PRE-COMMERCIAL METHOD OF THINNING IN THE STATE ENTERPRISE "SHOSTKA FORESTRY UNIT"

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Actuality of theme. Thinning are a generally accepted system for the purposeful formation of economically valuable foreststands with the desired composition, structure and productivity [1; 3; 4; 8; 9]. In the conditions of the SE "Shostka forestry unit" system of thinning are carried out periodically, part of trees is cut down in foreststands for the purpose of improvement of conditions of development for those trees which remained for the further growth. Due to the system of thinning, wood is harvested, which over time can be a natural waste. Thus, due to timely and high-quality thinning, the composition and structure of stands are improved, as well as the yield of liquid wood per unit area is increased, and the time for growing technically mature wood is reduced. In general, system of thinning contributes to the rational use of forest resources [1; 3; 4; 8; 9]. Of great importance is the presence of a set of standards governing their implementation [2; 4-6]. In 2020, SE "Shostka forestry unit" planned to take measures to improve the sanitary condition of forests on an area of 736.4 hectares. In Voronezh forestry subdivision, 212.6 ha were allocated for the system of thinning, including 85.1 ha for pre-commercial thinning.

The purpose of the research is to reveal the peculiarities of pre-commercial thinning in foreststands in the conditions of the specified enterprise. The object of study - the process of formation of foreststands by care felling. The subject of research is the specifics of the use of through pre-commercial thinning in pine foreststands of the specified enterprise.

The following research methods were used: monographic; silvicultural and forest inventory (for laying experimantal plots in order to establish silvicultural and forest inventory's indicators of forest stands); silvicultural and ecological (to provide typological characteristics of forest stands).

The scientific novelty of the research is the generalization of scientific approaches and the study of practical experience in conducting system of thinning in forest stands in the enterprise. The results of the research have practical application in the field of system of thinning, will improve the conduct of transitional felling in the study area.

SE "Shostka forestry unit" with an area of 27074.7 hectares is located in the north-western part of Sumy region in the Krolevets and Shostka administrative districts and the city of Shostka. The administrative and organizational structure of the enterprise includes 4 forestries: Myronivske (5743.7 ha), Sobytske (7366.6 ha), Shostkynske (5731.8 ha) and Voronezhke (8232.6 ha) [6]. According to forest zoning, the territory of the forestry belongs to the Kyiv-Chernihiv (Eastern Polissya) forestry district, the forest vegetation zone of Polissya. The climate of the forestry area is temperate-continental with long continental summers, sufficient rainfall and

relatively short mild winters. Among the climatic factors that negatively affect the growth and development of forest stands should be noted the presence of late spring and early autumn frosts, dry winds of the south-eastern and eastern directions. The territory of the forestry by the nature of the relief is a slightly undulating plain without sharp rises with elevations not exceeding 50-200 m above sea level and intersects the valleys of the left tributaries of the Desna River. The main types and kinds of soils: sod-podzolic (sod hidden-podzolic sandy or slightly humus, sod-slightly podzolic, sandy, clay-sandy, light and medium sandy, as well as sod-medium podzolic - 98%; peat-podzolic and peat-gley - 2%. Erosion processes are poorly developed. According to the degree of humidity, most soils are fresh and moist. Forest areas with excessive moisture account for 4.6% of the area covered with forest vegetation. The swamps cover an area of 234.5 hectares. Natural conditions are favorable for the growth and development of major forest species.

Research methods. During the collection of material for the planned research were used materials of forest management of the enterprise, reporting data on formation and rehabilitation of forests. Experimental plots were laid in the most common types of forest conditions in the most typical place of the site and placed at a certain distance from the road, clearings, meadows - not closer than 30 m (not closer to a distance equal to 2-3 tree heights). During the establishing of experimental plots in young stands, the requirements for involving the entire cycle of mixing of species were observed, in pure stands there should be at least 5 rows of the main breed in pure ones. The longer side of the trial area is located along the rows. The description of experimental areas is provided according to methods that are generally accepted in forestry and forest inventory: location of test area (name of enterprise, forestry, № quarter), undergrowth, soil type, relief. The forest typological description of all components of the forest stand was given, according to which the type of forest vegetation conditions was established [8; 10].

