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Monitoring of the phytosanitary condition of *Larix decidua* Mill. plants in the Modryna tract of the Zviahel Forestry branch of the State Enterprise Forests of Ukraine

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Abstract. Phytosanitary monitoring of forest stands is currently a relevant and important area of scientific research that ensures observation, assessment, and forecasting of the dynamics (changes) of the quantitative and qualitative (including sanitary) state of forests and underlies the development of an effective system of tree protection. The purpose of this study was to identify the species composition and distribution of dominant phytopathogen species in the Modryna tract of the Zvyagelske Forestry branch and to identify the primary factors of *Larix decidua* Mill. decline. This study employed

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phytopathological, entomological, forest inventory, and comparative methods. The study identified and registered typical symptoms of damage and the consequences of the harmful effects of pests of *L. decidua* trees in the Modryna tract, leading to a general weakening of their sanitary condition. Symptoms of larch needle cast (meria needle blight) and browning were recorded on the needles; on the trunks – typical manifestations of cankers and fruiting bodies of a unique basidiomycete – *Lariciphomes officinalis*. Apart from infectious pathologies, sporadic wind and storm damaged larch trees, as well as other negative effects of wind exposure, were recorded in the study areas. The species composition of the pests of the surveyed larch trees included the following insect species: *Cephalcia lariciphila, Sacchiphantes viridis* Ratz., *Coleophora laricella*, *Zeiraphera diniana* Gn., *Lasiomma laricicola* Karl. It was generalised that the main threat to the centuries-old larch trees is the complex effect of anthropogenic, abiotic, and biotic (including parasitic) environmental factors that constantly and to varying degrees affect the sanitary and physiological state of ancient larch trees. The findings of this study provide information for predicting the risks of spreading pathogens and pests, which allows managing these risks and preventing their further spread

Keywords: centuries-old plants; species composition; pathoentomological surveys; symptoms; resistance

INTRODUCTION

The principal purpose of phytosanitary monitoring is to obtain information necessary for forecasting and signalling outbreaks of dangerous pathogens and pests, as well as for making decisions on protective measures. Considering the gradual change in climatic conditions, prolonged dry periods without adequate natural moisture and cyclical dieback of native tree species, European larch confidently occupies its ecological niche in the forest stands of different regions of Ukraine (Debryniuk & Fuchylo, 2020), and the investigation of the phytosanitary condition of larch stands in the Zhytomyr Polissia region is particularly relevant. Thus, most of larch stands grow in the Right Bank of Ukraine (Zeidler *et al.*, 2022). By now, the promising forestry species *Larix decidua* Mill. has been successfully cultivated in Zhytomyr Polissia for decades, as it is well acclimatised, fast-growing, productive, slender, durable, and hard. The valuable qualities of larch timber are associated with its high density and specific gravity, the presence of tannins, and resistance to decay. In their studies, Y. Fuchylo *et al.* (2017) often refer to the European larch as a "coniferous oak". E. Kügler (2020) noted that European larch is planted mainly on rich and relatively rich soils in pure culture or with admixtures of other species in the stands.

The Modryna tract is a botanical monument of national significance, and according to its administrative location, it belongs to the Horodnytsia settlement community of the Zvyagel district of Zhytomyr region. It is managed by the Zvyagel Forestry branch of the State Enterprise Forests of Ukraine, on the territory of the 28th quarter of the Nadsluchanske forestry. This tract is a "living monument" to the beginning of artificial forest creation in Polissia (The project of the organisation..., 2019). This unique nature reserve area covers 36 ha, where old-growth European larch trees grown in the climatic conditions of Zhytomyr Polissia are protected. In this area, almost every third tree can be classified as a reference tree in terms of its quality indicators (Pasternak & Nazarenko, 2019; Tashev & Dzyba, 2023). Y. Fuchylo *et al.* (2017) notes that the oldest stands were created more than 190 years ago in the form of a larch alley by the great-grandson of the famous philanthropist Prince Józef Klemens Czartoryski, and a monument was erected at the planting site, which has been preserved to this day.

