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**SILVER BIRCH (*BETULA PENDULA* ROTH) IN THE FORESTS OF THE LEFT-BANK FOREST STEPPE OF UKRAINE**

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The area of birch stands in the forest resources of forest enterprises, which are entirely located in the Left-bank Forest Steppe, amounts from 86.1 hectares (the State Enterprise "Chuguevo-Babchanske Forestry") to 554.3 hectares (the State Enterprise "Gadyatske Forestry"). Birch stands area and its part in the forest area of analyzed enterprises decrease with longitude.

In analyzed Forest Enterprises of the Left-bank Forest Steppe, the mean age of birch stands varies from 31 to 50 years old; mean site class (bonitet) is 1A. Mean density of stocking and stock of birch stands tend to decrease from North to South.

Birch stands in the forest area of analyzed enterprises are represented in 32 forest types, mainly in the fresh and moist relatively poor conditions (subor), fresh and moist relatively fertile (sugrud) and fresh fertile (grud) site conditions. Obtained data must be used during investigations of sanitary condition of silver birch and the causes of its worsening.

**Key words:** silver birch (*Betula pendula* Roth), forest area, forest inventory parameters, types of forest site conditions.

**Introduction.** In the total forest area of the State Agency of Forest Resources of Ukraine, the area of silver birch (*Betula pendula* Roth) stands amounts to 5.7 % of forest covered area [2, 3]. Herewith in the Forest zone (Polissya), birch stands grow in the 10.8 % of the forested area [5], and in the Forest-Steppe zone birch stands area does not exceed 2 % of the total forested area [3]. In the Left-bank Forest Steppe silver birch often participates in protective stands, forest shelter belts, in the greening of cities, but rather rare in forest stands [1]. It may be connected with lower productivity and value of birch compared with pine and oak. It is known, that birch participation of over 30 % in forest stand composition adversely affects the growth of pine, because the birch grows more intensively and damages the pine by its branches [1].

However, the high ecological meaning of silver birch was proved, including its role in increase of resistance of mixed plantations to pests and diseases, particularly, to pine bark bug (*Aradus cinnamomeus* Panzer, 1806: Hemiptera, Aradidae) [7], root rot, fire damage etc. [1]. The rate of destruction of fallen foliage and twigs and enriching the upper horizons of soil by nutrients is higher in the birch and pine plantations than in pure pine stands [8]. Recently sanitary condition of silver birch has been worsened in many regions [4]. To recover the causes of this phenomenon it is necessary to recognize, which forest site conditions and stands are typical for this tree species, and then to carry out detailed research in the permanent sample plots.

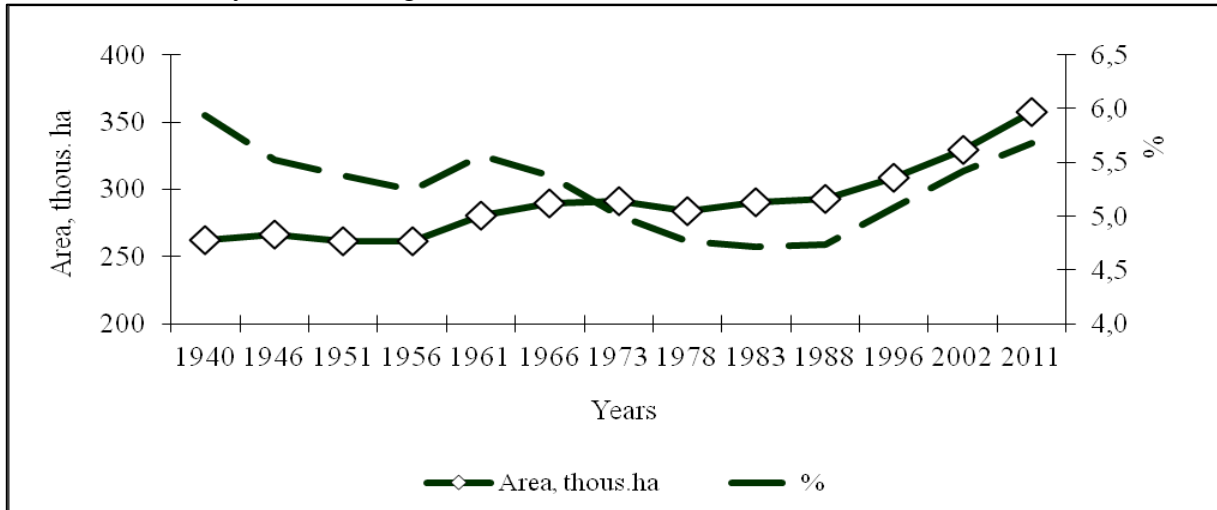
*The aim of this work* was to recognize the peculiarities of spread for silver birch in the stands of the Left-bank Forest Steppe by forest inventory data for State forest enterprises.