A list of trees was measured on the trial area with the measurement of the diameters of all trees at a height of 1.3 m from the soil surface: at the age of the clearing - 4 cm thick. Diameters and heights of 12-15 model trees are measured from the central degrees of thickness (to plot the height and establish the height category). The average diameter of the stand is determined by the cross-sectional area and the number of trees. The average height of the stand was determined by the height curve, which is built according to model trees [7; 8]. The quality of the forest stands was established on the scale of Professor M. M. Orlov. The stock of a stand is established by means of assortment tables of the corresponding forest tree species and the category of heights [2].

Intensity of forestry at the enterprise. The leading branch of the national economy of Ukraine is agriculture with the cultivation of cereals and livestock. The forest cover of the administrative districts on the territory of which the forestry is located is: Krolevets district - 29.7%, Shostka district - 29.3%. The economic activity of the forestry is aimed at the rational and efficient use of forest resources, improving soil protection, sanitation, health, aesthetic and other useful functions of the forest.

The intensity of forestry is high, as evidenced by key indicators. The annual volume of forest use (liquid) under the current forest management project is 81.7 thousand m^3, including 56.24 thousand m^3 from the commercial fellings. The average volume of forest use from 1 ha of forested forest areas is 3.2 m^3. Annual volume of forest reproduction works: creation of forest crops - 109.5 ha, promotion of natural regeneration - 40 ha.

The list of measures to improve the sanitary condition of forests for 2020 is planned: in Myronivske forestry subdivision - an area of 316 hectares, in Voronezhke forestry subdivision - 213.2 hectares, in Sobytske forestry subdivision - 207.2 hectares.

In Voronezhke forestry subdivision, the plan for the removal of commercial felling of Scots pine was assigned in 2019 - an area of 31.0 hectares with a liquid reserve of 11,073 m^3, in 2020 - 30.9 hectares and 11,332 m^3. The plan of system of thinning in Voronezh forestry for 2020 included (forest plantations with a predominance of Scots pine) for felling: for lighting - 36.0 hectares, clearing - 44.8 hectares, thinning - 46.7 hectares, precommersial felling - 85.1 hectares.

The existing organization of forestry works in the forestry unit is as follows: development of logging places of the commersial fellings, partial (up to 20%) care of plantations is carried out by contractors who enter into contracts with the forestry. All other forestry works, including timber removal, are carried out by specialized forestry brigades [6].

Characteristics of experimental plots. In the forest plantations of Voronezhke forestry subdivision 4 test areas have been laid in order to establish forestry inventory's indicators of stands and organizational-technical indicators of precommersial felling.

The purpose of precommersial fellings is to increase the growth of the best trees and increase the marketability of stands. Passage fellings are carried out in pine plantations from 41 years and older. Trees are divided into three categories: I - the best, II - auxiliary, III - undesirable. The intensity of care felling is set depending on the composition, age, quality class, structure, condition of plantations.

The provisions set out in the following normative documents were used to lay down temporary test plots for precommersial fellings and during the calculation of changes in forestry and tax indicators, the provisions of such normative documents as "Projects of organization and development of forestry" [6], in handbooks on forest inventory [2], "Rules for improving the quality of forests" [4], etc. were used.

Experimantal plot № 1 is laid in the quarter № 65, with an area of 11.5 hectares in Voronezhke forestry subdivision. The assessment description of the experimantal plot № 1 is given in table 1.

Table 1 - The assessment description of the experimantal plot № 1

Composition of forest tree species	Number trunks, pcs. * ha^{-1}	Average figures		The sum of cross-sectional areas, m^2* ha^{-1}	The density of standing trees	Stock of wood, m^3* ha^{-1}
		H, m	D, cm			
Before the precommersial felling						
100% *Pinus sylvestris* L.	1578	15,8	16,2	27,6	0,79	201
After the precommersial felling						
100% *Pinus sylvestris* L.	1351	15,3	15,8	24,2	0,69	176

The size of the experimantal plot is 0.5 ha. The composition of forest tree species before precommersial felling - 100% *Pinus sylvestris* L. Origin - artificial. Type of forest vegetation conditions - B_3. Forest site (quality class) - I. The density of standing trees - 0.79. Stock of wood - 201 m^3* ha^{-1}. Living ground cover - raspberries, forest lilies, strawberries. Soil type - sod-slightly podzolic sandy. The relief is flat. Age - 41 years. Type of felling - precommersial felling. The degree of liquefaction is 12.3%. The felled wood stock is 24.8 m^3* ha^{-1}: business wood– 3,6 м^3 m^3* ha^{-1}, firewood – 17.2 m^3* ha^{-1}, illiquid firewood - 0.4 m^3* ha^{-1}, bushes - 3.6 m^3* ha^{-1}.

