Seasonal Freeze-thaw Processes and Water and Salt Transport of Farmland Soil Protected by Shelterbelt in Hetao Irrigation Area

Sanaullah Magsi

School of Soil and Water Conservation, Beijing Forestry University, Haidian, Beijing, China

Abstract

Soil salinity, temperature, moisture, and related metrological data were measured quantitatively in farmland surrounded by a shelterbelt in the Hetao Irrigation area of Inner Mongolia from October 2020 to April 2021 to gain a better understanding of the status of soil water and salt transport from the seasonal freezing and thawing cycle. Findings indicate that the surface temperature of the soil varies significantly and that the change in soil temperature becomes more gradual as the depth of the soil increases. The rate of temperature decline during the freezing period is greater than the rate of temperature rise during the ablation phase, and when combined with the hysteresis of soil temperature fluctuations, the freezing period is approximately 10 days shorter than the ablation period. Seasonal freezing and thawing promote soil water migration due to phase shifts, and freezing causes the water content of the topsoil to rise while decreasing the soil water content of the subsurface layer. The soil water content steadily drops throughout the ablation and thawing phase. The content of the agricultural margins (0.3H, 4H) on both sides of the forest belts is less than the water content of the farmland (1H, 2H, 3H). At the same time, the close forest belt's decreasing time of soil surface water content is roughly 10 days later than that of the distant forest belt. With the deepening of the soil layer, the phenomenon of low soil water content in forest belts fades over time. When measured at various distances from the shelterbelt, there is essentially no difference in soil water content in the 100 cm soil layer. During the freezing and thawing period, the surface soil had two salt accumulations: one during the freezing phase and one during the ablation period, and the salt content of the soil body increased after the freezing and thawing process. Salt accumulates in various soil layers as a result of soil freezing, and this process continues. The salt in the melting layer converges to the surface during ablation, causing some salt loss in the deep soil. Soil salt buildup is relatively high in agriculture near the forest belt than in the remote shelterbelt. The movement of water and salt in soil reflects important features and salt variability is greater than that of water, implying that the salt transport mechanism is more difficult. The study's results contribute to the rule of soil water and salt transport in farmland within the protective shelterbelt network during freezing and thawing periods, and a fundamental theoretical foundation for agriculture in irrigation.

Keywords: Soil water and salt characteristics; Farmland shelterbelt; Seasonal freezing and thawing; Soil temperatur