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# HORIZONTAL INFILTRATION OF WATER IN SOIL COLUMNS AS AFFECTED BY A GEL-FORMING CONDITIONER

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**We conducted a laboratory experiment on the interrelationships among five rates, $R$ (0 to 1.6%), of a gel-forming conditioner (Jalma—containing 24.5% humic acids and 3.8% polysaccharides), water penetrability ($\lambda$), weighted-mean diffusivity ($\bar{D}$), swelling index ($S$), and effective mean pore radius ($\bar{r}$) of a loamy sand, a sandy loam, and a loam. For each of the three soils, the results indicated a highly significant linear increase in $S$ and a consequent exponential decrease in $\bar{r}$, $\lambda$, and $\bar{D}$ with increase of $R$. The effects of Jalma on these parameters were more marked on the loamy sand than on the other two soil samples.**

**Addition of 0.2, 0.4, 0.8, and 1.6% Jalma to the loamy sand sample significantly reduced $\lambda$ by about 19, 55, 83, and 98%, respectively, and $\bar{D}$ by about 38, 76, 96, and 100%, respectiely. The highest rate almost completely sealed the soil independent of its texture and reduced $\bar{D}$ to almost zero. We concluded that 0.4% Jalma is the optimum rate for soil water conservation. We argue that Jalma addition causes swelling of the soil matrix, reduces the effective mean pore radius, and consequently reduces $\lambda$ and $\bar{D}$. The effective mean pore radius proved to be a reliable predictor of $\bar{D}$ and $\lambda$ of the soil samples studied independent of their texture: $\lambda = 2.548\bar{r}^{0.49}$ ($r^2 = 0.960$), and $\bar{D} = 3.303\bar{r}^{1.075}$ ($r^2 = 0.958$).**

Proper modification of the pore-size distribution is a key for improving the productivity of coarse-textured soils that are limited by their low water-holding capacity and excessive deep percolation. Management of such soils must therefore aim for increasing the relative proportion of micro- and mesopores. Gel-forming conditioners, by their very nature, can achieve such an objective. Miller (1979) observed that a hydrolyzed starch polyacrylonitrile graft polymer (H-SPAN) increased surface soil swelling and decreased infiltration in sand, loam, and silt loam soils. Hemyari and Nofziger (1981) found that the sorptivities of a sandy loam, clay loam, and loamy sand, each treated with 0.4% H-SPAN, were reduced 38, 18, and 11%, respectively. Our previous research showed that the amount of water conserved by loamy sand columns treated with 0.4, 0.8, and 1.6% Jalma (super gel) were 4.3, 5.3, and 3.3 times those of the check columns (Al-Omran et al. 1987). These findings suggest that for efficient water conservation in sandy soils an optimum rate of Jalma should be applied. This desired rate should be high enough to reduce deep percolation losses, but low enough to prevent evaporation. In general, very limited research has been conducted on the influence of gel-forming conditioners in transient flow of water in unsaturated soils.

The main objectives of this study were to investigate the effect of five rates of Jalma: 0.0, 0.2, 0.4, 0.8, and 1.6% on soil water diffusivity, swelling, and effective mean pore radii of three soil samples and to establish relationships among the various variables.

## MATERIALS AND METHODS

Three bulk topsoil (10 to 25 cm) samples differing in texture were collected from the College Farm. The taxonomy and some of the properties of the soils, which were determined by standard procedures, are reported in Table 1 (Black 1965). The synthetic conditioner used was an organic super gel commonly known as Jalma (produced by S.A.I.D. Rue due Stade, 69120 Vaulx en Velin, France).[2] It contains 24.5% humic acids, of which 10.5% are water-soluble alkaline humates, 1.9% fulvic acid, and 3.8% polysaccharides. As delivered by the factory 1 kg of Jalma gel contains 0.0326 kg of dry Jalma and the remaining part is water. Quantities of Jalma gel predetermined to render spe-

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[2] The use of trade and firm names is for the information and convenience of the reader. Such use does not constitute an official endorsement of the product by King Saud Univ.