Assessment of success performance of natural reforestation with common beech (*Fagus sylvatica* L.) initiated as a result of soil preparation in selected compartments of the Bobolice Forest Division

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The aim of the study was to asses quality and number of natural restorations of beach trees according to the soil conditions. Soil conditions was determined by (between another): forest site type, density of trees in the tree stand, type of cutting and the age of saplings. It was fined that the best result was in the stands where density of trees was moderate (factor of wood by one hectare was about 0,7). Also reforestation after a subsequences tree catting was better than after single cutting.

Forest site types, treestand density

Introduction

Common beech is a primary forest forming species in the Bobolice Forest Division, covering 3210 ha, which accounts for 19% forested area of that division. Its volume share amounts to 17% large timber.

In the Bobolice Forest Division common beech is found mainly in closed, pure stands, first of all in sites denoted as Luzulo-Fagetum beech forests (9110) and less frequently: Asperulo-Fagetum beech forests (9130). From the economic point of view it is also essential that these stands additionally serve protection functions (soil and water conservation), constituting another reason to consider utilization of natural potential for regeneration in beech stands as a priority. The aim of the study was to assess success performance of natural regeneration in selected compartments of the Bobolice Forest Division, where the soil preparation operation was performed in autumn 2011.

On this basis it was attempted to assess optimal conditions which should be met by the beech stand in the regeneration period to effectively utilize the seed year.

Methodology

Soil preparation was performed after seed fall in October/November 2011 in 16 subcompartments by harrowing with a heavy disc harrow and by manual strip clearing. Overall soil preparation operations covered 19.25 ha in 4 forest districts. Seed crop may be defined as abundant.

Next in June/July 2012 natural regeneration was evaluated. Analyses were conducted on a total of 9 subcompartments with soil preparation area of 14.55 ha, which accounts for 75% soil preparation area in the forest division. In the subcompartments at representative transects sample plots of $1m^2$ were established, located 10 m apart. On average from 10 to 17 sample plots were established in each analyzed experimental site. In each plot all beech seedlings were counted regardless of their condition. In order to compare the results with those from sites with no soil preparation operations performed, mean numbers of seedlings were also determined in the sites with no soil preparation. The collected experimental material was analyzed using the mathematical methods.

Results

On average the number of seedlings in the sample plot with no soil preparation was adopted as 2 per $1m^2$ (Tab. 1).

Table. 1. Descriptive data, characteristics of experimental sites and the number of seedlings

Valuation elements of tree stand				Cutting/Year	Size of large timber cutting pro ha** [m^3]	Nmber of samples	Number of saplings (individuals)		
Age	Density	SDI*	Large timber m^3/ha				Medium	Maks	Witout soil preparation
115	Moderate	1,0	404	Sowing 2011	40	14	5,4	14	2
115	Moderate	1,0	506	Sowing 2010	150	15	12,5	21	2
120	Breaking	0,9	449	Sowing in plan 2013	-	10	6,9	14	2
115	Breaking	0,8	369	Sowing in plan 2013	193	10	6,3	18	2
125	Breaking	0,7	316/	Sowing in plan 2013	-	13	6,6	15	2
115	Breaking	0,8	390	Sowing in plan 2013	55	12	8,25	18	2
135	Breaking	0,6	316	Remov./Sowing 2010	90	17	35,3	67	2
130	Loose	0,5	296	Remov./Sowing 2010	100	17	37,2	61	2
115	Moderate	0,9	448	Sowing in plan 2013	-	16	8,3	18	2

**) Stand density index: Coefficient of potential wood volume to real wood volume

*) Large timber harvest from 1 ha in the period from 2008

Classification of analyzed sites in terms of the number of seedlings per 1 m^2 showed: weak (1 – 5 seedlings/m^2) – none; medium (6 – 10 seedlings/m^2) – 6 sites; good (1 – 20 seedlings/m^2) - 1 site; very good (over 20 seedlings/m^2) – 2 sites.

Results were subjected to mathematical analysis in the search for a dependency between the number of seedlings and: the age of stand; tree stocking index; stand closure degree; large timber volume per 1 ha.

