THE COMPARATIVE EFFECTS OF SURFACE APPLICATION VS. INCORPORATION OF VARIOUS MULCHING MATERIALS ON STRUCTURE, PERMEABILITY, RUNOFF, AND OTHER SOIL PROPERTIES

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The use of artificial soil mulches has recently been given extensive consideration by those interested in maintaining a favorable soil structure, an optimum moisture status throughout the growing season, and maximum control of runoff and soil erosion. Plant residues have been most frequently used as sources of mulching material.

Among the first effects of mulching to be studied were those which had to do with the moisture status and the accumulation of nitrates in the soil under straw mulch. Harris and Turpin (6), in 1917, reported an increased soil moisture content with straw mulch under irrigated and dry farming conditions in Utah. Lyon (11) in 1922 and Lamb and Chapman (10) in 1943 showed similar results for straw mulch in New York.

The literature contains very little information concerning the effects of mulching on the structure of the soil except for the work of Havis (8), who reported on the aggregation of a Wooster silt loam that had been mulched with straw continuously for 4 years in an apple orchard. He found this mulched soil to be more completely aggregated than the soil under bluegrass sod. The results of 7 years treatment with wheat straw mulch and chopped corn stover mulch in a peach orchard show an increase in the state of aggregation of the soil under these mulches as compared with bluegrass sod or manure treatment. Previously, Havis and Gourley (7) showed that the organic matter content, total porosity, and rate of water absorption of the surface soil was higher in the mulched soil than for the soil in bluegrass sod. Both of these orchard treatments were superior in each of these soil qualities to that of the cultivated soil.

The studies of Duley and Kelly (5), Borst and Woodburn (3), Browning and Sudds (4), and Lamb and Chapman (10), all of whom used straw, Beutner and Anderson (2) who used alfalfa and native grass, and Kidder, et al. (9), using soybean residues, corn stover, and wheat straw as the mulching material, clearly demonstrate the effect of surface application of mulching material on greatly increased infiltration rate and correspondingly reduced rate and quantity of runoff and erosion.

The purpose of this investigation was to study the effect of surface application and incorporation of various organic and inorganic mulching materials on the structure, permeability, infiltration capacity, organic matter content, and the soil moisture content of a given soil type.

EXPERIMENTAL PROCEDURE

This experiment was begun in 1939, at which time different mulching materials, namely, barnyard manure, straw, sawdust, chopped corn stover, charcoal, leaves, pine needles, bluegrass clippings, sand, and glasswool were surface applied as mulches and incorporated within the plowed layer or A horizon in triplicate to randomized 1/500-acre plots within a selected unit of Hagerstown silt loam which had previously been fallow for 2 years and was considered to be in good tilth. The plant residues materials were surface applied at a rate of 5 tons of dry weight per acre, and gravel was applied at the rate of 20 tons per acre. The glasswool was laid over the plot in a 3-inch layer at the time of application. Glasswool was the only mulching material that was not incorporated into the soil. One half of the amount of mulching material was added in the spring of each plot each succeeding year of the experiment in order to obtain satisfactory treatment conditions. The peat treatment was discontinued after 1941 because of the extreme difficulty in retaining the peat as a mulch. Because of its very low bulk gravity upon drying and fineness, the peat was blown away by the wind until only small patches of each plot remained covered with this material.

Weeds and grasses were removed from the experimental surface of the plots in which the mulching materials were incorporated by hoeing and cultivating and from the nonmulched plots by digging and pulling the volunteer growth.

In order to check the effect of these various mulching materials on the soil properties being studied, three additional plots which remained fallow and uncultivated were retained throughout the experimental area. Three additional plots were retained which remained fallow, but were hoed periodically in the same manner as were the mulched and nonmulched plots in order to retard weed growth.

The physical effects of three levels of fertilizer application under fallow uncultivated conditions were studied by application of 4-12-8 commercial fertilizer at the rate of 400 pounds per acre, nitrate of soda applied at the rate of 600 pounds per acre, and muriate of potash at 200 pounds per acre. These fertilizer treatments was triplicated.

Precipitation during the spring and summer of 1943 was normal, though the total rainfall occurring during five intense summer storms and the 1942 season was considered wet, the soil remaining moist almost continuously.

Each plot was sampled throughout the 1940, 1941, and 1942 growing seasons during periods of minimum rain. In these time soil moisture content was at a minimum. Fifteen samples were obtained from each plot by the use of a 1-inch soil sampling tube to a depth of 6 inches. These samples were composited and weighed and dried immediately in a laboratory at a temperature of 105°C, the loss in weight determined for each of the triplicated treatments, and the percentage moisture on the dry weight basis calculated.

Soil samples for structural analysis were taken on 0-3 and 3-6 inches in September 1941 and to a depth of 0-1, 1-3, and 3-6 inches in September 1942, using a steel 2.5-inch volume weight sampling cylinder. Horizon sections were taken for the purpose of structural analysis.