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SILVICULTURAL EFFECTIVENESS OF MEASURES TO AID TO NATURAL RENEVAL AT CLEARCUTS IN NOVOGRUDOK FORESTRY

Appointment to promote natural renewal at clearcuts significantly increases the probability of further form a tree stand with a predominance of conifers during the systematic care. The density of undergrowth on felling surveyed ranged from 6,973 to 3,250 units per hectare, while the proportion of valuable species from 62.1 to 83.35. Self-sown crow was presented only valuable species and the amount ranged from 550 to 1,603 units per hectare. Among the identified amount of undergrowth stored when cutting ranged from 12.7 to 83.1%. The highest average number of units of undergrowth valuable species found at the projective cover grass-shrub tiers of 30–50% and projective cover moss-lichen tiers of 20–40%. The least effect on undergrowth in underforest has canopy density of 0.1 to 0.3. Carrying out loosening the soil increases the amount of undergrowth valuable species for 3–4 years in 1.9–3 times, including self-sown crow in 1.6–4.4 times.

Key words: clear cutting, natural forest regeneration, underforest, undergrowth, self-sown crow.

Introduction. Restoration of coniferous plantations is the most important task of forestry of Belarus. At the same time, taking into account the criteria of the National forest certification system, the preservation of genetic and biological diversity, the sustainable plantations, the cost of creating forest plantations, need to pay more attention to their natural regeneration.

Currently Belarus is characterized by tendency to reduce the share of natural forests (2001 – 78.4, 2011 – 76.9%). This is in part because of the fact that large areas of logging sites after the continuous felling directed to artificial regeneration. At the same time, the natural regeneration of conifers quite successful if the quality of a set of measures to promote.

The purpose of this study – the establishment of basic efficiency of silvicultural activities to promote natural-in from resuming after clear-felling.

Main part. Evaluation of silvicultural effectiveness of measures to promote natural regeneration was carried out on sections 6 traveled by clear-felling of main use in 2011, 2012 and 2014 in Novogrudok Forestry. In 4 of them as a measure to promote applied mineralization plow PKL-70 and leaving seed trees on soil salinity alone, another one leaves only seed trees.

In all areas is also a different number of prior generations of young growth was taken into account. However, according to documents felling carried out without undergrowth preservation. All sites, except for the partition of the survey stratum 19 compartment 68 (Lovtsovskoe forest district), located in Vselyubskoe forest district (Table 1).

To account for the natural regeneration in the autumn of 2015 evenly over the territory of the plots laid 20 circular areas of 10 m² in areas not affected by salinity, and 20 rectangular fields area of 4 m² on the plow furrow.

On each area conducted individual enumeration young woody vegetation and self-seeding from the distribution of its determined projective cover living ground cover for the tiers and the closeness of underbrush by species. Determines the amount of the mineralized part of the plot. Also counted on seed trees on felling.

Characteristic undergrowth calculated in accordance with generally accepted forestry and forest inventory parameters and methods.

Felling of main use in Novogrudok forestry for the last 3 years was carried out on an area of 212.8 to 282.5 ha. The area of solid felling main use ranged from 126.5 to 225.6 ha. A significant proportion of forest plantations occupied with reforestation clearcuts (an average of about 75%). Under natural regeneration without conducting promotional measures allowed 7% of cutting areas.

Brief description of the felled areas and activities to promote natural reforestation carried out on cuttings, is reflected in the Table 1. The five felling logging 4–3 years were studied, and one – 1 year. After cutting on felling left from 5 to 11 pine seed trees per 1 ha.

The following year, after logging in September or October at five sites was conducted soil mineralization. The width of the plow furrows ranged from 0.8 to 1.2 m. The share of processed cutting area ranged from 20 to 29%.

Before felling in areas grew coniferous medium- and low-density stands with a significant participation of valuable tree species in the composition (80% or more). In one section was cut softwood tree stand. Felled plantations belonged to fern and oxalis series of forest types. Area cuttings ranged from 0.2 to 2.1 hectares.