**Materials and methods.** Forest inventory data for State enterprises of the State Agency of Forest Resources of Ukraine (by 1.01.2012) were analyzed for Chernigiv, Kyiv, Sumy, Poltava and Kharkiv regions. Database of Production Association "Ukrderzhlisproekt" was analyzed for the State Forest Enterprises which are located in the Left-bank Forest Steppe. Sumy region was represented by two State Enterprises (SE): "Okhtyrskе Forestry" and "Trostyanetske Forestry". Poltava region was also represented by two State Enterprises: "Gadyatske Forestry" and "Poltavske Forestry". Kharkiv region was also represented by six State Enterprises: "Vovchanske Forestry", "Gutyanske Forestry", "Zmiivske Forestry", "Chuguevo-Babchanske Forestry", "Skrypaivske Training & Experimental Forestry" of Kharkiv National Agrarian University named after V. V. Dokuchaev ("Skrypaivske TE Forestry"), and Kharkiv Forest Research Station of Ukrainian Research Institute of Forestry and Forest Melioration named after G.M. Vysotsky ("Kharkiv FRS").

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The data were analyzed using MS Excel. Coordinates for forests of each forest enterprise were evaluated as centroids of respective contours of the territory using MapInfo Mapping Package.

**Results.** The area of birch stands in the total forest area of Ukraine has increased from 262.1 thous. ha in 1940 to 289.8 thous. ha in 1966 (by 10.6 %), and for 1996–2011 from 308.8 thous. ha to 357.1 thous. ha (by 15.6 %) (Fig. 1).

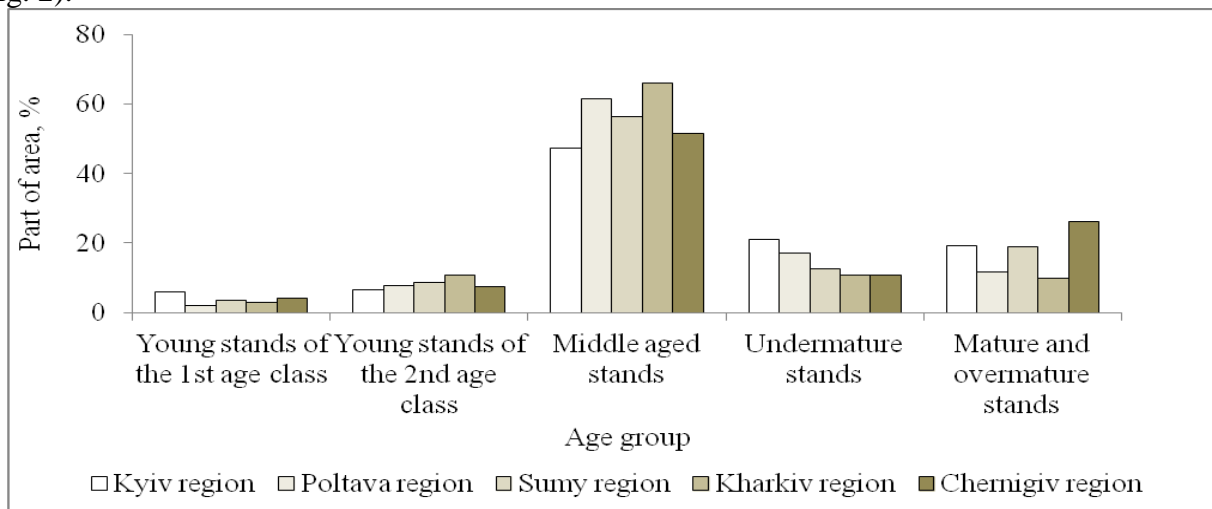


**Fig. 1 – Dynamics of birch stands area and their share in the area of forest covered lands in the total forest area of the State Agency of Forest Resources of Ukraine**

However, the share of birch stands area in the total forest covered area was 5.9 % in 1940, and declined steadily to 4.7 % in 1983. Only in 1996 it has increased to 5.1 %, and in 2011 to 5.7 % (see Fig. 1).

