Modelling the Soil Water Balance of Maize under No-tillage and Conventional Tillage Systems in Southern Brazil

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Abstract

No-tillage and crop residue practices could help improving water productivity (WP) in irrigated areas. Mulches increase the crop yield and WP by favouring the water status in the root zone and reducing soil evaporation. However, scientific knowledge tells that no-till systems change the soil physical properties by increasing the soil bulk density and reducing soil porosity, which can lead to alterations in soil water fluxes as well as the soil water dynamics in the soil-plant-atmosphere system. Thus, water balance models combined with field experiments can favour a better understanding of the soil water dynamics under different tillage systems and irrigation management. The present study aimed at assessing the performance of the soil water balance model SIMDualKc which applies the dual crop coefficient approach to partition crop evapotranspiration into crop transpiration and evaporation components of a maize crop cultivated under no-tillage and conventional tillage systems, and under different irrigation managements. Two experiments were carried out in the 1999/2000 and 2000/2001 growing seasons in an experimental field of the Agricultural Engineering Department of the Federal University of Santa Maria, Southern Brazil. Treatments consisted of a 2 x 2 factorial scheme, in a completely randomized design, with four replications. The tested treatments were: Factor A - irrigation management (irrigation and terminal water stress, irrigation was ceased after V7) and, Factor B - tillage system (no-tillage and conventional tillage). Soil water content was measured three times a week along crop seasons using a neutron probe until 1.10 m of soil depth. Irrigation was scheduled using as threshold a cumulative crop evapotranspiration of 25 mm and an irrigation depth that allowed raised the soil water content to field capacity was used. The SIMDualKc model was calibrated for each tillage and irrigation management using data from the first season and validated against data of the 2000/2001 season. Goodness of fit indicators were used to assess model performance and included a linear regression through the origin and an ordinary least-squares regression between observed and simulated soil water content, having respectively as indicators the regression coefficient (b0) and the determination coefficient (R2), the Root Mean Square Error (RMSE) and the Nash and Sutcliff model efficiency (EF). Results show the ability of the model to be further explored to support farm irrigation scheduling and tillage practices in southern Brazil.

Keywords: tillage systems, soil water balance, soil and water conservation, evapotranspiration partition, SIMDualKc model