Geophysical Research Abstracts,
Vol. 11, EGU2009-6897, 2009
EGU General Assembly 2009

Root water extraction under combined water and osmotic stress

J.C. van Dam (1), Q. de Jong van Lier (2), and K. Metselaar (1)

(1) Wageningen University, Dept. of Environmental Science, Wageningen, Netherlands (jos.vandam@wur.nl, 0031 317 419000), (2) Esalq-University of Sao Paulo, Dept. of Exact Sciences, Piracicaba, Brazil (qdjvlier@esalq.usp.br)

Many crop and water management issues pertain to the entire plant-root system and may include both water and osmotic stress. The challenge is to find a concise set of soil physical and plant physiological parameters which characterize this system and enable us to quantify root water uptake and stomatal conditions. Among the soil physical parameters, the matric potential function appears to be very useful to determine the onset of drought stress and the decline of root water uptake thereafter. We may use this concept at root level, but also at plant level. In the latter case the concept allows for soil physical and root density heterogeneity, soil water fluxes within the root zone, and compensation of root water uptake when certain parts of the root zone contain more water than other parts. The input parameters are often already used in vadose zone models: potential transpiration rate, root length density, minimum root surface pressure head and soil hydraulic functions.

Recently the authors extended their water uptake concept at root level to include osmotic stress due to salinity. In literature various concepts for combined water and salt stress are used. All these concepts include calibration parameters to accommodate the different root water uptake response to soil water pressure head and osmotic head. When using the matric flux potential, we may get rid of these calibration parameters. We employ the fact that osmotic head in the soil water due to salts counteracts the osmotic head in the roots. We will show simulated results of this concept and compare them to other common approaches. The developed concept shows the large influence of root density and soil hydraulic functions, factors which are usually not explicitly accounted for.

Also we hypothesize how the presented concept can be used in one- or multi-dimensional agrohydrological models with non-uniform root zones. No additional empirical input parameters are required. An important feature is automatic compensation of drought and salinity stress in particular parts of the root zone by extra root water extraction in less dry and/or saline parts.