DENDROBIOLOGY
2004, vol. 51, Supplement 87–90

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Autovegetative reproduction in conservation and selective cultivation of Norway spruce *Picea abies* (L.) Karst of Istebna race

Abstract: The paper discusses the results of rooting experiments conducted with the cuttings obtained from 8-year-old spruce trees of Istebna race. The studies investigated the effects of endogenous factors, such as the place of extraction, length and origin of cuttings, and an exogenous factor, which is a rooting stimulus.

Additional key words: rooting, cuttings, progeny

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Introduction

Mass autovegetative reproduction through cuttings is applied still wider and wider in clonal forestry. In Germany, Denmark, Sweden, Norway and Finland there are experimental stands which consist exclusively of the clones of plus-trees [Barzdajn 1998]. In Poland, a preservation programme for the perishing mountain spruce population in the Sudeten Mts is developed on the basis of clonal forestry. The programme was initiated by Prof. Janson from the Forest Research Institute (Janson 1993).

An attempt to root the cuttings of spruce was made with the aim of establishing the influence of such factors as the place at which a cutting was extracted from the crown of an 8-year-old tree, the length of the cutting, hormonal stimulation, and the genetic features of the specimens. The studies examined the effectiveness of rooting methods in the cultivation of the Istebna spruce.

Materials and methods

Rooting experiments were conducted on a plot of the Regional Gene Bank at the Wyrchczadeczka station (Zapowiedź Forest Range, Wisła Forest District) using cuttings taken from 8-year-old trees growing in the progeny archives of spruce *Picea abies* (L.) Karst. of Istebna race.

The material for rooting was taken on 30 March 2001 at the end of the winter break. From each of 30 progenies, groups of 5 trees were selected. From each tree, shoots from the upper and lower whorl were cut off. 0.3 and 0.4% IBA was used as a rooting stimulus. A total of 1045 cuttings were rooted in the Jiffy pots (Forestry 333675-126F) 3.6 cm in diameter and 7 cm in height. The rooting of the cuttings was established on the basis of roots growing through the Jiffy pot and the date of that observation was recorded. Immediately after assessment, the rooted cuttings were transplanted to separate plastic containers or plastic bags filled with substratum.

Statistical analysis was performed to determine the effects of endogenous rooting factors such as the place of extraction, kind and length of shoot, and progeny, and one exogenous factor – stimulus.

Results

The calculations made revealed the influence of progeny, the date of rooting, the whorl from which a cutting was taken, the kind of the collected shoot and its length on the percentage of the rooted cuttings (see Table 1).

Place at which cuttings were taken from a tree

Variance analysis (Table 1) showed that the whorl from which cuttings were taken had a statistically highly significant influence on the success of rooting. In all of the 30 progenies tested, cuttings from the lowest whorl took roots much better than those from the highest one, and progenies No 28 and 36 achieved even a 100% rooting success. Cuttings from progenies No 12 and 21 demonstrated the lowest ability to induce rhizogenesis: only those taken from the lowest whorl took roots (Fig. 1).

Length of cuttings

The length of a cutting had a highly significant effect on the rooting success (Table 1). In all the progenies tested, short (2–7 cm) cuttings took roots best. In the case of progeny No 12, even 100% of cuttings 2–4 cm long were rooted. A strong negative correlation was observed between the length of a cutting and the percent rooted (correlation coefficient = –0.93) (Fig. 2). The shortest cuttings (2–4 cm) took roots very well (60–70%), while those longer than 10 cm tended to root very poorly (< 30%). An analysis taking into account the effect of the whorl from which a cutting was obtained as well as its length demonstrated that the cuttings from the lowest whorl were more successful in rooting than those from the highest whorl for each class of length (Fig. 3).

Table 1. Variance analysis of factors influencing rooting success (for double classification with one observation)

Source of variation	Sum of squares	Degrees of freedom	Mean square	F	P
Progeny	15583.93	29	537.38	**3.0678	0.0018
Whorl	31639.75	1	31639.75	***180.6264	0.0000
Error	5079.84	29	175.17		
Progeny	14951.97	29	515.59	***3.3067	0.0010
Shoot	1036.88	1	1036.88	*6.6498	0.0153
Error	4521.83	29	155.93		
Progeny	24775.27	29	854.32	***2.8848	0.0000
Class of length	73650.17	4	18412.54	***62.1743	0.0000
Error	34352.68	116	296.14		
Progeny	15771.60	29	543.85	**2.8990	0.0027
Stimulus (01)	14.15	1	14.15	0.0754	0.7855
Error	5440.25	29	187.59		
Progeny	1801.98	29	62.14	1.1781	0.2756
Month	12503.24	3	4167.75	***79.0254	0.0000
Error	4588.32	87	52.74		

