УДК 630*174.754(476)

D. V. Shiman, PhD (Agriculture), assistant professor (BSTU);
G. V. Merkul, PhD (Agriculture), assistant professor (BSTU)

THE EFFECT OF TREES ISOLATION ON MOSSY PINE FOREST GROWTH WHEN CUTTING TREES OF PRODUCTIVITY CLASSES IV AND V

Due to the fact that there are still some contradictory viewpoints on the matter of increasing of forest total productivity by cleaning cuttings the given research has been done. The forest total productivity is made up of natural mortality as well as the volume of intermediate and final forest cuttings. It is impossible to indentify correctly the forest trees reaction of different productivity classes when a cleaning cutting has been carried out. Taking into account all facts mentioned above, a special permanent sample forest plot was laid in 1977 by the researchers of forest Silviculture department of the Belarusian State Technological University. The sample plot is represented by a 30-years pine mossy forest stand in Negoreloe experimental forestry enterprise. Based on the data from the permanent sample plot the cleaning cutting effect on productivity of pine mossy forest stands, and the process of their forming when one sampled and cut down trees of different productivity classes has been researched.

Introduction. Differentiation and loss of growing forest have a direct impact on successful forest regeneration and growth which should be considered complicated dynamic natural processes of forest structure formation, its spatial location, age structure, the interconnect system of phytocenosis in the course of ontogeny.

The exceptional reproduction capability of plants under favourable conditions and limited growing space contribute to their increased populations and coming closer together resulting in their interaction and enhanced competition for habitats and nutrition [1, 2].

Forests develop a certain phytogenous environment that is regarded as ecotope change caused by plants and other related organisms. The composition and structure of forest stands, their growth and development are determined by a variety of relationships between their components as well as by the limiting and regulatory functions of the environment.

Trees differentiation results from the genetic heterogeneity of populations, their relative uneven age structure clearly obvious in a natural young-growth stand, unequal spatial location of trees and variable microenvironment conditions [3–6].

Improvement cuttings in forests encourage stand composition formation, improved sanitary condition of stands, reduced fire hazards, preservation and enhancement of protective, water-conservative and other useful characteristics of forest, faster growing of large-sized timber, etc. Such cuttings have always been and remain the most important forestry activities. Notwithstanding the widely-known and indisputable silvicultural purposes of improvement cuttings, they can be seen as a source of additional wood harvest, making 35% of the total harvesting volume, though some three decades ago they did not approach 20%.

Research methodology and object-matters. The object-matter of research is an experimental plot of the department of silviculture of Belarusian State Technological University which was set up in a 30-year-old mossy pine forest of Negoreloye forest station of Negoreloye Experimental Forestry. The plot allows for four experimental options with a double number of replications:

1) check option (sections 1 and 7);

2) improvement option with cutting all trees of productivity class I and half of trees of productivity class II (sections 2 and 8);

3) improvement option with cutting all trees of productivity classes IV and V (sections 3 and 5);

4) improvement option with cutting all trees of productivity classes IV, V and half of trees of productivity class III (sections 4 and 6).

Experimental sections 1, 2, 3, 4 with area size of 33x30.3 m are located in quarter 102; sections 5, 6, 7, 8 of the same area size are located in quarter 103, growth conditions A_2 being equal over all the above areas. Section-by-section taxation of stands was made twice in 1977 (before and after cutting), subsequent taxations were carried out in 1987 and 2009.

The check option is meant to dead-trees cutting, option 2 is designated to crown thinning, options 3 and 4 – to low thinning.

Main part. The issue of increased general forest productivity due to improvement cuttings is still under discussion. Such productivity is a sum total of natural loss of growing forest and volumes of final and partial cuts. The fact is that until now there are some contradictory viewpoints on this problem, i.e.:

– improvement cuttings considerable increase general forest productivity (B. A. Shustov, G. R. Eitingen, P. V. Voropanov);

– according to M. E. Tkachenko, A. V. Tyurin, M. V. Davydov and other scientists, a considerable increase cannot be caused by improvement cuts alone;

– improvement cuttings do not increase general forest productivity which should be regarded as

a roughly constant value determined by specific soil conditions (N. P. Georgievski);

– improvement cuttings increase general productivity by 5–15% (A. V. Davydov, 1971), by 20% (S. N. Sennov, 1974), by 10–20% (P. P.Izyumski, 1969), by 5-10% (V/P. Timofeev, 1963), by 3–5% (A. M. Kozhevnikov), etc.;

– improvement cuttings increase general productivity in arid climate in recent and above all dry forests (P. S. Pogrebniak, 1968).

According to B. D. Zhilkin (1940), there are three possible scenarios of changing forest productivity by improvement cuttings: more light, warm weather, more nutrition and moisture may cause the growth increment of trees before final cut so that this increment will exceed the number of trees cut by thinning and general productivity in the given forested area may increase as compared to similar areas without thinning or with natural loss of growing trees; the volume increment of growing trees may correspond to the volume of trees cut by thinning, general productivity of an area unit may remain the same; the growth increment of remaining trees may not compensate for the cut trees volume, thus the resulting general productivity may decrease [7–9].

Improvement cuttings foreseen by official regulatory acts do not show a clear picture of how trees of different productivity classes respond to thinning. Hence, a special experimental plot "4b" was set up at the department of silviculture in 1977. The specified silvicultural-taxation characteristic of forest stands in the set-up area and pine tree dynamics of productivity classes by B.D. Zhilkin [7] is shown in Tables 1 and 2.

