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SOIL WATER EVAPORATION SUPPRESSION BY SAND MULCHES[1]

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This paper reports experiments performed to study sand as a soil mulch. The objective was to determine the comparative effectiveness of 0-, 2-, and 6-cm-thick covering sand layers in suppressing evaporation from columns of soil. Measurements were made by using potential evaporation rates of 1.1 and 0.55 cm/d. In addition to evaporation, soil water distribution with depth was measured for the different sand-cover treatments. Five treatments were studied: check (no sand mulch), 6 cm of coarse sand (C_6), 6 cm of fine sand (F_6), 2 cm of coarse sand (C_2), and 2 cm of fine sand (F_2). After 35 d of experiment, the cumulative evaporations for the check, C_6, F_6, C_2, and F_2 treatments were measured as 6.79, 1.50, 1.55, 3.76, and 4.62 cm of water, respectively, at a potential evaporation of 1.1 cm/d and, for the potential evaporation of 0.55 cm/d, was correspondingly 6.68, 0.95, 1.21, 2.71, and 4.28 cm. These sets of numbers show that there was marked evaporation reduction for the sand mulches with respect to bare soil (check). The 6-cm sand mulches were the most effective evaporation suppressors. For equal mulch thickness, coarse sand was only slightly more effective than fine sand.

Results from soil water distributions with depth for the various treatments also indicated that the sand mulches were effective in conserving soil water against evaporation losses. The mulches were effective in this order: $C_6 > F_6 > C_2 > F_2$.

Storage of water in soil is a major agricultural concern in arid and semiarid regions. In such areas, where the average annual precipitation is 50 cm or less, water frequently limits crop production. If there is not ample precipitation during the growing season, a crop either is irrigated or must rely on soil water reserves stored before the time of planting. Arnon (1976) reports that the more efficiently a soil can store precipitation the higher is the level of crop production. Unfortunately, in arid and semiarid regions with high evaporative demand, soil storage efficiencies are generally low. Improvements in management should concentrate on curtailing soil water evaporation.

Willis (1960) studied evaporation from layered soils in the presence of a water table and concluded that the existence of a coarse soil layer below a finer soil layer has a relatively small effect upon the evaporation rate. But he found a large effect when the surface layer was coarse. Also, he stated that, in the absence of a water table, stratification might significantly affect evaporation from recently moistened soils. Kirkham et al. (1967) investigated the effect of surface-sand mulch and subsurface-sand layers in preventing evaporation from soil. They found that a surface mulch is more effective than a subsurface layer in preventing evaporation. Unger (1971) used gravel layers in an attempt to suppress soil evaporation. He placed gravel layers at 5, 15, and 25 cm below the soil surface. He indicated that soil above gravel retained more water than at similar depths in uniform columns. He also found that evaporation from soil with gravel on the surface or at 5-cm depth was slower than from the check. Evaporation from soil with gravel at depths of 15 or 25 cm generally was more rapid than from the check.

Benoit and Kirkham (1963) investigated the comparative effectiveness of a dust, a ground corncob, and a gravel mulch in suppressing the evaporation of soil water. They stated that the gravel mulch was more effective than either a dust or a ground-corncob mulch. The dust mulch proved the least effective. Corey and Kemper (1968) also found gravel mulches to be effective in suppressing soil water evaporation.

Van Bavel and Hillel (1975) developed computer models to describe heat and water transport in soil profiles with and without dry covering mulches. Much lower evaporation was calculated for the profiles covered with a dry mulch than for the bare soil profiles.

Results of previous studies indicate that a dry

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