Among administrative regions, which are partly located in the Left-bank Forest Steppe and partly in Polissya, birch stands occupy 36.8 thous. ha in Chernigiv region, 23.2 thous. ha in Kyiv region, and 14.1 thous. ha in Sumy region. In Poltava region, which is located mainly in the Left-bank Forest Steppe, birch stands occupy 3.7 thous. ha, and in Kharkiv region, which is located partly in the Left-bank Forest Steppe and partly in the Steppe zone, they occupy 2.7 thous. ha.

However distribution of birch stands area of these regions by age is rather similar: middle aged stands dominate. Their share is the greatest in Kharkiv and Poltava regions (66 i 61.4 %), the lowest (47.4 %) in Kyiv region, and in Sumy and Chernigiv regions it is 56.5 and 51.6 %, respectively (Fig. 2).



**Fig. 2 Distribution of birch stands area by age groups in different administrative regions of Ukraine**

Young stands of the 1<sup>st</sup> age class occupy from 1.9 % of forested area in Poltava region to 5.9 % in Kyiv region, and mature and overmature stands occupy from 9.7 % in Kharkiv region to 26.3 % in Chernigiv region (see Fig. 2).

Mean age of birch stands is the lowest in Poltava and Kharkiv regions (41 and 42 years old, respectively), is 44 years old in Sumy and Kyiv regions and 46 years old in Chernigiv region.

Mean stock of birch stands is the highest (181 m<sup>3</sup>/ha) in Chernigiv region, and is 168 m<sup>3</sup>/ha in Kyiv region. It is the lowest in Kharkiv and Poltava regions (149 and 146 m<sup>3</sup>/ha) [3].

It was taken into account, that not only Forest Steppe but also other natural zones are represented in the analyzed regions. Therefore, the forest area of several forest enterprises, which are completely located in this zone, has been analyzed.

Birch stands area in the forest area of analyzed enterprises varies from 86.1 ha (SE "Chuguevo-Babchanske Forestry") to 554.3 ha (SE "Gadyatske Forestry"). This parameter does not depend on latitude, but decreases with longitude ( $r = -0.75$ ) (Table 1).

*Table 1*

**Characteristics of birch stands in the territory of forest enterprises depending on coordinates\***

State Forest Enterprise	Coordinates*		Area, ha	Part of area, %**	Part of plantations, %	Age, years	Site index	Density of stocking	Stock, m <sup>3</sup> /ha		Stock change, m <sup>3</sup> /ha
	Latitude	Longitude							mean	mature stands	
Okhtyrskе Forestry	50°18'	34°54'	214.2	0.9	52.8	45	1A.6	0.70	179	225	0.8
Trostryanetske Forestry	50°28'	34°28'	278.0	1.4	74.8	43	1B.9	0.72	190	246	1.2
Vovchanske Forestry	50°17'	36°56'	150.8	0.6	51.4	50	1A.3	0.66	186	255	3.7
Gutyanske Forestry	50°08'	35°21'	429.0	1.5	43.1	40	1A.6	0.64	128	181	1.4
Zmiivske Forestry	49°42'	36°22'	134.4	0.6	45.2	36	1A.2	0.69	144	182	4.0
Skrypaivske TE Forestry	49°44'	36°31'	19.7	0.2	25.4	41	1.4	0.66	123	100	3.0
Chuguevo-Babchanske Forestry	49°52'	36°44'	86.1	0.4	59.7	31	1A.1	0.62	99	160	0.3
Kharkiv FRS	50°09'	36°31'	297.2	1.5	94.2	39	1A.0	0.67	151	217	3.9
Gadyatske Forestry	50°22'	33°59'	554.3	2.0	63.2	39	1A.4	0.68	147	201	3.8
Poltavske Forestry	49°35'	34°32'	541.9	2.2	30.4	37	1A.9	0.72	147	224	2.1

*Notes:* \* Coordinates for each forest enterprise were evaluated as centroids of respective contours of the territory using MapInfo Mapping Package; \*\* – share of birch stands area in the area of forest covered lands, %.

