

DOUGLAS-FIR – PARTIAL SUBSTITUTION FOR DECLINING CONIFER TIMBER SUPPLY – REVIEW OF CZECH DATA

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ABSTRACT

The decrease is supposed of the coniferous assortments supply due to running changes of tree species composition in the Czech forests as well as due to the environmental changes in the next decades. The Norway spruce (*Picea abies* /L./ Karst.) is the most endangered species. The year timber supply decrease of this species is supposed in an extent of 0.9 mil.m³ in the next two decades (2013 – 2032) and more than 1 mil. m³ for all conifers. Cultivation of Douglas-fir (*Pseudotsuga menziesii* /Mirb./ Franco) can substitute N. spruce on specific sites and so eliminate partially the timber supply decline in the future. The cultivation of Douglas-fir could lead to increase of the plantation area from 5,800 ha (today) to the extent of 149,616 – 163,713 ha respecting legislative restrictions and recommendations of general management plans. This can represent increased timber increment of 300,000 – 650,000 m³ per year and substantially mitigate the coniferous timber supply fall in the next decades.

KEYWORDS: Douglas-fir (*Pseudotsuga menziesii* /Mirb./ Franco), silviculture, production potential, environmental effects, timber supply.

INTRODUCTION

Douglas-fir (*Pseudotsuga menziesii* /Mirb./ Franco) is an introduced tree species with the highest production potential among those from the temperate vegetation zone worldwide. It represents very often planted and cultivated species especially in France, Germany, Italy and United Kingdom (Šindelář and Beran 2004). In the Czech Republic, the area is represented by some 5,800 ha only, increasing by cca 100 ha per year. Even here, Douglas-fir represents a tree species with high potential use as any other conifer timber, having comparable or more suitable

properties (Kubeček et al. 2014, Vašíček 2014). The quality of Douglas-fir wood has been studied, for example, by Göhre (1958) and Hapla (2000), the impacts of cultivation measures on the wood quality by Hapla and Knigge (1985) and Hapla (1999). In local conditions, Remeš and Zeidler (2014) confirmed both production superiority, and both high timber quality of Douglas-fir. For successful introduction, the selection of proper provenances is necessary. For W-Europe, the Douglas-fir provenances from the coastal zone of the North American Pacific region seem to be the best, for Central Europe, more interior provenances are site corresponding. In other European countries, the populations originating from more continental climate could be selected (Beran 1995, Petkova et al. 2014, Popov 2014). In many regions, the site-proven local populations are available, because this species is planted for more than one century and the local conditions selected the most adapted genotypes, disposable both for natural as well as for artificial regeneration. Moreover, this highly productive species can be considered as site improving one with favorable effects on the soil and biodiversity comparing to the Norway spruce (Augusto et al. 2003, Kubeček et al. 2014, Menšík et al. 2009, Kantor 2008, Kantor and Mareš 2009, Podrázský et al. 2014a).

On the other side, Norway spruce (*Picea abies* /L./ Karst.), as the most important native species, has many problems connected with climate extremes (climate change), manifesting as large-area spruce decline at lower altitudes. So its replacing by other species at many sites is desirable. The changes in the species composition, together with stable pressure to more natural forest state and with N. spruce decline are leading to decrease of the N. spruce stand area and of spruce timber supply in the future, by probably year amount of 0.9 mil.m³ in the next two decades (MZe 2013, Podrázský et al. 2014b, Synek et al. 2014). So aim of the presented paper is to evaluate the option of partial replacing of the N. spruce by Douglas-fir, and to estimate the possible extent of this substitution.

MATERIAL AND METHODS

The supposed production of timber of particular tree species was presented by Synek et al. (2014). The potential allowable cut for N. spruce for the predicted period 2013–2032 was derived from the current database of forest management plans and guidelines according to the methodology for deriving logging perspectives (Vašíček et al. 2006).

