

FERTILIZATION EFFECT ON THE GRAND FIR PLANTATIONS*

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The article documents the fertilization effects on the plantation of Grand fir in the area of the Czech-Moravian Highland (area Žďárské vrchy), on typical poor sites (forest site group 5K – acid fir-beech site). The plantations were studied at the age of 7–16 years. The forest stands belong to the estate Lesy Dr. Radslava Kinského, they are located in the altitude 580 m a.s.l., the site is characterized by the forest type 5K8 and soil type Dystric Cambisol. As the amelioration matter is concerned, the slow-release fertilizer SILVAMIX[®] was used in the tabletted as well as powdered form. Despite relatively low amount of nutrients applied, the plantations showed considerable increment effect in the case of both fertilizer forms. On these poor sites, the favorable fertilization effects can be expected by introducing and re-introducing of more site-demanding tree species, including the species studied.

Grand fir; Czech-Moravian Highlands; fertilization; growth; increment; SILVAMIX[®]

INTRODUCTION

Chemical amelioration has a high potential use in many aspects in the forestry (Podrázský, 2006). Many researchers has been dealt with different treatments of silvicultural amelioration in many parts of the world since the beginning of the 20th century (Binkey, 1986). Also in the Czech countries the chemical site improvement has a long tradition (see the works of Němec, Mařan, Materna, Lhotský, et al.). One of the most promising ways how to utilize the fertilization in forests is the support of the site demanding tree species at their introduction or re-introduction on more extreme or degraded sites. The same approach is topical in conversion of the tree species composition of Czech forests after long-term cultivation of coniferous monocultures on many sites.

Grand fir (*Abies grandis* (Dougl. ex D.Don) Lindl.) is among the tree species with the highest production potential under conditions of the Central Europe. It is characteristic by rapid growth, production of high amount of technologically important wood and with remarkable landscaping and gardening value. In the past, also the decline of domestic White fir (*Abies alba*) contributed partially to the interest in this species in the past century. This aspect is less topical at present because of partial revitalization of White fir in the last decade. Also the environmentalistic obstacles represent certain limit for introduced tree species in general. But, as the result of past activities, the stands of Grand fir occupy several hundreds of hectares in the Czech Republic, this area being even larger in other European countries. Grand fir is studied as for its growth and production relatively well in the series of research plots and provenance experiments, documenting satisfactorily its production potential in the younger age

(Beran, 2006; Hofman, 1963; Šika, 1983; Vančura, 1990).

Those presentations are of older age and this species was not studied enough in the last period (Beran, 2006). Among other reasons, this is caused also by the minimal interest of the wood processing sphere in the introduced species because of missing market and restricted use – only limited number of species and assortments are demanded by big plants. To this situation, also the legislation problems are contributing, as well as the slight competence of the state administration to include the topic of biotechnologies and introduced tree species in the sustainable forestry concept in the CR. On the other side, the complex evaluation of all introduced species for their environmental aspects is missing almost totally, with few exceptions (e.g. Podrázský, 2003; Podrázský, Remeš, 2005a).

Another partly interlinked topic should be mentioned too: the introduction and re-introduction of more site-demanding species face series of problems on poorer and degraded sites. One of the options to overcome this shortage consists in the support of plantations by convenient fertilizing by deficient nutrients. E.g. the re-introduction of fir, beech, maple on sites after long-term cultivation of spruce and pine monocultures needs increased care for the next forest support.

There are preliminary results (Podrázský, Remeš, 2005b; Remeš et al., 2005) indicating good results. One of the most promising methods is the use of slow-release fertilizers of the SILVAMIX[®] series (Podrázský, 2006; Podrázský et al., 2005; Remeš et al., 2005). The presented article so deals with the fertilization experiment by these fertilizers on the plantation of Grand fir in the Czech-Moravian Highland.

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MATERIAL AND METHODS

The research was conducted on the plot with local name Babín 3 in the period 1997–2006. The experiment includes several particular research plots, the preliminary results have been published yet (P o d r á z s k ý , R e m e š , 2006). The plantation of the Grand fir was established in the shelter position under the stand of spruce, pine and individually admixed White fir in the years 1990–1991. The shelter is decreased in the last years from the value of ca 50% (1997) to almost 0%. The stand is described as 330C12, at the altitude 580 m a.s.l., the site is characterized as 5K8 – acid fir-beech site with *Vaccinium myrtillus*. The soil type was described as Dystric Cambisol. The SILVAMIX fertilizers were applied in spring 1997 in amounts: 4 tablets per 10 g of SILVAMIX FORTE for each plant, or 40 g of powdered SILVAMIX Mg. In the case of tableted fertilizer, it was spread by 10% more of nutrients, especially double dose of nitrogen. In particular years, it was determined and measured: mortality, height increment and total height by standard measuring devices – poles. The declining individuals were not measured in order to avoid both extremely sheltered and by roe-deer damaged individuals. The results were processed by the statistical program S-plus, the analysis variance was used.

RESULTS AND DISCUSSION

Fertilization represents an extreme variant in the forestry, in the silviculture respectively (P o d r á z s k ý , 2006). It should be applied, when the other options for silvicultural treatments failed, and in the economical way. The support of site demanding species on non-suitable sites is one of those reasons with high success potential. The Grand fir at the Babín 3 plot re-acted very rapidly and positively to the SILVAMIX fertilizer application. The mortality of the plantation was low because of well-established and prospering plantation at the time of fertilizer use. The thinning was performed at fertilized plots in 2002, for the fertilized trees were growing extremely fast (Table 1). Several stolen trees disappeared (Christmas trees).

