KAMH, M., WIESLER, F., ULAS, A., HORST, W.J. (2005): Root growth and N-uptake activity of oilseed rape (*Brassica napus* L.) cultivars differing in nitrogen efficiency. J. Plant Nutr. Soil Sci. 168, 130-137.

Abstract

Nitrate-N uptake from soil depends on root growth and uptake activity. However, under field conditions N uptake activity is difficult to estimate from soil N depletion due to different loss pathways. We modified a current method (mesh-bag method) to estimate nitrate-N uptake activity and root growth of two oilseed rape cultivars differing in N uptake efficiency as previously reported (Wiesler et al., 2001a). N-efficient cultivar (cv.) 'Apex' and N-inefficient cv. 'Capitol' were grown in a field experiment in 2002 on a silty clayey gleyic fluvisol near Göttingen, northern Germany, and fertilized with 0 (N_0) and 227 (N_{227}) kg N ha^{-1}.
In February 2002, PVC tubes with a diameter of 50 mm were installed between plant rows at 0 - 0.3 and 0 - 0.6 m soil depth with an angle of 45°. At the beginning of shooting, beginning of flowering, and at seed filling, the PVC tubes were substituted by PVC tubes (compartments) of the same diameter, but with an open window at the upper side either at a soil depth of 0 - 0.3 or 0.3 - 0.6 m allowing roots to grow into the tubes. Anion exchange resin at the bottom of the compartment allowed estimation of nitrate leaching. The compartments were then filled with root-free soil which was amended with or without 90 mg N kg^{-1} soil. The newly developed roots and nitrate-N depletion were estimated in the compartments after the installing period (21 days at shooting stage and 16 days both at flowering and grain-filling stages). Nitrate-N depletion was estimated from the difference between NO_3^--N contents of compartments containing roots and control compartments (windows closed with a membrane) containing no roots. The amount of nitrate leached from the compartments was quantified from the resin and has been taken into consideration in the calculation of the N depletion. N depleted from the compartments significantly correlated with root-length density.
Suboptimal N application to the crop reduced total biomass and seed-yield formation substantially (24% and 38% for 'Apex' and 'Capitol', respectively). At the shooting stage, there were no differences in root production and N depletion from the compartments by the two cultivars between N_0 and N_{227}. But at flowering and seed-filling stages, higher root production and accordingly higher N depletion was observed at N_0 compared to N_{227}. Towards later growth stages, the newly developed roots were characterised by a reduction of root diameter and a shift towards the deeper soil layer (0.3 - 0.6 m). At low N but not at high N supply, the N-efficient cv. 'Apex' exhibited higher root growth and accordingly depleted nitrate-N more effectively than the N-inefficient cv. 'Capitol', especially during the reproductive growth phase. The calculated nitrate-N uptake rate per unit root length was maximal at flowering (for the low N supply) but showed no difference between the two cultivars. This indicated that the higher N-uptake efficiency of cv. 'Apex' was due to higher root growth rather than higher uptake per unit of root length.