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SNOW COVER PROTECTIVE PLANTATIONS UNDER COMPLEX TERRAIN

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The results of researches of the snow cover in protective plantations growing in the difficult terrain are analyzed. It is founded the plantations formed snowpack thickness 20-45 cm, evenly placed around the grounds. Freezing of the soil was not fixed. Increasing of soil moisture resulted in a decrease in hardness and permeability, which ranged from 2,5-0,2 mm·min^{-1}, which is based on the possible absorption of moisture snow was respectively 150 and 12 mm.

Keywords: *complex terrain, protective stands, snow, snow-cover survey, soil freezing, water permeability, moisture reserves.*

Plant communities on the ravine and gully systems play an important soil, health and safety, aesthetic and environmental values [7]. Until now, Golosiiv forest partially preserved oak forests belonging to indigenous natural climax forests. They are sparse, with a wide-brimmed crowns with 0.4-0.5 density. Growing up on a light and dark forest soils that formed in loess loam, rich in mineral nutrients at optimal levels and groundwater 1.5-2.0 m tall oak forests become high evaluation performance. Yakubenko D. and Grygora I., describing the flora and vegetation of the Golosiivo forest, note that it is the forest-steppe character [9].

The aim of the study was to research the distribution of snow cover under tent protective plantations, its dynamics, supplies moisture and snow cover and soil permeability change in the latter.

The object of study. The study was conducted at the experimental area of the stationary mixed oak-maple forest stands, which is located within the Botanical Garden of the National University of Life and Environmental Sciences of Ukraine. The site is located on the slopes of the south- eastern exposure with impetuosity 120. Planting a composition 9Oak1Mamle+Robinia, Yornbeem, Pear (91% is Oak , 7.5 %

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- Maple, 1.5% - Robinia and single Hornbeam and Ordinary Pear), aged 70 years. There are gray forest soils [4].

Methods and materials of research. Forestry characteristics of the stands were carried out by known classic forest methods. Snow shootings continued in the period January - March 2013. To carry out snow shooting and determine the density of the snow used snow weight instrument BC-43. The number of measurements was 20-fold. Stocks snow moisture was determined by the formula 1.

$$P = h \cdot \rho \cdot 10, \qquad (1)$$

where P - supply of moisture, mm; h - thickness of the snow cover, cm; ρ - density of snow, $g \cdot cm^{-3}$ [6].

Soil hardness was measured using hardness Golubev in 20-fold repetition. Determination of soil moisture was carried by drying in an oven at a temperature $105^{o}C$ for 5 hours (five samples).

Determination of density assembly (volumetric weight) of soil was carried out by cutting the ring for five samples [1]. Soil moisture reserves were determined using the formula 2.

$$W = 100 \cdot h \cdot r \cdot \gamma, \qquad (2)$$

where W - ground water supply, $m^3 \cdot ha^{-1}$; h - thickness of the soil layer, m; r - unit weight (density assembly) of soil, $g \cdot cm^{-3}$; γ - soil moisture,% [5].

The temperature of air and soil were measured by thermometers. For prototypes applied selector of soil [3]. Permeability of soil was studied by using steel cylinders with a diameter of 80 mm, a height of 100 mm. Each cylinder half immerse into the soil and the upper part (50 mm) filled with water. Stopwatch measured the absorption time of 50 mm layer of water that meets the torrential rain. Number of measurements was 5. Humidity fading gray forest soils (HF) - 6.1%, the lowest moisture content (MC) - 24.0 % [2]. The difference between MC and HF N. Kaczynski called the range of active moisture (RAM) [8].

Results. A research of the distribution of the snow cover, installation of moisture in it and the soil permeability and changes carried out during the last tent protective plantations. The forestry characteristics of stands are shown in Table.

Table 1. Foretstry characteristics of plantations

Species	Age, years	Number of stems per hactar	Average		Density		Index of produc-tivity	Comple-teness	Stock, $m^3 \cdot ha^{-1}$
			H, м	D, см	G, $m^2 \cdot ha^{-1}$	P, (1,0)			
Oak	70	374	22,4	36,2	18,5	0,57	I	0,5	400
Maple	70	51	20,2	30,3	1,8	0,06	II	-	33
Robinia	70	13	21,2	31,4	0,8	0,03	II	-	6
Total	70	438	-	-	21,1	0,66	I	0,5	439

Note: *N* - number of trees, *H* - height, *D* - diameter, *G* - amount of cross-sectional area (absolute fullness), *P* - relative density.

