

Soil Under Pressure

A Discussion on Soil Compaction

What Is Soil Compaction?

Soil compaction is the compression of soil particles that reduces pore space in the soil. Soil compaction decreases the space in which air and water can access the soil, thereby increasing the bulk density of the soil. Reducing the pore space in soil decreases the infiltration of gases and water into the soil, leading to poor water uptake, poor nutrient cycling, increased difficulty for roots to penetrate deeper soil, and an overall reduction in crop yield.

How Does Soil Compaction Affect Crops?

Imagine you are in your living room, and all of a sudden, the walls and ceiling start to close in. The room gets smaller and smaller as the couches, tables, chairs, television, and bookshelves all compress into the decreasing volume of the room. Soon, there is not enough room to move around, and it feels like there is less air around you as your living room gets smaller and smaller. This is how plants and microbes feel when there is too much soil compaction! The soil beneath our feet is susceptible to compaction by vehicles, our own bodies, and the force of rain pounding on the soil surface. The more frequently soil experiences a heavy object or strong force on the surface, the more the soil will begin to compact and close necessary pore space. This limits the amount of water that can infiltrate the soil, the amount of air space within the soil, and the accessibility for roots to navigate within the soil.

How Does Compaction Occur?

Two types of soil compaction can occur:

- Natural
- Human-induced

Natural compaction results from exposure to precipitation, livestock grazing, and gravity pulling soil particles down. Human-induced compaction results from tillage and vehicle traffic. Heavy tractors and machines can create huge compaction with their wheels, and the first pass of a vehicle over a field accounts for up to 80% of soil compaction, compared to the following passes which account for far less.

How Do You Measure Soil Compaction?

One way to measure soil compaction is with a penetrometer. The penetrometer has a pressure gauge at the top, and gradients of measuring soil depth along the rod. You can test soil compaction anywhere you are interested, and it is a simple procedure. Take the penetrometer out to a field of interest, and place it over the ground. The rod should be driven into the ground slowly, and you should watch as the gauge increases the more you press down. Record the depth at which soil compaction reaches 200 and 300 psi. At 200 psi, plant roots start having difficulty penetrating compacted soils. At 300 psi, they make almost no progress whatsoever!

Do this at multiple sites of the field, and compare soil compaction between different fields to see where soil compaction is greatest so that you can assess future management from there. To get a good feel for compaction, take time to check out areas that you'd expect high compaction, like a driveway or the ground around your bonfire pit. Also, seek out areas with expected low compaction like a tree or fence line.

How To Assess Soil Compaction

Some key features of areas with excessive compaction can be:

- Areas with heavy foot/vehicle traffic
- Exposed soil and lack of vegetation
- Shallow plant roots
- Ponding

How to Decrease Soil Compaction

Soil compaction can be detrimental to crop yields, and it is important to make farm decisions that make sense for you in the context of your world. Here are some things you can do to reduce soil compaction:

- Limit the use of heavy machines and vehicles on wet soil
 - Wet soil compacts easier due to the pore space being occupied by water
- Create tracks in defined areas to limit traffic across the entire field and minimize compaction zones
- Add compost and other organic materials to increase organic matter in the soil
 - This increases microbial interactions that facilitate the building of soil structure
- Plant crops with deep taproots, like alfalfa and brassicas
 - Plants with taproots can penetrate deeper into the ground and take up water from deep, moist, compact soil.