

22 February 2016

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Fundamentals of Soil Science

3.3. Weight and Pore Space Relationships

... We are interested in density and pore space relationships because air and water are stored in and move through pore spaces. Also, plants need pore spaces for root extension.

3.3.1. Particle Density

... The particle density of any soil is defined as the mass (weight) per unit volume of soil particles (soil solids) and is frequently expressed as grams per cubic centimeter (g cm^{-3}). For many mineral soils the particle density will average about 2.6 g cm^{-3} . It does not vary a great deal for different soils unless there is considerable variation in content of organic matter or mineralogical composition.

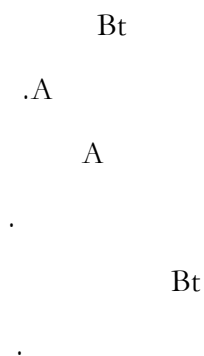
3.3.2. Bulk Density

The bulk density is the weight per unit volume of **oven dry** soil, commonly expressed as grams per cubic centimeter.

... The bulk density of granulated clay **surface** soils will commonly be in the range 1.0 to 1.3 g cm⁻³. Coarse-textured surface soils will usually be in the range 1.3 to 1.8 g cm⁻³. The greater development of structure in fine-textured surface soils accounts for their lower bulk density as compared to more sandy soils.

The bulk densities of the various horizons of the Miami loam given in Figure 1 show that the parent material is the densest layer. It has a bulk density of 1.8 g cm⁻³. Formation of structure during soil development caused the overlaying horizons to have lower bulk densities than the original parent material.

The Bt horizon in the Miami loam has a greater clay content than the A horizon. Its bulk density is greater than the A horizon and thus has a lower percentage of pore space. Clay deposition in the Bt horizon filled pore space and made the horizon more dense as the clay content increased. The general rule that fine-textured soils have more pore space



and lower bulk densities than coarse-textured soils may hold when comparable structural conditions exist.

Organic soils have very low bulk density compared to mineral soils. ... Values ranging from 0.1 to 0.6 g cm⁻³ are common.

3.3.3. Pore Space

... The percentage of pore space in a soil may be calculated from the bulk density and particle density if both are expressed in the same units of measurement (see the blackboard).

... In short, soil texture and structure exert a large influence on weight and pore space. As the density of a soil increases, the volume of pore space decreases, and vice versa.

References

Foth, H. D. 1978. Fundamentals of Soil Science. John Wiley & Sons, New York, USA

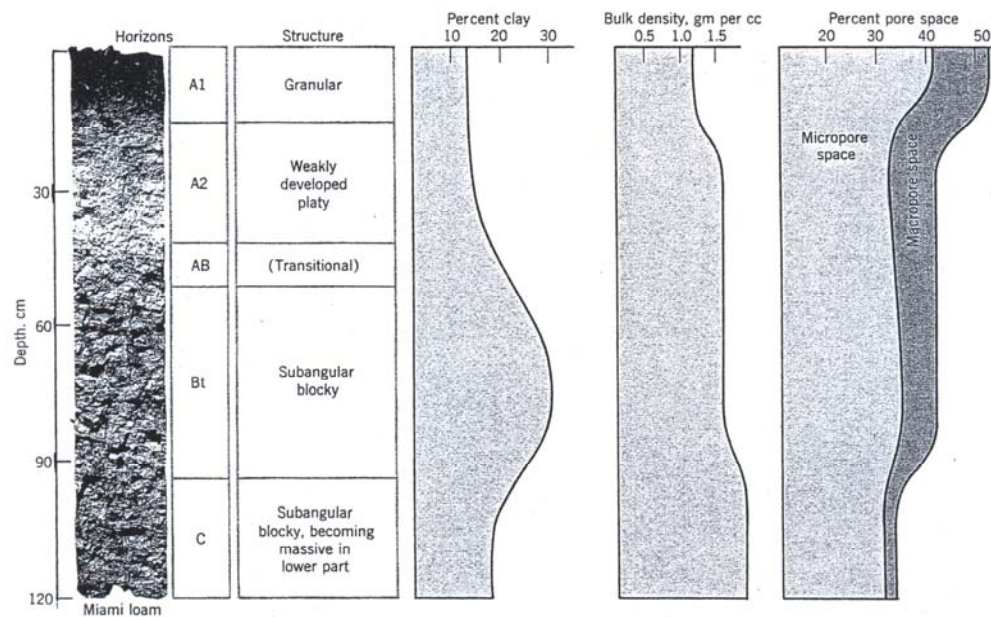


Figure 1 Horizon designations, structure, clay content, bulk density, and percentage pore space of horizons of Miami loam (Alfisol) (Source: Foth, 1978).

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