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Sanitary condition of pine plantations of the Polissia of Zhytomyr region**Romanchuk L.** **Didenko P.** *Polis National University*✉ wood112@ukr.net

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The sanitary condition of pine plantations in the conditions of Polissia of Ukraine was assessed. *Derevostan* grows in different types of forest vegetation conditions B2GDS, B3GDS, C2GDS, C3GDS. According to the data of 27 circular trial plots, which were established during 2018–2020 in the territory of the State Enterprise Zhytomyr LH Berezivske Forestry, the State Enterprise Korostyshivsk LH Ivnitske Forestry, the State Enterprise Korostensky LH APC Melenivske Forestry, which covered the typical growing conditions of pine plantations of Zhytomyr Oblast. The index of sanitary condition showed that the pine forest belonged to strongly weakened stands. Analyzing the sanitary condition during the research period, it is worth noting that in 2018, the tree stand of the plantations in the Ivnytsia Forestry was weakened, and the average index was 2.42. In Berezivsk and Melenivsk forests, the sanitary condition index was 2.58 and 2.67, which indicates that the degree of damage is average, and the plantations are strongly weakened.

Based on the results of the research, it was established that in 2019 the sanitary condition in the Bereziv forestry improved and amounted to 2.12. By state category, the largest number of I category is 2019 – 40.0 %, 2019 II – 27.6 %. In the Ivnytsia forestry, the sanitary condition index was 2.52, the plantations were greatly weakened. In the Meleniv Forestry, the average sanitary condition index of 2.44 indicates that the tree stand is weakened.

It is proven that in 2020 the sanitary condition improved compared to other years of research and amounted to 2.11. In Ivnytsia Forestry, the sanitary condition remains very weak. In the Meleniv Forestry, the average sanitary condition index was 2.29, which indicates that the tree stand is weakened.

It has been established that pests, diseases and forest fires are the biggest deterioration of the sanitary condition in the territory of Zhytomyr Oblast. To prevent the development of these negative factors, it is necessary to create mixed pine plantations, to carry out timely felling of forest care.

Key words: condition categories, sanitary condition index, type of forest vegetation conditions, completeness, Scots pine.

Problem statement and analysis of recent research. On the territory of Zhytomyr Oblast, outbreaks of pest reproduction in pine stands have been observed in recent years. Only in the forests of the State Forestry Agency, 200,000 hectares of pine plantations have already been covered by the foci of bark beetles and related diseases[1]. The acuteness of this problem is indicated by the large areas covered by continuous sanitary felling to prevent the spread of complex foci of stem pests [2–4].

In their works, such scientists as V.L. Meshkova, M.M. Padii, M.N. Rimsky-Korsakov, P.A. Haychenya, E.H. Mozolevskaya. However,

the research of these scientists was primarily aimed at a comprehensive study of the features of the development and reproduction of conifer pests, and at the same time, modern ecological and climatic features that exerted their characteristic influence on them were not taken into account [5–9].

As a result of the climate change from temperate continental to continental, there is an increase in air temperature and drought in the summer, which causes a decrease in the level of groundwater and a change in the hydrologic regime of the soil (pine has a superficial root system). The lack of water in the tissues of

trees leads to the simultaneous attack of several types of pests (apical bark beetle, small pine borer, etc.) along the entire vertical profile of the trunk and skeletal branches of the crown. Strong winds also cause a lot of damage, as they shake the trees, which in turn leads to undermining of the roots and their weakening. A high temperature regime causes a sharp increase in the transpiration of trees. Pine plantations weakened by high temperatures and other factors are subject to destructive effects and become a good fodder base for pests [10–11].

The aim of the research – to determine the index of the sanitary condition of pine plantations and the influence of various biotic and abiotic factors on the territory of Zhytomyr Region.

Material and methods of research. The research was carried out during 2018–2020 on sod-podzolic soils of the Zhytomyr region. The object is pure and mixed pine forests in the territory of Polissia of Zhytomyr Oblast.