European larch is not sensitive to low temperature conditions, grows successfully with common oak, and under appropriate mixing schemes does not cause significant loss of deciduous species from the composition of stands. Yu. Debryniuk (2020) notes that due to differentiation processes, high vital status is observed in larch stands of older age groups. About 90% of the plants are healthy and relatively healthy, and the most productive larch plantations in Western Polissia are those with narrowly crested bark, trunks well-cleaned from knots, and medium-density crowns.

European larch has an exotic status among conifers. In winter, the plants shed their needles, and in spring they are covered with new needles. It is worth noting the rather rapid accumulation of trunk stock by larch stands in the forest conditions of the Horodnytsia region – an average of 2 t/ha (The project of the organisation..., 2019). O. Krynytska *et al.* (2021) and V. Pisarenko *et al.* (2020) pointed out that in young larches, the main cause of plant dieback is a lack of moisture and turf process, and therefore all efforts are aimed at preventing these causes in forest areas. The phytosanitary condition of larch cultures varies with age. According to V. Buzun *et al.* (2018), in Vinnytsia and Sumy regions, an intensive growth of larch is observed, while in Kharkiv region, larch has the best indicator in fresh class I rich areas (9 points) and in fresh poor areas and class II fairly poor areas (7 points).

In Europe, *L. decidua* and *L. kaempferi*, together with a hybrid between them (*L.*×*eurolepis*), are important forest trees. According to modern data from P. Kunttu *et al.* (2021), larch canker is a fungal disease that causes ulcers that disfigure branches and trunks. It is considered the most damaging pathology of larch in Europe,

especially at low altitudes and poorly drained areas (Bidolakh *et al*., 2021). Studies on European larch canker conducted in England, Wales, and Scotland suggest that larch canker is not caused by frost but is probably caused by a primary infection by *Trichoscyphella willkommii* (Hart.) Nannf (Zeidler *et al*., 2022).

According to R. Hartig, in France, European larch cancer has been confirmed to be caused by the pathogen *Lachnellula willkommii* (R. Hartig) Dennis, and with age, this tree species loses its uniform habit, and therefore it is planted less often (Kunttu *et al*., 2018). Japanese larch and hybrid larch are ahead of it in terms of value and resistance to canker. Hybrid larch would be planted more frequently if sufficient seeds were available. V. Hayova *et al*. (2020), M. Shevchenko *et al*. (2021) recorded that several decades ago, also in Italy, various lesions of the European larch crown by pathogenic fungi were observed. Other fungal diseases include the needle disease *Meria laricis*, which causes significant defoliation, the root rot *Heterobasidion annosum*, and the fungus *Phaeolus schweinitzi*. In July, the crowns of larch forests turned yellow due to *Meria laricis*. Low temperatures and heavy precipitation were probably favourable factors in this case. After the 2000s, severe damage was caused by *Mycosphaerella laricina*, a rarely studied pathogen whose effects are exacerbated by hot temperatures and humidity in summer. In addition, insect outbreaks, especially of *Zeiraphera diniana*, have led to slower tree development with economic losses of tree stands (Büntgen *et al*., 2020). Larch plants were resistant to windbreaks, but at the same time vulnerable to *Ips typographus* and other species of the Ips genus, such as *Ips cembrae*. K. Godvod *et al*. (2018) also associate the above bark beetles as carriers of pathogenic fungi. *Coleophora laricella* and *Zeiraphera diniana* can lead to significant defoliation.

The purpose of this study was to conduct ecological and pathological (pathoentomological) monitoring to establish the species composition and distribution of pathogens in larch stands and to identify factors of their weakening.

MATERIALS AND METHODS

The study was conducted during 2021-2023, carrying out forest pathological monitoring of stands in the Modryna tract of the Zvyagelske Forestry branch of the State Enterprise Forests of Ukraine (Fig. 1). Particular attention was paid to the tree stands in the autumn and spring, when pathogens and pests were actively developing. Desk review and identification of the material was carried out at the Department of Forestry, Forest Culrures, and Forest Inventory of Polissia National University and the Department of Forestry of the National University of Life and Environmental Sciences of Ukraine according to specialised methods (phytocoenology, forestry, mycology, ecology, forest inventory) (Lavrov *et al*., 2018; Methodology of forestry research (biogeocenological) research, 2023; The world of mushrooms, 2023).

