Geophysical Research Abstracts
Vol. 17, EGU2015-4766, 2015
EGU General Assembly 2015

Measurements of water uptake of maize roots: insights for traits that influence water transport from the soil

Mutez A. Ahmed, Mohsen Zarebanadkouki , Eva Kroener, and Andrea Carminati
Division of Soil Hydrology, Georg-August University of Göttingen, Göttingen 37077, Germany (mahmed@gwdg.de)

Water availability is a primary constraint to the global crop production. Although maize (*Zea mays* L.) is one of the most important crops worldwide, there is limited information on the function of different root segments and types in extracting water from soils. Aim of this study was to investigate the location of water uptake in maize roots.

We used neutron radiography to: 1) image the spatial distribution of maize roots in soil and 2) trace the transport of injected deuterated water (D_2O) in soil and roots. Maize plants were grown in aluminum containers ($40\times38\times1$ cm) filled with sandy soil. The soil was partitioned into different compartments using 1-cm-thick layers of coarse sand. When the plants were two weeks-old we injected D_2O into selected soil compartments. The experiments were performed during the day (transpiring plants) and night (non transpiring plants). The transport of D_2O into roots was simulated using a convection–diffusion numerical model of D_2O transport into roots. By fitting the observed D_2O transport we quantified the diffusion coefficient and the water uptake of the different root segments.

The maize root architecture consisted of a primary root, 4-5 seminal roots and many lateral roots connected to the primary and seminal roots. Laterals emerged from the proximal 15 cm of the primary and seminal roots. Both during day and night measurements, D_2O entered more quickly into lateral roots than into primary and seminal roots. The quick transport of D_2O into laterals was caused by the small radius of lateral roots. The diffusion coefficient of lateral roots (4.68×10^{-7}cm^{2}s^{-1}) was similar to that of the distal segments of seminal roots (4.72×10^{-7}cm^{2}s^{-1}) and higher than of the proximal segments (1.42×10^{-7}cm^{2}s^{-1}). Water uptake of lateral roots (1.64×10^{-5}cms^{-1}) was much higher than that of the distal segments of seminal roots (1.18×10^{-12}cms^{-1}). Water uptake of the proximal seminal segments was negligible.

We conclude that the function of lateral roots is to absorb water from the soil, while the function of the primary and seminal roots is to axially transport water to the shoot. Breeding for lateral roots with high radial conductivity and seminal roots with large xylem vessels diameter would be beneficial in agroecosystems where water is available. In contrast, in arid and semi-arid areas seminal roots with a smaller xylem vessel diameter combined with deep branching of laterals would reduce transpiration rate and at the same time allow the uptake of water stored in the subsoil (Richards and Passioura 1989).

Reference

Richards RA, Passioura JB. (1989) A breeding program to reduce the diameter of the major xylem vessel in the seminal roots of wheat and its effect on grain yield in rain-fed environments. **Australian Journal of Agricultural Research** 40, 943–950.