Experimantal plot № 2 is laid in the quarter № 7, with an area of 2.6 hectares in Voronezhke forestry subdivision. The assessment description of the experimantal plot № 2 is given in table 2.

Table 2 - The assessment description of the experimantal plot № 2

Composition of forest tree species	Number trunks, pcs. * ha^{-1}	Average figures		The sum of cross-sectional areas, m^2* ha^{-1}	The density of standing trees	Stock of wood, m^3* ha^{-1}
		H, m	D, cm			
Before the precommersial felling						
100% *Pinus sylvestris* L.	370	29,9	36,2	38,0	0,81	507
After the precommersial felling						
100% *Pinus sylvestris* L.	329	28,9	35,8	33,8	0,72	451

The size of the experimantal plot is 0.5 ha. The composition of forest tree species before precommersial felling - 100% *Pinus sylvestris* L. Origin - artificial. Type of forest vegetation conditions - B_3. Forest site (quality class) - I. The density of standing trees - 0.81. Stock of wood - 507 m^3* ha^{-1}. Living ground cover - lily of the valley, heather, ortilia unilateral. Soil type - soda-slippery podzolits sandy scrap. The relief is flat. Age - 110 years. Type of felling - precommersial felling. The degree

of liquefaction is 11.0%. The felled wood stock is 56 m^3* ha^{-1}: business wood– 5,8 м^3 m^3* ha^{-1}, firewood – 43.8 m^3* ha^{-1}, liquid from the crown - 1.1 m^3* ha^{-1}, bushes - 5.1 m^3* ha^{-1}.

Experimantal plot № 3 is laid in the quarter № 36, with an area of 4.0 hectares in Voronezhke forestry subdivision. The assessment description of the experimantal plot № 3 is given in table 3.

Table 3 - The assessment description of the experimantal plot № 3

Composition of forest tree species	Number trunks, pcs. * ha^{-1}	Average figures		The sum of cross-sectional areas, m^2* ha^{-1}	The density of standing trees	Stock of wood, m^3* ha^{-1}
		H, m	D, cm			
Before the precommersial felling						
100% *Pinus sylvestris* L.	692	22,5	24,1	31,7	0,76	327
After the precommersial felling						
100% *Pinus sylvestris* L.	612	22,0	23,5	26,0	0,62	268

The size of the experimantal plot is 1.0 ha. The composition of forest tree species before precommersial felling - 100% *Pinus sylvestris* L.. Origin - artificial. Type of forest vegetation conditions - B_3. Forest site (quality class) - IA. The density of standing trees - 0.76. Stock of wood - 327 m^3* ha^{-1}. Living ground cover - forest lily of the valley, blueberries.. Soil type - soda-slippery podzolits sandy scrap. The relief is flat. Age - 63 years.

Type of felling - precommersial felling. The degree of liquefaction is 18.1%. The felled wood stock is 59.2 m^3* ha^{-1}: firewood - 32 m^3* ha^{-1}, liquid from the crown - 0.5 m^3* ha^{-1}, illiquid firewood - 3.5 m^3* ha^{-1}, bushes - 23.2 m^3* ha^{-1}.

Experimantal plot № 4 is laid in the quarter № 36, with an area of 2.5 hectares in Voronezhke forestry subdivision. The assessment description of the experimantal plot № 4 is given in table 4.

Table 4 - The assessment description of the experimantal plot № 4

Composition of forest tree species	Number trunks, pcs. * ha^{-1}	Average figures		The sum of cross-sectional areas, m^2* ha^{-1}	The density of standing trees	Stock of wood, m^3* ha^{-1}
		H, m	D, cm			
Before the precommersial felling						
100% *Pinus sylvestris* L.	510	26,5	28,3	36,0	0,80	425
After the precommersial felling						
100% *Pinus sylvestris* L.	458	25,8	29,5	32,9	0,73	389

The size of the experimantal plot is 1.0 ha. The composition of forest tree species before precommersial felling - 100% *Pinus sylvestris* L. Origin - artificial. Type of forest vegetation conditions - B_3. Forest site (quality class) - IA. The density of standing trees - 0.8. Stock of wood - 425 m^3* ha^{-1}. Living ground cover - raspberries, lilies of the valley, strawberries. Soil type - sod-slightly podzolic sandy. The relief is flat. Age - 83 years.