The territory of the experimental site is characterized by a flat topography. The soil is medium-podzolic sod, characterized by a sandy mechanical composition, good water permeability and aeration, which contributes to the relatively rapid decomposition of organic substances and significant leaching of mineral

nutrition elements from the upper horizons to the lower ones. When performing the work, both general scientific and special research methods were used. To assess the sanitary condition of pine plantations, trial plots were laid in moist screeds (C3GDS), fresh screeds (C2GDS), Zhytomyrskyi LG Berezivske Forestry, fresh pine (B2GDS) and fresh cinders (C2GDS) Korostyshivskyi LG Ivnytske Forestry SE, Korostenskyi LG APC Melenivske forestry in wet sub-forests (B2HDS), fresh sub-forests (B3HDS). Test plots were established according to generally accepted methods in forestry and ecology. The research was based on the classical method of comparative forest ecology with its detailing by individual ecological and forestry areas. On the test areas, a complete reaccounting of trees was carried out, and the tax indicators of the plantations were determined. Assessment of the quality of plantations was carried out using the scale of M.M. Orlov.

According to the methodology of the Ukrainian Research Institute of Forestry and Agroforestry named after H.M. Vysotsky, the sanitary condition of each tree was determined on a 6-point scale, followed by the calculation of the average index of the sanitary condition of the plantation, which was calculated according to the formula.

$$I = \frac{(i_1 * n_1) + (i_2 * n_2) + (i_3 * n_3) + (i_4 * n_4) + (i_5 * n_5) + (i_6 * n_6)}{N}$$

I – stand index;

$i_1 - i_6$ – tree condition categories (from I to VI);

n_i – is the number of trees of one state category;

N – total number of assessed trees on the trial area, individuals.

The indices of the condition of plantations are characterized by: 1.0–1.50 – healthy; 1.51–2.50 – weakened; 2.51–3.50 – very weakened; 3.51–4.50 – drying; 4.51–6.00 – dry, [12–21].

The research was conducted during 2018–2020 on sod-podzolic soils in the Zhytomyr region. Prospects for further research will be aimed at improving tree stands.

Research results and discussion. The research results showed that the decrease in the viability of pine plantations in the years 2018–2020 is largely characterized by the distribution of trees by categories of sanitary condition (Table 1).

Table 1 – Sanitary condition of pine plantations in the Bereziv Forestry of the State Enterprise of Zhytomyr LGA

Year	№PP	The number of trees by state category: numerator, units, denominator, %						The total number of trees in the trial plots, piece	Iss
		I	II	III	IV	V	VI		
2018	PP1K	190	50	11	9	0	0	260	1,38
		73,1	19,2	4,2	3,5	0	0	100	
	PP2	35	59	109	83	24	10	320	3,09
		10,9	18,4	34,1	25,9	7,5	3,1	100	

Continuation of Table 1

	PP3	23	51	97	65	26	16	278	3,27
		8,3	18,3	34,9	23,4	9,4	5,8	100	
2019	PP4K	205	83	10	0	0	1	299	1,37
		68,6	27,8	12	0	0	0,3	100	
	PP5	77	105	63	29	5	2	281	2,21
		27,4	37,4	22,4	10,3	1,8	0,7	100	
	PP6	69	54	93	46	27	9	298	2,78
		23,2	18,1	31,2	15,4	9,1	3	100	
2020	PP7K	182	76	14	9	0	0	281	1,48
		64,8	27	5	3,2	0	0	100	
	PP8	92	71	71	34	16	2	286	2,36
		32,2	24,8	24,8	11,9	11,9	5,6	100	
	PP9	84	68	54	50	18	4	278	2,49
		30,2	24,5	19,4	18	6,5	6,5	100	

The distribution by categories in a healthy plantation of PP1K is as follows: I – 73.1 %, II – 19.2 %, the rest of the categories occupied a small share, namely III – 4.2 %, IV – 3.5 %. In other test plots PP2 and PP3, the sanitary condition index was equal to 3.09 and 3.27. The cause of this condition is the apical bark beetle, which significantly weakens the plantation. According to the state categories in PP2, the largest share falls on III – 34.1 %, IV – 25.9 %, there is also a small share of V – 7.5 %, and VI – 3.1 %. It is worth noting that PP3 is characterized by status categories as follows: III – 34.9 %, IV – 23.4 %, V – 9.4 %, which in turn shows that the trees are strongly affected and have undergone drying. Plantation PP4K has a good health status score of 1.37, while PP5 is 2.21 and PP6 is 2.28 due to the fact that these plantations were affected by the crown bark beetle and windbreak. On PP4K, the most in terms of condition categories I – 68.6 %, II – 27.8 %, III – 12.0 %, this indicates that the plantation is healthy and does not need impro-

vement measures. On PP5, according to status categories II – 37.4 %, III – 22.4 %, the reason for this distribution is the apical bark beetle. In PP6, the distribution of trees II – 18.2 %, and III – 31.2 %, IV – 15.4 %.

