

Postprint: Spatiotemporal Evolution Characteristics of Soil Salinity in Non-mulched Drip-irrigated Winter Wheat in Arid Regions

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Abstract

To investigate the sustainability of mulch-free drip irrigation technology for winter wheat, a densely planted crop, in the arid region of Xinjiang, a continuous field monitoring experiment was conducted in wheat farmland in Qitai County. By collecting soil samples at different depths from 0–80 cm from the drip tape center to both sides, and using geostatistical analysis, the transport patterns of soil salinity in wheat fields over 8 years of drip irrigation application were studied. The results showed that: Soil salinity in each layer conformed to a log-normal distribution, and with increasing years of drip irrigation, salinity content in the 0–80 cm soil layer gradually decreased. After 8 years of drip irrigation, the desalination effect in the 0–20 cm root zone was relatively pronounced; after 6 years, the salt leaching effect in the surface 0–60 cm layer was significant, with salts being leached to and accumulating in a certain area below 60 cm. With increasing years of drip irrigation, salinity migrated from the drip center to both sides and deeper layers; after 8 years, salts gradually accumulated in the area below 60 cm under the dripper and beyond 40 cm horizontal distance from the dripper. With increasing years of drip irrigation, wheat yield gradually increased. It is recommended that under the current irrigation regime, drip irrigation frequency be increased and the amount of water per irrigation be reduced. This study can provide theoretical support for the large-scale promotion of mulch-free drip irrigation technology for wheat.

Full Text

Spatiotemporal Evolution of Soil Salinity in Winter Wheat Fields Under Drip Irrigation Without Mulching in Arid Regions

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Abstract

To investigate the sustainability of winter wheat cultivation under drip irrigation in arid regions, a long-term field experiment was conducted in Qitai County, Xinjiang. Soil samples were collected along a radial profile from the drip irrigation center outward at depths of 0–80 cm. Based on geostatistical analysis, a winter wheat field with 8 years of drip irrigation history was selected to examine soil salinity distribution patterns. The results demonstrated that: (1) Soil salinity exhibited a log-normal distribution. With increasing duration of drip irrigation, soil salt content in the 0–80 cm layer gradually decreased. After 8 years of drip irrigation, significant desalination occurred in the 0–20 cm rhizosphere layer. After 6 years, notable desalination was observed in the 0–60 cm soil profile, with salt accumulation occurring beneath this depth; (2) As the duration of drip irrigation increased, soil salts migrated both downward to deeper layers and laterally outward from the central irrigation zone; (3) Winter wheat yield progressively increased with extended drip irrigation. It is recommended to increase irrigation frequency while reducing the application volume under the current irrigation regime. These findings provide scientific support for promoting mulching-free drip irrigation technology for winter wheat production in arid regions.

Keywords: winter wheat; without mulch; drip irrigation; soil salinity; arid area; Qitai; Xinjiang

References

- [1] Study on Tamarix invasion patterns in the Bighorn Basin, Wyoming, USA. *Journal of Arid Environments*, 2006, 65(1): 111–128.
- [2] GONG Lu, LIU Zeng-yuan, TASHPOLAT Tiyip, et al. Soil salinity characteristics and determinants at different soil types in oasis of extreme arid region. *Arid Zone Research*, 2015, 32(4): 657–662.
- [3] ZHAO Xi-mei, XIA Jiang-bao, CHEN Wei-feng, et al. Effect of groundwater depth on the distribution of water and salinity in the soil-Tamarix chinensis

system under evaporation conditions. *Acta Ecologica Sinica*, 2017, 37(18): 6074-6080.

[4] SUN Hai-yan, YE Han-chun, XU Li, et al. Water and salt migration under saline wasteland in a desert-oasis area at the lower edge of a plain reservoir. *Arid Zone Research*, 2017, 34(5): 967-971.

[5] JIN Zhi-feng, HUDAN Tumarbay, MOU Hong-chen, et al. Soil water and salt migration in cotton field under soil freezing-thawing temperature. *Arid Zone Research*, 2013, 30(4): 623-627.

[6] ZHANG Gang, ZHOU Zhi-yu, ZHANG Cai-ping. The effect of land use on the level of salt and organic matter in saline soil. *Acta Prataculturae Sinica*, 2007, 16(4): 15-20.

[7] ZHANG Peng-rui, LI Xu-lin, CUI De-jie, et al. Characteristics of water and salt under different land use in heavy coastal saline-alkaline land. *Journal of Soil and Water Conservation*, 2015, 29(2): 117-121.

[8] LIU M X, YANG J S, LI X M, et al. Distribution and dynamics of soil water and salt under different drip irrigation regimes in Northwest China. *Irrigation Science*, 2013, 31(4): 675-688.

[9] WANG Xiao-yan, FENG Yue-hua, LI Yun, et al. Spatial variability of soil physicochemical properties and their auto-correlations at village-region in karst mountainous area, Guizhou Province. *Acta Ecologica Sinica*, 2015, 35(9): 2926-2936.

[10] GOWING J W, ROSE D A, GHAMARNIA H. The effect of salinity on water productivity of wheat under deficit irrigation above shallow groundwater. *Agricultural Water Management*, 2009, 96(3): 517-524.

[11] ISIDORO D, GRATTAN S R. Predicting soil salinity in response to different irrigation practices, soil types and rainfall scenarios. *Irrigation Science*, 2011, 29(3): 197-211.

[12] ZHANG Z, HU H, TIAN F, et al. Soil salt distribution under mulched drip irrigation in an arid area of Northwestern China. *Journal of Arid Environments*, 2014, 104(4): 23-33.

[13] WANG R, KANG Y, WAN S, et al. Salt distribution and the growth of cotton under different drip irrigation regimes in a saline area. *Agricultural Water Management*, 2011, 100(1): 58-69.

[14] YANG Jiu-gang, HE Ji-wu, MA Ying-jie, et al. Effects of irrigation frequency on salt distribution and leaching in cotton field. *Transactions of the Chinese Society for Agricultural Machinery*, 2013, 44(12): 120-128.

[15] WANG Feng, SUN Jing-sheng, LIU Zu-gui, et al. Effect of different irrigation scheduling on salt distribution and leaching in cotton field. *Research of Soil and Water Conservation*, 2013, 20(1): 186-192.

[16] SUN Lin, LUO Yi. Study on the evolution trends of soil salinity in cotton field under long-term drip irrigation. *Research of Soil and Water Conservation*, 2013, 20(1): 186-192.

[17] [FIGURE 4] The wheat yield in fields with different years of drip irrigation.

[18] [TABLE 1] Soil salinity characteristics under different irrigation years.

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

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