Figure 1. *General view of the Modryna tract (block 28 of Nadsluchanske forestry)*
Source*: compiled by the authors of this study*

This study employed phytopathological, entomological, forest inventory, and comparative methods. The results were presented using tabular and graphical research methods and methods of comparison. During detailed pathoentomological surveys of the tree stands, species diversity was described, and infectious disease pathogens were registered and identified. The sanitary condition of the tree stands, and individual large specimens was determined according to the generally accepted scale of categories (Sanitary rules…, 2020) (Table 1).

The types of identified pests on old-growth plants and the consequences of their activities were investigated (Sanitary rules…, 2020). The degree of defoliation of crowns of forest woody plants by category is presented in Table 2.

Table 1. *Determination of the phytosanitary status of forest woody plants by category*

Class index, score	Condition of the woody plant
I	healthy
II	weakened
III	very weakened
IV	drying
V	fresh deadwood
VI	old deadwood

Source*: Sanitary rules in the forests of Ukraine (2020)*

Table 2. *Determination of the degree of defoliation of crowns of forest woody plants by categories*

Category, score	Condition of the crown of a woody plant
0	no signs
1	up to 10% needle shedding
2	11-50% needle shedding
3	51-75% needle shedding
4	over 75% needle shedding

Source: *Sanitary rules in the forests of Ukraine (2020)*

The study selected 20 centuries-old larch trees with typical signs of damage, namely, affected needles, pest flight holes, fruiting bodies of macromycetes on trunks, symptoms of exudate leakage, and webbed nests. The first category included 9 specimens, the second – 7 specimens, and the third – 4 specimens.

The condition of the crowns was determined using a DJI Phantom 4 unmanned aerial vehicle (made in the People's Republic of China), dividing them into dense, medium-density, and loose. Mycological samples were collected on centuries-old specimens of European larch according to the ontogenetic features of the found species. In specialised laboratories, samples were identified by microscopy using MBI-3 and MBS-9 instruments (PTP ASMA-Prybor LLC, Ukraine) (magnification from ×8 to ×100), temporary micropreparations, mycological identifiers, and electronic photo identifiers Mushroom Identify (Index Fungorum, 2023; The world of mushrooms of Ukraine, 2023). The current Latin names of fungal pathogens (macro- and microbiota) were presented following the nomenclature database (Index Fungorum, 2023). The prevalence of pathogens was determined by the proportion of trees with typical fruiting bodies in the total number of woody plants in the study areas.

RESULTS AND DISCUSSION

Forest pathological monitoring and forest pathological examination in the Modryna tract are carried out on an ongoing basis. The phytosanitary condition is maintained properly. However, during the study, the effects of storms and windfalls were recorded. The forest, as a natural landscape, consists mainly of tall woody plants, which can cause roughness (unevenness) of the Earth's surface and become an obstacle to the movement of air flows. Even though the European larch forms a deeply developed root system with a taproot and strong side roots, which ensures its high wind resistance, a negative impact of wind was noted on the research site. The most visually noticeable manifestations of the direct effect of wind on larch trees were the formation of lopsided crowns, trunk tilt (sometimes deformation), and uneven growth of trunks, which is most often observed in glades and forest edges, i.e., in open areas where strong winds of one direction act. Strong and dry winds can also lead to the drying out of the assimilation apparatus of woody plants, as the moisture coming from the root system does not compensate for the losses that occur through the crown.

Furthermore, windblow (trees falling out together with the root system) and wind slash (tree trunk breaking at a certain height) of European larch were recorded in the Modryna tract (Fig. 2). The danger of these phenomena depends heavily on the characteristics of the wind, season, age of the tree plant, its sanitary and physiological condition, type and factual condition of the soil surface, etc. Under the direct influence of air masses, woody plants can be severely swayed, which often leads to the rupture of individual roots and, as a result, the entire tree dries up. This is especially dangerous when the wind gusts match the amplitude of the woody plant's oscillation. Low-power winds can break individual branches and shoots, damage the assimilation apparatus and vegetative organs. Mechanical damage to a tree by wind can be significantly aggravated if it carries particles of sand or snow. The indirect impact of wind on woody plants can also be manifested through the blowing of soil from under the root system,

covering the tree with sand, and through the interaction of mechanical factors (and, as a result, damage to plants) of their shoots with the shoots of other plants. Notably, wind has a substantial impact on the formation of snow cover, which determines the structure of vegetation (mosaic vegetation) in the long term.

