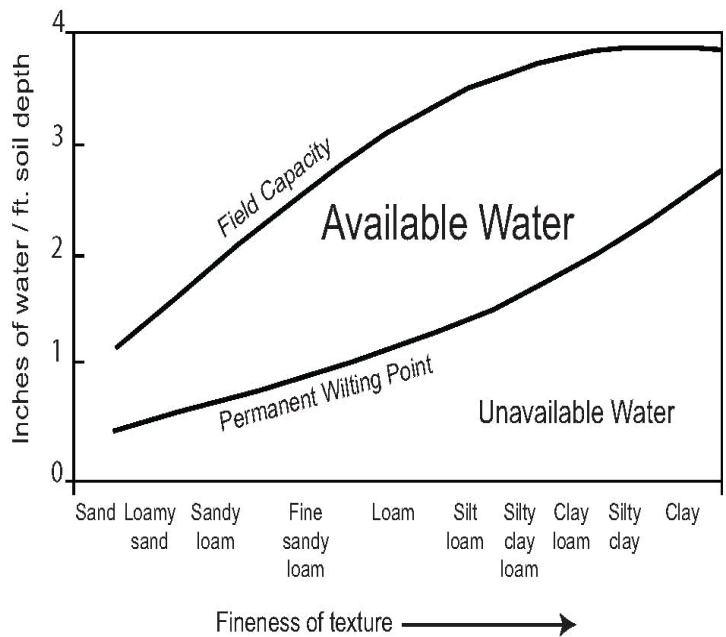
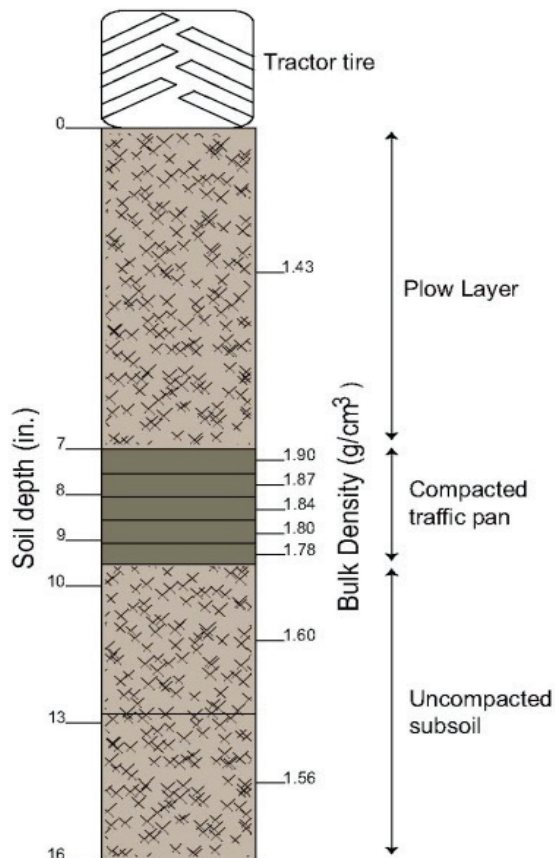


Soil Health - Bulk Density

General Relationship of Soil Bulk Density to Root Growth Based on Soil Texture*

Soil Texture	Ideal Bulk Density for Plant Growth (g/cm ³)	Bulk Density that Affects Root Growth (g/cm ³)	Bulk Density that Restricts Root Growth (g/cm ³)
Sand, Loamy Sand	<1.60	1.63	>1.80
Sandy Loam, Loam	<1.40	1.63	>1.80
Sandy Clay Loam, Clay Loam	<1.40	1.60	>1.75
Silt, Silt Loam	<1.40	1.60	>1.75
Silt Loam, Silty Clay Loam	<1.40	1.55	>1.65
Sandy Clay, Silty Clay, Clay Loam	<1.10	1.49	>1.58
Clay (<45 percent clay)	<1.10	1.39	>1.47

*Does not apply to red clayey soils and volcanic ash



Relationship between available water and texture (Ohio Agronomy Guide, 14th Ed., Bull. 472-05).

Compacted plow layer inhibits root penetration and water movement through the soil profile (adapted from *The Nature and Properties of Soils, 10th edition*).

Soil Health - Bulk Density

Measuring Bulk Density and Soil Moisture

Materials needed:

3" Diameter aluminum ring	Scale (1 g. precision)
Wood block	1/8 cup (29.5 mL) measuring scoop
Rubber mallet	Ceramic coffee cup or paper plate
Flat-bladed knife	18" metal rod, probe or spade
Resealable plastic bags	Access to microwave oven
Permanent marker	

Procedure:

1. Carefully clear all residue from the soil surface. Drive the ring into the soil to a depth of 3" using the mallet and block of wood. The top of the ring should extend 2" above the soil surface.
2. Remove the ring by first cutting around the edge with the flat-bladed knife. Place the trowel underneath the ring (to keep the sample in the ring), and carefully lift the ring out.
3. Remove excess soil from the bottom of the ring with the knife.
4. Place the sample in a resealable plastic bag. Label the bag.
5. Weigh the sample, including the bag. Record the weight.
6. Weigh an identical, clean, empty bag. Record the weight.
7. Weigh empty cup or paper plate to be used in Step 8. Record the weight.
8. Use the entire soil core to determine water content and dry soil weight.
 - a. Mix soil core thoroughly by kneading the plastic bag.
 - b. Remove level 1/8-cup scoop of loose soil from bag. Place in the weighed cup or plate (Step 7).
9. Weigh both moist soil removed from the plastic bag and the cup or plate. Record the weight.
10. Place soil and cup or plate in microwave oven. Dry in 4-minute cycles at medium power.

Calculations:

Abbreviations and letter in examples and tables:

Wt - weight; π - 3.14; gr - grams; r - radius of inside diameter of ring/core

Volume of soil core (cm³):

$$V = \pi r^2 \times \text{height}$$

Soil water content of subsample (gr/gr):

$$\text{SWC} = \frac{\text{wt of moist soil} - \text{wt of oven-dry soil}}{\text{wt of oven-dry soil}}$$

Dry weight of soil core based on water content of subsample (gr):

$$\text{Dry wt of soil core} = \frac{\text{wt of moist soil} + \text{bag (gr)} - \text{wt of bag (gr)}}{[1 + \text{soil water content (gr/gr)}]}$$

Bulk density calculation (gr/cm³):

$$\text{Db} = \text{Dry wt of soil core} \div \text{vol of soil core}$$