The cutting intensity in 1977 was low and made up only 16.5% of the total volume, owing to cutting of the smallest trees of productivity classes IV and V the amount of felled trees comprised 43.6%.

As a result only 27 m^3/ha of wood was cut. The 32-year period increment made up 208 m^3/ha which completely compensated for possible increment of cut trees as the newly-formed stand volume exceed the control numbers by 21 m^3/ha.

Based on the results of research in 2009 it can be noted that the number of trees in the after-cut area is slightly fewer.

Table 1

Silvicultural-taxation characteristic of forest stands in the study plot and their dynamics (option with cutting trees of productivity classes IV and V (sections 3 and 5))

Indicators		1977		2009	
		Before cut	After cut	Control	Improved (thinned) stand
Composition		8p2b	8p2b	9p1b	9p1b
Age, years		30	30	62	62
Average diameter, cm		9.3	10.8	23.2	24.4
Average height, м		10.6	12.8	20.2	20.6
Total cross sectional area, m^2/ha		25.71	19.23	33.40	35.08
Density		1.00	0.69	0.95	0.99
Thickness, trees/ha		3627	2047	787	760
Volume, $м^3$/ha		164	137	324	345
Intensity, %	By stock	16.5		–	–
	By tree number	43.6		–	–
Current volume change, $м^3$/ha		–	–27	+160	+208
Grwing space of one tree, $м^2$/ha		2.76	4.89	12.71	13.16

Table 2

Dynamics of pine trees by productivity classes

Options by observation years		Number of trees by productivity classes, (trees./ha) / (%)					
		I	II	III	IV	V	Total
1977	Before improvement cut	36 1.2	622 20.9	942 31.6	712 23.9	668 22.4	2980 100.0
2009	Control	51 7.5	145 21.3	238 35.0	129 19.0	117 17.2	680 100.0
	Before improvement cut (cutting of trees of productivity classes iv and v)	42 6.4	175 26.8	210 32.2	120 18.4	106 16.2	653 100.0
	After improvement cut (cutting of trees of productivity class i and half of trees of productivity class ii)	43 5.6	178 23.1	181 23.5	203 26.4	165 21.4	770 100.0

However, due to larger size of the trees, the average diameter, height, relative thickness and stand volumes exceed control indicators that prove positive impact of the low thinning with cutting of trees of productivity classes IV and V on forest stand formation.

Table 2 shows that research results of 2009 reveal a relatively uniform distribution of pine trees over the sections under consideration (productivity classes ranging from II to V). The share of pine trees of productivity classes I-III was 53.7% before cut. In 2009 the control section yielded 63.8%, after-cut section with cutting of productivity classes IV and V yielded 65.4%, that with cutting of trees of productivity class I and half of trees of productivity class II – 52.2%. These figures prove the viewpoints of certain researchers about positive impact of improvement cutting on the growth increment without any regard to the characteristics of cut trees.

Conclusion. The intensity of thinning in mossy pine forest was low in 1977 making up about 17% of the total volume, but owing to cutting of the smallest trees of productivity classes IV and V amounted to 44% by the number of trees.

Over 32 years the current stand volume change comprised 208 m^3/ha thus completely compensating for possible increment of the cut trees as the increment volume exceeded that of the control section by 21 m^3/ha.

Relatively uniform distribution of pine trees over the sections under consideration proves the advisability of subsequent improved thinning with primary cutting of trees of productivity classes IV and V. This will allow the increment growth of better trees and create necessary conditions for natural regeneration and pine young growth.

References

1. Дыренков, С. А. Структура и динамика таежных ельников / С. А. Дыренков. – Л.: Наука, 1984. – 182 с.

2. Колпиков, М. В. Лесоводство с дендрологией / М. В. Колпиков. – М.: Гослесбумиздат, 1954. – 496 с.

3. Голод, Д. С. Структура, закономерности размещения и формирования растительности Беларуси: автореф. дис. … д-ра биол. наук: 03.00.05 / Д. С. Голод; Ин-т эксперимент. ботаники им. В. Ф. Купревича. – Минск, 1995. – 32 с.

4. Луганский, Н. А. Лесоведение: учеб. пособие / Н. А. Луганский, С. В. Залесов, В. А. Щавровский. – Екатеринбург: Урал. гос. лесотехн. акад., 1996. – 393 с.

5. Нестеров, В. Г. Общее лесоводство: учеб. для студентов вузов / В. Г. Нестеров. – М. – Л.: Гослесбумиздат, 1954. – 655 с.

6. Уиттекер, Р. Сообщества и экосистемы / Р. Уиттекер. – М.: Прогресс, 1980. – 327 с.

7. Жилкин, Б. Д. Классификация деревьев по продуктивности / Б. Д. Жилкин. – М.: Лесная пром-сть, 1965. – 109 с.

8. Сеннов, С. Н. Лесоведение и лесоводство: учеб. для студентов вузов / С. Н. Сеннов. – М.: Академия, 2005. – 256 с.

9. Тихонов, А. С. Лесоводство: учеб. пособие для студентов / А. С. Тихонов. – Калуга: Гриф, 2005. – 400 с.

Received 21.01.2013