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RESEARCH ARTICLE

# Water and salt movement in different soil textures under various negative irrigating pressures

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**Abstract**

This study examined the effect of different negative pressures and soil textures on water and salt movement to improve the efficiency of negative pressure irrigation (NPI). Four soil textures of varying fineness (Loamy Sand, Loam, Silty Loam, and Sandy Loam) and three negative pressure values (0, –5, and –10 kPa) were used. As irrigation time increased, wetting front movement speeds decreased, and as negative pressure increased, wetting front size decreased. Coarse soils had the smallest wetting front under greater negative pressure. Next, water infiltration rate decreased as irrigation time increased, and coarse soils had the lowest average infiltration rate under greater negative pressure. Finally, salt content increased with distance from the irrigation emitter and with increased negative pressure. Further, coarse soils were found to have decreased desalination under greater negative pressure. Thus, soil texture has a strong effect on NPI efficiency. However, by adjusting pressure values in accordance with soil texture, soil water content can be controlled and maintained. These findings are important to the improvement of NPI systems, increasing their practicality for agricultural use.

**Keywords:** negative pressure irrigation, volumetric water content, soil salt content, soil texture

## 1. Introduction

Chinese agricultural water consumption is 400 billion $m^3$ every year, which accounts for 65% of the nation's total water consumption (MWRPRC 2013). Irrigation accounts for more than 90% of the nation's total agricultural water consumption. Due to these extensive irrigation needs, China's effective irrigation water use (0.5), the ratio of irrigated water used by crops to total irrigated water, currently lags behind that of developed nations (0.7–0.8) (Hu 2013). It is therefore of great importance to increase water use efficiency through the improvement of existing irrigation methods. One such technique that has received recent attention is negative pressure irrigation (NPI), which relies on soil matrix suction to irrigate crops. By altering negative pressure, NPI controls water distribution based on the soil texture around crop roots during the entire growth period. NPI is a high-efficiency method that improves crop quality and increases water savings (Nalliah and Ranjan 2010). First, it can potentially be tailored to specific field conditions, and the second, the roots

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