EVALUATION OF FOREST REGENARATION RESULTS AFTER STUMP EXTRACTION IN JOINT STOCK COMPANY 'LATVIAN STATE FORESTS'

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Abstract
With the increase in demand for renewable energy resources, new studies are carried out about under - utilized resources, namely, stumps. To begin to use stumps in industrial application, it is necessary to find out stump extraction influence on the environment, biodiversity, forest regeneration and other important factors. In Zemgale forestry, Misas and Klīves forest districts managed by Joint stock company "Latvian State Forests" (LSF) study on stump extraction in woodlands where clear-cuttings done in 2006 was carried out in the block No. 177, compartments No. 1 and 5, as well as the block No. 176, compartments No. 3 and 9. In these territories two research objects were made where in November-December 2007 stump extraction as well as soil preparation were performed. Main tasks of the project were to evaluate the results of forest natural seeding and coppice ingrowths in natural regeneration areas and evaluate the use of different methods for artificial reforestation with spruce and pine containerized seedlings. It was observed that more seedlings were cut off in the areas where soil scarification with stump extractor was performed if compared to areas prepared with a disc trencher.
Key words: forest regeneration, soil preparation, stump extraction.

Introduction

In Latvia, the use of tree biomass in energy production has two main advantages – resources are renewable and available locally. Forest area in Latvia counts for 3497.08 thousand hectares (+/- 23.53 thousand hectares or 0.67%) and covers 54.14% of Latvia's territory (Jansons, 2009). During the last ten years annual cutting volume of timber resources has been 10 to 12 million m^3 (State Forest Service, 2011). Unused annual potential of stump biomass in Latvia is around 1.3 million $tons_{dry\ mass}$ (Adamovičs et al., 2009).

Extraction of stumps improves soil structure by reducing its density and improving aeration processes, thus making favourable conditions for development of new stands. Removal of rotten spruce stumps from felling area reduces risk of new stand trees infection with root rot (Vasaitis et al., 2008).

In 2007, Joint stock company "Latvia State Forests" (LSF) in clear-cuttings of Zemgale forestry, Misas and Klīves forest districts performed stump extraction and soil preparation for afforestation with a specialized stump extractor bucket. Number of planting spots in extracted area and mineralised lines in control area were made in amount that corresponds to a necessary number of spruce or pine seedlings (Stādīšanas, sēšanas un …, 2011).

All forest stands in these sample plots were clear-cut with a harvester in the autumn 2006. Tree branches in all sample plots were compacted into strip roads, except in the block No. 177, parcel No. 5, where branches were left scattered in the felling area.

The extraction of stumps was done in November – December, 2007, a year after felling. Stump extraction in felled areas must be performed alongside with soil preparation for regeneration of areas where stumps have been removed by natural or artificial reforestation.

Aim: Verify whether it is possible to combine the stump extraction with soil preparation in Latvia weather conditions to prepare necessary number of planting spots to regenerate forest area with the spruce or pine containerized seedlings

Tasks:

1. Divide in rows and mark areas for the research;
2. Perform forest regeneration with the spruce of pine containerized seedlings;
3. Establish and monitor sample plots.

Materials and Methods

The total area of the study plots is 7 ha from which 5.7 ha were regenerated with spruce containerized seedlings and 1.3 ha with pine containerized seedlings.

There are *Hylocomiosa and Myrtillosa* forest growth types in the research areas located in the block No. 177, parcels No. 1 and No. 5; therefore, the parcel No. 1 was afforested with spruce containerized seedlings, but the parcel No. 5 with pine containerized seedlings.

After stump extraction, splitting and putting in piles along strip roads (stump piling along skid trail), with extraction-splitting device, it is possible to make soil scarification in mineralized ridges or small mounds. Stump extraction-splitting device in open position is pressed into soil and then by pulling upper tongue of device mineralized ridge in length of 1 to 2 meters or small mound by overturning turf is made. Stump extracting excavator while standing in one place can reach area from 24 to 28 m^2 (extraction-splitting device maximal reach range is 7 meters). Thus, it can prepare 6 to 8 mineralized ridges or small mounds. It

ensures necessary number of beds for planting spruce, pine or any other deciduous tree seedlings in felling area with removed stumps.

Research objects of the project - clear-cuttings with extracted stumps were placed in LSF Zemgale forestry, Misa forest district block No. 177, parcels No. 1 and 5, and for comparison clear-cuttings in Klīve forest district block No.176, parcels No. 3 and 9 were chosen.

In the block No. 177, parcel No. 1 four rows were established: the first row for 'natural regeneration', second row 'planting in rows', third row 'irregular planting' and fourth row 'ridges prepared with scarifier'. In the first row 'natural regeneration' stump extraction alongside soil preparation was done; the row was established at the side of the felling area provided for natural regeneration that borders with full-grown forest with superior stand of spruce ensuring afforestation of this area with natural seeding. In the second row 'planting in rows' stump extraction together with soil preparation was done; along the longest side of the felling area a line was stretched for an employee who will perform regeneration of the row to move along the line and plant spruce containerized seedlings. In the third row 'irregular planting' stump extraction as well as soil preparation was performed; in the row an employee would freely choose places where to plant spruce containerized seedlings. In the fourth row 'ridges prepared with scarifier' stump extraction simultaneously with soil preparation was performed where after that the soil was prepared with a scarifier 'Bracke T21.1'; employee would plant the spruce containerized seedlings in ridges prepared with a scarifier at the bottom of the ridge or on the top, depending on the conditions of the area. In the block No. 177, parcel No. 5 identical rows are established according to aforementioned method, where pine containerized seedlings are used in order to perform row afforestation.

