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Effect of field crops on soil water content in root zone

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The objective of this study was to identify and quantify biometrical characteristics of plants which play a key role as factors affecting soil water dynamics in the root zone of field crops. For this purpose, an improved steady-state soil-vegetation-atmosphere transfer model was developed and tested. The idea of the model is based on Darcy's law, continuity equation, Penman-Monteith equation and the assumption that the effect of the plant water storage on transpiration rates can be neglected. A soil water budget algorithm was used to estimate the soil water content in the root zone. The model takes into account the impact of the water uptake by plants on soil water content in the root zone as well as the effect of interception on precipitations reaching the soil surface. The verification of the model was carried out for surface soil layers beneath maize stands growing in different soil and climatic conditions. Results of model simulations were used to determine the response of the soil water content in the root zone of the maize stand to changes in stand characteristics. Obtained results indicated that the stomatal resistance and physiological control of the transpiration has a great importance for time variability of the soil water content in the root zone. These factors, together with changes in the leaf area index and the root system development, affect substantially the evapotranspiration rate as well as the water uptake by roots of plants. Model simulations led to conclusions that seasonal changes in the root/shoot ratio can significantly influence the soil water dynamics in the root zone during the growing period. It was shown that the seasonal reduction of the soil water content in the root zone beneath the stand with high root/shoot ratio was greater in comparison with situation below stands with lower root/shoot ratio growing under the same environmental conditions. Model applications provided a possibility to compare seasonal changes in the soil water content in the root zone of field crops with the situation in the surface layer of the bare soil. The obtained results were completed by separating the soil and at-

mospheric effects on transpiration what enabled to express the partial dependences of soil water content in the root zone on individual plant characteristics. A case study was carried out with aim to simulate the impact of changes in plants characteristics on soil water content for selected soil and weather conditions. It was found that the influence of plant characteristics on soil water content in the root zone has been manifested very intensively when plants suffered by water stress. On the other hand, when canopies are well supplied with soil water, the evapotranspiration is governed by atmospheric factors and plants have only a small effect on the soil water content in the root zone. Finally, importance of obtained results for better understanding of interrelations between the soil water content in the root zone and plant water regime is evaluated and potential applications of model simulations in irrigation management are discussed.