

# The effect of soil temperature and soil moisture on the soil water movement

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The current study was conducted to investigate the effect of soil properties, soil temperature, soil moisture and salinity on soil water and salt movements. Fulfilling the purpose of this study required calculating some thermal properties i.e. thermal conductivity, volumetric heat capacity and thermal diffusivity of a loamy sand soil and a clay one at different temperatures and different moisture contents. Soil water movement was studied under two temperature gradients (0.4 °C/cm and 0.8 °C/cm), two initial levels of applied NaCl (salinity), and 4 levels of moisture content. The obtained results could be summarized in the following:

- 1-Thermal conductivity increased with increasing soil moisture contents of the studied soils. Although each of the other physical properties was not of significant effect on thermal conductivity; yet these properties together seemed to contribute to determining the value of this parameter.
- 2-Values of volumetric heat capacity of the loamy sand soil were higher than those of the clay ones. Moisture content was the only physical property that correlated significantly with the values of the volumetric heat capacity. Calculating the multiple correlation coefficient between this thermal parameter and the studied physical properties assured that the value of this parameter is a final product of the soil physical properties.
- 3-Values of the thermal diffusivity decreased with increasing moisture content of both the studied soils. The effect of moisture on this parameter was significantly negative. The calculated multiple correlation coefficient between thermal diffusivity and the studied soil physical properties seemed to be more obvious by increasing the number of these properties. In another meaning, although some physical properties are of more pronounced effect than the others, yet the feature is completed through putting the other physical properties into consideration.
- 4- Values of both thermal conductivity and thermal diffusivity increased markedly with increasing soil temperature. On the other hand, values of the volumetric heat capacity was not affected with soil temperature.
- 5 Rising the temperature gradient from 0.4 to 0.8 °C/cm increased the net moisture content in both the studied soils. The soils are more sensitive at low moisture content (25% of the field capacity) to rising temperature gradient. Factors affecting water movement under the studied temperature gradients could be arranged according to their importance in the following descending orders: Soil properties > moisture content > temperature gradient.
- 6-Net moisture content of the studied soils were correlated negatively and significantly with the initial moisture content. On the other hand, no certain effect could be observed due to salinity or temperature gradient on the values of net moisture content. Water movement under the high temperature gradient (0.8 °C/cm) was easier than that under the low temperature gradient (0.4 °C/cm).
- 7-The factors involved in the heat consumed for water movement could be arranged in the following descending order: Temperature gradient > moisture content > soil properties. This occurred under the low level of the applied NaCl (400 ppm), while under the higher level of applied salinity (4000 ppm) the contribution of the above mentioned factors took the order: Moisture content > temperature gradient > soil properties. The heat consumed in water movement correlated positively and significantly with the initial moisture content. Salinity did not show any significant effect on heat consumed for water movement. However, introducing values of salinity together with initial moisture content was found to be of highly positive significant correlation with values of the heat consumed in water movement. The combination between both of temperature gradient and initial moisture content were found to be of highly significant effect on values of the heat consumed in water movement.

The effect seemed more pronounced by introducing more physical properties with the above mentioned ones such as salinity. Chloride movement was taken as indication for salt movement. The Cl movement is affected by both temperature gradient and moisture content, however, the effect of the former seemed to be lower than that of the latter.