Feature of the snow cover in 2013 is that heavy snowfall fell during the period when there was no frost covered the ground and a thick layer of snow. During the entire observation period (January-March) of soil freezing were recorded. Experiments were carried out January16-18, February 04, March 11-24 (Fig.1).

a *b* *c*

Fig. 1. Snow shooting
a- weight snow tool BC-43; *b* - measuring the density of snow;
c - conducting measurements of the thickness of the snow cover

According to the observations of the current date formation of stable snow cover was - December 3, 2012 and the date of its destruction - April 3, 2013. Thus, the total duration of the snow cover was 121 days.

Temperature of soil thickness tended to increase (from +1^{o}C - 16.01 till +6^{o}C - 24.03), and although there has been a decrease in temperature to - 10^{o}C under heavy snow cover, which played a protective role in cooling the soil has occurred.

During the period of study the thickness of the snow cover has been changing gradually increasing from January, 16 (25 cm) to February, 04 the occurrence of major importance - 45 cm. On March there was decreasing the thickness of the snow cover due to compaction, partial melting and sublimation. Average values of the density of the snow had increase from 0.15 to 0.30 g·cm^{-3}, and supplies the moisture contained in the snow cover, depending on its thickness increased from 37.5 mm to 90.0 mm (16.01-04.02) and then decreased to 60.0 mm (24.03), as can be seen in Table. 2.

Table 2. Results of the research

Indices	Dates Research				
	16.01	18.01	04.02	11.03	24.03
The thickness of the snow, cm	25	30	45	31	20
Snow density, g·cm^{-3}	0,15	0,16	0,20	0,25	0,30
Stock moisture snow cover, mm	37,5	48,0	90,0	77,5	60,0
Frozen solid soil, cm	0	0	0	0	0
The hardness of the soil, kg·cm^{-2}	13,3	12,8	12,2	11,0	9,8
Soil moisture,%	10,5	12,6	14,2	18,7	22,3
Density assembly soil, g·cm^{-3}	1,15	1,15	1,15	1,15	1,15
The thickness of the soil surface, m	0,2	0,2	0,2	0,2	0,2
Supply of moisture in the soil, mm	24,2	29,0	32,7	43,0	51,3
Permeability of soil, mm·min^{-1}	2,5	0,9	0,5	0,3	0,2
Possible absorption snow water per hour, mm	150	54	30	18	12
Temperature, deg.	+5	+5	-10	-6	+10
The temperature of the soil under the cover of snow, deg.	+1	+2	+5	+4	+6
Possible stock at MC, mm	55,2	55,2	55,2	55,2	55,2

Between the hardness of the soil and its permeability, provided there is a slight fluctuation of moisture dependence - increased hardness of the water permeability decreases [7]. Soil hardness index decreased from 13.3 to 9.8 kg·cm^{-2}, however, the rate of permeability is not increased and decreased from 2.5 to 0.2 mm·min^{-1}. In this case, reducing the hardness did not lead to an increase in permeability due to increased soil moisture as a result of snowmelt, which in turn led to the inhibition of the process of absorption of water.

By reducing water penetration possible (estimated) amounts of moisture absorption snowy ground in January totaled 150 mm and moisture 10.5%, and in March fell to 12 mm for soil moisture has almost reached the lowest water content 22.3 % (MC - 24 0% [2]).

Calculations of soil moisture reserves were taken for 0-20 cm layer. During the period of research, through thick snow cover, physical evaporation did not occur, and the replenishment of stocks in the soil layer is significant. Change in inventories of moisture from 24.2 mm (January) to 51.3 mm (March) suggests that, compared with a constant (55.2 mm) at the time of the study the lowest moisture content is almost reached. These results give reason to believe that excess moisture (over MC) as free gravity will move into the lower layers of the soil.

If HF of gray forest soils is 6.1 % [2], the supply of moisture in the 0-20 cm layer will be 14.0 mm ($W = 100 \cdot h \cdot r \cdot \gamma = 100 \cdot 0{,}2 \cdot 1{,}15 \cdot 6\ 1 = 140.3$ $m^3 \cdot ha^{-1}$ or 14.0 mm) when the lowest moisture content (MC - 4.0 %) the stock is 5.2 mm respectively. DAV for this soil is 55.2 - 14.0 = 41.2 mm. Spring water supply active only in the top layer of soil yields encouraging basis for the development of vegetation. Investigated oak stands high performance by increasing growth class and class, and its stock is 439 $m^3 \cdot ha^{-1}$.

Conclusions. In plantations that grow in a complex topography revealed a uniform distribution of the snow cover. As heavy snowfalls occurred in frost-free period, and the thickness of the snow cover was within 20-45 cm over the entire period of research (January – March, 2013) of soil freezing were recorded. Due to the zero temperature ground (16^{o}C) was slowly melting snow and soil moisture replenishment. Increased soil moisture resulted in a decrease in its hardness and permeability (from 2.5 to 0.2 $mm \cdot min^{-1}$), which in terms of probability of absorption of moisture under the snow was 150 and 12 mm.

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