Sanitary condition indices for PP7K – 1.48, which indicates a healthy plantation, PP8 – 2.36, PP9 – 2.49, weakened plantation. The reasons that weakened PP8 and PP9 is the apical bark beetle.

The best indicators by state categories are on PP7K, namely I – 64.8 %, II – 27.0 %, III – 5.0 %, IV – 3.2 %. It is worth noting that on PP8 and PP9 there are damage to the tree by apical bark beetle.

During 2018–2020, the sanitary condition of the pine plantations in the DP Korostyshivsk LG was unsatisfactory, the cause of this condition being pests – the crown bark beetle, which causes the death of pine stands.

During 2018–2020, test plots were laid in pine plantations in Ivnytskyi Forestry (Table. 2).

Table 2 – Sanitary condition of pine plantations in the of Ivnytskyi Forestry of SE Korostyshivskiy LG

Year	№PP	The number of trees by state category: numerator, units, denominator, %						The total number of trees in the trial plots, piece	Iss
		I	II	III	IV	V	VI		
2018	PP10K	198	84	10	7	2	0	301	1,44
		65,8	27,9	3,3	2,3	0,7	0	100	
	PP11	48	78	85	65	20	8	304	2,84
		15,8	25,7	28	21,4	6,6	2,6	100	
	PP12	45	58	83	72	17	11	286	2,98
		15,7	20,3	29	25,2	5,9	3,8	100	
2019	PP13K	223	88	12	3	1	0	327	1,38
		68,2	26,9	13,6	0,9	0,3	0	100	

Continuation of Table 2

	PP14	30	41	113	75	19	13	291	3,14
		10,3	14,1	38,8	25,8	6,5	4,5	100	
	PP15	42	71	80	77	23	16	309	3,05
		13,6	23	25,9	24,9	7,4	5,2	100	
2020	PP16K	193	71	8	5	3	0	280	1,44
		68,9	25,4	2,9	1,8	1,1	0	100	
	PP17	45	67	63	70	32	19	296	3,14
		15,2	22,6	21,3	23,6	23,6	10,8	100	
	PP18	18	57	84	94	35	10	298	3,34
		6	19,1	28,2	31,5	11,7	11,7	100	

In PP10K, the sanitary condition index is 1.44, which indicates a healthy plantation. In PP11 and PP12, the sanitary condition index is 2.84 and 2.98, respectively, which in turn indicates a very weakened plantation.

According to the status categories, in PP10K the largest number of trees is in I – 65.8 % and II – 27.9 %, this indicates that the plantation is healthy and has no signs of weakening. In PP11, a large proportion of trees have drying and signs of weakening II – 25.7 %, III – 28.0 %, IV – 21.4 % the cause is apical bark beetle. PP12 is a mixed plantation with a share of common oak and hanging birch, this in turn, how to remove drying and weakening pine trees will contribute to the improvement of the plantation. PP12 has a sanitary condition index of 2.98, which belongs to the category of very weakened plantation. The pine plantation is characterized as follows by categories of trees II – 20.3 %, III – 29.0 %, IV – 25.2 %, this shows that a large number of trees have signs of weakening and need to be removed from the plantation. The reason for the weakening of the tree stand on PP12 is the presence of apical bark beetle. The sanitary condition index in the control plot is 1.38, which indicates that it is a healthy plantation.

In the following test areas PP14 and PP15, the sanitary condition indices indicate that the plantation is very weakened. According to the

status categories, PP4K I – 68.2 %, II – 26.9 %, while in PP14 the most trees are in III – 38.8 % and IV – 25.8 %, this in turn is characterized by the fact that the plantation needs sanitary and health measures to remove and plant diseased trees. In PP6, which belongs to the arriving category of Scots pine trees, the categories were distributed as follows: II – 23.0 %, III – 25.9 %, IV – 24.9 %. The reason that had an impact on the pine plantation is the apical bark beetle, which in turn weakened and led to the drying of the tree stand.

