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Water exchange process and water uptake for irrigated maize cropland in a desert-oasis transition area, Northwest China

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Soil water and groundwater convert frequently under cropland in a desert-oasis transition area, Northwest China. Crops variedly utilize soil water and groundwater during different growth periods under the cropland with shallow groundwater. The study of water exchange process under irrigated cropland has important significance for regulating the contradiction between water saving and groundwater recharge in the desert-oasis transition area. Soil moisture and soil matric potential at depths ranging from 0 to 70 cm were measured using HydraProbe II and TEROS-21 soil sensors in maize (Zea mays L.) fields in 2019. Stable isotope (δ^2H□δ^{18}O) in different water sources (precipitation, irrigation water, soil water, crop stem, and groundwater) was also measured. The results showed that the groundwater depth varied between 0.57-1.07 m during the maize growth periods. The groundwater depth increased in summer due to the influence of pumped well, while the depth decreased in autumn resulting from the irrigation return water. In the maize growing season, soil moisture and water potential at depths from 10 cm to 30 cm responded to three irrigation times, while soil moisture and water potential below the depth of 50 cm were greater and kept a steady state, which were affected by upward capillary rise of groundwater. The relationship of soil water stable isotope values was δ^2H=2.45δ^{18}O-31.41, which was lower than the slope of the local atmospheric precipitation line due to the evaporation effect. The soil water stable isotope values at depth of 10 cm varied, while the variation of soil water stable isotope values decreased with the increase of soil depth. The soil water stable isotope values at the depths from 70 to 90cm were close to the groundwater isotope values, which were affected by the groundwater. The stable isotope values in crop stem water were relatively scattered, indicating that the maize used multiple water sources and the water use strategy changed during the growth periods.