Figure 2. *Phenomena of windblow and wind slashes in the area under study*
Source: *compiled by the authors of this study*

During the detailed pathoentomological surveys of tree stands within the Modryna tract, pathologies of infectious origin were registered and identified, as well as the results of pest activity (Fig. 3), which exacerbate the overall phytosanitary condition at the studied sites.

Figure 3. *Results of pest complex activity on model woody plants of European larch*
Source: *compiled by the authors of this study*

They are dangerous for twenty-year-old trees (Fuchylo *et al.*, 2017). Overcrowding reaches no more than 2%. The prevalence of pathogens (Fig. 4, left) was determined by the proportion of trees with typical fruiting bodies in the total number of woody plants and is presented in the diagram. The distribution of pests on larch plants in the study area is presented in Figure 4 (right).

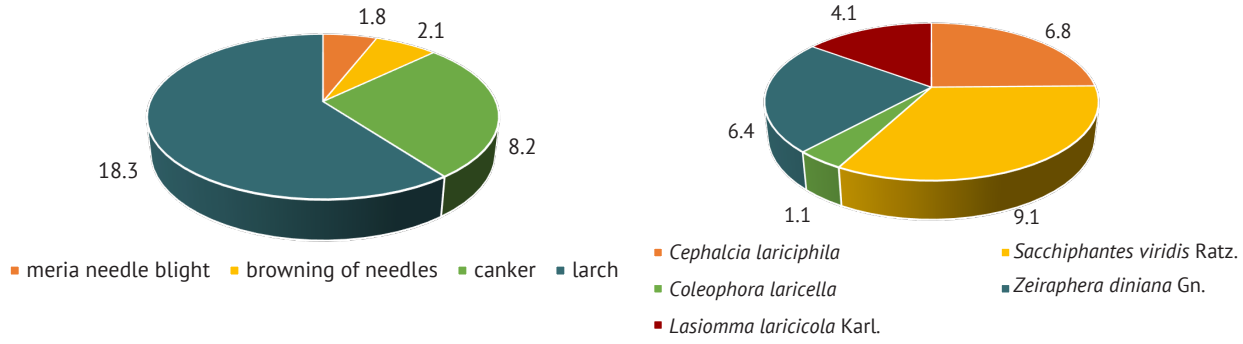

Figure 4. *The spread of infectious diseases (left) and pests (right) in the Modryna tract*
Source: *compiled by the authors of this study*

Larch needles clearly showed symptoms of larch needle cast (Fig. 5, left) and browning (Fig. 5, right), which lead to a change in the normal colour of the needles and rapid needle shedding.

Figure 5. *Symptomatic signs of infection of larch needles by pathogens Meria laricis (left) and Rhizosphaera kalkhoffii (right)*
Source: *compiled by the authors of this study*

Deformation of larch trunks was recorded, which is associated with the tree being affected at an early young age (3-20 years) by the pathogen of canker. At the site of the infection, a typical canker growth was observed, which was covered with oleoresin, which blackened during the oxidation process (Fig. 6 left). On some fallen shoots, directly under the crown of trees infected with canker, *Lachnellula willkommii* apothecia in the form of a white saucer were observed on a trunk, 4-6 mm in diameter. It was noted that the growth of the affected tree is significantly reduced. The prevalence is rare (less than 10.0%). It is worth noting the discovery of *Larchophomes officinalis* on a growing plant in the form of a basidioma (Fig. 6, right).

Figure 6. *Symptoms of damage by Lachnellula willkommii (left) and the fruiting body of Fomitopsis officinalis (right)*
Source: *compiled by the authors of this study*

Even though *F. officinalis* causes brown rot of wood on the trunk, it is listed in the Red Book of Ukraine with a rare status (Fuchylo *et al.*, 2017). The species diversity of infectious agents on the studied plants of European larch in the Modryna tract is presented in Table 3.

