

Simulation of soil water transport in apple-soybean alley cropping system under drip irrigation and film mulching

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Alley cropping and mulched drip irrigation are widely used techniques for achieving high yields and water savings. Understanding the soil water distribution characteristics of alley cropping farmland under mulched drip irrigation is crucial for improving water use efficiency, increasing yields, and boosting income. This study aimed to investigate soil water under different irrigation amounts and film mulching times through a two-year field experiment. In the experiment, two upper limits of irrigation amount (50% and 80% of field capacity) and two film mulching times (soybean sowing to podding stage and film mulching throughout the growth period) were set. The HYDRUS-2D model was used to simulate the difference in soil water at various positions and the two-dimensional distribution characteristics of soil moisture in alley cropping drip irrigation farmland. The results showed that the soil moisture model based on HYDRUS-2D had high precision, with a coefficient of determination ranging from 0.60 to 0.93 and a root mean square error ranging from 0.006 to 0.038 cm³/cm³. In the horizontal direction, the soil moisture content at 2.3 m from the tree row increased by an average of 4.87% to 17.65% compared to other distances. In the vertical direction, the maximum soil moisture content was observed in the 40 cm soil layer, with an increase of 26.04% to 42% compared to the 10 cm soil layer. The 2D soil water distribution showed that the water saturation zone of drip irrigation was mainly concentrated in the 0-20 cm soil layer. These findings can serve as a reference for developing irrigation schedules for alley cropping farmland under drip irrigation.