental functions of PFSs. Therefore, the decisive role in this ratio belongs to tree species with less sensitivity to humidity and higher resistance to elevated temperatures. It is worth mentioning that the research objects of these authors are located in the same natural-climatic zone of the Forest-Steppe and should be considered in the context of climate change. In the process of studying the most common forest protective windbreaks in the Southern Steppe, Y. Bila (2022) emphasises their positive impact on the microclimate of adjacent agricultural fields.

Regarding the historical value of FPSs created in Ukraine, the so-called “Dokuchaev” windbreaks studied by P.A. Hetman (2023) have great importance based on more than 120 years of experience in their creation and functioning. These windbreaks are a unique forest meliorative object that systematically attracts the attention of researchers. The author, based on the analysis of cenotic characteristics of the studied windbreaks, notes the similarity of their species composition and structure of groups, where common oak (*Quercus robur* L.) and common ash (*Fraxinus excelsior Michx*.) are used as forest-forming species. Compared to this study’s object, they are notably older in age and give confidence in the prospects for their further use. It is necessary to note the similarity of the structural features of FPSs, particularly in terms of their dense construction. The herbaceous layer of the windbreaks investigated by P.A. Hetman (2023) is characterised by moisture-loving, moisture-resistant, and shade-tolerant species compared to the herbaceous cover of field edges. Similar results in the formation of forest biocenosis were obtained by G.O. Lobchenko (2015).

In the studies conducted by O.P. Polishchuk (2009) and D. Řeháček *et al.* (2016), it was also found that the maximum effect of protective windbreaks is achieved when optimal structures are formed. These structures show the best results in reducing the speed of damaging winds (Böhm *et al.*, 2014). The density of these plantings correlates with their construction (Ostapchuk & Sovakov, 2016). M. Bogoslovska & Yu. Yelisavenko (2022) conducted a study on protective windbreaks as integral biocenoses in the Vinnytsia region. They conducted examinations of these windbreaks in areas of the region that are characterised by steppe-like natural and climatic conditions. These objects perform important eco-stabilising functions in preserving agro-landscapes from negative natural factors. The majority of windbreaks in the studied region were created using a combined type of mixing, with the presence of main, accompanying, and shrub species. Similarly to this study, the authors also examined tree species such as common oak, common ash, sycamore maple, and silver birch. The predominant number of tree species in these plantings belong to the I class of site quality, have a satisfactory condition, and are characterised by an age interval of 60 to 75 years. The authors also emphasise the need for silvicultural management in windbreaks to maintain the initial structure and ensure effective forestry and ameliorative impact on adjacent agricultural lands.

PFSs are an important component of the agricultural landscape, which provides protection of field land from adverse natural factors and, as a result, contributes to the increase in crop yields (Sovakov, 2010; Sytnyk, 2005). In this context, N. Zvorska & V. Shlapak (2022) investigated the effect of PFSs on sunflower yield for the Cherkasy region in 2019-2021. In their study, the authors note that the impact of windbreaks on the yield of agricultural crops in ecotone landscapes is influenced by multiple factors. The yield depends on the plant varieties, their resistance to disease pathogens, the natural-climatic conditions of the locality, the type of windbreak structures and their sanitary condition. Thus, the results of these studies fully correlate with the given study regarding the range of effective protective effects of PFSs.

To improve legislation in the context of optimising the area of linear windbreaks and to ensure effective management practices, the Order of the Cabinet of Ministers of Ukraine No. 725-r "On Approval of the Concept for the Development of Agroforestry in Ukraine" (2013) has been developed. This concept identifies the main factors of inefficient protection of agricultural fields and proposes key measures to address them. Legislative support for agroforestry implementation in Ukraine is being provided to implement this concept (Yukhnovsky *et al.*, 2016).

Recent studies highlight various aspects of the condition and protective effect of PFSs. The conducted studies in the windbreaks of the "Pyriatyn-Agrolis" ME are distinguished for their comprehensive approach to assessing their condition.

Conclusions

Despite a number of objective and subjective factors (lack of management, proper protection, efficient management, etc.), a forest environment has developed by the age of 70, capable of providing suitable conditions for plant growth in the plantations and fulfilling their protective functions.

The experimental windbreaks were found to be monoclonal, growing in the type of forest vegetation conditions known as fresh oak forests. In the course of the study, it was determined that the proportion of common oak in their composition ranged from 3 (TSP 3) to 9 (TSP 5) units. The average height was identified as a determining parameter for the assessed windbreaks, ranging from 18.6 to 21.6 m for the second bonitet class. Protective heights, which usually have higher values compared to the averages, ranged from 19.6 to 23.4 m.