In the block No. 176, parcel No. 9 soil was prepared with a scarifier prior to stump extraction. Reforestation was completed with spruce containerized seedlings planted in ridges prepared with a scarifier.

In the block No. 176, parcel No. 3 soil for afforestation was prepared with a scarifier in the spring 2007 and afforested with spruce containerized samplings planted in ridges prepared with a scarifier.

In all sample plots planting of spruce and pine containerized seedlings was done with a tree planting tool.

Planting material was delivered from the LSF nursery garden.

For further monitoring of seedling development, sample plots were established in spruce and pine afforested areas. In each plot on the longest diagonal four round shaped sample plots were established with the radius of 2.82 meters (25 m^2) (Noteikumi par koku ..., 2009). The number of trees was estimated with a similar method described in Cabinet Regulation No. 892 'Regulation on Tree Felling in Forest Lands'.

Data was processed using Microsoft Excel program Data Analysis, Descriptive Statistics.

Results and Discussion

Results of young forest stand preservation in sample plots (SP) are given in Table 1. Stand inventory results show that total loss of seedlings during the first vegetation period was not significant, especially taking into account a dry summer period from May to August in 2007 (Laika apstākļi gada …, 2007). However, during a young stand weeding process in irregularly planted areas around 600-700 seedlings per hectare was cut down. Here the large number of cut seedlings is related to dense vegetation and irregular planting method which requires additional concentration during weeding operation in order to find every seedling.

When making weeding in the areas where soil preparation was done with a disc trencher and a straight line planting of spruce containerized seedlings was done in ridges prepared with a disc trencher, the number of cut seedlings was 200 per hectare whereas in the areas where soil scarification was performed with a stump extraction-splitting device, the number of cut seedlings was 400 per hectare which could be explained with the fact that during the planting process it was not always possible to find prepared planting place for seedlings right next to the straight line. Therefore, planting here was done more in irregular manner. One can conclude that in irregularly regenerated forest areas where spruce containerized seedlings have not been planted in straight lines, the number of cut seedlings is two times larger and the weeding operation here should be done more carefully. Caution in weeding operation results in decrease of productivity and increase of costs.

After weeding in areas where soil preparation was done with a disc trencher and a straight line planting of pine containerized seedlings was done in the ridges, the number of cut down seedlings was 700 per hectare, but in the areas where soil scarification was performed with a stump extraction-splitting device and pine seedling planted irregularly, the number of cut down seedlings was 700 per hectare. In areas where the soil scarification was performed with a stump extraction-splitting device and the aim was to perform regular planting of pine containerized seedlings, it was not always possible to find a prepared planting place for seedlings right next to the straight line and planting there was done irregularly resulting in 400 cut

Table 1

Survival of seedlings in sample plots

Block and parcel No.	Code of enumerated sample plots	Number of seedlings in 25 m² sample plots						
		After planting		Dried and decayed seedlings		Cut down seedlings		Remaining number of seedlings, units per ha
		Number of seedlings, units per ha	Number of seedlings per SP	Number of seedlings, units per ha	Number of seedlings per SP	Number of seedlings, units per ha	Number of seedlings per SP	
Block No. 177, Parcel No. 1	St - E	2600	6.5 ±0.3	200	0.5 ±0.5	400	1 ±0.4	2000
	N - E	1800	4.5 ±0.5	200	0.5 ±0.5	500	1.3 ±0.5	1100
	F – E	2100	5.3 ±0.5	100	0.3 ±0.3	200	0.5 ±0.5	1800
Block No. 177, Parcel No. 5	St – P	3600	9 ±0.6	400	1 ±0.6	900	2.3 ±0.5	2300
	N – P	2600	6.5 ±0.3	-	-	700	1.8 ±1.0	1900
	F – P	3600	9 ±0.6	-	-	700	1.8 ±0.6	2900
Block No. 176, Parcel No. 9	A - F	2500	6.3 ±0.3	100	0.3 ±0.3	500	1.3 ±0.5	1900
Block No. 176, Parcel No. 3	N - F	2700	6.8 ±0.6	400	1 ±0.4	500	1.3 ±0.5	1800

Abbreviations:
St-E – Planting in rows;
N-E – Irregular planting;
F-E – Ridges prepared with a scarifier;
A-F - Ridges prepared with a scarifier, after that stump extraction was done;
N-F - Ridges prepared with a scarifier.

seedlings per hectare during the weeding operation. One can conclude that in irregularly regenerated forest areas where pine containerized seedlings have not been planted in straight lines, the number of cut down seedlings is 29% larger than in regularly planted areas.

It is possible to ensure favourable soil preparation for natural regeneration in sufficient quality as well as prepare necessary number of planting spots for planting forest when the stump extraction is done alongside soil preparation for the forest regeneration (Lazdiņš, 2011). In both areas - testing, and control, pioneer tree species like aspen and birch were more active in natural regeneration, but naturally regenerated pine and spruce seedlings were observed in very small quantities. Faster natural regeneration with aspen and birch matches with forest natural stabilization process, when after felling or destruction of a forest site, pioneer tree species are first to take over the area, forming unstable secondary forest sites (Bisenieks and Gavrilovs, 2006).

Conclusions

1. In Latvia, with the use of stump extraction-splitting device, it is possible to prepare necessary number of planting spots to regenerate forest area with the spruce or pine containerized seedlings.
2. The number of cut down seedlings was by 29% larger in areas where regeneration with a pine containerized seedlings done in straight lines than in areas where it done irregularly.
3. To reduce cut down seedlings during young stand weeding, it is necessary to work out teaching aids for the young stand weeding operation in areas where the soil preparation has been done with a stump extraction-splitting device.

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