THE LEADING EDGE

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A PUBLICATION DEDICATED TO MAXIMIZING YIELD POTENTIAL

Avoid the Compaction Curse

Keep soil happy and healthy by managing soil compaction

All farmers would agree that highly compacted soil is unhealthy soil—and many studies have been conducted to confirm this claim. Some researchers estimate that crop yields in compacted soil can be as much as 60 percent lower than in healthy, uncompacted soil.i

Recognizing the problem may not be difficult, but it will provoke a host of questions. What causes soil compaction? How can it be avoided? How do you tell if reduced yields are caused by compacted soil, and not something else entirely?

Working the field when the soil is wet causes compaction lines that are visible after planting and throughout the growing season. The results of compaction appear most dramatically on the yield monitor.

Soil sleuthing—finding the real culprit

The basic formula of good soil for crop production is about 25 percent water, 25 percent air, and 50 percent soil particles. The water and air portion–or pore space–can be reduced by tillage, wheel traffic, etc. That, in a nutshell, is soil compaction.

There are several symptoms of soil compaction. Tillage to solve compaction can easily cost $7 to $10 per acre or more, so it is important to make sure soil compaction is actually the cause of problems before taking steps to correct it.

One symptom is stunted crop height. Since this can be caused by other problems, determine if it is caused by compacted soil by digging up plants and examining root depth and structure—roots in compacted soil will be shallow and malformed.

Another symptom may be water ponding in fields. Obviously, compacted soil allows less water penetration, so the water will sit on top of the soil instead of sinking in.

There are also technical tests that can be used to determine whether soil is compacted. Test the strength of the soil with a tile probe, spade, or penetromer—though dry soil will have significant strength even if uncompacted. Then, compare that measurement with measurements made in an adjacent area unlikely to be compacted, such as fence rows or adjacent fields with different field traffic.

The negative effects of soil compaction

A healthy root system is critical for plant growth. The best way to check if compaction is affecting root growth is to dig up a plant.

Compacted soil can cause poor root penetration, reduced internal soil drainage, reduced rainfall infiltration, and lack of soil aeration. As mentioned above, the right proportions of air and water are critical to providing a healthy soil environment for root systems.

The long-term results of soil compaction are nothing to scoff at. Poor plant growth is the result of low soil moisture and air availability to the root system.

Research has shown that increased vehicle traffic, resulting in compacted soil, delays seedling emergence and causes variable emergence rates. This, in turn, hurts yields.

Compacted soil can also result in increased fertilizer and operating costs. Earlier and larger volumes of surface runoff and major soil loss due to water erosion mean fertilizer loses. Highly compacted soils also require more horsepower to till, which means higher fuel usage, and tillage and planting equipment may not even function properly in unyielding soils.

No simple solutions

Though there are measures to take once you know your soil is compacted, the only completely effective solution is to avoid it in the first place. The primary cause of compaction is heavy machinery running in fields, especially in wet weather. According to the Iowa State University Extension, "Conservation tillage practices and traffic management need to be the main strategies in avoiding soil compaction and improving yield." ii.

As farms have increased in size, so has the size and weight of farm equipment. Heavier equipment unavoidably means more compacted soil. That's why it is so important to regulate the traffic of machinery to minimize the impact of heavy machinery causing soil compaction. Though the soil under the wheel tracks may become compacted, the rest of the field will be unaffected. Minimum and no-till practices make it much easier to reduce damaging field traffic.

The time of year and weather also affect the risk of soil compaction. Wet soil is much more easily compacted than dry. Refrain from field operations on the first day a tractor can be operated in the field after rain without getting stuck. If it is unavoidable, use controlled traffic lanes. If soil is dry or frozen, not much compaction may occur.

If a tillage pass in the fall is necessary to incorporate residue, choose an option that limits compaction, such as shallow vertical tillage tools. These tools, designed to penetrate only the top three inches of soil, help ensure soil damage is controlled and the creation of any root-restricting layers is avoided. Most shallow, coulter-based vertical tillage tools have fairly low horsepower requirements and are a good choice for tillage in combine-trod fields post-harvest.

Shallow vertical tillage done with wavy coulters is an effective way to size and incorporate residue which aids decomposition over winter without risking high levels of compaction.

Vertical tillage has

If compaction has already occurred, deep tillage

other benefits. Read more in Leading Edge issue 81.

can be considered as a remedy. In dry soil, a subsoiler or chisel plow can reduce compaction—it will do little in wet soil. Till only to the depth of the compacted layer. Make sure to select proper subsoiler shanks to achieve desired mixing and residue cover.

Don't let compacted soil rob your yields

Study after study has been done on the effects of soil compaction, and though the numbers vary, all agree on one thing—soil compaction has a negative effect on crop growth and yield. Keep your soil healthy and happy by avoiding soil compaction with the right tools and smart management choices.

i. Jodi DeJong Hughes, "Tires, Traction and Compaction," University of Minnesota Extension, 2009, http://www.extension.umn.edu/distribution/cropsystems/M1271.html.

ii. Mark Hannah and Mahdi M. Al-Kaisi, "Understanding & Managing Soil Compaction," Iowa State University Extension, September 2009, http://www.extension.iastate.edu/publications/pm1901b.pdf.

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