Soil management groups—A tool for communicating soils information[1]

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ABSTRACT

A "soil management group" concept was developed in Michigan to communicate soils information and to aid in the use of soil survey reports and maps. This concept, used for approximately 20 years, combines soils with similar profiles, management requirements, and responses to like management practices. Numbers and letters are used to provide for easy recall of the dominant profile texture, natural drainage class, and other important profile characteristics. The addition of slope and erosion, if severe or very severe, to the soil management group forms a soil management unit. Soil management groups and units have been used to locate research sites and to summarize research results. Fertilizer and no-till recommendations, soil drainage system designs, selection of coniferous planting stock, and farmland evaluations have been based on these groups. The degree of limitation of soil management units for several land uses, including municipal waste water disposal has been developed to aid land use planners.

Additional index words: Soil management units, Dominant profile texture, Natural drainage, Slope.

TO DATE, more than 10,000 soil series have been identified in the USA. This number is increasing as new areas are mapped and refinements in the new classification system are made. The number of soil series that have been identified within a single state is likely to be large. In Michigan, more than 275 soil series have been mapped. It is difficult, if not impossible, for an individual, especially someone who isn't a soil classifier, to easily understand, interpret, and recall without suitable notes the characteristics of this large number of soils. As a result soil scientists have frequently failed to communicate soil survey information effectively with land use planners and other potential users, including farmers. Consequently soil survey reports and maps are not used as extensively as desired.

As an aid in communicating soils information through the use of soil survey reports and maps, a "soil management group" concept was developed jointly by the Michigan Agricultural Experiment Station, the Cooperative Extension Service, and the Soil Conservation Service working with the National Project in Agricultural Communications. Refinements made in the past 20 years have eliminated many early problems.

The objective of this paper is to describe the soil management group concept and to illustrate how it is used in Michigan.

THE SOIL MANAGEMENT GROUP CONCEPT

The soil management group (SMG) concept combines soil series with similar dominant profile texture and natural drainage conditions. These groups are designated systematically with numbers and letters. This enables one to recall significant properties which affect various uses.

Mineral soils are given a number based on the dominant profile texture as follows: 0—fine clay, more than 60% clay; 1—clay, 40 to 60% clay; 1.5—clay loam and silty clay loam; 2.5—loam and silt loam; 3—sandy loam: 4—loamy sand; and 5—sand. Because of significant differences in available water holding capacities, the sands are further subdivided based on the development of the B horizon: 5.0 for sands with strong subsoil development, 5.3 for sands with medium subsoil development, and 5.7 for sands with weak or no subsoil development.

Soils developed from uniform parent materials are represented by one number (left column, Table 1). Soils developed from two storied parent materials or with contrasting textures in their profiles are represented by fractions (left column, Table 2). The numerator represents the texture of the upper story and the denominator the lower story. For example, 3/2 represents soils with 50 cm to 1 m of sandy loam over loam to silty clay loam.

Soils which are very gravelly or stony throughout their profile are indicated by a capital "G." Alluvial or lowland soils having stratified materials and subject to flooding are preceded by a capital

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Table 1—Interrelationships of soil management groups for soils developed from uniform parent material

Dominant profile texture	Symbols	Natural drainage class: Well and moderately well drained a	Somewhat poorly drained b	Poorly and very poorly drained c
Fine clay, over 60% clay	0	0 a	0 b	0 c
Clay, 40-60% clay	1	1 a	1 b	1 c
Clay loam and silty clay loam	1.5	1.5 a	1.5 b	1.5 c
Loam and silt loam	2.5	2.5 a	2.5 b	2.5 c
Sandy loam	3	3 a	3 b	3 c
Loamy sand	4	4 a	4 b	4 c
Sand with strong subsoil development	5.0	5 a	5 b	5 c
Sand with medium subsoil development	5.3	5.3 a	5 b	5 c
Sand with weak or no subsoil development	5.7	5.7 a	5 b	5 c
Gravelly or stony loamy sand to loam	G	Ga	Gbc	Gbc
Bedrock, less than 50 cm	R	Ra	Rbc	Rbc
Alluvial or lowland soils	L			
loamy	L-2	L-2a	L-2c	L-2c
sandy	L-4	L-4a	L-4c	L-4c