The height increment of the control variant and on the fertilized treatments was statistically different since the first year of the experiment (Table 2), the differences increased in the next years. On the contrary, the difference between fertilized variants was negligible, despite the statistically significant difference to the control was determined during the whole study period. The height increment was considerably high also on the extreme site studied and in the shade (shelter) position. The tendency of slightly higher increment on variants with tablet form application comparing to powder one is not significant, but stable and interesting. This variant was characteristic by 10% higher nutrient amount, especially with double amount of nitrogen. This nutrient can be limiting at the studied locality, what was documented also on neighbouring plot with plantation of beech or sycamore (P o d r á z s k ý , 2006).

Different growth trends resulted in more than 30% higher total height of fertilized variants in the year 2006 (Table 3). The fertilization accelerated the height increment of firs, even in the shelter position. The period of high exposition to browsing by large herbivores was considerably shortened. Fertilization appears to be a convenient silvicultural treatment at the site-demanding tree species re-introduction. The effects of the treatment are visible even after 10 years, despite of low amount of fertilizer owing to the biomass of the target stand and the uptake of the shelter trees. Nutrients were effectively used and cycled. Fertilization appeared as convenient treatment of the support of site demanding tree species at their re-introduction in the forest stands. This was proven also at plantation and fertilization of other tree species in other cases using the SILVAMIX fertilizers (R e m e š et al., 2005). On the contrary, the plantation response can be very slight using the fertilizer at the species growing in convenient conditions, e.g. at spruce in the same site and location (P o d r á z s k ý , R e m e š , 2006).

Table 1. Effect of different SILVAMIX fertilizers on the Grand fir plantation on the Babín 3 locality – dynamics of number of individuals on the plots

Variant	Number of individuals		
	1997	2003	2006
Control	89	87	86
SILVAMIX tabl.	85	67	65
SILVAMIX pow.	89	74	72

Note: Thinning on fertilized variants in 2002

CONCLUSIONS

The results of application of amelioration materials depend always on the stand and site character. Under conditions of very poor site and the intensively growing plantation of relatively site demanding tree species we can expect high efficiency of these silvicultural treatments. However, the analysis of the tree species nutrition should precede in any case (P o d r á z s k ý , R e m e š , 2004).

The site demanding tree species supported by fertilization can be highly recommended in similar cases, i.e. at introduction and/or reintroduction of site demanding species. In our case, despite relatively low amount of nutrients applied, the plantations of Grand fir showed considerable increment effects in the case of both fertilizer forms. The height increment was significantly higher in the whole study period, 1997–2006, by 5–15 cm annually. The total height reached 398 cm for the control variant, 527 cm and 520 cm for both fertilized ones.

The studied fertilizer SILVAMIX showed long-lasting and positive effects. It appears to be a convenient tool for use in similar cases, i.e. at plantation poor and degraded sites.

Table 2. Effect of different SILVAMIX fertilizers on the Grand fir plantation on the Babín 3 locality – dynamics of height increment

Variant	Height increment – cm				
	1997	2003	2004	2005	2006
Control	19.4 a	37 a	45	41	36
SILVAMIX tabl.	24.8 b	49 b	59	50	41
SILVAMIX pow.	24.3 b	49 b	55	46	39

Note: Different indices indicate statistically significant differences

Table 3. Effect of different SILVAMIX fertilizers on the Grand fir plantation on the Babín 3 locality – dynamics of height

Variant	Height of plantations – cm				
	1996	2003	2004	2005	2006
Control	59.3	276 a	321 a	362 a	398 a
SILVAMIX tabl.	66.1	377 b	436 b	486 b	527 b
SILVAMIX pow.	63.6	380 b	435 b	481 b	520 b

Note: Different indexes indicate statistically significant differences

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Vliv přihnojení na prosperitu výsadeb jedle obrovské.

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Přihnojení stanovištně náročnějších dřevin se pokládá za efektivní podporu výsadeb v případě konverze smrkových a borových monokultur. Příspěvek dokládá vliv přihnojení na výsadbu jedle obrovské v oblasti Českomoravské vysočiny (Žďárské vrchy), na typických chudých stanovištích (SLT 5K). Byly sledovány přihnojené a kontrolní výsadby ve stáří 7–16 let (1997–2006). Plochy se nacházejí na území majetku Lesy Dr. Radslava Kinského, v nadmořské výšce 580 m n. m., stanoviště je charakterizováno LT 5K8 a půdním typem Kambizem dystrická. Jako meliorační látka bylo aplikováno pomalu rozpustné hnojivo SILVAMIX[®] ve formě práškové a tabletové. Přes poměrně malou dávku živin vykazovaly výsadby značnou růstovou reakci na obě formy hnojiva, obě varianty s aplikací melioračních materiálů se přitom ve svých účincích prakticky nelišily. Kultury a později mlaziny vykazovaly minimální mortalitu, na přihnojených variantách již bylo nutno přistoupit k prořezávkám (tab. 1). Výškový přírůst mlaziny (tab. 2) byl do roku 2003 statisticky významně vyšší na hnojených variantách, trend se zachoval i v pozdějších letech. Výsledkem je výrazné zvýšení výšky hnojených porostů (tab. 3) jako důsledek i poměrně slabého hnojivého zásahu. Na těchto chudých stanovištích tak lze očekávat příznivý efekt dodání deficitních živin při vnášení náročnějších druhů dřevin včetně daného druhu jedle a účinek hnojení je možno označit jako vysoce efektivní.

jedle obrovská; Českomoravská vrchovina; hnojení; růst; přírůst; SILVAMIX[®]

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