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FEATURES OF THE SPECIES COMPOSITION BASED ON THE TROPHIC ANALYSIS OF ARTIFICIAL WOODY PLANTATIONS IN THE KRYVYI RIH MINING AND INDUSTRIAL DISTRICT

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Introduction. The study of the trophic characteristics of the species forming the artificial woody plantations on the anthropogenically altered territories of the Dnipro Steppe is an urgent task of forest protection and horticultural management in the Dnipro Region. Artificial woody plantations of Kryvyi Rih, which are located in contrasting ecological conditions and represent the main varieties of artificial woody and shrub plantations in the region, were chosen as the object of research. These are objects of horticulture, sanitary, water protection and urban forest protection tracts.

Materials and Methods. The following methods were used to achieve the goal and fulfill the tasks of the study: forest taxation; phytocenological; dendrological; recording the dendroflora, determining phytomelioration and recreational functions of tree groups, as well as the vital state of tree vegetation; physiological, leaf surface area, number of leaves on model branches; analytical and statistical methods of processing materials for the analysis of the experimental data.

Results. Woody ecosystems on the territory of the Kryvyi Rih mining and metallurgical region are very unevenly distributed. They are concentrated mainly in river banks, forest protection plantations, and artificial plantations of protective territories of settlements. Forest cover has significant differences in different territories of Kryvyi Rih. It does not reach the optimal level when forests have the most positive effect on the climate, soils, and water resources, mitigate the consequences of erosion processes. Neither does it suffice the needs of an increasing wood production. Creation of a forest seed base of tree species on the basis of selection will ensure a considerable enhancement in both productivity and biological resistance of artificial woody plantations to the climatically and anthropogenically changed conditions in the region.

Conclusions. The type of ecological structure of woody plantations in the study areas is reflected in the duration of the environmental transformation effect of tree vegetation by trophic characteristics (from 45.46 % of mesotrophs and 31.82 % of megatrophs to 4.55 % of oligomesotrophs and oligomegatrophs) on the soil and edaphic conditions of the territory.

Keywords: artificial woody plantations, trophic adaptation mechanisms, the Dnipro Steppe conditions, industrial areas, new forest ecosystems

INTRODUCTION

In studies on the physiology and introduction of woody plants, the basis of growth and adaptogenesis is described as the process of a constant new formation of structural elements and adaptation of the plant species (organs, tissues, cells and individual parts) to local conditions (Chand, *et al.*, 2021; Brown & Koenig, 2022; Tiziani, *et al.*, 2023).

In the anthropogenically altered landscapes of the Dnipro Steppe, regulation of abiotic atmospheric and soil-forming processes, in particular due to the density of artificially created woodland ecosystems through the dynamic restoration of soil fertility, is, in our opinion, a promising program for the post-war resource restoration of forest reserves in the regions of Ukraine. The soil cover is an important basis for the photosynthetic activity of artificial woody plantations in the steppe and forest-steppe zones of Kryvyi Rih. Over the past decades, significant amount of data on the problem has been accumulated. A real increase in the average air temperature over an evolutionarily short time interval is forecasted. Additionally, there is a growing manifestation of anomalous natural phenomena, such as droughts, floods, hurricane winds, as well as displacement of the boundaries of forest vegetation zones and areas of distribution of tree species (Bianchi, *et al.*, 2023; Polishchuk & Antonyak, 2022). Natural forest management climate projects and research on the restoration potential of forest ecosystems, including carbon sequestration processes in artificial woody plantations, can provide about a third of the cost-effective CO_2 emission reductions that need to be implemented by 2030 to avoid crossing the global average limit of 2°C temperature increase (Lisein, *et al.*, 2022; Vacek, *et al.*, 2023; Ding, *et al.*, 2023). As part of solving the problem of mitigating regional climate change and the consequences of this phenomenon by optimizing the performance of carbon storage or conservation functions by woodland ecosystems, we have prioritized research into the trophic composition of artificial woody plantations of the Kryvyi Rih Mining and Industrial District.

The tree species composition of anthropogenically altered ecosystems, as well as the trophic composition of artificial woody plantations in industrial regions were examined both in the Dnipro Steppe and beyond these territories (Solomakha, *et al.*, 2021; Savosko, *et al.*, 2021; Kvitko, *et al.*, 2021; Kvitko, *et al.*, 2022; Wang, *et al.*, 2023; Carlson, *et al.*, 2023; Seliger, *et al.*, 2023; Pretzsch, *et al.*, 2023).