The following dependencies were observed between the number of seedlings in analyzed experimental sites and:

Tree stocking – with a reduction of tree stocking the number of seedlings in investigated sample plots increased (Fig. 1).

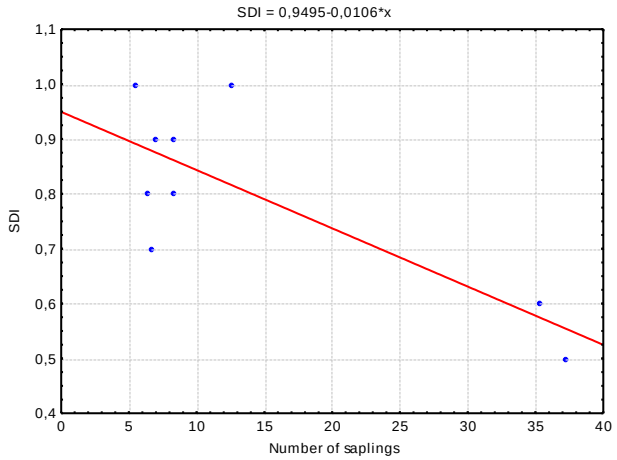

Fig. 1. A graph of mean sample scatter – mean number of seedlings, and stand tree stocking (SDI)

Age – with an increase in age of stand the number of seedlings in analyzed sample plots increased (Fig. 2).

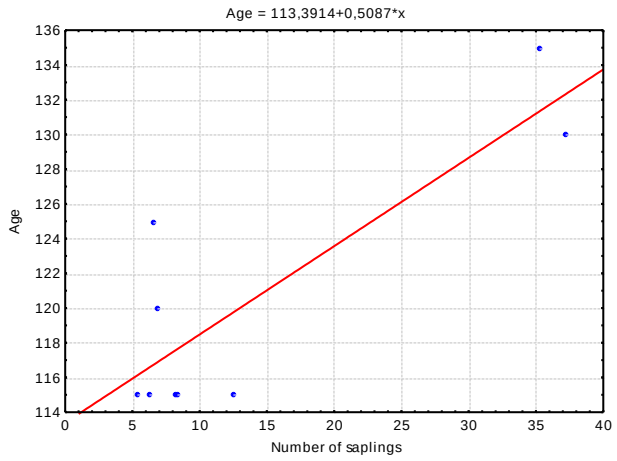

Fig. 2. A graph for sample plot scatter – mean number of seedlings and tree stand age

Stand closure – with a reduction of tree stocking in stand the number of seedlings also increased (Fig. 3).

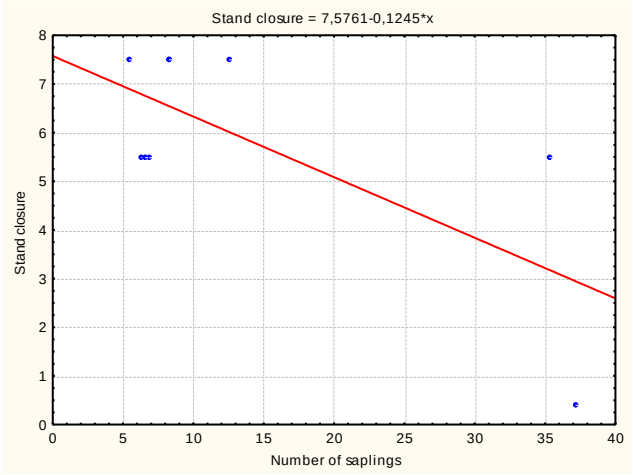

Fig. 3. A graph of sample plot scatter – mean number of seedlings and stand closure.

Discussion and conclusions

Analyses were conducted on seedlings aged several months, so the final result of effectiveness of the performed operation may be determined only in the next year, when this year's seedlings become stable natural seeding. However, results observed to date need to be documented to facilitate future management of beech stands at each stage of their development.

Seed cuttings in beech stands should be planned in the year of the expected abundant or medium seed crop. Abundant seed crop may be predicted based on observations of beech crowns in autumn or winter in the year preceding the flowering season – round flower buds may be seen (Skrzyszewski et al. 2012).