The share of birch in the forest area of analyzed enterprises varies from 0.4 % in the State Enterprise "Chuguevo-Babchanske Forestry" to 2.2 % in the State Enterprise "Poltavske Forestry" and also decreases with longitude ( $r = -0.73$ ).

Artificial birch stands occupy less than a half of all birch area in the State Enterprises "Skrypaivske TE Forestry" (25.4 %), "Poltavske Forestry" (30,4 %), "Gutyanske Forestry" (43,1 %) and "Zmiivske Forestry" (45.2 %), from 50 to 75 % in the rest of forest enterprises, and only in the SE "Kharkiv FRS", almost all birch stands (94.2 %) are of artificial origin (see Table 1).

Mean age of birch stands varies from 31 (SE "Chuguevo-Babchanske Forestry") to 50 years old (SE "Vovchanske Forestry"). At the same time, birch stands of the VIII and even X age classes occur in the stands in the enterprises of forest-steppe part of Poltava and Sumy regions. The mean

site class (bonitet) of the birch stands in analyzed forest enterprises is 1A, in the SE "Trostyanske Forestry" it is 1B, and in the SE "Skrypavske TE Forestry" it is 1.4 (see Table 1).

The mean density of stocking of birch stands is from 0.62 in the SE "Chuguevo-Babchanske Forestry" to 0.72 in the SE "Trostyanske Forestry" and in the SE "Poltavske Forestry". Overall, this parameter is the lowest in the analyzed forest enterprises of Kharkiv region (0.62–0.67). It is 0.68–0.72 in the forest enterprises of Poltava region and 0.70–0.72 in the forest enterprises of Sumy region (see Table 1).

The stock of the birch stands per 1 hectare is the highest in the forest area of analyzed enterprises in Sumy region (179–190 m<sup>3</sup>/ha), in Poltava region it is 147 m<sup>3</sup>/ha, and in Kharkiv region it tends to decrease from North to South (from 186 m<sup>3</sup>/ha in the SE "Vovchanske Forestry" to 99 m<sup>3</sup>/ha in the SE "Chuguevo-Babchanske Forestry"). The stock of mature birch stands is 225–246 m<sup>3</sup>/ha in the forest area of analyzed enterprises in Sumy region, 201–224 m<sup>3</sup>/ha in Poltava region, 160–255 m<sup>3</sup>/ha in Kharkiv region. Stock change of birch stands is the highest in the SE "Zmiivske Forestry" (4 m<sup>3</sup>/ha). It is rather high in the State Enterprises "Kharkiv FRS" (3.9 m<sup>3</sup>/ha), "Gadyatske Forestry" and "Vovchanske Forestry". It is considerably less in the State Enterprises "Skrypavske TE Forestry" (3 m<sup>3</sup>/ha) and "Poltavske Forestry" (2.1 m<sup>3</sup>/ha), and the lowest in the State Enterprises "Okhtyrskе Forestry" (0.8 m<sup>3</sup>/ha) and "Chuguevo-Babchanske Forestry" (0.3 m<sup>3</sup>/ha) (see. Table 1).

In the forest area of analyzed enterprises, 32 forest types are revealed. There are 3 types of poor site conditions (A – bors), 6 types of relatively poor site conditions (B – subors), 15 types of relatively fertile site conditions (C – sugruds) and 9 types of fertile site conditions (D – gruds), and by humidity, 1 type is very dry (hygrotop 0), 5 types are dry (hygrotop 1), 11 types are fresh (hygrotop 2), 9 types are humid (hygrotop 3), 5 types are wet (hygrotop 4) and 3 types are swamps (hygrotop 5). The highest diversity of forest types (32 types) occurs in the SE "Poltavske Forestry", the lowest (20 types) is in the SE "Skrypavske TE Forestry". Birch stands grow in 20 forest types. By trophotops there are 2 types of poor site conditions, 5 types of relatively poor site conditions, 10 types of relatively fertile and 7 types of fertile site conditions, and by hygrotops there are 3 dry, 8 fresh, 8 humid, 3 wet and 1 swamp. The birch was never found in very dry forest site conditions (Fig. 3).