Type of felling - precommersial felling. The degree of liquefaction is 8.5%. The felled wood stock is 36 m^3* ha^{-1}: firewood - 29.6 m^3* ha^{-1}, liquid from the crown - 0.3 m^3* ha^{-1}, illiquid firewood - 2.5 m^3* ha^{-1}, bushes - 3.6 m^3* ha^{-1}.

Analysis of research results. Forestry approaches to the use of precommersial fellings with the laying of experimental plots were developed on the example of pure pine plantations. Experimental forest stands grow in conditions of moist soil moisture. Forest stands grow in high quality classes, most of them are high-density or close to such.

When assigning organizational and technical indicators of precommersial felling, the light-loving nature of Scots pine was taken into account. It is known that at the age of lighting and clearing pine quickly drowns out deciduous trees and shrubs, at the age of thinning - needs to adjust enough light in crowns, and at the age of clearings - the corresponding area of nutrition in the soil.

It is known that in research conditions (fresh and wet stands), especially for pine stands of artificial origin, the formation of the assortment structure of stands with the use of weak degrees of liquefaction may be unsatisfactory due to the initial excessive density of stands [7-9]. The latter can lead to damage to pine stands by snowstorms.

The precommersial felling at the experimental plot № 1 was assigned in a 41-year-old stand with a composition of *Pinus sylvestris* L. (100%) with a weak degree of liquefaction (12% in stock, completeness reduced from 0.79 to 0.69). The average volume of wood whip was 0.2 m^3. The felling was carried out by a combined method with a selection of pine trees: damaged trees, those that lagged behind in growth, in groups with excessive density. The composition of the stand is already economically feasible. The purpose of felling was to continue the care of the shape of the crown and trunk of the best pine trees, as well as the beginning of the care of trees for soil-light growth (increase in thickness). The next reception of through felling should be carried out in 7-8 years with a weak degree of liquefaction.

The precommersial felling at the experimental plot № 2 is planned in a 100-year-old forest stand with a composition of of *Pinus sylvestris* L. (100%) with a weak degree of liquefaction (11% in stock, completeness reduced from 0.81 to 0.72). The average volume of wood whip was 1.05 m^3. The purpose of felling was to create optimal conditions for the growth of the best trees in thickness, as well as for seed formation. The next reception of through felling should be carried out in 10 years with a weak degree of liquefaction.

The precommersial felling at the experimental plot № 3 was assigned to a 63-year-old stand with a composition of *Pinus sylvestris* L. (100%) with a liquefaction intensity of 18.1%, while the completeness was reduced from 0.76 to 0.62. The average volume of wood whip was 0.4 m^3. 80 pine trees are intended for felling per 1 ha.

The precommersial felling at the experimental plot № 4 is assigned in an 83-year-old stand with a composition of *Pinus sylvestris* L. (100%) with a liquefaction intensity of 18.1%, while the completeness is reduced from 0.8 to 0.73. The average volume of wood whip - 0.58 m^3. 31 pine trees are assigned for felling per 1 ha.

Conclusions. The vast majority of Scots pine stands are characterized by high growth rates, so they need constant silvicultural care to prevent natural tree loss. The company pays considerable attention to silvicultural care of stands – the system of thinning is carried out in a timely manner and in sufficient quantities.

When taking pine trees to precommersial fellings, a combined method of care felling was used: from the upper part of the canopy pine trees with defects were selected, and from the lower part - pine trees that lagged behind in growth, and thickened pine tree groups were thinned. In addition, the formation of large windows, which can lead to the appearance of grass vegetation, was avoided.

With a careful silvicultural approach to the formation of the spatial-parametric structure of forest stands from the moment of closing the crowns in young stands to the age of natural maturity, you can increase the productivity of forest stands and their biological stability.

The average apiary technology with an apiary width of 50 m is used for works during precommersial fellings. The felling of the forest takes place with the help of gasoline-powered saws "Husqvarna", "Shtil" and others. The felling of felled trees takes place in the apiary. Skidding of assortments takes place on skidding drags is carried out by the MTZ-82 tractor with the hydraulic capture. Sorting and stacking of assortments is carried out in the upper warehouse.

Compliance with the requirements of current regulations and taking into account the results of research cited in the literature will allow in the future through through felling in these studies, as well as in general all measures for forest formation and rehabilitation, grow valuable forest stands in appropriate types of forest conditions, forest areas and forest categories.

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