The extent of the potential area suitable for the Douglas-fir cultivation was derived from Pulkrab et al. (2014). The calculation was based on the typological system of the Czech Republic, area of particular forest types and recommendations for the species composition and restrictions of the environmental character (protected areas etc.).

Comparison of the N. spruce and Douglas-fir production was based on the review of Kubeček et al. (2014), summarizing the synthesis concerning the production of both species considered. This presented review has so to utilize more original publications and some necessary proportion of auto-citations is so unavoidable.

RESULTS AND DISCUSSION

Synek et al. (2014) compared the potential timber felling according to the individual tree species on the national level with the long-term statistics, they might expect a considerable decrease in the main commercial species – spruce. Regarding the particular decades, the first

decade (2013 – 2022) would have spruce felling volumes at a level of the year 2012. However, a marked decrease by up to 1.6 mil. m³ would occur in potential annual spruce felling volumes development in the next decade (2023 – 2032). In case that there would be considered balanced felling volumes in the both decades, we would have to count with an annual drop by 0.9 mil. m³ as compared with the year 2012. The equability of spruce felling volumes in the subsequent decades will be most affected by the development of incidental (calamity) fellings. This situation can be even worsened by N. spruce decline in many regions of the country as well as in other European regions (MZe 2013, Šrámek et al. 2015). The substitution of N. spruce on large areas is necessary by other tree species to maintain vitality and stability of the Czech forests.

At present, Douglas-fir is dominating at some 5,800 ha of the forest lands (Vašíček 2014), with considerably higher potential (Kubeček et al. 2014). Assuming recommendation of the forest management plans, convenient sites and environmental restrictions, the areas disposable for this species cultivation represent 149,616 – 163,713 ha in the Czech Republic range (Pulkrab et al. 2014). This area can be used only continuously, so the substitution of the N. spruce by Douglas-fir will be not very fast, but lasting several decades. In each case, there is considerable potential for Douglas-fir area increase also in other areas, then assumed by present rules, changing the forestry paradigm with global changes in the sector space and the global environment (O'Hara 2015).

The use of substitute tree species instead of N. spruce on a part of its area of cca 1.3 mil ha is necessary. Its proportion decrease from 50.7 of the forested area to assumed 36.5 % (MZe 2013) will represent an important management treatment in the coming future. The improved management of coniferous timber represents vital challenge for the whole sector. The substitution of this species by Douglas-fir is considered as a tool mitigating this problem substantially. It could eliminate not only the production problems, but partly also the undesirable changes in forest soils caused by the N. spruce outside its natural range (Augusto et al. 2003, Máliš et al. 2010, Oulehle and Hruška 2005).

Analyzing the individual tree growth performance, Kantor (2008) and Kantor and Mareš (2009) documented much higher growth potential of the Douglas-fir, based on individual tree size. Quantification of the increment of the whole stands, Kubeček et al. (2014) documented the higher mean annual increment of the Douglas-fir stands comparing with N. spruce in a size of 2 – 4 m³ ha⁻¹.y⁻¹ in average growing conditions for Douglas-fir. Considering the minimum allowable area and increased growth performance, at substituting these two species, an increased increment can be calculated in the range between roughly 300,000 to 650,000 m³.y⁻¹ in similar time span, as the N. spruce timber supply decrease is to be expected. So the substitution represents considerable remedy potential for the wood industry in the next decades, using both introduced as well as local reproduction material (Martiník et al. 2014).

CONCLUSIONS

Douglas-fir represents very suitable substitution for the N. spruce on a part of its today range, which is not native at all too. The convenient area is roughly 10 % of the N. spruce distribution area, predominantly increased by the human activities in the last centuries. The minimum acceptable area of Douglas-fir stands can be assumed in the limits of 149,616 – 163,713 ha, which can be reached in several decades. This can continuously result in an increased annual increment of 300,000 to 650,000 m³.y⁻¹ in this time period. Moreover, favorable effects of this species on the forest soils and forest plant communities can be supposed as a consequence of this substitution.

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