Table 2—Interrelationships of soil management groups for mineral soils with contrasting textures in their profile

Dominant profile texture	Symbols	Natural drainage class: Well and moderately well drained a	Somewhat poorly drained b	Poorly and very poorly drained c
Sandy loam, 36-100 cm, over clay	3/1	3/1 a	3/1 b	3/1 c
Sandy loam, 50-100 cm, over loam to clay loam	3/2	3/2 a	3/2 b	3/2 c
Sandy loam, 50-100 cm, over gravelly sand	3/5	3/5 a	3/5 b	3/5 c
Loamy sand, 36-100 cm, over clay	4/1	4/1 a	4/1 b	4/1 c
Sand to loamy sand, 50-100 cm, over loam to clay loam	4/2	4/2 a	4/2 b	4/2 c
Sand to loamy sand, 1.0-1.5 m, over loam to clay	5/2	5/2 a	5/2 b	5 c
Loam, 50-100 cm, over bedrock	2/R	2/R a		
Sandy loam, 50-100 cm, over bedrock	3/R	3/R a	3/Rbc	3/Rbc
Sand to loamy sand, 50-100 cm, over bedrock	4/R	4/Ra	4/Rbc	4/Rbc

Table 3—Interrelationships of soil management groups for organic soils

Depth of organic materials	Underlying material	Very poorly drained (c)
Greater than 130 cm		Mc
40-130 cm	clay	M/lc
40-130 cm	sandy loam to clay loam	M/3c
40-130 cm	loamy sand to sand	M/4c
40-130 cm	marl	M/mc
40-130 cm	bedrock	M/Rc

"L." Soils which are less than 50 cm to bedrock are indicated by a capital "R." Soils having 50 cm to 1 m of soil material over bedrock are subdivided by the characteristics of the overlying materials as the numerator of a fraction: 2/R—loam over bedrock; 3/R—sandy loam over bedrock; and 4/R—loamy sand or sand over bedrock.

Organic soils are indicated by a capital "M" for muck or peat. Thin, 40 to 130 cm, organic soils are subdivided by characteristics of the underlying mineral materials (Table 3): M/1—muck over clay; M/3—muck over sandy loam to clay loam; M/4—muck over loamy sand or sand; M/m—muck over marl; M/R—muck over bedrock. Thick, greater than 130 cm, organic soils are given only the symbol "M."

Lower case letters are used to indicate natural drainage conditions: a—well and moderately well drained; b—somewhat poorly drained (formerly called imperfectly drained); and c—poorly and very poorly drained. The term natural drainage refers to the conditions under which the soil was formed and not to whether the soil is ditch or tile drained. The letters follow the numbers or capital letters of the dominant profile texture in the soil management group symbol. The interrelationships among soil management groups are shown in Tables 1, 2, and 3. The Oa soil management group represents naturally well drained soils containing more than 60% clay (Table 1).

The somewhat poorly drained, poorly drained, and very poorly drained gravelly or stony soils are combined into one soil management group, Gbc (Table 1). These drainage classes of the shallow and very shallow bedrock soils are similarly combined. The somewhat poorly and poorly drained, alluvial soils are also combined but drainage is indicated by c, for example, L-2c (Table 1).

Other soil profile characteristics important to land use planning are indicated by adding a dash and a second lower case letter to the number for the dominant profile texture and lower case letter for natural drainage. A lower case "a" after a dash indicates soils with very strongly acid (pH less than 4.5) subsoils. A lower case "c" following a dash indicates calcareous or limy conditions within 25 cm of the surface. A lower case "d" indicates dense or compact subsoils. A lower case "h" indicates hardened or cemented subsoils (ortstein). A lower case "s" indicates stratification with fine sands and silts. For example, the 4/2c-c soil management group includes all soils which are calcareous within 25 cm of the surface, which developed with 50 to 100 cm of sand or loamy sand over loam to silty clay loam under naturally poorly drained conditions.