Timber walls consist principally of conifers, rarely coniferous-deciduous premature and mature stands of trees, indicating that a sufficient amount

of seeds. Survey cuttings showed that technology event to promote the natural regeneration does not fully comply with regulations. The number of seed trees varies from 5 to 11 pcs./ha. At the same time, the regulatory and technical documentation is recommended to leave 10 to 15 trees per 1 ha. Additionally, it is recommended to keep 5–10 different species of trees per 1 hectare for the maintenance of biodiversity, which was not observed in the surveyed clearings. In stands with the presence of deciduous trees soil salinity should be carried out in late autumn, after the fall of the leaves. Saving regrowth refers to an important passive (requires no additional cost) as to promote natural regeneration.

According to a survey among registered by the number of young woody vegetation regrowth saved in cutting is from 12.7 to 83.1% (Table 2).

The number of young woody plants by species, including self-seeding is shown in Tables 2–3. In the first section (compartment 45 stratum 7) the total number of young woody plants amounted to 6,704 pcs./ha, of which 68.6% represented valuable species.

Recorded in 2,677 pcs./ha prior regrowth of natural regeneration, regrowth stored during logging, including 1,361 pcs./ha of valuable species. After cutting the four years 4,027 pcs./ha appeared the young woody vegetation (80.4% valuable species), including a 1,509 pcs./ha self-sown. Composition of the renewal 3P2S2O2B1As+M, Ald. black.

In the compartment 45 stratum 10 the total number of young woody plants amounted to 6,973 pcs./ha, of which 62.6% represented valuable species. Considered 3,177 pcs./ha (45.6%) prior regrowth of natural regeneration, including 1,338 pcs./ha of valuable species. After felling in four years came 3,796 pcs./ha young woody vegetation (79.7% of species), including 1,630 pcs./ha self-seeding. Composition of the renewal 4P3B1S1O1As+M.

In compartment 43 stratum 18 the total number of young woody plants amounted to 5,140 pcs./ha, of which 83.3% represented valuable species. It was noted in 1,540 pcs./ha (30.0%) prior generation undergrowth, including 1,390 pcs./ha of valuable species. After felling in four years came to 3,600 pcs./ha young woody vegetation (81.1% of species), including 1,460 pcs./ha self-seeding. Composition of the renewal 4P3S2O1B+As.

The fourth section (compartment 68 stratum 23) the total number of young woody plants amounted to 5,960 pcs./ha, of which 79.9% representation valuable species. Revealed in 1,340 pcs./ha (22.5%) prior generation undergrowth, including 1080 pcs./ha of valuable species. After felling in three years came 4,620 pcs./ha young woody vegetation (76.8% of species), including 930 pcs./ha self-seeding. Composition of the renewal 4S3P2O1B+As, M.

In the compartment 68 stratum 19 the total number of young woody plants amounted to 5,585 pcs./ha, of which 62.1% represented valuable species. Considered 709 pcs./ha (12.7%) prior generation undergrowth, including 422 pcs./ha of valuable species. After logging in three years came 4,876 pcs./ha young woody vegetation (62.4% of species), including 739 pcs./ha self-seeding. Composition of the renewal 3P3S2B1As1O.

In compartment 43 stratum 34 the total number of young woody plants reached 3,250 pcs./ha, of which 70.8% represented valuable species. Considered in 2,700 pcs./ha (83.1%) prior generation undergrowth, including 1,750 pcs./ha of valuable species. After cutting 550 pcs./ha young woody vegetation (all valuable species) appeared in one year, including 550 pcs./ha self-seeding. Composition of the renewal 3P2S2B2O1As+Ald. black.

On average, the proportion of valuable species was 62%. Undergrowth dominated by small conifers. Most of the young woody vegetation refers to the trustworthy. Its share in softwood averages 92%.