*** highly significant effect < 0.001 ** significant effect < 0.010 * weakly significant effect < 0.050

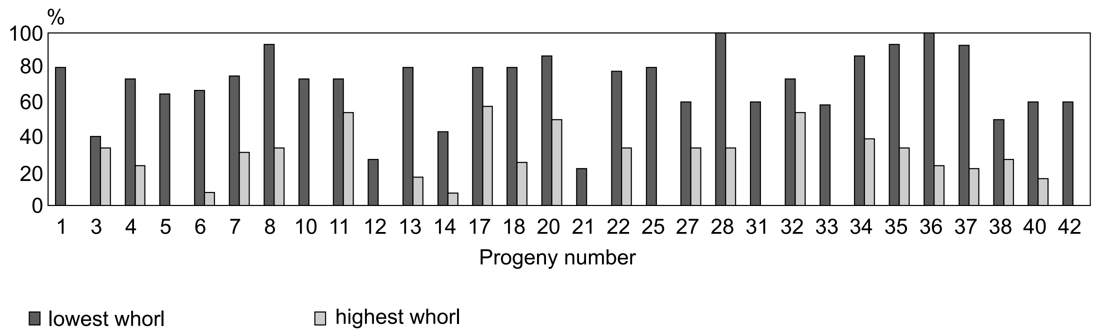

Fig. 1. Percentage of rooted cuttings as dependent on whorl in 30 progenies of Istebna spruce

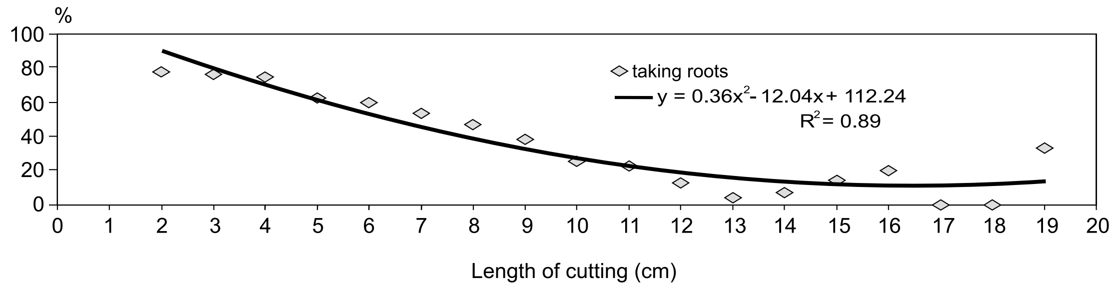

Fig. 2. Percentage of rooted cuttings as dependent on length of cutting

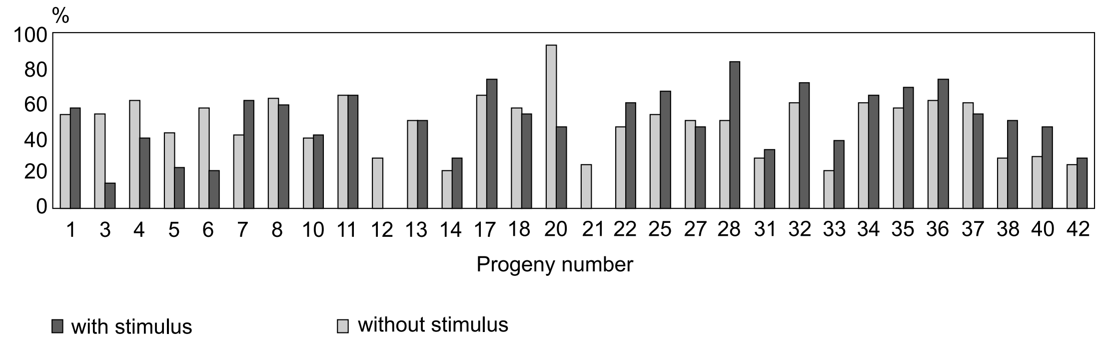

Fig. 3. Percentage of rooted cuttings as dependent on whorl and length class of cutting

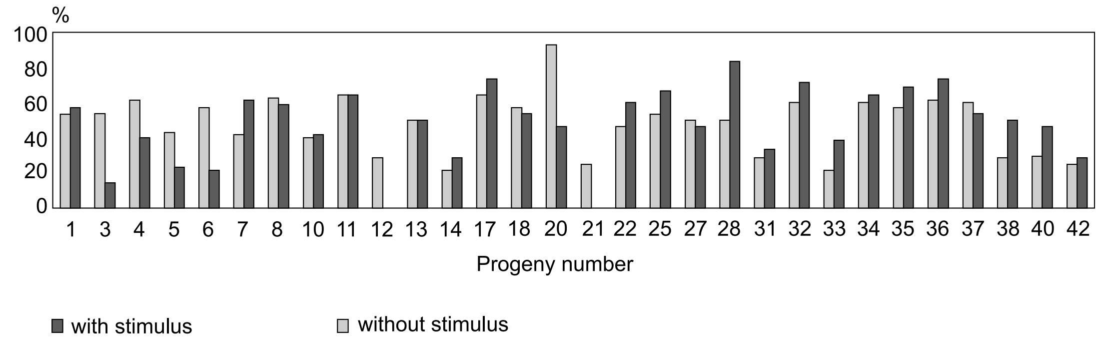

Fig. 4. Percentage of rooted cuttings as dependent on stimulus in 30 progenies of Istebna spruce