If a soil has two or more other important profile characteristics, two or more letters follow the dash. For example, the 2.5b-cs includes soils with a dominant profile texture of loam or silt loam, that are somewhat poorly drained, calcareous within 25 cm of the surface and stratified with fine sands and silts.

THE SOIL MANAGEMENT UNIT CONCEPT

For many uses of soils information, soil management groups must be further subdivided. The slope of the land affects the suitability for various uses. Slope classes have been arbitrarily established and designated by capital letters. Those commonly used in Michigan are: A—0 to 2% slopes; B—2 to 6% slopes; C—6 to 12% slopes; D—12 to 18% slopes; E—18 to 25% slopes; and F—greater than 25% slopes. The addition of a slope symbol to the soil management group symbol forms the soil management unit symbol (SMU).

For some uses, such as cropland, the amount of accelerated soil erosion is important. The following four classes of erosion have been defined to describe the degree of water erosion which occurred previous to mapping: 1—slight; 2—moderate; 3—severe; and 4—very severe (Soil Survey Staff, 1951). The erosion class symbol is added to the soil management unit symbol only if the class is severe or very severe.

Soil management units combine soils with similar profiles, management requirements and responses to like management practices. For example, 1.5aE3 represents soil profiles of clay loam textures that are well drained, have 18-25% slopes and which are severely eroded.

USES OF SOIL MANAGEMENT GROUP CONCEPT

Agriculturalists have used the soil management group concept since its inception. Fertilizer recommendations are based on both soil test results and soil management groups (Christenson et al., 1972). As early as 1962, the concept was used to predict the fertilizer requirements of sugarbeets (Shickluna, 1962a). While there is a wide range in test levels within any group, the average levels were distinctly characteristic for each group (Shickluna, 1962b; Robertson et al., 1975a, 1975b).

Crop yield potentials have been estimated for most soil management groups. The yield potentials assume good management practices and adequate drainage for the somewhat poorly and poorly drained soils (Christenson et al., 1972). The field yield capacity is calculated from the yield potentials and allows a person to evaluate his managerial skills (Robertson, 1969). The yield potentials and the soil management groups are the basis for the productivity groupings which the Michigan State Tax Commission uses for equitable farmland evaluation (Michigan State Tax Commission, 1972).

The design of artificial drainage systems is based on soil management groups (Engberg et al., 1963). The spacing between tile lines is dependent upon soil permeability which commonly varies with texture. Soils stratified with fine sands and silts (indicated by an "s" after a dash) require special blinding to prevent soil material from flowing into the tile. Open ditches in these soils are difficult to maintain because ditchbanks are unstable.

Recommendations for no-tillage systems are based on soil management groups (Robertson et al., 1975). Soil management groups are being used in the selection of coniferous planting stock (Bell, 1971).

Recently soil management groups and units have been used for nonagricultural land use planning. They have been used to compare the performance of existing septic tank disposal fields (Mokma and Whiteside, 1972) and in designing systems for the disposal of municipal waste waters (Schneider and Erickson, 1972). Degrees of limitation of soil management units have been determined for residential development with and without public sewer, highways and streets, parks and recreation, cropland and woodland (Mokma et al., 1974). One of Michigan's 14 regional planning commissions is using such information in making land use planning decisions.

Soil management groups have been used in the selection of research plots and summarizing research results. These summaries have been effective in communicating the information to interested groups.

The soil management group concept is very useful in communicating soils information at public meetings and in lectures to students with little soil science background. The concept can be described in a short time with audience comprehension. The audience can easily understand future references to soil management groups and units at later points in the presentation. Reference to soil series names are meaningless unless the properties of each series are described.

The soil management group concept has been an effective tool for communicating soils information in Michigan and in helping land use planners utilize soil survey reports and maps in their decision making process.

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