

Root type matters: measurements of water uptake by seminal, crown and lateral roots of maize

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Roots play a key role in water acquisition and are a significant component of plant adaptation to different environmental conditions. 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 root water uptake in mature maize.

We used neutron radiography to image the spatial distribution of maize roots and trace the transport of injected deuterated water (D_2O) in soil and roots. Maize plants were grown in aluminum containers filled with a sandy soil that was kept homogeneously wet throughout the experiment. When the plants were five weeks-old, we injected D_2O into selected soil regions. The transport of D_2O was simulated using a diffusion-convection numerical model. By fitting the observed D_2O transport we quantified the diffusion coefficient and the water uptake of the different root segments. The model was initially developed and tested with two weeks-old maize (Ahmed et. al. 2015), for which we found that water was mainly taken up by lateral roots and the water uptake of the seminal roots was negligible.

Here, we used this method to measure root water uptake in a mature maize root system. The root architecture of five weeks-old maize consisted of primary and seminal roots with long laterals and crown (nodal) roots that emerged from the above ground part of the plant two weeks after planting. The crown roots were thicker than the seminal roots and had fewer and shorter laterals. Surprisingly, we found that the water was mainly taken up by the crown roots and their laterals, while the lateral roots of seminal roots, which were the main location of water uptake of younger plants, stopped to take up water. Interestingly, we also found that in contrast to the seminal roots, the crown roots were able to take up water also from their distal segments.

We conclude that for the two weeks-old maize 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. For the five weeks-old maize, water was mainly taken up by the crown roots and their associated laterals. The ability of crown roots to uptake water from the distal segments can help maize to extract water from deep soil layers and better tolerate drought.

Reference

Ahmed MA, Zarebanadkouki M, Kaestner A, Carminati A (2015) Measurements of water uptake of maize roots: the key function of lateral roots. *Plant and Soil* 1–19. doi: 10.1007/s11104-015-2639-6