EGU2020-16325
https://doi.org/10.5194/egusphere-egu2020-16325
EGU General Assembly 2020

Assessing canopy temperature-based water stress indices for soybeans under subhumid conditions

Angela Morales Santos and Reinhard Nolz
Institute for Soil Physics and Rural Water Management, Department of Water, Atmosphere and Environment, University of Natural Resources and Life Sciences, Vienna, Austria (a.moralessantos@boku.ac.at)

Sustainable irrigation water management is expected to accurately meet crop water requirements in order to avoid stress and, consequently, yield reduction, and at the same time avoid losses of water and nutrients due to deep percolation and leaching. Sensors to monitor soil water status and plant water status (in terms of canopy temperature) can help planning irrigation with respect to time and amounts accordingly. The presented study aimed at quantifying and comparing crop water stress of soybeans irrigated by means of different irrigation systems under subhumid conditions.

The study site was located in Obersiebenbrunn, Lower Austria, about 30 km east of Vienna. The region is characterized by a mean temperature of 10.5°C with increasing trend due to climate change and mean annual precipitation of 550 mm. The investigations covered the vegetation period of soybean in 2018, from planting in April to harvest in September. Measurement data included precipitation, air temperature, relative humidity and wind velocity. The experimental field of 120x120 m^2 has been divided into four sub-areas: a plot of 14x120 m^2 with drip irrigation (DI), 14x120 m^2 without irrigation (NI), 36x120 m^2 with sprinkler irrigation (SI), and 56x120 m^2 irrigated with a hose reel boom with nozzles (BI). A total of 128, 187 and 114 mm of water were applied in three irrigation events in the plots DI, SI and BI, respectively. Soil water content was monitored in 10 cm depth (HydraProbe, Stevens Water) and matric potential was monitored in 20, 40 and 60 cm depth (Watermark, Irrometer). Canopy temperature was measured every 15 minutes using infrared thermometers (IRT; SI-411, Apogee Instruments). The IRTs were installed with an inclination of 45° at 1.8 m height above ground. Canopy temperature-based water stress indices for irrigation scheduling have been successfully applied in arid environments, but their use is limited in humid areas due to low vapor pressure deficit (VPD). To quantify stress in our study, the Crop Water Stress Index (CWSI) was calculated for each plot and compared to the index resulting from the Degrees Above Canopy Threshold (DACT) method. Unlike the CWSI, the DACT method does not consider VPD to provide a stress index nor requires clear sky conditions. The purpose of the comparison was to revise an alternative method to the CWSI that can be applied in a humid environment.

CWSI behaved similar for the four sub-areas. As expected, CWSI ≥ 1 during dry periods (representing severe stress) and it decreased considerably after precipitation or irrigation

(representing no stress). The plot with overall lower stress was BI, producing the highest yield of the four plots. Results show that DACT may be a more suitable index since all it requires is canopy temperature values and has strong relationship with soil water measurements. Nevertheless, attention must be paid when defining canopy temperature thresholds. Further investigations include the development and test of a decision support system for irrigation scheduling combining both, plant-based and soil water status indicators for water use efficiency analysis.