Table 3. *Species diversity of L. decidua pathogens in the Modryna tract*

English name of the pathology	Latin name of the pathogen (Index Fungorum)	Affected organ	Typical symptoms
Larch needle cast or meria needle blight	*Meria laricis*	Pine needles	The infected needles had sporadic dark brown spots that covered the entire surface. The infected needles were brown, curled, weakened, and shed prematurely
Browning of needles	*Rhizosphaera kalkhoffii*	Pine needles	Premature needle shedding caused by a change in the typical normal colour of the needles at the base of the shoots to a yellow-brown colour
Canker	*Lachnellula willkommii*	Shoots, trunk	The formation of brown depressed wounds, near which subsequently formed plaques, which, when destroyed, opened a cankerous wound. The infection site was covered with oleoresin, which later blackened
Agarikon (Laricifomes officinalis)	*Fomitopsis officinalis*	Trunk	The fruit bodies had a form of perennial caps with a whitish-yellow furrowed surface, which was gradually covered with cracks. The hymenophore of the basidioma is tubular

Source: *compiled by the authors of this study*

The pathologies recorded on the larch trees under study included larch needle cast, needle browning, canker, and agarikon. Pathogens affected needles, shoots, and trunks of trees with varying intensity. *M. laricis* and *L. willkommii* were the most damaging, causing visible signs of larch plants dieback. The effects of activities inherent in larch pests were also recorded (Table 4).

Table 4. *Types of identified pests on Larix decidua Mill. plants in the Modryna tract*

English name of the pest	Latin name of the pest	Damaged organ of a woody plant	Impact of activities
Web-spinning larch sawfly	*Cephalcia lariciphila* (Wachtl, 1898)	Pine needles	Eaten pine needles on shortened shoots
Fir and larch green adelgids	*Sacchiphantes viridis* Ratz.	Pine needles	Formation of a multi-chambered hive, which can contain up to 120 larvae at once
Western larch case-bearer	*Coleophora laricella* (Hübner)	Needles and shoots	Drying out of the ends of the needles, with pest forming a protective cover for its larvae
Larch tortrix	*Zeiraphera diniana* (Gn.)	Pine needles	Formation of webbed nests and pine needle eating
Larch fly	*Lasiomma laricicola* Karl.	Seeds and cones	The larvae developed in the cones, making winding passages and damaging the soft parts of the scales and seeds, often damaging the cone stem. The affected scales and seeds were brown, while cones completely dried out

Source: *compiled by the authors of this study*

The species of identified pests on *L. decidua* trees in the study area were represented by web-spinning larch sawfly, fir and larch green adelgid, western larch case-bearer, larch tortrix, and larch fly. The pests affected needles, shoots, seeds, and cones of trees with varying intensity. Thus, the larch needles within the study area are damaged by the following pests: web-spinning larch sawfly, fir and larch green adelgid, western larch case-bearer (Fig. 7, left) and tortrix (Fig. 7, right). However, significant damage and potential danger in forest pathology monitoring should be expected from the effects of the larch fly.


Figure 7. *The results of activity of Coleophora laricella (left) and webbed nest of Zeiraphera diniana (right)*
Source: *compiled by the authors of this study*

Specifically, all trees of the first category had a dense, healthy crown, no defoliation, and only a few pathogens. Of all the larch models, 9 were found to be such woody plants. Trees of the second category of phytosanitary condition (7 specimens) had a medium-density crown, defoliation degree of 1 point, and typical signs of damage by macromycetes and pests (Table 5).

Table 5. *Characteristics of the phytosanitary state of European larch trees*

Woody plant No.	Inventory characteristics		Phytosanitary category	Degree of defoliation, points	Crown density	Species composition of pathogens and pests
	Diameter, cm	Height, m				
1	64	33	I	0	dense	sporadic browning of needles
2	70	37	III	2	loose	larch tortrix, web-spinning larch sawfly
3	70	37	III	2	loose	needle browning, canker, web-spinning larch sawfly

Table 5. Continued

Woody plant No.	Inventory characteristics		Phytosanitary category	Degree of defoliation, points	Crown density	Species composition of pathogens and pests
	Diameter, cm	Height, m				
4	77	49	II	1	medium density	agarikon, larch adelgid
5	71	37	I	0	dense	sporadic browning of the needles
6	76	45	II	1	medium density	*Lasiomma laricicola* Karl.
7	68	35	II	1	medium density	agarikon, larch case-bearer
8	66	34	I	0	dense	–
9	63	32	I	0	dense	–
10	69	35	II	1	average density	
11	64	33	II	1	average density	canker, larch adelgid
12	78	49	II	1	average density	larch tortrix
13	64	34	II	1	average density	
14	68	35	I	0	dense	–
15	78	49	III	2	loose	canker, agarikon, larch tortrix
16	75	40	I	0	dense	sporadic browning of the needles
17	57	28	I	0	dense	sporadic signs of larch needle cast
18	59	29	I	0	dense	–
19	64	34	I	0	dense	sporadic browning of the needles
20	72	38	III	2	loose	agarikon, canker, larch case-bearer