Physiological processes of adaptation of woody plantations to ground cover contamination and dust or gas pollution have been studied in the works of both foreign and domestic researchers (Lanhui, *et al.*, 2023; Carlson, *et al.*, 2023; Seliger, *et al.*, 2023; Pretzsch, *et al.*, 2023; Danylchuk, *et al.*, 2023; Danylchuk, *et al.*, 2024).

Such authors as G. R. Quentin *et al.*, R. Q. Grafton *et al.* (2021), L. Chu *et al.* (2023) highlight the priority of a special functional-purpose "carbon" system of forestry objects for optimizing the development of artificial woody plantations, accompanying carbon storage, conservation and complex carbon- and climate-regulation.

Researches (Wu, *et al.*, 2021; Savosko, *et al.*, 2021; Kvitko, *et al.*, 2021; Chen, *et al.*, 2023) proved that in optimal soil and climate conditions, gas resistance of woody plants is always higher than in unfavorable conditions on depleted soils or substrates. Young plants, their shoots and leaves are more exposed to aerogenic harmful substances (Savosko, *et al.*, 2021).

The purpose of the research is to analyze the trophomorphic spectrum of the tree species composition groups in the conditions of climatic changes of the steppe and forest-steppe zone, to determine the trophic mechanisms of adaptation of artificially introduced woody plant species in the territory of the Kryvyi Rih District within the Dnipro Steppe.

MATERIALS AND METHODS

Geographic coordinates of the study area span from 48 19 to 47 28 south latitude and from 32 58 to 33 47 west longitude. The length from north to south is 96 km, from east to west 62 km.

The city of Kryvyi Rih has an area of 430 km^2 and produces a lot of thermal radiation into the atmosphere of the surrounding natural environment (Savosko, *et al.*, 2021; Kvitko, *et al.*, 2022). The city can be called an "island of heat". The city forms not only the local climate, but also significantly influences the climate of the surrounding territory (Savosko, *et al.*, 2021; Kvitko, *et al.*, 2021). In addition, in each district of the city of Kryvyi Rih, microclimatic differences can be observed, which are characterized by their mesoclimatic features (Map of geobotanical zoning of Ukraine, 2023; Physical and geographic zoning of Ukraine, 2023). A geomorphological analysis of research plots of artificial forest plantations according to A. L. Belgard (Savosko, *et al.*, 2021; Kvitko, *et al.*, 2021), the landscape type, and the geochemical relief type was performed in accordance with methodological recommendations and research works (Sparks, 2003; Bulmer, 2014; Hancock, *et al.*, 2019; Maus, *et al.*, 2020; Vriens, *et al.*, 2020; Sabatini, *et al.*, 2021; Wu, *et al.*, 2021; Chen, *et al.*, 2023). Geographical and genetic features of the physical state of soils, soil type, grain size composition, presence of salinity, soil trophic characteristics of the study area, and moisture content of hygrotops were studied according to the conventional methods (Pansu, *et al.*, 2006; Hancock, *et al.*, 2019; Savosko, *et al.*, 2021; Wu, *et al.*, 2021; Chen, *et al.*, 2023).

In the territory within the Kryvyi Rih Iron-ore Basin (Kryvbas), woody plantations are represented by the main types of tree and shrub plantations. In particular, the study addressed objects of horticultural and park management, sanitary and water protection and urban dust protection tracts. Woodland ecosystems located in regional natural and climatic conditions include wood ecosystems of the Gurivsky Forest (Dolynskyi district of Kirovograd region is located at a distance of about 50 kilometers from sources of technogenic pollution and on the border of the Kryvyi Rih Iron-ore Basin); woodland ecosystems in the vicinity of the village of Novotaromske in the floodplain of the Bokova River near the village of Sofiivka (the old name of the village of Valove) of the Kryvyi Rih district of the Dnipropetrovsk region and the village of Tarasivka (Sofiivskyi district of the Dnipropetrovsk region). These woodland ecosystems are located 30–50 km from industrial enterprises that are almost not polluted by dust emissions from metallurgical enterprises and are of both natural and artificial origins. The study used cartographic materials from the Internet resources Google Maps and lk.ukrforest.com (Sabatini, *et al.*, 2021; Shao, *et al.*, 2023; Geobotanical zoning map, 2023).

