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Nitrogen forms affect root structure and water uptake in the hybrid poplar

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Abstract The study analyses the effects of two different forms of nitrogen fertilisation (nitrate and ammonium) on root structure and water uptake of two hybrid poplar (*Populus maximowiczii* x *P. balsamifera*) clones in a field experiment. Water uptake was studied using sap flow gauges on individual proximal roots and coarse root structure was examined by excavating 18 whole-root systems. Finer roots were scanned and analyzed for architecture. Nitrogen forms did not affect coarse-root system development, but had a significant effect on fine-root development. Nitrate-treated trees presented higher fine:coarse root ratios and higher specific root lengths than control or ammonium treated trees. These allocation differences affected the water uptake capacity of the plants as reflected by the higher sapflow rate in the nitrate treatment. The diameter of proximal roots at the tree base predicted well the total root biomass and length. The diameter of smaller lateral roots also predicted the lateral root mass, length, surface area and the number of tips. The effect of nitrogen fertilisation on the fine root structure translated into an effect on the functioning of the fine roots forming a link between form (architecture) and function (water uptake).

Keywords Nitrogen fertilisation · Hybrid poplars · Root structure · Fine roots · Proximal roots · Water uptake · Sapflow

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