In 2020, test plots were laid for PP16K, PP17, PP18 in the Ivnytsia Forestry of the Korostyshiv Forest Farm. The index of sanitary condition in the control trial plots of PP16K was 1.44, which indicates that the plantation is healthy. According to the status categories I – 68.9 % and II – 25.4 %, which shows a tree stand without signs of damage. In PP17, the state categories were distributed as follows: I – 22.6 %, III – 21.3 %, IV – 23.6 %, V – 23.6 %.

It is worth noting that PP18 has a sanitary condition index of 3.34, which shows that the stand is very weakened and requires sanitary selective felling. The reason that led to the weakening is the apical bark beetle, which had favorable conditions for its development.

During 2018–2020, test areas were laid in pine plantations in the Meleniv Forestry (Table 3).

Table 3 – The sanitary condition of pine plantations in the Meleniv Forestry of the State Enterprise Korostenskyi LG APC

Year	№PP	The number of trees by state category: numerator, units, denominator, %						The total number of trees in the trial plots, piece	Iss
		I	II	III	IV	V	VI		
2018	PP19K	163	105	8	4	1	0	281	1,49
	PP20	58	37,4	2,8	1,4	0,4	0	100	3,2
		28	62	125	88	37	8	348	
		8	17,8	35,9	25,3	10,6	2,3	100	

Continuation of Table 3

	PP21	20	45	107	73	26	16	287	3,32
		7	15,7	37,3	25,4	9,1	5,6	100	
2019	PP22K	190	95	10	6	2	2	305	1,5
		62,3	31,1	10,5	2	0,7	0,7	100	
	PP23	61	96	97	48	19	3	324	2,62
		18,8	29,6	29,9	14,8	5,9	0,9	100	
	PP24	29	78	117	95	38	12	369	3,19
		7,9	21,1	31,7	25,7	10,3	3,3	100	
2020	PP25K	190	86	10	4	3	2	295	1,47
		64,4	29,2	3,4	1,4	1	0,7	100	
	PP26	58	109	96	53	20	6	342	2,67
		17	31,9	28,1	15,5	15,5	5,8	100	
	PP27	48	109	97	54	22	6	336	2,74
		14,3	32,4	28,9	16,1	6,5	6,5	100	

Thus, it can be seen from table No. 3 that the sanitary condition index of 1.49 on PP19K shows that the plantation is healthy. Number of d Table No. 3 shows that the sanitary condition index of 1.49 on PP19K shows that the plantation is healthy. The number of trees corresponding to the I and II status categories is 58.0 % and 37.4 %, respectively. On PP20 and PP21, the health status index is 3.2 and 3.32, which indicates that the tree stand is severely weakened. PP20 is characterized by the fact that 35.9 % and 25.3 % of the trees are in the III state category, respectively, while the I and II state categories account for 7 % and 15.4 %, respectively.

Unsatisfactory indicator of the condition category is on PP21 in the plantation, compared with PP19K, V and VI, 9.1 % and 5.6 %, respectively, while on PP19K it is 0.4 %. This negative trend is caused by two factors: the first is the root sponge, which had a negative impact on the tree stand, and the second is the apical bark beetle. The impact of pests and diseases negatively affected the condition and productivity of the tree stand.

Test plots PP23 and PP24, which were surveyed and planted in 2019, are characterized by a strongly weakened sanitary condition index compared to control PP22K. Plantation PP23 is clean because the composition is 10C3, the index of planting is 2.62 – a strongly weakened tree stand. the largest number of common pine trees II – 29.6 %, III – 29.9 %, IV – 14.8 % state categories, while PP4K I – 62.3 %, which makes up the main part of the forest, this in turn indicates that most of the

tree stand has no signs of damage, has good growth, normal size.

PP24 has a health index of 3.19, indicating that it is a severely weakened stand. Most trees are characterized by mechanical damage, needles of yellow-green color, and the presence of dry branches. The distribution by status categories is such that the most are III and IV categories, namely 35.9 % and 24.6 %. It is worth noting that there is also V class equal to 10.2 %, while on PP4K 0.6 %. The cause of severe weakening is trunk pests, the apical bark beetle, which damages the tree stand.

