Miscellaneous Papers

Chemical and Physical Characteristics of Bowdoin Clay from the Milk River Valley of Montana

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The Milk River Valley is located in the northern part of the State of Montana. A 1928 soil survey by DeYoung, et al. (1) gives 624,000 acres of surveyed land; this area was included in a strip of land 170 miles long from east to west, 2 to 15 miles wide and lying 30 to 65 miles south of the Canadian boundary. The acreage of Bowdoin clay mapped was 15.5% (about 98,000 acres) of the surveyed area. This soil is the most extensive one in the valley.

The Bowdoin series is located on the lower flood plain of the Milk River. DeYoung (1) gives this description of a rather typical profile. "From 0 to 6 inches, grayish-brown massive cloddy noncalcareous clay, the surface soil of which shows wide cracks when dry; from 6 to 18 inches, grayish-brown or gray faintly columnar clay which breaks into very hard clods when dry and contains some salt mottlings; from 18 to 36 inches, light gray clay profusely mottled with white salt accumulations and some rust-brown stains, some of the salt accumulations being slightly calcareous; and from 36 to 60 inches, light brownish-gray distinctly calcareous very fine sandy loam." DeYoung states that this soil is in general uniform in physical characteristics. The surface horizon has developed from outwash material of the shale formations that outcrop in breaks bordering the valley.

The nearly level or depressional topography of Bowdoin clay makes it subject to overflow and standing water. This soil is characterized by a heavy, plastic clay surface which allows water to penetrate slowly and is subject to considerable shrinkage upon drying. In many places soluble salts have accumulated in noticeable amounts. These characteristics make the management of this soil very difficult.

Associated with Bowdoin clay and closely related to it in physical characteristics is the Harlem clay. The surface of this soil is slightly darker in color and is shallower and more variable in depth than is the Bowdoin. The lighter textured material usually occurs closer to the surface. This soil was mapped on 5.5% of the area by DeYoung (1).

Chemical and physical data on the Bowdoin clay have not been determined to any extent. The present investigation was undertaken to secure an indication of chemical and physical measurements which would be possible improvement program.

PROCEDURE AND METHODS

Samples were secured from three sites on the Development Farm, U. S. Bureau of Reclamation, Montana. This farm is located in a large area of Bowdoin clay. Samples were taken at three depths at each site, 0 to 8 inches, 8 to 12 inches, and 12 to 18 inches. They were air dried and then ground to pass a 2-mm sieve. It was necessary to use a mechanical pulverizer to complete the grinding of all of the samples.

The methods used for the chemical and physical measurements were those of the U. S. Regional Salinity Laboratory, Riverside, Calif. These methods have been compiled and published by Richards et al. (7). Semi-micro methods were used for all chemical determinations on soil extracts.

The samples extracted were allowed sufficient time for equilibrium at the desired moisture contents before extractions were made on the moistened soil or extracts from it.

Fifteen atmosphere and one-third atmosphere percentages were determined using the pressure manometer apparatus as described by Richards (5, 6). This apparatus was used to remove extracts from the soils at moisture contents below saturation.

Measurements of permeability were carried out in the procedure developed by Fireman (2), for disturbed soil. The water used was prepared to contain salts in close to simulate Milk River water (Stabler, 9). The water contained in milliequivalents per liter: sodium bicarbonate, 5.9; magnesium chloride, 0.36; calcium sulfate, 2.30; and calcium chloride, 1.60. Two amendments were used, gypsum and calcium chloride. Gypsum, equal to 1% by weight, was mixed into the soil in the permeameter and raked in before packing the soil in the permeameter and raked in before packing the soil in the permeameter.

The determination of the cation exchange capacity is frequently made now in use at the Salinity Laboratory (7). The results were determined on these combined extractions. The excess acetate was removed from the samples by repeated washings with 95% ethanol. The soil was then extracted...