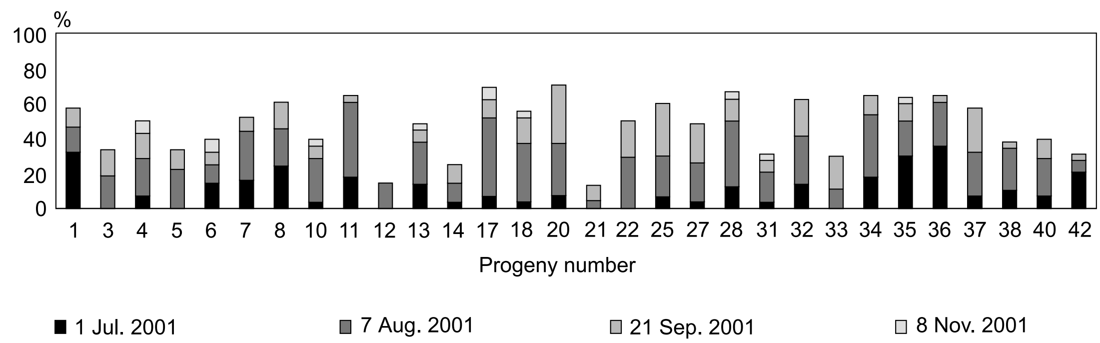

Fig. 5. Total success of rooting in 30 progenies of Istebna spruce

Rooting stimulus

Stimulus did not show any statistically significant effect on rooting (Table 1). The cuttings taken from progenies No 12 and 21, which rooted poorest, took roots only in the variant with a stimulus applied (Fig. 4).

Genetic effect of progeny

For most of the rooting factors the effect of progeny was significant or highly significant (Table 1). The majority of progenies rooted well (Fig. 5). Progenies No 20 and 17 performed best, while progenies

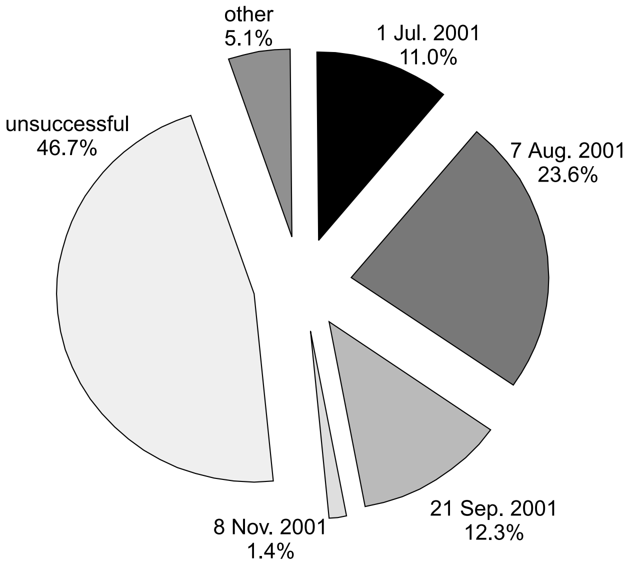

Fig. 6. Percentage of rooted cuttings as dependent on date of observation

No 12 and 21 showed less than 20% of rooted cuttings.

Time of rooting

The influence of time on the rooting of cuttings was highly significant (Table 1). The first cuttings took roots in the 10th week of experiment, 11% of cuttings had roots in the 13th week, 35% in the 19th week, 47% in the 25th week, and 48% in the 32nd week of experiment (Fig. 6). Between 1 July and 7 August, 23.6% of the planted cuttings took roots. This period showed the highest dynamics of rooting.

Conclusions

1. The Istebna spruce shows a great variation in rooting effectiveness. Most of the progenies tested exhibited a genetically determined ability to take roots. A small group of progenies did not have this ability. The progenies of plus-trees No 92, 2936, 5191, 5198, 5207, 5211, 5214, 5215 and 5216 rooted best, whereas those of trees No 2938 and 5199 were unable to root without hormonal stimulation.
2. Most of the cuttings (90%) obtained from 8-year-old spruce trees at the end of the winter break took roots within 25 weeks of planting (in the 10th week at the earliest).
3. The cuttings taken from the second-row shoots of 2–7 cm length, growing from lower whorls, proved to be the most suitable for rooting.
4. Stimulus appeared to have no influence on the effectiveness of rooting. Delivering hormones induced artificially the rooting process in the progenies which otherwise were unable to root (progenies of plus-trees No 2938 and 5199).

References

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