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Root water uptake modeling compared to field experiments in Brazil

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Information about root water uptake partitioning over depth is important for hydrological and crop growth modeling. Under wet conditions, experimental results show that this partitioning is highly correlated to root length density. Plants may compensate for water content heterogeneity when one or more of the rooted layers get drier. Some models deal with this matter in an empirical way, increasing simulated uptake from wetter layers when dry layers are present. We recently proposed a physically based method to model root water uptake partitioning which includes not only root length density but also a composite soil physical characteristic, the matric flux potential (not the matric potential) of respective soil layers (De Jong van Lier et al., 2008). Experiments have been performed to test this model under greenhouse conditions, showing the model to predict a higher tolerance to drought than experimentally verified. To correct this, a root system efficiency factor was included, coping for the effects of uneven root distribution within layers, imperfect root-soil contact and other possible causes for this discrepancy.
To test model performance under field conditions, field experiments are being carried out in Piracicaba, São Paulo State, Brazil. A first crop (common bean, Phaseolus vulgaris) has been monitored between June and August, 2010. A second crop, soy bean (Glycine max) was seeded in November, 2010; harvest is expected in March, 2011. In both crops, two irrigation schemes are imposed: a fully irrigated plot and a plot where irrigation is suspended during the reproductive crop development stage. Soil water status is monitored by six polymer tensiometers and six Decagon EchoProbe sensors per plot, installed at two observation points and three depths: 0.05 m, 0.15 m and 0.3 m.
Soil hydraulic properties were determined using the Wind evaporation method; root length density per depth is determined by root mass as well as root image analysis. Observed water contents and pressure heads are compared to predictions by the SWAP model using the root water uptake partitioning as proposed by De Jong van Lier et al. (2008). Results of these comparisons will be shown and discussed.

References

De Jong Van Lier Q, Van Dam JC, Metselaar K, de Jong R, Duijnisveld WHM (2008) Macroscopic root water uptake distribution using a matric flux potential approach. Vadose Zone J 7:1065-1078