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Significant differences in seed germination among seed lots from individual trees of *Taxus baccata* L. after ten months of stratification*

Abstract

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Significant differences in seed germination (from 10 to 76%) among seed lots from individual trees of *Taxus baccata* L. after ten months of stratification were observed. After 19 months of stratification these differences were much smaller (from 73 to 100%). Therefore it is recommended that for establishing plots securing the gene pool of a yew population, seeds from each mother tree should be collected and stratified separately. Otherwise, the gene pool of the progeny may be impoverished by uncontrolled reductions of the progeny of trees characterized by poorly germinated seeds.

Additional key words: *Taxus baccata* L., seed germination, conservation, stratification.

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INTRODUCTION

English yew (*Taxus baccata* L.) occurs all over Europe (Bugala 1978). Although English yew has a wide geographical range, it has remained in natural plant communities in only few stands, and it is generally considered as a declining species. Being a rare and valuable species, English yew is strictly protected by law in Poland. Nevertheless, even in strict nature reserves it does not regenerate naturally well and is dying out. This is especially noticeable in the largest Polish *T. baccata* reserve in Wierzchlas (Król 1993). Lately, it has been demonstrated that the seeds from the Wierzchlas Reserve have a high genetic value for reforestation (Lewandowski et al 1995). However, there are some difficulties with restoration because of problems with

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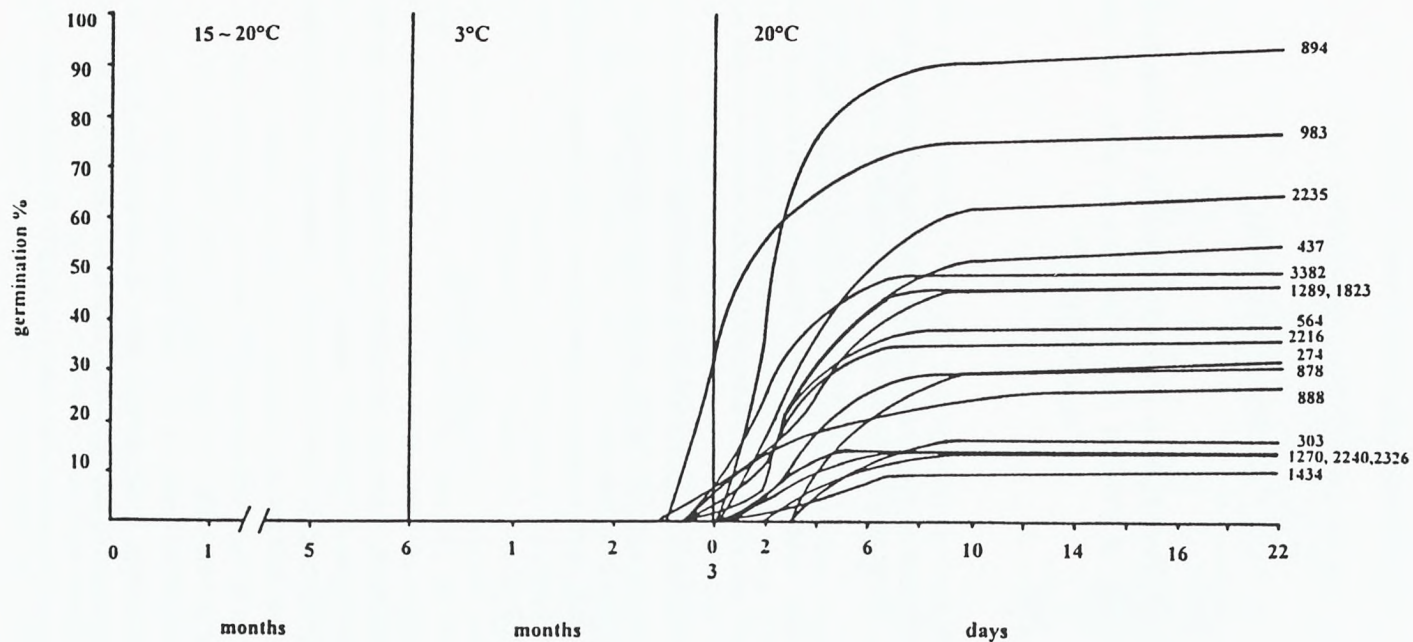


Fig. 1. Course of germination of *T. baccata* seeds for 17 mother trees during a 3-phase stratification. In phase I 48-hour cycles 15 ~ 20°C and 15 ~ 20°C (24 + 24 hours/cycle) were applied for six months; in phase II temp. 3°C for three months; and in phase III temp 20°C for 22 days.

sexual reproduction of this species. Seeds of the English yew are characterized by delayed germination, caused simultaneously by a seedcoat, and by incompletely developed and deeply dormant embryos (Suszka 1985). In 1985 Suszka developed a method, which shortened the time necessary for germination of seeds to 10–11 months. But there is still too little information on reactions of seeds from individual trees to the proposed treatment. The study presented here evaluated the percentage of germinated seeds of *T. baccata*, collected from individual trees in the Wierzchlas Reserve, after stratifications according to Suszka methods.