For laboratory analytical studies, soil samples, leaf litter and litter collected, transported and stored according to requirements were selected. Within the areas under study, indicators of the biomass of artificial woody plantations were established taking into account the tree species composition, the amount of wood per tier, the height of the wood and the total height of the tree stand, the diameter of the tree stand, the stock of wood, and the vital state of the tree vegetation (Sparks, 2003; Forkuor, *et al.* 2020; Arabadzhy-Tipenko, 2020; Stanturf, *et al.*, 2021; Sabatini, *et al.*, 2021).

The analysis of the flora adventitious fraction was carried out according to the recommendations of forest taxa. In stationary areas, their area, the location of tree and shrub plants, and the number of plants in the accounting areas were determined. Taxation studies of the tree stand were carried out according to standard methods; the analysis of the forest typological structure was carried out according to the of forest typology (Barker & Pilbeam, 2010; McDonald, 2014; Sabatini, *et al.*, 2021; Bobko, 2018; Kvitko, *et al.*, 2021). Within the monitored areas, the vertical structure of plantations was assessed, and the height and trunk diameter of trees of the first, second and third tiers were measured longitudinally. Their height was studied with a modern laser altimeter (Nikon Forestry 550). Binding of plots and soil sections was carried out using GPS satellite positioning devices.

Recreational tolerance of vegetation cover was assessed according to the methods (Barker & Pilbeam, 2010; McDonald, 2014; Bobko, 2018; Kvitko, *et al.*, 2021). To characterize the state of the understory and undergrowth, an assessment was made by the methods and units of recreational loads on forest natural complexes (Arabadzhy-Tipenko, 2020; Stanturf, *et al.*, 2021; Kim, *et al.*, 2022). According to the established methods, the level of recreational loads and the stage of plant community digression were determined.

The obtained data analysis was carried out using MS Excel 2016 software. The researched results were processed by the method of variable statistics at the level of significance $P > 0.05$ (Bulmer, *et al.*, 2014; West, 2017; Kobylynska & Huseva, 2020; Sabatini, *et al.*, 2021).

RESULTS AND DISCUSSION

Forest ecosystems, situated in favorable ecological conditions in relation to the city of Kryvyi Rih, are represented by natural plantations of the Hurivskiy Forest (3 natural and artificial sites are located in the floodplain of the Bokovenka River and on the territory of the forestry), forest ecosystems in the vicinity of Novotaromske village (3 sites of natural and artificial origin located in the floodplain of the Bokova River), forest massif in the vicinity of Tarasivka village (3 plots of natural and artificial origin). They were formed with the dominance of oak trees (*Quercus robur* L.), the estimated age of which is 180–80 years (**Fig. 1*A***).

