A SIMPLE SOIL AIR PERMEAMETER

RECENT work of soil conservation specialists has shown the far-reaching detrimental influence of puddling or "sealing" of the soil surface produced by the impact of rain drops, trampling of livestock, or deposition of eroded clay. Once initiated, the process of soil surface waterproofing in time leads to so-called "splash erosion" or other forms of denudation. Aside from the ills of soil depletion, the decreased ability of soil to soak up rain deprives plants of water which is lost through run-off.

The puddled condition of the soil can be detected in several ways, for instance, by determining porosity of soil, its volume weight, or its infiltration capacity. These methods, however, are time-consuming, and their replacement by a simple field test appears to be highly desirable. One way to accomplish this task is offered by Janert, a German pedologist; he suggested measuring the air permeability of soil, a property closely related to soil infiltration capacity. Essentially, air permeability is determined by manometric recording of the resistance of soil to the passage of forced air. Based on this principle, a portable equipment was devised by making use of a sphygmomanometer, i.e., apparatus for taking blood pressure.

The assembled air permeameter consists of a brass cylinder 6 inches long and 1.25 inch in diameter which is sharpened at the open end and provided at the top with a 1-inch air inlet corrugated for attachment of \( \frac{1}{4} \)-inch rubber tubing. The rubber tubing connects the brass cylinder with the constant pressure chamber and sphygmomanometer by means of a "T" tube. The chamber is provided with either a rubber hand bulb or a foot pump.

The brass cylinder is inserted into the soil to a depth of 2 inches, the release valve is opened, and the constant pressure chamber filled with air until the mercury reaches the maximum height and comes to equilibrium. The reading is recorded directly in millimeters of the mercury column (Fig. 1).

Determinations are made at least 24 hours after rain to insure that the soil moisture is at field capacity or less. Since the air permeability of soil is not influenced by capillary pores, but by the large noncapillary openings, the differences in soil moisture below field capacity do not appreciably modify the results obtained. The rapidity and simplicity of the procedure, requiring no reagents, and the portable nature of the equipment are outstanding advantages of the suggested test.

Preliminary trials with the described air permeameter have led to several interesting observations. The most conspicuous results were obtained on the effect of grazing, which in some silt loam soils increased the original resistance to air flow in the surface soil from 10 mm to as much as 80 mm, or a "blood pressure" definitely indicating a critical condition of the soil body. Analyses of soils of the same type supporting a virgin forest or field crops have shown that prolonged cultivation may increase the resistance of soil to the passage of air as much as 300\%, e.g., from 15 mm to 45 mm. To what extent this increase may be detrimental to crop production thus far has not been investigated. In some instances the unsatisfactory productive capacity of soil was traced to the illuviation of the deeper soil layers, rather than to compaction of the surface horizon. This condition seems to have a special significance in soils of orchards and nurseries. However, in forest soils the air impermeability of the lower strata was not always found to be detrimental to the growth of trees. For instance, the study of the suitability of Wisconsin soils for pulpwood production has revealed the highly beneficial effect of a compacted lower stratum, undoubtedly due to a higher water retention. As a general rule, soils with compacted B-horizons, showing air permeabilities between 35 mm and 60 mm were found to support nearly double the volume of aspen and jack pine as compared with soils underlain by pervious substrata showing a pressure of less than 10 mm. — S. A. WILDE, Soils Department, University of Wisconsin, Madison, Wis.

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