Source: *compiled by the authors of this study*

A significant species composition of infectious agents was found on larch trees of the third phytosanitary category (4 specimens). All trees in this category have a loose crown, needles, pest holes, fungal fruiting bodies, webbed nests. Thus, it was found that the main threat to larch trees is the complex effect of anthropogenic, abiotic, and biotic (including parasitic) environmental factors that constantly and to varying degrees affect the sanitary and physiological state of larch trees.

Phytosanitary monitoring of the current state of forests is a key source of information on their condition and potential predictors of impact. The monitoring results allow forecasting the sanitary situation in the future in the studied forest stands and developing the best and effective measures to limit the spread of dominant pest and pathogen species. Based on the findings of the study on the actual phytosanitary status of *L. decidua* woody plants, it is possible to develop the best forest management strategies and identify the necessary measures to support ecosystem stability.

S. Ward and B. Aukema (2019) investigated the biology of the invasive defoliator *Coleophora laricella*, data on the degree of defoliation, as well as the impact of meteorological conditions on pests of the *Larix* genus, namely *Larix laricina* (Du Roi) K. Koch. and *Larix occidentalis* Nutt. This species is also registered by the authors of the study on *L. decidua*. U. Büntgen *et al*. (2020) noted climate change as a possible driving factor in disrupting 8-9 outbreak cycles of *Zeiraphera diniana*. The study conducted do not allow refuting or confirming these conclusions, as it was aimed solely at identifying the factors of weakening of the European larch in the Modryna tract. J. Holuša & K. Drapela (2023) and J. Embacher *et al*. (2023) propose to predict defoliation of *Larix decidua* trees caused by sawflies (Hymenoptera: Symphyta), namely *Cephalcia lariciphila* and *Tomostethus nigritus*, based on the relationship between population density using logistic regression. The authors of the current study did not conduct such research.

Authors from different continents, A. Harris *et al*. (2021), H. Dun *et al*. (2022; 2023), found that the main cause of the phenomenon of "rapid larch death" is the invasive oomycete *Phytophthora ramorum*. This phytopathogenic species has not been registered by the authors within the study area. E. Kügler (2020) conducted screening assays to assess the resistance of *L. decidua* to *Lachnellula willkommii*. However, in contrast to the studies conducted, Kügler does not provide a detailed description of the typical symptoms of this disease, which would be advisable when selecting experimental trees

in the field. C. Robin *et al.* (2023) established the influence of *Larix decidua* genetic origin on susceptibility to the pathogen of canker and found that specimens of trees of Central European origin are the most resistant. Further research of the state of the unique trees growing in the Modryna tract by the authors of the present study also involves the formation of a "map of resistant trees" that are immune to pathogens and pests.

CONCLUSIONS

The Modryna tract is a unique nature reserve area where European larch trees grown in the climatic conditions of Zhytomyr Polissia are protected. The phytosanitary condition of the tree stands is maintained properly, however, during the study, the effects of wind slashes and windblows and the pathogenic complex of infectious agents were recorded.