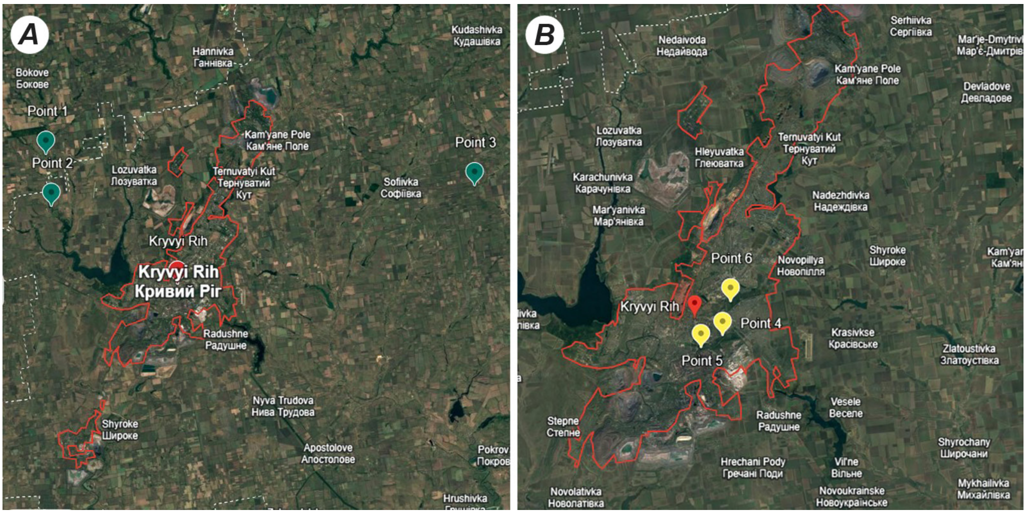

Fig. 1. Location of experimental plots of artificial woody plantation: ***A*** – in a natural environment without aerotechnogenic pollution; ***B*** – in an urbanized environment with a moderate and significant level of aerotechnogenic pollution

Woodland ecosystems situated in favorable ecological conditions within Kryvyi Rih city are represented by the natural stands of the Veseli Terny Arboretum (5 plots located in the northern part of Kryvyi Rih, the floodplain of the Saksagan River).

Forest phytocenoses that grow in relatively moist conditions and were formed as sanitary water-protective woodland ecosystems in the territories of Kryvyi Rih city are represented by water-protective plantations of the Karachunivskyi Reservoir (5 sites located in the southwestern part of Kryvyi Rih, the floodplain of the Ingulets River); water protection and dust protection plantings of the "Artem-1" mine tract (3 sites located in the central part of Kryvyi Rih, floodplain of the Saksagan River), and dendrological park "Dovhyntsivskyi" (9 plots located in the eastern part of the city of Kryvyi Rih, floodplain of the Saksagan River). In Kryvyi Rih, the specified forest phytocenoses are in relatively unfavorable ecological conditions under the influence of dust and gas emissions from the mining and industrial production of iron ore and its beneficiation. Woody ecosystems of water protection plantations are of both natural and artificial origin, with age range between 120 and 150 years. The woodland ecosystems of the Dovgyntsivskyi Arboretum (2 sites) and the water protection plantations of the Karachunivskyi Reservoir belong to the zone with unfavorable ecological conditions for the growth and development of woody plants. They include such species as *Quercus robur* L., *Fraxinus excelsior* L., *Robinia pseudoacacia* L, *Quercus rubra* L., *Tilia cordata* L., *Pinus sylvestris* L. In this ecological zone, all plantations are exclusively of artificial origin and were created approximately 50–80 years ago (**Fig. 1*B***).

Sanitary dust-absorbing and noise-proof woody plantations of artificial origin, 90–60 years old, and located in the zone of adverse ecological conditions are represented by woody plantations of the urban and sanitary-protective forest belts (6 plots, tract of Dnipropetrovsk highway, "Kiltse Sobornosti", territory of PJSC "ArcelorMittal Kryvyi Rih"). The plantations are dominated by *Quercus robur* L., *Fraxinus excelsior* L., *Acer negundo* L., and occasionally by *Ulmus laevis* L. It should also be noted that the edaphic conditions are characterized by a low level of moisture (except for the plantations of one area due to flooding with technical waters of PJSC "ArcelorMittal Kryvyi Rih") and very significant aerotechnological pollution due to their proximity to the mining and metallurgical enterprises of the city.

Table presents comparative indicators of statistical analysis using the Student's *t*-test for unrelated data on the density of woody plant species tree stands in both natural ecosystems and anthropogenically modified territories under the influence of man-made industrial facilities located within the zonal climatic conditions of the Dnipro Steppe region.

Indicators of statistical analysis using Student's *t*-test for unrelated data on tree density in the study areas

Two-sample *t*-test with equal variances		
Statistical results	Indicators N_1	Indicators N_2
Observations of selected tree species	27	27
Main dominant tree stand species	69.73 %	71.99 %
Quercus robur L.	19.72 %	15.51 %
Robinia pseudoacacia L.	19.42 %	8.33 %
Fraxinus excelsior L.	9.63 %	24.31 %
Acer campestre L.	10.41 %	15.28 %
Acer negundo L.	10.55 %	8.56%
Other tree species	30.27 %	28.01 %
Mean value	24.22	16,01
Sample variance	1521.79	696.02
Pooled variance	1108.89	
Hypothetical difference between means	0	
t-statistics	0.91	
P(T<=t) one-sided	0.18	
t critical one-sided	1.67	
P(T<=t) two-sided	0.37	
t critical two-sided	2.01	

