EGU24-18268, updated on 18 Apr 2024
https://doi.org/10.5194/egusphere-egu24-18268
EGU General Assembly 2024
© Author(s) 2024. This work is distributed under
the Creative Commons Attribution 4.0 License.

Root hairs prevent excessive losses in leaf water potential of field grown maize at high atmospheric vapor pressure deficits even in wet soils

Florian Stoll[1,2], Osman Mustafa[3,4], Asegidew Akale[2], Andrea Carminati[1], Jan Vanderborght[3], Matthieu Javaux[5], and Mutez Ahmed[2]

[1]Physics of soils and terrestrial ecosystems, ETH Zurich, Zurich, Switzerland (florian.stoll@usys.ethz.ch)
[2]Root-Soil Interactions, TU Munich, Munich, Germany
[3]Institute of Bio- and Geosciences IBG-3: Agrosphere, Jülich Reserach Center, Jülich, Germany
[4]Department of Botany and Agricultural Biotechnology, University of Khartoum, Khartoum, Sudan
[5]Earth and Life Institute, UC Louvain, Louvain-la-Neuve, Belgium

High atmospheric vapor pressure deficits lead to high transpiration demands which can induce plant water stress because of large dissipation of water potential within plant tissues, but also because the transpiration demand exceeds the possible root water uptake rate from the soil. The latter point might be particularly critical in coarse textured soils which display poor soil-root contact and an unsaturated hydraulic conductivity curve steeply decreasing with matric potential. Root hairs can increase the possible root water uptake rate by increasing the root-soil contact and the effective root radius. Thus, we hypothesize that plants with functional root hairs display (1) less negative leaf water potentials at midday at high transpiration rates in comparison to plants without root hairs; and (2) that this effect is more pronounced in coarse textured soils at low soil matric potentials.

To test these hypotheses, we grew two maize (*Zea mays*) genotypes (wildtype and its root hairless mutant) in two contrasting soil textures (Sand vs Loam). We measured leaf water potential (leaf Psychrometer), transpiration rate (sap flow), atmospheric vapor pressure deficit, soil water potential and soil water content every ten minutes for 30 consecutive days in summer of 2023.

The root hair bearing wildtype consistently maintained a higher transpiration rate at relatively less negative leaf water potentials when the atmospheric vapor pressure deficit was high. This effect was more pronounced in coarse textured soil (sand) even in relatively wet soils (soil matric potentials > -100 kPa).

We concluded that root hairs enabled plants, in relatively wet soils to maintain high transpiration rates without excessive leaf dehydration. This suggests that at high atmospheric vapor pressure deficit, losses in the hydraulic conductivity of the rhizosphere can already limit transpiration even when the soil would be typically considered wet. Our findings highlight the importance of rhizosphere processes and their relevance for plant water use at the field scale.