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Investigation of water productivity for maize with focus on the difference in global radiation between a greenhouse and a field site

Sebastian Kloss and Niels Schütze
Technische Universität Dresden, Institute of Hydrology and Meteorology, Dresden, Germany (sebastian.kloss@tu-dresden.de)

Simulation models for crop growth become increasingly important to investigate yield development and water consumption, which help reducing the experimental expenditures and performing scenario analyses, particularly in the light of finding adaption strategies to cope with limited water supply. Often, small pot greenhouse experiments are conducted to evaluate the suitability of a crop or a certain irrigation strategy. Results from such experiments serve then as a recommended management practice for application in the field.
Previous investigations on water productivity for maize from greenhouse experiments have shown, that crop growth modeling was only successful when observed global radiation was increased by more than 50%. This suggests a higher exposure to global radiation of the crop in greenhouses and makes the transfer of results to the field difficult.
In this contribution, a study is presented that investigates WP of maize with focus on the difference in global radiation between a greenhouse and field site. An intensively monitored irrigation experiment with containers in a greenhouse was conducted. Two deficit and one full irrigation treatments for two different soils were investigated. Irrigation was controlled by a soil-water potential sensor capable of measuring tensions between pF0 and pF7 with the goal to achieve a high WP. Other sensors included tensiometers, TDR, VH400 soil water sensors, and Hydra probes. Two containers were placed on scales which served as minilysimeters to determine the soil-water balance throughout the growing period of the crop. All containers were placed so that no shading would occur between them.
The greenhouse was compared to an outdoor site with an equal setup of maize grown in containers and a field site with maize growing under field conditions. Measurements of the global radiation between those three sites were taken in weekly intervals with a sensor measuring the global radiation from six spatial directions at the same time. The study concludes with the quantification of the crops' different exposure to global radiation at the three sites and compares achieved crop yields and water consumption. Results give a first indication about the actual difference in global radiation exposure and how to improve simulation models when conduction small pot irrigation experiments and transfer of their results to the field.