Birch stands of analyzed forest enterprises of Sumy region are located mainly in the fresh and humid relatively poor site conditions (18.1–29.7 and 8.9–22.7 % from total area of birch stands respectively), fresh and humid relatively fertile site conditions (7.6–37.5 and 8.8–18.9 %) and fresh fertile site conditions (17.5–23.4 %) (Table 2).

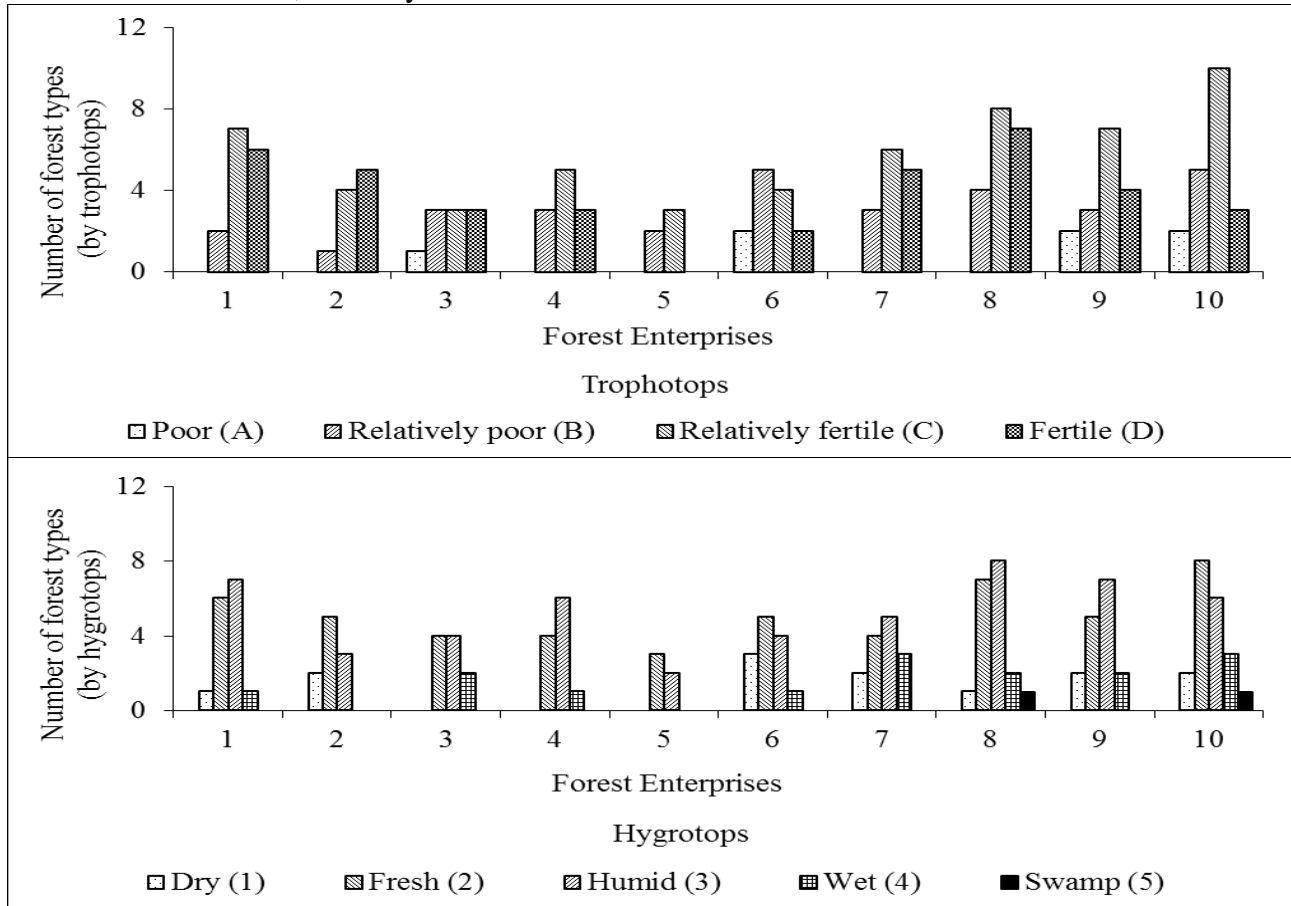
In the forest enterprises of Poltava region the share of birch stands area in such forest site conditions is rather similar: it is 15.2–34.4 and 17.2–24.9 % in fresh and humid relatively poor site conditions, 15.2–22.6 and 11.7–18.8 % in fresh and humid relatively fertile site conditions, and slightly smaller in fresh fertile site conditions (3.2–12.7 %) (see Table 2).