MATERIAL AND METHODS

Seeds were collected in September 1995, when the arils were red, separately from 17 trees of English yew, growing in a natural stand of *T. baccata* in the Wierzchlas Reserve (Tuchola Forests). After collection, separately for each tree, seeds were cleaned and subjected to stratification according to the methods proposed by Suszka (1985). First, the seeds were stratified for 6 months at the cyclically alternating temperature 15 ~ 20°C (24 + 24 hours/cycle), followed by a cool stratification at + 3°C for about 3 months, until the seeds started to germinate. After that seeds were transferred to 20°C and the percentage of germinated seeds was recorded every day until the end of germination (about 3 weeks) (Fig. 1). As the number of seeds was limited (70 from each tree), they were stratified only in one replication. Seeds were considered as germinated when radicals reached seed length. The rest of nongerminated seeds were stratified again.

RESULTS AND DISCUSSION

Germination of seeds from some trees started at the end of the cold phase of stratification. After transferring seeds to the temperature of 20°C the germination increased rapidly during the first six days for most trees and next it stopped after 22 days. The average cumulative germination curves were plotted for each mother tree (Fig. 1). The differences in germination curves are very pronounced. For example, seeds from tree no. 983, started to germinate during the cold phase, continued to germinate at the temperature of 20°C and achieved a high percentage of germination after 8 days. Seeds from another tree (no. 894) started to germinate immediately after transfer to 20°C. This seed lot had a rapid initial germination and achieved almost total germination by 8 days. In contrast, seeds from tree no. 1434 germinated slowly to reach only 10% germination after 22 days. Differences in germination of seeds coming from individual trees after 9 months of stratification were considerable

(Tab. 1). The percentage of seeds that germinated after this treatment ranged from 10% (tree no. 1434) to 93% (tree no. 894). On average, 39% of seeds germinated.

A great variation in seed colour and size (expressed as 100-seed mass) was observed among the studied trees (Tab. 1). For example, all seeds in the sample of ripe seeds of tree no. 888 were green-coloured, while 100% of seeds in samples from six other trees were brown-coloured. 100-seed mass ranged from 3.88 g (tree no. 1434) to 6.03 g (tree no. 878). In the analysed seeds a correlation between the rate of germination after ten months of stratification and both seed colour ($r = 0.25$) and 100-seed mass ($r = 0.08$) was statistically non-significant.

Table 1

Percentage of yew seeds germinated after 10 and 19 months of stratification for 17 mother trees of the forest reserve near Wierzchlas. The table shows also the percentage of brown seeds in the samples and mass of 100 seed

Tree No.	Germinated seeds % after:		Brown seeds [%]	Mass of 100 seeds [g]
	10 months	19 months		
274	32	99	100	4.80
303	16	83	10	5.00
437	54	93	59	5.06
564	39	99	100	5.62
878	31	84	97	6.03
888	27	100	0	5.30
894	93	99	100	4.95
983	76	93	97	5.24
1270	14	97	89	5.55
1289	47	94	9	5.02
1434	10	87	100	3.88
1823	47	100	95	5.62
2216	36	100	100	5.90
2235	64	73	90	4.66
2240	14	100	97	4.89
2326	16	77	36	4.75
3382	49	97	100	4.96
Mean (SE):	39.1 (23.4)	92.8 (8.6)	×	×

After 22 days of observation, all nongerminated seeds were stratified again. After another 9-months stratification the majority of seeds germinated. The total percentage of seeds that germinated after 19 months of stratification was high and reached on average 92.8%. Seeds of tree no. 2235 germinated most poorly (73%), while in samples from four other trees 100% of seeds germinated (Tab. 1).

It seems that large differences in seed germination after 10 months of stratification result from genetic control of this process in English yew. However, too small seed

samples and lack of replications do not allow to perform an appropriate statistical analysis. Genetic variation in germination of some coniferous tree species has been reported to be under maternal genetic control (Bramlett et al 1983, Hoff 1987, El-Kassaby et al. 1993). Variation in seed germination was considered to be an adaptation for survival under extreme environmental conditions (Jain 1982).

CONCLUSIONS

Application of stratification according to the method proposed by Suszka (1985) allows to shorten the time necessary for yew seed germination to one growing season. Nevertheless, differences between individual mother trees in the time necessary for embryo ripening and overcoming dormancy are considerable. Therefore it is recommended that for establishing plots securing the preservation of gene pool of a yew population, seeds from each mother tree should be collected and stratified separately. It is especially important when only 10-months stratification is applied. Otherwise, the gene pool of the seedlings may be impoverished by uncontrolled reductions of the progeny of trees, characterized by poorly germinated seeds.

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**Istotne różnice w kiełkowaniu nasion pochodzących
z pojedynczych drzew cisa pospolitego (*Taxus baccata* L.)
po dziesięciu miesiącach stratyfikacji**

Streszczenie

Po 10 miesiącach stratyfikacji stwierdzono istotne różnice w kiełkowaniu nasion (od 10 do 76%) pomiędzy próbkami zebranymi z pojedynczych drzew cisa pospolitego (*Taxus baccata* L.) w rezerwacie w Wierchlesie. Po 19 miesiącach stratyfikacji różnice te były znacznie mniejsze, a całkowite kiełkowanie nasion osiągnęło od 73 do 100%. W związku z tym zaleca się, aby przy zakładaniu powierzchni mających na celu zabezpieczenie puli genowych populacji cisa, nasiona zbierać i stratyfikować osobno z pojedynczych drzew. W innej sytuacji można znacznie zawęzić pulę genową potomstwa, zwłaszcza w wypadku prowadzenia wyłącznie dziesięciomiesięcznej stratyfikacji.