Note: N_1 – density of tree species in the areas within the zonal conditions of natural ecosystems; N_2 – density of woody vegetation species in areas within the anthropogenic territories

We conducted an analysis of the trophomorphic spectrum of woodland ecosystems. The analysis of tree species of artificial woody plantations of the Kryvyi Rih district in accordance with soil studies (Eko-Passport of Kryvorizhia, 2017; Savosko, *et al.*, 2021; Map of geobotanical zoning of Ukraine, 2023, Physical and geographic zoning of Ukraine, 2023), identified 5 groups of trophomorphs including oligotrophs (undemanding species), oligomesotrophs (relatively moderately demanding), mesotrophs (moderately demanding), mesomegatrophs (relatively demanding) and megatrophs (very demanding). In the areas of natural forest ecosystems and artificial woody plantations, which are in relatively favorable ecological conditions, megatrophs prevail in the total number of species in accordance with classical approaches in calculations of species richness (make up 70.81±0.26 %). The number of oligomesotrophs was much smaller (21.29±0.02 %). Mesotrophs and mesomegatrophs were even lower, 4.87±0.04 % and 3.03±0.06 %, respectively. Oligotrophs were absent. According to the analysis of the trophicity of areas with groups of sanitary and water-protective artificial woody plantations, megatrophs make up 35.13±0.38 %, oligomesotrophs – 28.71±0.15 %, mesotrophs – 17.29±0.12 %, mesomegatrophs – 12.22±0.07 %, oligotrophic species amount to 6.67±0.03 %. In the selected territory with ecologically unfavorable conditions for sanitary dust-absorbing and noise-reducing artificial woody plantations, megatrophs make up 68.01±0.36 %, oligomesotrophs – 23.01 ± 0.28 %, mesotrophs – 9.01±0.04 %, mesomegatrophs and oligotrophs are absent (**Fig. 2**).

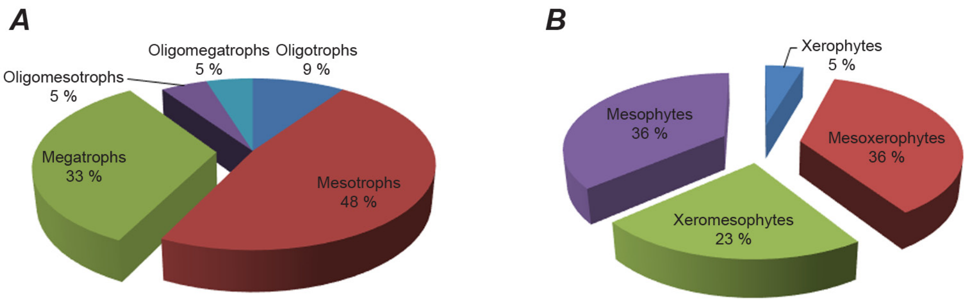

Fig. 2. Indicators of the division of woody vegetation adaptation: ***A*** – according to nutrition; ***B*** – according to environmental factors

The trophicity of woody plants depends to a greater extent on the characteristics of the soil cover and the indicators of leaf litter. Therefore, we conducted studies of leaf litter of woodland ecosystems of the Kryvyi Rih district. The leaf litter of woody plant species of the Kryvyi Rih district contains from 6.12±0.05 to 18.15±0.09 % of ash substances (10–11±0.06 % on average), calcium – from 0.075±0.0063 to 0.84±0.012 % (0.37±0.005 % on average), magnesium – from 0.07±0.001 to 0.28±0.0017 % (0.14±0.008 % on average).

