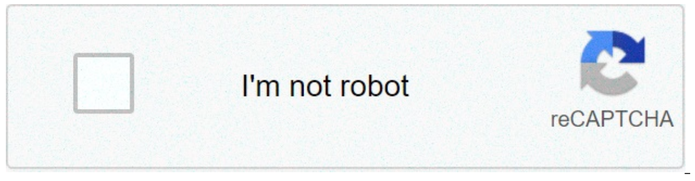

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What do you mean by bulk density

Soil Quality for Environmental Health Home > Indicators > Bulk Density What it is: Bulk density is an indicator of soil compaction. It is calculated as the dry weight of soil divided by its volume. This volume includes the volume of soil particles and the volume of pores among soil particles. Bulk density is typically expressed in g/cm3. Why it is important: Bulk density reflects the soil's ability to function for structural support, water and solute movement, and soil aeration. Bulk densities above thresholds indicate impaired function (see table 1). Bulk density is also used to convert between weight and volume of soil. It is used to express soil physical, chemical and biological measurements on a volumetric basis for soil quality assessment and comparisons between management systems. This increases the validity of comparisons by removing error associated with differences in soil density at time of sampling. Table 1. General relationship of soil bulk density to root growth based on soil texture. Soil Texture Ideal bulk densities for plant growth (g/cm3) Bulk densities that restrict root growth (g/cm3) Sandy < 1.60 > 1.80 Silty < 1.40 > 1.65 Clayey < 1.10 > 1.47 Specific problems that might be caused by poor function: High bulk density is an indicator of low soil porosity and soil compaction. It may cause restrictions to root growth, and poor movement of air and water through the soil. Compaction can result in shallow plant rooting and poor plant growth, influencing crop yield and reducing vegetative cover available to protect soil from erosion. By reducing water infiltration into the soil, compaction can lead to increased runoff and erosion from sloping land or waterlogged soils in flatter areas. In general, some soil compaction to restrict water movement through the soil profile is beneficial under arid conditions, but under humid conditions compaction decreases yields. The following practices can lead to poor bulk density: Consistently plowing or disking to the same depth, Allowing equipment traffic, especially on wet soil, Using a limited crop rotation without variability in root structure or rooting depth, Incorporating, burning, or removing crop residues, Overgrazing forage plants, and allowing development of livestock loafing areas and trails, and Using heavy equipment for building site preparation or land smoothing and leveling. What you can do: Any practice that improves soil structure decreases bulk density; however, in some cases these improvements may only be temporary. For example, tillage at the beginning of the growing season temporarily decreases bulk density and disturbs compacted soil layers, but subsequent trips across the field by farm equipment, rainfall events, animals, and other disturbance activities can recompact soil. On cropland, long-term solutions to bulk density and soil compaction problems revolve around decreasing soil disturbance and increasing soil organic matter. A system that uses cover crops, crop residues, perennial sod, and/or reduced tillage results in increased soil organic matter, less disturbance and reduced bulk density. Additionally, the use of multi-crop systems involving plants with different rooting depths can help break up compacted soil layers. To reduce the likelihood of high bulk density and compaction: Minimize soil disturbance and production activities when soils are wet, Use designated field roads or rows for equipment traffic, Reduce the number of trips across the area, Subsoil to disrupt existing compacted layers, and Use practices that maintain or increase soil organic matter. Grazing systems that minimize livestock traffic and loafing, provide protected heavy use areas, and adhere to recommended minimum grazing heights reduce bulk density by preventing compaction and providing soil cover. Conservation practices resulting in bulk density favorable to soil function include: Conservation Crop Rotation Cover Crop Deep Tillage Prescribed Grazing Residue and Tillage Management For more information go to Soil Management Practices. Measuring bulk density: The Cylindrical Core Method is described in the Soil Quality Test Kit Guide, Section I, Chapter 4, pp. 9 - 13. See Section II, Chapter 3, pp. 57 - 58 for interpretation of results. Photo: A three inch diameter ring is hammered into the soil to collect bulk density samples. Arshad M.A., Lowery B., and Grossman B. 1996. Physical Tests for Monitoring Soil Quality. In: Doran J.W., Jones A.J., editors. Methods for assessing soil quality. Madison, WI. p 123-41. In this fourth installment in the Everyday Soil Science series, we move our discussion