Considering the distance of effective protective influence of the windbreaks, the calculated indicators ranged from 588 to 702 m. Therefore, all the researched windbreaks (except TSP 6) provide reliable protection for agricultural crops with a safety margin of up to 17%. According to the existing structures, windbreaks are dense and do not meet the conditions for effective protection of field land and require silvicultural measures to create an optimal windbreak structure. Additionally, the investigated windbreaks require forest melioration measures.

Assessment of eight windbreaks based on the sanitary condition index yielded the following: two healthy windbreaks (TSP 2 and 4), four weakened windbreaks (TSP 1, 3, 7, 8), and two severely weakened windbreaks (TSP 5 and 6). According to the quality class, the distribution was as follows: the first quality class was observed in TSP 2, the third class in TSP 5 and 6, and the second quality class was characteristic of the remaining plantations (TSP 1, 3, 4, 7, 8).

The prospects for further studies on these objects are determined by the need for inventorying considering their condition and meliorative properties, implementing a complex of silvicultural measures to form optimal structures, and addressing the legal issue regarding their subordination to specific landowners. Monitoring WBs in terms of their condition will allow systematic observation of the effective protection of field land. The condition of windbreaks growing in areas where combat actions took place can be determined using unmanned aerial vehicles before their demining.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgements

None.

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Сучасний стан полезахисних лісових смуг Лівобережного Лісостепу України

Володимир Миколайович Малюга

Доктор сільськогосподарських наук, професор
Навчально-науковий інститут лісового і садово-паркового господарства
Національний університет біоресурсів і природокористування України
03041, вул. Горіхуватський шлях, 19, м. Київ, Україна
https://orcid.org/0000-0002-9786-0239

Олександр Вікторович Соваков

Кандидат сільськогосподарських наук, доцент
Навчально-науковий інститут лісового і садово-паркового господарства
Національний університет біоресурсів і природокористування України
03041, вул. Горіхуватський шлях, 19, м. Київ, Україна
https://orcid.org/0000-0003-4586-0410

Сергій Миколайович Дударець

Кандидат сільськогосподарських наук, доцент
Навчально-науковий інститут лісового і садово-паркового господарства
Національний університет біоресурсів і природокористування України
03041, вул. Горіхуватський шлях, 19, м. Київ, Україна
https://orcid.org/0000-0002-9449-3023

Анотація. Актуальність дослідження пов'язана із необхідністю визначення сучасного стану полезахисних лісових смуг, як складової лісоаграрного ландшафту конкретного регіону. Мета роботи полягала у проведенні комплексної оцінки полезахисних лісових насаджень. Під час досліджень використані дані дистанційного зондування землі за космічними знімками, що надало можливість визначити параметри полів, розміщення системи полезахисних лісових смуг і їхні параметри. Лісотаксаційні роботи виконувалися за загальноприйнятими у лісовій таксації методиками з уточненнями для смугових насаджень. Клас якості полезахисних смуг визначали за відсотком здорових дерев від загальної їх кількості, а індекс санітарного стану розраховували відповідно встановлених категорій. На підставі аналізу отриманих даних чітко прослідковується спадна послідовність дуба звичайного від 9 до 3 одиниць у складі насаджень. Полезахисні смуги створювалися за типом дубових гніздових із розміщенням гнізд дуба 5,0×3,0 м і загальною шириною смуги 15,0 м. У широкі 5-метрові міжряддя додатково вводилися два ряди супутніх, а в ряди гнізд – супутні та чагарникові види рослин. Аналіз характеристики смугових насаджень показав, що вони мають захисні висоти від 19,6 м до 23,4 м та створюють надійний захист прилеглих польових угідь. Виходячи із дальності ефективного захисного впливу лісосмуг можна відмітити, що розрахункові показники забезпечують захист з надійним запасом міцності до 17 %. За необхідності створення нових лісових смуг гніздовим способом на перспективу пропонується використання ефективнішої схеми, особливості якої полягають у розміщенні супутніх деревних видів у крайніх рядах з метою запобігання розростанню крон узлісних рядів у сторону поля. Завдяки отриманим результатам виникла можливість провести комплексну експертну оцінку стану полезахисних лісових смуг за такими критеріями: лісівничо-таксаційні параметри, меліоративні властивості та індекс санітарного стану

Ключові слова: склад насаджень; схеми змішування; конструкція; захисний вплив; індекс стану; клас якості