Predicting Malt Barley Yields and Water use in Two Contrasting Rainfall Years to Improve Supplemental Irrigation Schedules Under Water Scarcity Conditions

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Abstract

Barley is usually cropped during the Winter-Spring season and may require supplemental irrigation in dry years. When malt barley is cropped for the industry, irrigation is used to achieve high commercial yields taking into consideration that irrigation should be ceased about one month prior to harvesting in order to achieve high malt quality. Data from two crop seasons of *Hordeum vulgare* L. cv. Publican, one dry and the second wet, cropped in a farmer's field located in the Ribatejo region, Portugal, were used for calibrating and validating the SIMDualKc soil water balance model, to assess the ability of a simplified approach (SIMDualKc model coupled with the Stewart's global model) for grain yield predictions and to parameterize and test the AquaCrop crop growth and yield model. The SIMDualKc model calibration consisted in deriving the basal crop coefficients (Kcb) and depletion fractions for no stress (p) along the crop growth stages using available soil water (ASW) observations throughout the season. Validation of the model consisted in using the calibrated parameters for the wet season. Results have shown a good agreement between observed and predicted ASW, with low errors of estimate (RMSE < 9% of the total available water) and high modelling efficiency (EF > 0.85). The AquaCrop model was parameterized for the canopy cover curve using data derived from LAI observation with good results (RMSE < 5.2% and EF > 0.97). It was also tested using the referred observed ASW data, however showing lower accuracy than SIMDualKc and a bias in ASW estimations. Good yields predictions were obtained with both the simplified approach and with AquaCrop, with deviations not exceeding 17% of observed grain yields. Under dry climatic conditions and using two sowing dates, several supplemental irrigation strategies were designed and evaluated using both models. The feasibility assessment of those alternatives was performed analysing the water-yield impacts and various water productivity indicators. Results have shown that there could be advantageous to adopt early sowing and supplemental deficit irrigation. Furthermore, results showed that rainfed malt barley may not be economically feasible under dry climatic conditions, thus indicating that this strategy should be adopted with caution by farmers. This study shows that SIMDualKc model is more adequate than AquaCrop for irrigation scheduling proposes and that both modelling approaches herein applied can be used for yield predictions and to support farmers' advice.

Keywords: dual crop coefficients, crop transpiration and soil evaporation, soil water balance model, Stewart's model, AquaCrop model, simulation modelling