Impact of the Natural Deposits of Saudi Arabia on Selected Physical Properties of Calcareous Sandy Soil

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ABSTRACT

Most of the agricultural soils in Saudi Arabia are calcareous sandy soils. Some constraints of production in these soils are low water holding capacities, high infiltration rates, high evaporation rates and low water use efficiency. Remediation of these unfavorable properties by using synthetic soil conditioners is very costly. However, it is possible to overcome these constraints by using natural clay deposits. The present study was undertaken to investigate the effect of two local natural deposits on relative swelling index (RSI), intermittent evaporation (E), percentage of water conserved (PWC) and soil moisture distribution in calcareous sandy soil. The two natural deposits are commercially known as AQUAGEL and BENTONITE. Five rates 0, 1, 2, 3 and 4% of each deposit were added to a sandy calcareous soil. The results showed that addition of both deposits caused a considerable increase in RSI. The relationship between the RSI and concentrations of the natural deposits were expressed by exponential equation with R^2 equals 0.991. The magnitude of the increase in RSI of the soil using 1, 2, 3, and 4% AQUAGEL were 1.69, 2.96, 4.6, and 7.92 times that of the untreated soil, while for BENTONITE at the same concentrations, RSI were 1.62, 2.09, 4.24 and 5.77 times that of the control. The results also showed that the concentrations of natural deposits application were significantly effective in reducing the cumulative evaporation and have increased the percentage of water conserved in the soil columns. At the end of the last cycle, E at different rates ranked as follows: 0 > 4 > 1 > 2 > 3% for AQUAGEL and 0> 1 > 2 > 3 > 4% for BENTONITE. After the termination of the experiment PWC values at the rate of 1, 2, 3, and 4% were 2.34, 2.66, 2.93, and 2.18% times that of the control for AQUAGEL, and 1.07, 1.23, 2.14 and 2.81 times that of the control for BENONITE. It can be concluded that the addition of higher rates of AQUAGEL (above 3%) caused more swelling effect and consequently increased the E and reduced PWC.

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INTRODUCTION

Most cultivated soils in Saudi Arabia are calcareous sandy soils (Bashour et al., 1983). These soils are characterized by low organic matter content, low specific surface area, low water holding capacity, high infiltration rate, excessive deep percolation losses and high cumulative evaporation, causing inefficient water use. Thus, the productivity of these soils is limited by these constraints. Several management practices such as the application of synthetic soil conditioners were carried out to improve some physical properties of sandy soil and its productivity (Miller, 1979; Johnson, 1984; Mustafa et al., 1988; Al-Omran et al., 1987; Choudhary et al., 1995 and Al-Harbi et al., 1996). The application of synthetic soil conditioners on large scale in agricultural land could be unfeasible because of their high cost, insufficient longevity, reduction of water absorption capacity with salinity which restrict their application under field conditions (Armbrust and Dickerson, 1971; Shalaby, 1993 and Al-Darby et al., 1993). Thus, the introduction of natural deposits might be a good mean to alleviate some of the above-mentioned soil constraints and thus increase soil productivity. Afifi (1986) reported that the addition of clay deposits (Bentonite) to the sandy soil increased the retention and the availability of soil moisture as well as the increase of the cohesive forces among their