RAPID COLORIMETRIC DETERMINATION OF SOIL ORGANIC MATTER

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EXISTING methods for the determination of soil organic matter involve weighings on an analytical balance, titration, and other technical manipulations requiring special skill and laboratory facilities. These methods are not well adapted for rapid analyses required in practical soil management. An attempt was made, therefore, to devise a simple and rapid method which could be used by extension specialists, horticulturists, and foresters.

The method devised, a colorimetric procedure, is based upon the reduction of a dichromate solution by organic matter in the presence of sulfuric and phosphoric acids, as previously described by Schollenberger and Wilde and Patzer. The reduction of chromic ions to the chromous state produces a gradual change in color of the solution ranging from bright orange to bluish-green. By adjusting the size of the soil sample, as well as the concentration and amount of reagents used, it was possible to obtain a suitable color range corresponding to definite contents of organic matter. The original standards were prepared by the use of various amounts of anhydrous dextrose and a permanent color scale was assembled from cellulose-acetate paper of different colors.

SPECIAL EQUIPMENT

Measuring spoons calibrated to deliver 0.5 and 0.25 gram samples of oven-dry sandy loam soil, respectively.
Erlenmeyer flasks, "Pyrex", 50 ml.
Ostwald-Folin transfer pipette, 2 ml.
Thermometer, 0 to 200° C; not longer than 10 inches.
Test tube, "Pyrex", 6 x 1 inch with 20 ml mark.
Cenco-Wilde color scale.

REAGENTS AND STANDARDS

Potassium dichromate solution.—Dissolve 9.807 grams of oven-dry reagent grade potassium dichromate in 75 ml of water. Add 1 ml of concentrated sulfuric acid and make up to 100 ml in a volumetric flask. Keep the solution in a tightly stoppered container.

Sulfuric-phosphoric acid mixture.—Add 4 parts by volume of concentrated sulfuric acid, C.P. grade, to 1 part of 85% phosphoric acid, U.S.P. grade.

Standard solutions.—Dissolve 1.875 grams of anhydrous dextrose, reagent grade, in 100 ml of distilled water. Use a Mohr micro-pipette to place in a series of 1 x 6-inch tightly stoppered container.

PROCEDURE

Pass the air-dry soil through a 20-mesh sieve and fill the measuring spoon heaping full. Pack down tightly with the spatula and loosely with the top of the measuring spoon. If the soil is low or medium in organic matter, use a measuring spoon calibrated to deliver a 0.5-gram sample; if the soil is high in organic matter, use the 0.25-gram calibrated spoon. Experience will soon teach the analyst which size of sample is preferable. In the event calibrated spoons are not available, the sample may be weighed out.

Transfer measured sample into a 50-ml Erlenmeyer Pyrex flask and add exactly 2 ml of potassium dichromate, using the Ostwald-Folin transfer pipette. Empty the pipette completely by blowing out the last few drops. Add 20 ml sulfuric-phosphoric acid mixture. The acid should be poured down the sides of the flask while slowly rotating the flask in an iron-plated electric stove, or on any other suitable source of heat, at a temperature between 160° and 170° C for 5 minutes.

Remove flasks from the hot plate and cool in the air until temperature is 140° C, or less. Fill the

potassium dichromate solution into the flask. Add 0.1 ml to each successive tube. Use 10 tubes, leaving one without reagents to serve as a blank. Add to each tube 1 ml of dichromate and 9 ml of sulfuric-phosphoric acid mixture. The reduction of chromic ions to the chromous state produces a variation of color ranging from bright orange to bluish-green. Allow solutions to cool and dilute with water to a volume of 20 ml. These standards, beginning with 0.1 ml and increasing 0.1 ml in each consecutive tube. Use 10 tubes, leaving one without reagents to serve as a blank. Add to each tube 1 ml of dichromate and 9 ml of sulfuric-phosphoric acid mixture. The reduction of chromic ions to the chromous state produces a gradual change in color of the solution ranging from bright orange to bluish-green. By adjusting the size of the soil sample, as well as the concentration and amount of reagents used, it was possible to obtain a suitable color range corresponding to definite contents of organic matter. The original standards were prepared by the use of various amounts of anhydrous dextrose and a permanent color scale was assembled from cellulose-acetate paper of different colors.