In the southern forest enterprises of the forest-steppe part of Kharkiv region (State Enterprises "Chuguevo-Babchanske Forestry", "Skrypavske TE Forestry", "Zmiivske Forestry") the part of birch stands in fertile site conditions does not exceed 11.1 %, in fresh and humid relatively fertile it is 13.4–20.8 and 7.8–47.7 %, respectively; in fresh and wet relatively poor fertile site conditions it is 8.4–34.1 and 13.7–28.2 %, respectively (see Table 2).

In the northern forest enterprises of Kharkiv region (State Enterprises "Vovchanske Forestry", "Gutyanske Forestry" and "Kharkiv FRS") the share of birch stands in fresh relatively poor site conditions is 3.3–22.5 %; in fresh and humid relatively fertile site conditions it is 13–18.5 % and 0–40 %, respectively; in fresh fertile site conditions it is from 5.3 to 73.8 % (see Table 2).

We have evaluated, that birch stands occupy the greatest part by area from all stands in the humid oak-pine relatively poor site conditions. It is 17.3–34.7 % in the forest enterprises of Kharkiv region, 42.3–46.6 % in the forest enterprises of Poltava region, and 60.9–61.7 % in the forest enterprises of Sumy region. Birch stands area in the fresh oak-pine relatively poor site conditions varies from 0.6 to 2.4 % from all stands in this forest type. In the forest types of humid relatively

fertile site conditions the share of birch stands is from 2 to 43.7 %, in fresh fertile site conditions it does not exceed 0.3 %, and only in the SE "Kharkiv FRS" it is 1.5 %.



**Fig. 3 – Distribution of forest types with birch stands by trophotops (upper) and hygrotops (lower) (State Enterprises: 1 – Vovchanske Forestry; 2 – Kharkiv FRS; 3 – Gutianske Forestry; 4 – Chuguevo-Babchanske Forestry; 5 – Skrypaivske TE Forestry; 6 – Zmiivske Forestry; 7 – Trostyanetske Forestry; 8 – Okhtyrsk Forestry; 9 – Gadyatske Forestry; 10 – Poltavsk Forestry)**

Table 2

**Distribution of birch stands by forest site conditions in the State Forest Enterprises of the Left-bank Forest Steppe, %**

Forest site conditions	Vovchanske Forestry	Kharkiv FRS	Gutyan-ske Forestry	Chuguevo-Babchanske Forestry	Skrypaivske TE Forestry	Zmiiv-ske Forestry	Trostyanetske Forestry	Okhtyrsk Forestry	Gadyatske Forestry	Poltavsk Forestry
A <sub>1</sub>	–	–	–	–	–	1,6	–	–	0,9	0,1
A <sub>2</sub>	–	–	1,9	–	–	1,3	–	–	1,9	0,8
B <sub>1</sub>	–	–	–	–	–	1,5	0,5	–	0,1	–
B <sub>2</sub>	18,9	3,3	22,5	8,4	17,8	34,1	18,1	29,7	34,4	15,2
B <sub>3</sub>	4,6	0,0	5,8	17,9	13,7	28,2	8,9	22,7	17,2	24,9
B <sub>4</sub>	–	–	3,4	–	–	1,9	–	2,8	–	3,8
B <sub>5</sub>	–	–	–	–	–	–	–	–	–	10,2
C <sub>1</sub>	–	0,3	–	–	–	–	–	–	–	–
C <sub>2</sub>	14,8	13,0	18,5	20,1	20,8	13,4	37,5	7,6	15,2	22,6
C <sub>3</sub>	4,6	0,0	40,0	35,3	47,7	7,8	8,8	18,9	11,7	18,8
C <sub>4</sub>	–	–	–	–	–	–	–	–	–	0,2
D <sub>1</sub>	2,6	7,5	–	–	–	0,8	0,4	–	–	0,2
D <sub>2</sub>	31,4	73,8	5,3	11,1	0,0	9,4	23,4	17,5	12,7	3,2
D <sub>3</sub>	23,1	2,1	2,6	7,2	0,0	–	1,8	0,8	5,4	–
D <sub>4</sub>	–	–	–	–	–	–	0,6	–	0,5	–
Total	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

