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Postprint: Study on Water Transport Characteristics in the Vadose Zone of the Weining Plain

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Abstract

Rainfall, irrigation infiltration, and phreatic water evaporation play significant roles in the groundwater cycle of the Weining Plain. To accurately evaluate vertical infiltration recharge and evaporation of groundwater in the Weining Plain, two vadose zone in-situ test sites were established in Zhongwei and Zhongning, with observation periods from June 2013 to November 2013 and from April 2014 to October 2014. Soil water suction, temperature, lithology, and water movement parameters at different burial depths were obtained at both test sites, and the localized flux method was employed to calculate surface evapotranspiration, infiltration, and water table evaporation and infiltration. The results indicate that: under conditions of identical vadose zone lithology, same irrigation period (July–October), and similar total irrigation amounts, the crop irrigation pattern determines the intensity of irrigation recharge to the phreatic water. The recharge amount from corn under few-large-events irrigation (150 mm per application) was 373.65 mm, far greater than the 152.3 mm under many-small-events irrigation (50 mm per application) for eggplant. However, under the premise of identical vadose zone lithology, same crop, and unchanged irrigation pattern, the net recharge intensity to the water table was similar in the same period: the net flux at the water table at the Zhongning test site was 32.88 mm from July to October 2013, and 57.42 mm in the same period of 2014. Under rainfall conditions or with small irrigation amounts (50 mm), vegetation growth hinders water percolation in the vadose zone; with large irrigation amounts (100 mm and 150 mm), vegetation growth promotes water percolation in the vadose zone.

Full Text

Moisture Migration Characteristics in Vadose Zones in Weining Plain

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Abstract

Moisture migration—including precipitation infiltration, irrigation infiltration, and phreatic water evaporation in the vadose zone—plays a critical role in groundwater circulation. To accurately quantify water exchange through the vadose zone in the Weining Plain, this study established two in-situ experimental sites in Zhongwei County and Zhongning County, Ningxia Hui Autonomous Region, China. Observations were conducted from June to November 2013 and from April to October 2014. Soil water pressure, temperature, texture, and hydraulic parameters were measured at various depths, while evapotranspiration, surface infiltration, and groundwater evaporation and infiltration were calculated using the oriented flux method.

At the Zhongwei site, groundwater recharge through the vadose zone in maize fields (373.65 mm) was substantially greater than in eggplant fields (152.3 mm). The maize fields received low-frequency irrigation with large volumes per application (150 mm), whereas eggplant fields received high-frequency irrigation with small volumes (50 mm). This indicates that under similar soil texture, irrigation period (July–October), and total irrigation amounts, crop irrigation patterns fundamentally determine recharge quantities to the phreatic aquifer.

At the Zhongning site, net groundwater recharge through the vadose zone was 32.88 mm from July to October 2013 and 57.42 mm during the same period in 2014, suggesting that with consistent soil texture, crop type, and irrigation pattern, interannual variation in recharge remains relatively small. Vegetation growth during rainfall or small irrigation events (50 mm) hinders water infiltration into the vadose zone, whereas large irrigation volumes (100–150 mm) accelerate infiltration.

Keywords: Weining Plain; vadose zone; moisture migration characteristics

Note: Figure translations are in progress. See original paper for figures.

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