



# 16A

## SOIL TECH NOTES

# Compacted Zone In Soil

**CONCERN:** "I hear a lot of talk about a hard pan in soils. Is that a real problem? I guess I just need to deep rip it and get rid of it that way?"

### **COMPACTION IS A PROBLEM:**

Compaction can occur in the surface layers of soils or it can occur deeper in the subsoil.

Caused by a change in the bulk density of the soil. Bulk density has to do with amount of pore space compared to the mineral matter content. Good soils should have 50% or more pore space, both micro and macro pores.

Surface layer with bulk density of 1.4 g/cc has a pore space of about 48-50%. If the surface is compacted to a bulk density of 1.8 g/cc, pore space drops to 30-35%. Much of the loss of pore space is in the macro pores which are especially important for water and air movement.

The size and continuity of pores controls whether larger microbes, such as protozoa, can prey upon bacteria and fungi. Smaller pores favor bacteria and smaller predators over fungi and larger predators.

Arthropods are severely affected by compaction. The predatory species of nematodes is also affected.

Compaction can cause restricted root growth, poor root zone aeration, drainage problems, less oxygen in the root zone, less available water holding capacity, more loss of Nitrogen through denitrification, more runoff and erosion due to surface crusting and sealing, etc.

Sandy soils generally have higher natural bulk densities since total pore space is less than with loamy soils

If not addressed at the time, compaction layers in the surface can become thicker and more pronounced.

Deeper compaction layers are more difficult to remove since root volume is less and natural soil structure is much less developed deeper into the soil.

The two "natural" forces that compact soil are gravity and water, noticeably rainfall impact!! These two tend to cause apparent "compaction" in no-till soils and in sandy soils.

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**POSSIBLE SOLUTIONS:**

Cover crops, and any practices that increase organic matter, serve a good purpose here to break up hard pan layers. The increased and generally aggressive rooting systems of many cover crops can penetrate and force apart the compacted soil particles. Organic matter acts as a “buffer” to keep soil particles apart and channels between the particles open. Organic residues on the soil surface help cushion the effect of soil compaction. It also binds micro-aggregates and macro-aggregates in the soil with an organic “glue”

In heavily tilled soils, bacteria are dominant. To form the organic “glue” (Glomalin) that binds soil particles together, fungi must be present. Fungi need a more continuous living cover which supplies a constant source of carbon and relatively stable conditions in the soil. Under these conditions, more Glomalin is produced and more macro-aggregates are formed.

Deep (10-12” or more) tillage is often assumed to break up hard pans. Deep tillage is really **never a permanent fix** for this problem. To be effective at all, the surface must be dry and able to “shatter” when the tool is pulled through. If not, the shank will just cut a slot through moist soil which will then close in later.

Track vehicles have been shown to put lower pressure on the soil which should produce less compaction

Travel lanes in fields will reduce the overall compaction of a field by keeping all the vehicles working in the field to confined areas. Compaction for the **entire field** is then minimized.

Lowering tire pressure in wheeled vehicles has also been shown to reduce compaction.

Stay out of fields that are wet for sure, but also avoid those that are “moist” and will form a ball of soil that sticks together when squeezed.

**Summary:** Increasing SOM protects soil from compaction in five ways.

1. Surface residue resists compaction because it acts like a sponge to absorb weight of heavy equipment traffic.
2. Organic residues are less dense than soil particles. Lower bulk density, more pore space.
3. Roots create voids and spaces for air and water movement, but in a controlled way so that excessive amounts of oxygen don't enter the soil and “burn up” existing organic matter.
4. Roots supply food for microorganisms, especially fungi, which keep the soil from compacting.
5. Roots supply exudates, or organic excretions, that “glue” the soil particles together and form **macro**-aggregates in the soil, instead of **micro**-aggregates which can plug soil pores.



National Soil Health Website:  
[www.nrcs.usda.gov/wps/portal/nrcs/main/national/soils/health/](http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/soils/health/)