Unfortunately, in silviculture practice it is very difficult to obtain such information and to refer it to the main cutting plant in beech stands, since foresters plan and perform quality control estimates in the period of spring – summer of the year preceding flowering. Thus it is impossible to observe the above mentioned changes at this stage of crown development in the stand.

The aim of seed cutting is to create advantageous conditions on the forest floor by increasing access to water, light and air, required for seed germination and seedling survival in the next 3 years. Cutting operations are performed after seed fall or in winter at a high snow cover. Inferior trees with excessively developed crowns need to be removed, leaving relatively small gaps in closure. Secondary stand or even the shrub layer need to be removed, as they would hinder access to light. Cutting intensity should be adapted to stand closure, but it should not exceed 20-30% stand volume (Bernadzki, 2000). After cutting the crowns of trees in the dominant stand should gently touch at windy weather. In turn, the stocking index after seed cutting should be min. 0.7 (Jaworski 1990), while according to Barn (after Skrzyszewski 2012) in beech stands growing at an altitude of 470 – 490 m asl the greatest success of natural regeneration (70 thousand seedlings/ha) was observed after seed cuttings, in which the stocking index decreased to 0.5 (Skrzyszewski 2012). Wałecki (1983) claimed that the best conditions for the formation of beech regeneration at stand closure of 0.6 –

0.7. The index value of 0.7 seems to be the safe stocking limit.

As it was reported by Bernadzki (2000), already 5 seedlings per 1 m^2 is a satisfactory value, whereas Barn considers this threshold to be 7 seedlings/m^3 (Skrzyszewski 2012). The number of seedlings in analyzed sample plots ranged from 5.4 to 37.2 seedlings/m^2, obtaining an average result for the forest division of 14.08 seedlings/m^2. Thus we may hope that at least a part of the stand produced by the young generation stand will survive and enter a more stable phase of its life, i.e. natural seeding, followed by undergrowth, to become the main stand in the future (compare Kurek 2012).

When analysing the recorded results it may be stated that the best results for natural regeneration (on average over 35 seedlings/m^2) were recorded in the subcompartments, in which the stocking index was max. 0.7 (666k, 712a). Also satisfactory results were reported (on average 12.5 seedlings/m^2) in compartment 242d in the Kurowo forest district – there in 2010 a cutting operation was performed, in which almost 150m^3/ha were harvested, thus considerably reducing stocking from 1.0 to approx. 0.7. The relatively average (6.6 seedlings/m^2) success of natural regeneration in compartment 682b, where the stocking index was also 0.7, seems to be rather surprising.

In the subcompartments where a successive seed cutting was performed a better result was observed than in those, where this cutting was the first regenerative felling.

This is probably connected with the effect of improved soil and light conditions. We need to remember that the thick, undecomposed litter layer or excessive sod formation hinder seed germination (Skrzyszewski 2012) after (Poleno and Vacek 2009), while an increased access to light contributes to faster litter decomposition and thus leads to improved growth conditions for seedlings.

There is a close relationship between such traits as age, stocking and stand closure, and the number of seedlings in the analyzed sample plots. Such a situation is connected with the fact that in older stands the role of the regeneration process is greater and previous regenerative felling (preparatory cuts, seed cuttings) had a marked effect on the investigated dependence (better light and moisture conditions).

In fragments, where soil preparation operations were not performed (control plots) weak natural regeneration was observed (0 – 4 seedlings/m^2), thus it seems justified to perform this measure.

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Естественное возобновление популяции бука (Fagus Sylvatica L.) и состояние почвы

Изложение

Целью исследования было определение количества и качества естественно возобновляемой популяции бука (Fagus Sylvatica L.) в зависимости от состояния почвы. Условия этого процесса определялись, среди прочего, типом леса, густотой и возрастом древостана, а также видом вырубок. Установлено, что лучшие результаты отмечены в древостанах средней густоты (характеризующихся показателем густоты 0,7 на гектар). Кроме того восстановление лесных массивов после предыдущих вырубок проходило успешнее, чем при единичных вырубках деревьев.

Мест обитания субъект леса, сгустить древостоя

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