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Effects of fine roots on the distribution of soil water and soil organic carbon in a shelterbelt modified agricultural system

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Shelterbelts, also termed windbreaks, play a significant role in reducing soil erosion, sand drift, and protecting crops, livestock and farmstead. Cropland shelterbelts are known to improve the microclimate and provide protection against sand-related damages to crops. However, the protection of shelterbelts to crops may be complicated by fine roots near the edge of the shelterbelt, which directly affects the absorption of soil water and the accumulation of soil organic carbon. In this study, we investigated the effects of shelterbelt fine roots on farmland soil water content (SWC) and soil organic carbon density in an agricultural system located in northern China. The distribution characteristics of fine-root biomass density, soil water content and soil organic carbon density were measured at the 0-200 cm soil depth in a farmland shelterbelt system at distances of 0.3H (H is the windbreak height), 0.5H, and 0.7H from the shelterbelt with three replicates. Soil samples were randomly collected in the center of the cropland. The results showed that fine roots of shelterbelts concentrated at the depth of the 20-60 cm soil layer, whereas the fine roots of the crop summer squash (Cucurbita pepo L.) were mainly found within the top 20 cm of the soil profile. With the presence of shelterbelt fine roots, strong SWC deficiency that occurred up to100 cm in the soil profile was observed. The SWC was deficient at all sampling points, the overall shallow layer deficient was larger than the deep layer. In contrast, the soil organic carbon was cumulative, and the overall deep accumulation was greater than the shallow layer. The effects of fine roots on SWC and soil organic carbon density variations in different soil layers were inconsistent. The information accrued in this study can be used to evaluate the effect of farmland shelterbelt on soil water and soil carbon in the Hetao irrigation area of Inner Mongolia, northern China.