Location young woody vegetation on sites registered as a uniform and non-uniform or group.

In pine incidence rates range from 0.50 to 0.90, spruce – 0.30–0.70, oak – 0.10–0.55, birch – 0.20–0.75, aspen – 0.10–0.40, maple – 0.05–0.25, black alder – to 0.10.

Despite the fact that all felling carried out without undergrowth preservation, the areas recorded from 422 to 1,750 pcs./ha undergrowth valuable species growing under the canopy of the stand prior to cutting, that is by 76.1% (cutting 2014) to 12.2–22.7% (felling, 2012) and 29.6–32.5% (2011 of cutting). Thus, pre-natural regeneration, even taking into account the fact that the cabin is not aimed at its preservation, has a large enough value for the formation of a new forest generation of valuable tree species.

Therefore, we believe that in the standard documentation necessary to abandon the establishment of a minimum amount of undergrowth to assign clear-felling with its preservation.

It is necessary to keep any number of young growth of valuable tree species, which will contribute to the conservation of local biodiversity and the formation of a new stand with a large participation of these breeds in the formulation.

The highest average number of copies of the young woody plants valuable species on survey sites (3.3 pcs.) at a fixed projective cover grass-shrub tiers of 30–50% and projective cover moss-lichen tiers of 20–40%. The smallest impact on young woody vegetation undergrowth provides closeness with from 0.1 to 0.3 as the maximum average number of copies observed in closeness 0.2 (2.7 pcs.).

Table 1

Brief description of the felled areas and measures to promote natural renewal

| Compartment/ stratum | Feature felled stand | | | | Felling, year | The area of cutting, ha | Mineraliza- tion soil, % | Seed plant, pcs./ha |
|-------------------------|----------------------|---------------|-------------------|---------|------------------|----------------------------|-----------------------------|------------------------|
| | composition | age, years | forests site type | density | | | | |
| 45/7 | 10P | 100 | P. sorrel | 0.4 | 2011 | 1.0 | 29 | 11 |
| 45/10 | 8P2B | 90 | P. bracken | 0.5 | 2011 | 1.0 | 27 | 5 |
| 43/18 | 7S2P1B | 95 | S. sorrel | 0.6 | 2011 | 2.1 | 20 | 7 |
| 68/23 | 7P3S | 95 | P. sorrel | 0.6 | 2012 | 0.2 | 20 | – |
| 68/19 | 10P+B | 85 | P. bracken | 0.6 | 2012 | 1.1 | 25 | 9 |
| 43/34 | 3B3As2Ald.bl.2P+O | 70 | B. sorrel | 0.6 | 2014 | 2.1 | – | 6 |

Table 2

Characteristics of natural renewal

| Com- part- ment/ stra- tum | The number of surviving after cutting undergrowth, pcs./ha | | | | | | | | | The number that appears on the cutting undergrowth, pcs./ha | | | | | | | | | | Total pcs./ ha |
|--|---|-----|-----|-------|-----|------|-----|-------|-------|--|-------|-------|-----|-----|-------|--------------------|-----|-----|-------|----------------------|
| | P | S | O | B | As | Ald. | M | total | P | S | O | B | As | M | total | incl. self-seeding | | | | |
| | | | | | | | | | | | | | | | | P | S | O | total | |
| 45/7 | 357 | 789 | 215 | 934 | 94 | 144 | 144 | 2,677 | 1,434 | 940 | 862 | 289 | 284 | 218 | 4,027 | 860 | 434 | 215 | 1,509 | 6,704 |
| 45/10 | 989 | 276 | 73 | 1,406 | 360 | – | 73 | 3,177 | 2,124 | 625 | 276 | 484 | 214 | 73 | 3,796 | 1,000 | 422 | 208 | 1,630 | 6,973 |
| 43/18 | 710 | 550 | 130 | 100 | 50 | – | – | 1,540 | 1,240 | 1,070 | 580 | 420 | 290 | – | 3,600 | 650 | 520 | 290 | 1,460 | 5,140 |
| 68/23 | 210 | 610 | 130 | 180 | 80 | – | 130 | 1,340 | 1,560 | 990 | 1,000 | 760 | 180 | 130 | 4,620 | 360 | 340 | 230 | 930 | 5,960 |
| 68/19 | 68 | 354 | – | 146 | 141 | – | – | 709 | 1,475 | 1,371 | 198 | 1,197 | 635 | – | 4,876 | 413 | 263 | 63 | 739 | 5,585 |
| 43/34 | 700 | 650 | 400 | 450 | 400 | 100 | – | 2,700 | 200 | 200 | 150 | – | – | – | 550 | 200 | 200 | 150 | 550 | 3,250 |