Based on the authors' long-term research on woody plants of *L. decidua* in the Modryna tract, typical symptomatic signs of infection, as well as the consequences of pest activity that weaken the overall sanitary condition of the studied objects, were identified and described. Larch needles clearly show the typical symptoms of larch needle cast (meria needle blight) (causative agent – *Meria laricis* Vuill 1896) and browning (causative agent – *Rhizosphaera kalkhoffii* Bubák 1914); on the trunks – the consequences of the pathogenesis of canker (pathogen – *Lachnellula willkommii* (Hartig) Dennis, 1962) and fruiting bodies of *Fomitopsis officinalis* (Batsch Bondartsev & Singer, 1941). Apart from pathologies of infectious aetiology, negative effects of wind exposure were recorded in the study areas. The most visually noticeable manifestations of the direct effect of wind on *Larix decidua* woody plants are the formation of flag-shaped crowns, trunk tilt and deformation, and trunk eccentricity. There are sporadic larch trees affected by wind slash and windblow. The species composition of pests of European larch trees is limited to the following: web-spinning larch sawfly (*Cephalcia lariciphila* (Wachtl, 1898), fir and larch green aldegids (Sacchiphantes viridis Ratz.), western larch case-bearer (*Coleophora laricella* (Hübner)), larch tortrix (*Zeiraphera diniana* (Gn.)), larch fly (*Lasiomma laricicola* Karl.).

A detailed examination of 20 model European larch trees was carried out and the phytosanitary category of each plant was established. Specifically, all trees of the first category had a dense, healthy crown, no defoliation, and only a few pathogens. Of all the larch models, 9 were found to be such woody plants. Trees of the second category of phytosanitary condition (7 specimens) had a medium-density crown, defoliation degree of 1 point, and typical signs of damage by macromycetes and pests. A significant species composition of infectious agents was found on larch trees of the third phytosanitary category (4 specimens). All trees in this category have a loose crown, needles, pest holes, fungal fruiting bodies, webbed nests.

Thus, the visual inspection of larch trees growing within the Modryna tract makes it possible to register general violations of morphological characteristics and physiological state of the surveyed trees under the influence of the combined action of the above-mentioned factors, which is confirmed by the average indicators of the phytosanitary category and the degree of defoliation. Undoubtedly promising is a future systematic approach regarding the development of an algorithm for assessing and monitoring the condition of the unique *Larix decidua* trees growing in the Modryna tract with the establishment (identification) of the root causes of weakening and the main "aggressors of deterioration", which will create an exceptional "map of resistant larch trees" and use the obtained seed material for the formation of new immune larch stands.

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CONFLICT OF INTEREST

The authors of this study declare no conflict of interest.

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Моніторинг фітосанітарного стану рослин *Larix decidua* Mill. в урочищі «Модрина» філії «Звягельське лісове господарство» Державного підприємства «Ліси України»

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Анотація. Фітосанітарний моніторинг лісових насаджень наразі є актуальним і важливим напрямком наукових досліджень, який забезпечує спостереження, оцінювання і прогнозування динаміки (змін) кількісного і якісного (у т.ч. санітарного) стану лісів, а також виступає основою для розробки ефективної системи захисту деревостанів. Метою дослідження була ідентифікація видового складу і поширення домінантних видів фітопатогенів на території Урочища «Модрина» філії «Звягельське лісове господарство» та виокремлення первинних чинників ослаблення *Larix decidua* Mill. Під час проведення досліджень застосовано фітопатологічні, ентомологічні, лісівничо-таксаційні, порівняльні методи. Було зафіксовано та ідентифіковано типові симптоми ураження, а також наслідки шкодочинного впливу шкідників дерев *L. decidua* в урочищі «Модрина», що ведуть до загального ослаблення їхнього санітарного стану. На хвої зафіксовано симптоми інфікування шютте (меріозу) і побуріння; на стовбурах – типові прояви ступінчастого раку та плодові тіла унікального базидіоміцети – модринофомесу лікарського. Окрім інфекційних патологій, на досліджуваних ділянках зафіксовано поодикові вітровальні та буреломні дерева модрини, а також інші негативні прояви впливу вітру. Видовий склад шкідників обстежуваних дерев модрини включає наступні види комах: павутинний модриновий пильщик, ялицево-модриновий зелений хермес, модринова міль чохликова, модринова листовійка, муха модринова. Узагальнено, що головною загрозою для великовікових дерев модрини є комплексна дія антропічних, абіотичних та біотичних (у т.ч. паразитарних) чинників навколишнього середовища, що постійно та в різній ступені впливають на санітарний та фізіологічний стан великовікових модринових дерев. Результати досліджень надають інформацію для прогнозування ризиків поширення збудників хвороб та шкідників, що дозволяє управляти цими ризиками та запобігати їхньому подальшому розповсюдженню

Ключові слова: великовікові рослини; видовий склад; патоентомологічні обстеження; симптоматика; резистентність