On PP26 and PP27, which were surveyed in 2020, the plantations are strongly weakened. On the control test plots of PP25K, the stand is healthy with a sanitary condition index of 1.47. Analyzing the ratio of percentages by categories of trees on PP26, PP27 in comparison with PP25K, it can be noted that the presence of V and VI is 15.5 % – 5.8 %, while on PP25K it is 1.1 % – 0.7 %. The basis of the number of trees and percentage on PP25K is 66.9 %, while PP26 and PP27 II-III category is 31.9–28.1 %. The reason for this ratio is the presence of a fire on PP26, which had a negative impact on the pine plantation. On PP27, the factor of weakening and deterioration of the sanitary condition is pests that pose a threat to pine plantations.

Conclusions. In the period of 2018–2020, 27 test plots were laid on the territory of forestry.

It was established that on the trial plots, the abiotic factors, the apical bark beetle that weakens the tree stand, the sanitary condition index are within the norm and the plantations do

not require sanitary improvement measures. On those test areas where there are diseases of the root fungus, the apical bark beetle, and the influence of climatic factors, the index of sanitary condition is outside the normal range. The plantations need summit and rehabilitation measures, for the removal of trees and the rehabilitation of the plantation.

The study of the sanitary condition in the trial areas showed that most of the stands, 55.5 %, have slight damage, 45.5 % – plantations, 45.5 %

have an average degree of damage, the causes are apical bark beetle and root fungus, which, under the influence of climatic factors, have a significant negative impact on plantations. The average sanitary condition index for 2018 is 2.58 in Berezivskiyi, 2.42 in Melenivskiyi, and 2.67 in Ivnytskyi. In 2019, Berezivske has the best state of pine plantations – 2.12, the worst – Ivnitky Forestry has an indicator of 2.52, Melenivske has an average indicator of 2.44.

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Санітарний стан соснових насаджень Полісся Житомирщини

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Оцінено санітарний стан соснових насаджень в умовах Полісся України. Деревостан росте у різних типах лісорослинних умов В2ГДС, В3ГДС, С2ГДС, С3ГДС. За даними 27 кругових пробних площ, які були закладені протягом 2018–2020 років на території ДП Житомирський ЛГ Березівське лісництво, ДП Коростишівський ЛГ Івницьке лісництво, ДП Коростеньський ЛГ АПК Меленівське лісництво, які охопили типові умови вирощування соснових насаджень Житомирщини. Індекс санітарного стану показав, що сосновий деревостан належав до сильно ослаблених насаджень. Аналізуючи санітарний стан в період досліджень варто зазначити, що у 2018 році в Івницькому лісництві деревостан ослаблений, а середній індекс становив 2,42. У Березівському та Меленівському лісництвах індекс санітарного стану становив 2,58 та 2,67 – це вказує, що ступінь пошкодження середній, а насадження сильно ослаблені.

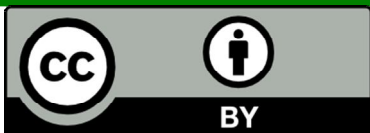
За результатами досліджень встановлено, що у 2019 році санітарний стан у Березівському лісництві

покращився і становив 2,12. За категоріями стану найбільше I категорії – у 2019 становило 40,0 %, 2019 II – 27,6 %. У Івницькому лісництві індекс санітарного стану становив 2,52, насадження були сильно ослаблені. У Меленівському лісництві середній індекс санітарного стану 2,44 вказує на те, що деревостан ослаблений.

Доведено, що у 2020 році санітарний стан покращився у порівнянні з іншими роками досліджень і становив 2,11. У Івницькому лісництві санітарний стан залишається сильно ослабленим. У Меленівському лісництві середній індекс санітарного стану становив 2,29, це вказує на те, що деревостан ослаблений.

Встановлено, що найбільше пошкоджують санітарний стан насаджень на території Житомирщини шкідники, хвороби та лісові пожежі. Для запобігання розвитку цих негативних чинників потрібно створювати мішані соснові насадження, проводити вчасно рубки догляду за лісом.

Ключові слова: категорії стану, індекс санітарного стану, тип лісорослинних умов, повнота, сосна звичайна.



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