Table 3

Number of undergrowth (total/including self-seeding), pcs./ha

| Record plot | Pine | Spruce | Oak | Birch | Aspen | Alder black | Maple | Total |
|---------------------------|-------------|-------------|-----------|---------|---------|----------------|---------|--------------|
| Compartment 45 stratum 7 | | | | | | | | |
| With soil salinity | 2,500/1,250 | 4,000/1,250 | 1,750/250 | 2,500/– | 250/– | – | 1,000/– | 12,000/2,750 |
| Without soil salinity | 1,500/700 | 800/100 | 800/200 | 700/– | 500/– | 100/– | 100/– | 4,500/1,000 |
| Compartment 45 stratum 10 | | | | | | | | |
| With soil salinity | 4,500/1,000 | 2,250/750 | 750/500 | 3,750 | 500/– | – | – | 11,750/2,250 |
| Without soil salinity | 2,600/1,000 | 400/300 | 200/100 | 1,200 | 600/– | – | 200/– | 5,200/1,400 |
| Compartment 43 stratum 18 | | | | | | | | |
| With soil salinity | 3,750/1,250 | 2,500/1,000 | 750/250 | 1,500 | 500/– | – | – | 9,000/2,500 |
| Without soil salinity | 1,500/500 | 1,400/400 | 700/300 | 300 | 300/– | – | – | 4,200/1,200 |
| Compartment 43 stratum 18 | | | | | | | | |
| With soil salinity | 3,250/1,000 | 3,000/500 | 3,000/750 | 1,500 | 500/– | – | 500/– | 12,000/2,250 |
| Without soil salinity | 1,400/200 | 800/100 | 800/300 | 800 | 200/– | – | 200/– | 4,200/600 |
| Compartment 43 stratum 18 | | | | | | | | |
| With soil salinity | 2,500/750 | 4,000/750 | 750/250 | 2,000 | 1,250/– | – | – | 10,500/1,750 |
| Without soil salinity | 1,200/300 | 900/100 | 900/– | 1,100 | 600/– | – | – | 3,800/400 |

Conducting soil salinity to an increase in the total number of young woody plants in 3–4 years in 2.1–2.9 times, including self-seeding in 1.6–4.4 times in comparison with the sites without mineralization. Number of copies of valuable species has increased from 1.9 to 3 times.

Conclusion. Implementation of measures to promote natural regeneration in clearings and in the fern forest types sorrel series significantly increases the likelihood of further form a tree stand with a predominance of conifers during the systematic care.

Differences in the amount of woody plants in clearings in the bracken and sorrel series of forest types have been identified.

Density of undergrowth in the surveyed cuttings ranged from 6,973 to 3,250 pcs./ha, while the proportion of valuable species from 62.1 to 83.4%.

Self-seeding was presented only valuable species and the amount ranged from 550 to 1,603 pcs./ha.

Conducting soil salinity increases the number of young woody plants valuable species of 3–4 years in 1.9–3 times, including self-seeding in 1.6–4.4 times in comparison with the sites without mineralization.

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