From Forest Nursery Notes, Summer 2009

48. © Consequences of nitrogen deficiency induced by low external N concentration and by patchy N supply in *Picea abies* and *Thuja occidentalis*. Gloser, V., Sedlacek, P., and Gloser, J. Trees 23:1-9. 2009.

Trees (2009) 23:1–9
DOI 10.1007/s00468-008-0248-1

ORIGINAL PAPER

Consequences of nitrogen deficiency induced by low external N concentration and by patchy N supply in *Picea abies* and *Thuja occidentalis*

Vít Gloser · Pavel Sedláček · Jan Gloser

Received: 6 November 2007 / Revised: 30 May 2008 / Accepted: 9 June 2008 / Published online: 17 July 2008

Abstract We examined the responses of two coniferous species *Picea abies* and *Thuja occidentalis* to decreased nitrogen availability. Plants were grown for 2 months in inorganic substrate irrigated by nutrient solution. Nitrogen availability was reduced either by lower N concentration in the nutrient solution or by a patchy supply of a high N concentration to only one side root isolated in a split-root setup where the rest of the root system received all nutrients except N. At the end of cultivation we measured rates of net photosynthetic CO_2 uptake, net nitrogen and water uptake, some structural characteristics (dry mass of fine roots, dry mass and area of needles) and the total N content of needles. For a more detailed analysis of the distribution of the newly acquired N within the shoot, ^{15}N was administered to subsets of plants in each of the three treatments. Low N availability resulted in lower specific leaf area in *Thuja* but not in *Picea*. The decrease of net photosynthesis at lower N supply was greater in *Picea* than in *Thuja*. Photosynthetic nitrogen use efficiency, however, linearly decreased with increasing N content only in *Thuja*. Patchy N supply caused uneven distribution of newly acquired labeled nitrogen and total N but did not result in significantly greater heterogeneity in the rate of photosynthesis among branches both in *Picea* and in *Thuja* plants. We conclude that both examined species possess mechanisms that reduce adverse effects of patchy N supply and restricted nitrogen transport in xylem to some parts of crown on their photosynthetic carbon assimilation.

Communicated by M. Conovas.

V. Gloser (✉) · P. Sedláček · J. Gloser
Department of Experimental Biology, Masaryk University,
Kotlářská 2, 611 37 Brno, Czech Republic
e-mail: VitGloser@sci.muni.cz

Keywords Norway spruce · Western white cedar · Sectorial xylem anatomy · PNUE · Photosynthesis · ^{15}N labelling

Introduction

Availability of nitrogen, one of the most important nutrients for plant growth, fluctuates in time and space (Jackson and Caldwell 1993; Stark 1994). In natural ecosystems N availability frequently limits plant metabolic processes and insufficient nitrogen may result not only in slower growth rate but also in altered biomass distribution and plant morphology.

Species show a wide range of morphological and functional responses to N limitation. It should be mentioned, that even in nutrient poor habitats some small areas with greater soil N availability may occur. In response to such nutrient-rich patches, roots may proliferate, they may increase specific nutrient uptake rate, and/or they may live longer (Jackson et al. 1990; Pregitzer et al. 1993; Robinson 1994; van Vuuren et al. 1996; Hodge 2004). Both greater root proliferation and stimulated specific uptake rate lead to greater nutrients acquisition by plants. Besides the enhancement of N uptake, plants respond to N limitation by increasing the nitrogen use efficiency. Namely nitrogen productivity as well as photosynthetic nitrogen use efficiency usually increases under N limitation (Boot et al. 1992; Garnier et al. 1995) but large differences exist among species.

Distribution of nutrients within a plant, however, can be as equally important as the total nutrient content for normal growth and development of the plant. In contrast to studies assuming homogeneous distribution of N within shoot segments, only limited information is available about