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Intermittent Evaporation from Soil Columns as Affected by a Gel-forming Conditioner[1]

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ABSTRACT

The effect of an organic super gel commercially called Jalma (containing 24% humic acids, and 3.8% polysaccharides) at rates of 0.0, 0.4, 0.8, and 1.6% on aggregation index (AI) and relative swelling index (RSI) of loamy sand, sandy loam, and clay loam soils was studied. Furthermore, the influence of these rates and two irrigation intervals, 7 and 14 d, on intermittent evaporation from surface-treated soil columns were also investigated. Twenty-two or 44-mm of water were applied every 7 or 14 d, respectively. The soil columns were placed in a walk-in controlled growth chamber with potential evaporation of 8.2 mm/d. Addition of 0.4% Jalma significantly increased AI of the three soils by 33 to 38%. Increase of the Jalma rate to 0.8% significantly improved the AI of the fine-textured sample but not the coarse-textured samples. Further increase to 1.6% had no significant effect on the AI of the three samples. The lowest rate of Jalma significantly increased RSI of the three samples. The results also indicated a sharp, significant increase in RSI with increase in Jalma rate to 1.6%. In general, Jalma treatment significantly reduced cumulative evaporation and hence increased the amount of water conserved (AWC) after the first wetting/drying cycle. After four evaporation cycles, on 0.4% treated loamy sand, sandy loam, and clay loam soils, the AWC values were, respectively, 4.3, 3.2, and 1.5 times that of the untreated soils. The AWC values for untreated loamy sand, sandy loam, and clay loam soils irrigated every 14 d were, respectively, 2.6, 1.7, and 1.6 times those irrigated weekly.

Additional Index Words: **aggregation, swelling, water conservation, sandy soils, Jalma, soil conditioner.**

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MOST AGRICULTURALLY IMPORTANT SOILS of Saudi Arabia are calcareous, sandy, and low in fertility status (Bashour et al., 1983). Productivity of such soils is partly limited by their low water-holding capacities and excessive deep percolation rates that eventually cause low fertilizer and water use efficiencies. These limitations become of particular importance under hot, arid conditions prevalent in the country. The above-mentioned soil constraints can conceivably be alleviated through use of synthetic polymers that are capable of absorbing water to between 40 to 500 times their own weight, and, hence, are loosely referred to as superabsorbents. Prominent among these are hydrolyzed starch polyacrylonitrile graft copolymer (super slurper), vinyl alcohol–acrylic acid copolymers, and polyacrylamides.

These superabsorbents can increase water supply to growing plants and improve water use efficiency (El-Hady et al., 1981; Tayel and El-Hady, 1981). Johnson (1984) found that polyacrylamide reduced evaporation and increased available water of coarse sand, and the effects varied with type of commercial product used. Miller (1979) found that super slurper increased soil swelling and decreased infiltration. Hemyari and Nofziger (1981) found that sorptivities for sandy loam, clay loam, and loamy sand soils treated with 0.4% super slurper were reduced 38, 18, and 11%, respectively, and that loamy sand and sandy loam soils treated with super slurper retained more water than untreated soils. The conditioner had little effect on water retention in clay loam soil.

Gel-forming conditioners (superabsorbents), by their very nature, may cause soil swelling. Furthermore, if they contain cementing agents, such as humic substances and/or polysaccharides, they may cause formation of stable aggregates or increase their stability (Cheshire, 1979; Tisdall and Oades, 1982; Chaney and

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