Obtained data must be used during the research of *Betula pendula* sanitary condition and the causes of its deterioration.

**Conclusions.** Area of birch stands in the forest area of forest enterprises, which are totally located in the Left-bank Forest Steppe, varies from 86.1 ha (State Enterprise "Chuguevo-Babchanske Forestry") to 554.3 ha (State Enterprise "Gadyatske Forestry"). Birch stands area and its share in the forest area of analyzed enterprises decrease with longitude.

The mean age of birch stands in analyzed Forest Enterprises of the Left-bank Forest Steppe varies from 31 to 50 years old; mean site class (bonitet) is 1A. Mean density of stocking and stock of birch stands tend to decrease from North to South.

Birch stands in the forest fund of analyzed forest enterprises are represented in 32 forest types, mainly in the fresh and moist relatively poor conditions (subor), fresh and moist relatively fertile (sugrud) and fresh fertile (grud) site conditions. Obtained data must be used during investigations of silver birch's sanitary condition and the causes of its worsening.

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БЕРЕЗА ПОВИСЛА (*BETULA PENDULA* ROTH) У ЛІСАХ ЛІВОБЕРЕЖНОГО ЛІСОСТЕПУ УКРАЇНИ

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Площа березових насаджень у лісовому фонді лісогосподарських підприємств, які суцільно розташовані у Лівобережному Лісостепу, становить від 86,1 га (ДП «Чугуєво-Бабчанське ЛГ») до 554,3 га (ДП «Гадяцьке ЛГ»). Площа й частка берези у лісовому фонді досліджених підприємств зменшуються з географічною довготою.

Середній вік березових насаджень у проаналізованих лісогосподарських підприємствах Лівобережного Лісостепу становить від 31 до 50 років, середній бонітет –1А. Середні повнота та запас березових насаджень мають тенденцію до зменшення з півночі на південь.

У лісовому фонді проаналізованих підприємств березові насадження представлені у 32 типах лісу, переважно у свіжих і вологих суборах, свіжих і вологих сугрудах та свіжих грудах. Одержані дані мають бути використані під час досліджень санітарного стану берези повислої та причин його погіршення.

Ключові слова: береза повисла (*Betula pendula* Roth), лісовий фонд, таксаційні показники, типи лісорослинних умов.

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**БЕРЕЗА ПОВИСЛАЯ (*BETULA PENDULA* ROTH) В ЛЕСАХ ЛЕВОБЕРЕЖНОЙ ЛЕСОСТЕПИ УКРАИНЫ**

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Площадь березовых насаждений в лесном фонде лесохозяйственных предприятий, полностью расположенных в Левобережной Лесостепи, составляет от 86,1 га (ГП «Чугуево-Бабчанское ЛХ») до 554,3 га (ГП «Гадячское ЛХ»). Площадь и доля березы в лесном фонде проанализированных предприятий уменьшаются с географической долготой.

Средний возраст березовых насаждений в проанализированных лесохозяйственных предприятиях Левобережной Лесостепи составляет от 31 до 50 лет, средний бонитет – 1А. Средняя полнота и запас березовых насаждений имеют тенденцию к уменьшению с севера на юг.

В лесном фонде проанализированных предприятий березовые насаждения представлены в 32 типах леса, преимущественно в свежих и влажных суборах, свежих и влажных сугрудках и свежих горах. Полученные данные следует использовать при исследовании санитарного состояния березы повислой и причин его ухудшения.

**Ключевые слова:** береза повислая (*Betula pendula* Roth), лесной фонд, таксационные показатели, типы лесорастительных условий.

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