SOIL MOISTURE AND PLANT GROWTH IN RELATION TO $pF$  
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THE concept of the $pF$ curve for expressing the relation between the amount of water in a soil and the force with which it is held there was introduced by Schofield (5)\(^3\). The $pF$ is defined as the logarithm of the negative hydrostatic head, in cm, in equilibrium with a sample of moist soil. Schofield showed that a number of the well-known soil moisture constants could be expressed by a definite $pF$ value.

The investigations reported herein are concerned with (a) the nature of the forces that retain different amounts of water in soils ranging from saturated to oven-dry conditions, and (b) the significance to plant growth, runoff, percolation, and drought of the amounts of moisture held with various intensities.

METHODS

Soil samples of different textures varying from silt loam to clay, sand samples of uniform particle size, and samples of extracted colloid were the materials used in this study.

The quantity of water retained by these materials against different forces was determined by two methods, namely, by placing the saturated material on a porous membrane that separated it from a region of lower pressure, and by subjecting the saturated material to desiccation over sulfuric acid of various concentrations.

In the first method, the samples were subjected to pressure over membranes of collodion and cellophane in an ultrafilter capable of withstanding 300 pounds per square inch pressure. After allowing 16 hours for establishment of equilibrium, the sample was removed and the moisture content determined by drying at 105°C. The quantity of water forced through the membrane was measured directly for samples containing no colloidal material. The force with which the water was retained by the soil is expressed as the difference in pressure in grams per square centimeter between the upper and lower sides of the membrane. Samples of soil placed over sulfuric acid were desiccated until they ceased to lose weight. The quantity of moisture retained by the soil was determined by drying the sample in the oven.

The equivalent pressure was calculated according to the equation used by Schofield (5). The ultrafilter method covered the portion of the $pF$ scale from 0 to 4.34, while the vapor pressure method covered the $pF$ scale from 4.34 to 7.0.

RESULTS

PRESSURE-MOISTURE RELATIONS OF SAND AND SILT FRACTIONS

The pressure-moisture curves for three soils are shown in Fig. 1. The different positions of a number of the familiar constants for soil moisture are indicated. Similar curves for samples of silt and of sand of fairly uniform particle size are given in Fig. 2.

These curves show three distinct relations between the properties of the sample and the quantity of water retained against different intensities of force. They demonstrate first that the quantity of water held near $pF$ 0 represents complete saturation of the sample. All free water flooding the surface of the sample was removed by the slight amount of pressure applied to obtain $pF$ 0; but at this low $pF$ value surface tension prevented the removal of the water in the spaces between the

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\(^3\) Figures in parenthesis refer to "Literature Cited", p. 41.