According to numerous studies data, the content of ash in leaf litter is a fairly informative indicator of the forest ecosystems state (Kim, *et al.*, 2022; Singh, *et al.*, 2023). At the same time, the level of ash elements demonstrates the type of adaptation of the woody and shrubby plants to the microclimates of the biotopes of the Dnipro Steppe. In the ground full loads of ash elements show the intensity of the impact of woody plantation on the soil in the Kryvyi Rih district conditions. Analysis of the results obtained showed that there is from 4.21 to 8.92 % of ash, with an average value of 7.08 ± 2.02 in the leaf litter of artificial forest plantations. Cumulative calculations demonstrate that the forest ecosystems of Kryvyi Rih produce from 50 to 200 g/m^2 of leaf litter, with an average value of 125–130 g/m^2 annually. Such indexes are typical of deciduous forests, both in zonal and azonal (steppe landscapes) habitats (Savosko, *et al.*, 2021). The supply of ash elements (44.38–72.01 %) and calcium (40.97–50.45 %) from leaf litter to the soil depends on the botanical and ecological characteristics of tree plantations. Separate woody plantations within the region are characterized by certain differences in the ecological state and indicators of leaf litter flows. It should also be noted that this amount of substances burned to ashes level corresponds to such indicators established in other industrial regions of Ukraine.

The use of differentiated approaches to assessing the vitality of artificial woody plantation, taking into account quantitative indicators of wood reserves, natural conditions and forest productivity, make it possible to model the further process of forest ecosystems development, determine the objective state of the industrial objects territories in the land use and the risk of forest fires for further possibility of reducing greenhouse gas emissions from alternative forest use in the region.

Figure 2*A* shows the trophic indicators of the economic use of nutrients in the process of forest ecosystems growth in the territory of the Kryvyi Rih Mining and Industrial District. The trophic processes of artificial woody plantations also depend on the characteristics of tree communities (afforestation, reforestation or forest conservation). Results of the studies on these phenomena can be applied in further implementation of economic (wood harvesting) and social projects (ecological and social), taking into account the degree of public expediency (**Fig. 2*B***).

We conducted an analysis of the physiological and ecomorphic spectrum of woodland ecosystems according to the level of moisture requirements of tree species (**Fig. 2*B***). As a result of the analysis, 5 groups of hygromorphs were identified: xerophytes (plant species of dry environments), xeromesophytes (tree species that grow in conditions with temporarily insufficient moisture, moderately demanding on the level of moisture), mesoxerophytes (tree species relatively adapted to moderately humid environments), mesophytes (tree species that grow in moderately humid habitats). According to classical approaches in calculations by species richness mesophytes and mesoxerophytes prevail in the total number of species (the share of the former species is 36.37±0.25 %, that of the latter – 36.37±0.18 %). The number of xeromesophytes is much smaller – 22.72±0.18 %. The share of xerophyte species is, accordingly, minimal and amounts to 4.54±0.06 %.

The obtained results confirm the opinion that artificial woody plantations can be an effective in compensating greenhouse gas emissions. The use of significant adaptive properties of tree species of artificial woody plantations of the Kryvyi Rih district can provide an opportunity to reduce public costs by improving forest management at the sub-national level of the region, with the prospect of implementing projects of artificial woody plantations to increase the level of carbon absorption in local ecosystems.

Given the crucial environment-transforming role of forest vegetation, it can be assumed that an introduction of woody-shrub plantations of various species or varieties can give rise to new trophic relationships to increase the stability of artificial woody plantations in the climatic conditions of the steppe (Lykholat, *et al.*, 2022; Ali-Tavakoli-Kaghaz, *et al.*, 2023).

In combination with the complex abiotic and anthropogenic conditions of the Kryvyi Rih district, the centres of urban ecosystems will prolong the stability of the living environment for tree vegetation, limit the sharp changes in temperature fluctuations, and contribute to the improvement of the climatic conditions of the industrial areas of the Dnipro Steppe.

In order to check the development processes of the possibilities of using artificial woody plantations of Kryvyi Rih within the Dnipro Steppe in the future, it is promising to analyze the sensitivity of the physiological stability of forest ecosystems to anthropogenic changes regarding the uncertainty of the influence of climatic factors and other modern risks on the amount of wood growth with a periodicity of 5 years in the region. The obtained results can be used for monitoring the current state of forest ecosystems in the conditions of urban landscapes.

CONCLUSION

The trophic analysis of the species richness of forest ecosystem sites in natural conditions of the research region and artificial woody plantations in relatively favourable urbanized conditions showed the predominance of megatrophic and oligomesotrophic tree species, with the presence of the other three niche types in sufficient quantities. This contributes to the stability of species diversity at the expense of trophic niches for the introduction and acclimatization of woody shrub species in the future. There are certain differences in the trophic spectrum. The appearance of oligotrophs indicates the possibility of further expansion of the species spectrum of woody vegetation on the territory of water protection plantation ecosystems of Kryvyi Rih city. The dominance of megatrophs and oligomesotrophs was found in the ecosystems of sanitary, dust-absorbing and noise-reducing artificial woody plantations.

