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Long-term biomass production and nutrient uptake of birch, alder and willow plantations on cut-away peatland

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ABSTRACT

The leafless above-ground biomass production of planted silver birch (*Betula pendula*), downy birch (*Betula pubescens*), grey alder (*Alnus incana*), indigenous willows (*Salix triandra* and *Salix phylicifolia*) and an alder-willow mixture growing on a cut-away peatland area in Central Finland was investigated during a period of 18 (willows) or 19 (birches and alders) years. Biannual fertilization of the birches (0, NPK) and alders (0, PK) and annual fertilization of the willows (NPK1, NPK2) were continued for 10 years. *S. phylicifolia* had the highest yield (123 t ha^{-1}). The yield of the fertilized downy and silver birch was 112 t ha^{-1} and 108 t ha^{-1} respectively, and that of fertilized grey alder 85 t ha^{-1}, and alder *S. triandra* mixture 93 t ha^{-1}. The mean annual increment of willow was highest at the age of 10 years (*S. phylicifolia* 7.9 t ha^{-1} a^{-1}; *S. triandra* 5.6 t ha^{-1} a^{-1}). NPK-fertilization increased the 19-year biomass production of downy and silver birch by 14 and 29 t ha^{-1} respectively and PK fertilization that of alders by 25 t ha^{-1}. The alder plantations bound more N, P, K, Ca and Mg per unit leafless biomass produced after 10–11 growing seasons than the silver birch and downy birch plantations. The silver birch used more N, K and Ca, but similar amounts of P and Mg per unit leafless biomass produced than the downy birch. *S. triandra* used more N, P, K and Mg per unit biomass produced than *S. phylicifolia* and both birch species.

1. Introduction

The need for reducing greenhouse gas emissions is increasing the value of renewable energy obtained from forests. Wood-based fuels and recovered fuels are playing a leading role in Finland in attempts to reach national and European Union goals for increasing the use of renewable energy. The share of wood-based fuels out of total energy consumption in 2006 was 21%. In recent years the utilization of logging residues from final fellings and trees harvested in thinnings for energy production has increased rapidly. In addition to using wood fuels derived from existing forests, the establishment and utilization of woody biomass energy plantations are gaining new interest in many countries. Short-rotation forestry refers to the cultivation of fast-growing deciduous tree species, regenerated through sprouts, using short-rotation periods, intensive methods and dense stocking. Exotic *Salix* species have mainly been used in the short-rotation experiments conducted in Finland [1–8]. The biomass production of fertilized, densely planted alders, birches and poplars (southern Finland) has also been investigated [9–12]. However, because longer rotations are needed for birch and alder, the study period has so far been too short (5–9 years) to cover the whole rotation. Earlier studies on biomass production in dense, naturally regenerated and coppiced birch and alder stands have clearly demonstrated the biomass production potential of birches and grey alder [e.g. [3,13–19]].

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