



Ruts, Soil Compaction or Both?

The 2019 harvesting season will go into most area farmers' memory banks as one of the worst they've experienced, in regards to the conditions faced trying to get crops out of the field. Wet soils created stress on equipment, stuck equipment that needed extra time and effort to get out of the field, and miles upon miles of wheel ruts that need to be managed prior to planting this year. Ruts are a visible problem, but soil compaction is less readily seen and is the real profit killer.

Soil compaction is the result of compression of the soil. In its natural state, soil is not like a jar of sand, where you can see and separate every grain singly. Soil particles mix with the living and dead organic matter in the soil to form aggregates. The aggregates allow stable pore space to be found within the soil that allows air and water to move through the soil. Envision a jar filled with bb's vs. a jar filled with golf balls. There is a lot more space between the golf balls than between the bb's.

Heavy equipment moving over wet soil causes the pore space to be squeezed out of the soil, or at least a particular layer of the soil. Now, we've created a zone that is not permeable and acts more like a layer of concrete than actual soil because the particles are squished together and have no aggregate structure left. These layers cause many problems in subsequent years. Symptoms of compaction can include poor seed germination and survival; stunted growth; pancake rooting (lateral instead of vertical root formations); nutrient deficiencies; increased likelihood of drought effects; and overall poor growth. All told, soil compaction will usually decrease crop yield 10 to 50% and can do so for multiple years if not mitigated properly.

However, it is interesting to note that ruts do not equal soil compaction in all cases. Certainly, the ruts themselves are a problem and fields with any type of rutting need to have surface tillage passes conducted to smooth them out prior to planting. In many cases, rutting was caused because the soil was saturated or over-saturated and resulting soil compaction is either relatively minimal or just located in the upper 2-6 inches of the soil. This type of compaction is fairly simple to 'fix', and can generally be done with normal tillage equipment that fits into a farm's plans, anyway. Of course, care needs to be taken to do so when soil conditions are correct.

The worst type of soil compaction is subsoil compaction, which is found between 8" and 24" deep in the soil profile. It takes a very different approach to fix this type of compaction. One is to use deep, vertical tillage implements. These long-shanked implements can reach down up to 24" deep, if necessary, but take extreme horsepower to do so, usually 30-50 hp/shank. Further, they really only break through about 10-15% of the compaction layer. But, this is often enough to allow roots to find their way to deeper soil and for excess water to drain properly. However, the cost in dollars per acre is significant, and it often results in rocks and infertile soil being brought toward the surface.

Fixing the rest of the zone of compaction requires roots, or a farm can simply try to use roots and time to break the compaction. Deep, strong-rooted crops such as alfalfa and oilseed radishes can have impact fairly quickly, especially if the layer of compaction is not too thick. Mixes of root growth patterns are usually more effective in total, as big taproots can hopefully break through the zone and heavy fibrous root systems of grass plants can work on the upper portions of the compaction zone and eventually get through, as well.

Even with good plant growth, compaction's effects can negatively affect plant growth for many years. As an extreme example, the established trails of covered wagons can still be found in some soils yet, today. Freeze/thaw cycles can help mitigate surface compaction, but don't do much for subsoil compaction. As such, it is best if we can prevent soil compaction from occurring and most farms really do their best to do so. Waiting until drier soil conditions are present is usually the most effective way to prevent field compaction, but is not always an option. In most field conditions, the first implement pass causes about 75% of the compaction. Thus, driving over less of the field and creating trails which can then be managed differently is actually better than driving once over most of the field.

These same theories apply to home gardens, as tilling to the same depth every year, walking over the soil when it is too wet, or pulling carts over the garden area can all cause compaction. In the home garden, roots are probably the best fix for compaction, although deep implements, such as broad forks, can also work, or completing a double digging process if in small zones.

Multiple UW-Madison Division of Extension resources exist to assist farmers and gardeners better understand compaction and how to prevent or alleviate it. Nearly all land-grant universities also have developed resources on this topic, and all of them can help you to gain more understanding of the issues surrounding compaction. Two resources I would recommend reading are Wisconsin Extension publication A4158 'Managing Soil Compaction at Planting and Harvest' by Soil Scientist Francisco Arriaga and A3367 'Soil Compaction: Causes, Concerns, and Cures' (Wolkowski & Lowery).

If you are really interested in the topic, Scott Reuss, Marinette County Agriculture Agent, has compiled many pertinent resources into a single document that can be found under the Agriculture tab of the Marinette County UW-Madison, Div. of Extension web page, at <https://marinette.extension.wisc.edu/agriculture/>

You can also contact him directly with any agriculture or horticulture questions you may have, at 715-732-7510 or e-mail to scott.reuss@wisc.edu