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“Development on the margin”

Using the Aquacrop Model to Optimise Deficit Irrigation Scheduling of Cotton in Uzbekistan

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Abstract

The global water demand for irrigated agriculture, municipal and industrial consumption mainly driven by population growth is increasing against limited fresh water resources. To cope with the disadvantageous impacts of climate change on water resources availability and to fulfil water demands by ecosystems is challenging water management. Irrigated agriculture, by far the biggest water user with low efficiency, is therefore under high pressure to increase water productivity. For rational management of limited water supply, advanced irrigation scheduling and innovative technologies are needed. Various models aiming at crop water management for irrigated and rainfed conditions have been developed. Whether simple such as CROPWAT or sophisticated such as APSIM, CROPSYSTs etc., their problem is either limited quality of results or high demand for input data. Conversely, AquaCrop is a promising approach which simulates achievable yields of major crops as a function of water consumption under rainfed, supplemental, deficit, and full irrigation conditions, with comparatively justifiable data demand. To derive both the optimal irrigation schedule and optimise the deficit irrigation schedule for cotton, AquaCrop was used in Khorezm/Uzbekistan. The novelty of this study lies in the fact that the Hydrus-1D model was used to quantify the daily capillary rise due to shallow groundwater, because combined with AquaCrop it can overcome the missing consideration of the capillary rise in the standard version of AquaCrop. Alongside optimal irrigation schedule, deficit strategies were also derived in two ways 1) proportionally reduced water supply (RWS) of 20, 40, 50 and 60 % throughout the crop growth and 2) introduction of stress at specific crop growth stages. The results show that proportionally RWS of 40, 50 and 60 % resulted into 14, 30 and 48 % yield reduction respectively. During stress at the late crop development stage, a RWS of 12 % resulted in a yield increase of 8%. Conversely, during stress at the earlier crop development stage, yield loss was 17%. During water stress at the late ripening stage, no yield loss was observed. In conclusion, AquaCrop is a useful tool in irrigation management under water scarcity conditions at field and scheme level.

Keywords: AquaCrop, deficit irrigation, irrigation scheduling, water scarcity