to two important indicators of soil health that are often overlooked by gardeners and landscape professionals — bulk density and porosity. The weighty subject of bulk density relates simply to the ratio of solids (i.e., sand, silt, and clay particles) to pore space (porosity) in a given sample of soil. Bulk density typically increases as the ratio of solids in a soil increases, and conversely decreases as the ratio of solids decreases. Looked at from the porosity perspective, bulk density increases as pore space decreases. The relationship of bulk density and porosity is reciprocal. As one increases, the other decreases. Picture a brick. The brick is nearly 100% solid, so we'd say it has a "high" bulk density. Now picture a big sponge with lots of nooks and crannies of different sizes. The sponge is approximately 50% pore space, so we'd say it has a "low" bulk density. I could get mathematical on you at this point to quantify bulk density, but let's keep it simple and focus on the relative difference. Brick = high bulk density. Sponge = low bulk density. Generally speaking, loose, rich in organic matter, well aggregated and porous soils have a low bulk density. Sandy soils on the other hand have relatively high bulk since the sand particles can interlock to form a more solid mass with little pore space. This translates into sandy soils being easily compacted. Bulk density then is an indicator of a common soil health problem that we've all encountered at some point – compaction. Compaction affects infiltration, rooting depth, water holding capacity, soil porosity, the availability of plant nutrients, and the activity of soil microbes. Compacted soils have high bulk density. Compacted soil with restricted root depth Improving bulk density, alleviating compaction, and increasing soil porosity can be achieved through several easy-to-do management practices. Minimize soil disturbance by working the smallest area of soil possible with the least intrusive tool possible. Avoid rototilling, plowing and other forms of mechanical soil disturbance. When transplanting plants from large-sized containers, create lateral openings in the planting hole to facilitate air, water, and root movement. Never till or operate equipment when soils are wet. Utilize mulch, plant stubble, compost, and green manure (cover) crops to displace the weight of people and equipment on the soil surface. Always keep soil covered, even during short-term work activities. Use a diversity of plant materials (deep rooted as well as shallow rooted) to break up compacted soil layers. Aerate turf and planted areas twice annually using a tine-type aeration device. Apply a top-dressing of ¼" compost and/or compost tea every three months to all turf and planted areas to maintain active soil biology. Implementing the practices above will go a long way to keeping the bulk density of your soil more like a sponge rather than a brick. And who plants in a brick…? For more information about bulk density and soil porosity contact your local Master Gardener office, or click here to download an educational factsheet from the USDA, Natural Resources Conservation Service. Remember, soil sustains life! ~The Soil Sommelier Bulk density, also called apparent density or volumetric density, is a property of powders, granules, and other "divided" solids, especially used in reference to mineral components (soil, gravel), chemical substances, (pharmaceutical) ingredients, foodstuff, or any other masses of corpuscular or particulate matter. It is defined as the mass of the many particles of the soil material divided by the total volume they occupy. The total volume includes particle volume, inter-particle void volume, and internal pore volume.[1] Bulk density is not an intrinsic property of a material; it can change depending on how the material is handled. For example, a powder poured into a cylinder will have a particular bulk density; if the cylinder is disturbed, the powder particles will move and usually settle closer together, resulting in a higher bulk density. For this reason, the bulk density of powders is usually reported both as "freely settled" (or "poured" density) and "tapped" density (where the tapped density refers to the bulk density of the powder after a specified compaction process, usually involving vibration of the container.[2]) Soil Further information: Soil § Density The bulk density of soil depends greatly on the mineral make up of soil and the degree of compaction. The density of quartz is around 2.65 g/cm3 but the (dry) bulk density of a mineral soil is normally about half that density, between 1.0 and 1.6 g/cm3. In contrast, soils rich in soil organic carbon and some friable clays tend to have lower bulk densities (