Introduced species of woody and shrub plants can be included in the trophic composition of artificial woody plantations to strengthen the sustainability ecosystems and reduce the impact of invasive species in Kryvyi Rih district. Based on the results of this study, the following species with a high level of survivability and stability, which have proven themselves for 60 to 120 years in the conditions of technogenic load of the Kryvyi Rih district of the Dnipro Steppe, can be recommended to be used for the above mentioned purposes: *Quercus robur* L., *Populus* sp., *Mórus nígra* L., *Fraxinus excelsior* L., *Cornus sanguinea* L., *Úlmus laévis* Pall., *Prunus spinosa* L., *Rosa canína* L., *Berberis* L., *Chaenomeles* Lindl.

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COMPLIANCE WITH ETHICAL STANDARDS

Conflict of Interest. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Human Rights. This article does not contain any studies with human subjects performed by any of the authors.

Animal studies. This article does not contain any studies with laboratory animals performed by any of the authors.

AUTHOR CONTRIBUTIONS

Conceptualization, [M.K.; O.L.]; methodology, [M.K.; Y.L.]; validation, [M.K.]; formal analysis, [M.K.; T.L.]; investigation, [M.K.; O.L.,]; resources, [M.K.]; data curation, [O.L.; M.G.]; writing – original draft preparation, [M.K.]; writing – review and editing, [M.K.; O.L.; T.L.]; visualization, [M.K.]; supervision, [Y.L.; M.G.]; project administration, [Y.L.]; funding acquisition, [–].

All authors have read and agreed to the published version of the manuscript.

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ОСОБЛИВОСТІ ВИДОВОГО СКЛАДУ ЗА ТРОФІЧНИМ АНАЛІЗОМ ШТУЧНИХ ДЕРЕВНИХ НАСАДЖЕНЬ КРИВОРІЗЬКОГО ГІРНИЧНО-ПРОМИСЛОВОГО РАЙОНУ

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Вступ. Вивчення трофічних особливостей видів, що утворюють штучні деревні насадження антропогенно змінених територій степу Дніпра, є актуальним завданням лісозахисного та садово-паркового господарства Дніпровського регіону. Об'єктом дослідження обрано штучні деревні насадження Кривого Рогу, які розташовані в контрастних екологічних умовах і є основними різновидами штучних деревно-чагарникових насаджень регіону. Це об'єкти садово-паркового господарства, санітарно-гігієнічні, водоохоронні та міські лісозахисні урочища.

Матеріали та методи. Для досягнення поставленої мети і виконання поставлених завдань використовували такі методи: лісова таксація; фітоценологічний, дендрологічний методи; облік дендрофлори, визначення фітомеліоративних і рекреаційних функцій деревних угруповань, а також життєвого стану деревної рослинності;

площа листкової поверхні, кількість листків на модельних гілках; аналітико-статистичні методи обробки матеріалів для аналізу експериментальних даних.

Результати. Лісові екосистеми на території Криворізького гірничо-металургійного регіону розташовані дуже нерівномірно. Вони зосереджені переважно в берегах річок, лісозахисних насадженнях, штучних насадженнях захисних територій населених пунктів. Лісистість на різних територіях Кривого Рогу має значні відмінності. Він не досягає оптимального рівня, коли ліси найбільш позитивно впливають на клімат, ґрунти, водні ресурси, пом'якшують наслідки ерозійних процесів, а також зростання виробництва деревини. На селекційній основі перспективним і актуальним є створення лісонасіннєвої бази деревних порід, яка забезпечить значне підвищення не тільки продуктивності, а й біологічної стійкості штучних деревних насаджень до кліматичних і антропогенно змінених умов регіону.

Висновки. Тип екологічної структури визначався світловою та трофічною структурою насаджень і тривалістю її середовищеперетворювальної дії на ґрунтово-едафічні умови території.

Ключові слова: штучні деревні насадження, механізми трофічної адаптації, степові умови Дніпра, промислові території, нові лісові екосистеми

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