Soil compaction may be cutting into your yield

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Abstract
As crop growth progresses into early July, it is time to take a few minutes to check your corn and soybean fields for signs of soil compaction. Several factors can indicate soil compaction, including stunted plants, slow infiltration and ponds of water, high surface runoff and soil erosion under normal or light rainfall, evidence of poor root system establishment, and nutrient deficiency, i.e., compaction can result in reduced potassium uptake.

Keywords
Agricultural and Biosystems Engineering, Agronomy

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Test for soil compaction

To determine whether soil compaction is a concern in your field, begin by testing the soil resistance to penetration with a tile probe, spade, or penetrometer. Dry soils have significant strength even if not compacted, so it is wise to compare your observations and measurements with adjacent areas that are not compacted, e.g., fencerows, fields with different traffic, and adjacent idle land. Compare different areas in your field at the same time to ensure similar moisture conditions. Dig up a few plants and check for adequate root structure.

Effects of soil compaction

In favorable years, moisture availability, timing of rainfall, and fertilizer use can mask the effects of compaction. But the impact on yield has been reported to be as much as 10 to 20 percent in unfavorable years. Another major effect of soil compaction is the alteration of the soil's physical (bulk density, soil strength, and porosity) and the hydraulic (infiltration rate and movement of water within the soil profile) properties. Changes in the soil's physical properties alter the ratio of water to air in soil. Plant roots require air as well as water to develop a healthy root system.

Causes of compaction

The main causes are field traffic and machinery, and to a lesser extent, livestock. As the size of farms has increased, the size of the equipment also has increased. But more importantly, compaction is caused by management mistakes. Soil compaction is most likely to occur when soil moisture is at or near field capacity, that is, when soil pores or voids are filled with
equal amounts of air and water. Under these conditions, aggregates can be "lubricated" by water and readily reposition themselves through the air spaces under heavy traffic and when farm equipment is used.

**Minimizing soil compaction**

The first step in minimizing soil compaction is to avoid field operations when soil moisture is at or near field capacity. The best guideline is to let the field dry. Before doing fieldwork, check the soil moisture by using a quick field test. A field test can consist of molding a length of soil between your index finger and thumb and observing the stability of the resulting soil ribbon, or molding soil into a ball in your hand and observing whether the soil breaks apart when you toss the ball into the air.

A second step is the use controlled traffic lanes. Avoid driving loaded grain carts randomly through the field, because most damage occurs in the first pass of the implement. Grain tank extensions on combines also add to the load on soil. On frozen soils, grain cart and combine traffic may not cause much compaction.

Third, check wheel and tire size and pressure. Larger wheels and tires allow better flotation, whereas lower tire pressures reduce the load on the soil. Increase the tire's "footprint" with larger wheel diameters. You can work with your implement and tire dealer to make decisions about specific equipment, but the cost may pay off quickly. In a 4-year continuous corn experiment in alluvial soils in southeastern Iowa, Iowa State University (ISU) researchers found that soil farmed with equipment exerting a maximum of 6-psi surface pressure yielded nine more bushels of corn per acre than soil farmed with more conventional equipment exerting 16-psi surface pressure.

Fourth, consider applying manure in fall on drier soils. Winter freeze-thaw cycles may reduce or reverse the damage. And consider conservation tillage. Conservation tillage is the best long-term solution. It makes sense—avoid tillage and avoid passes through the field and you do not disrupt the soil structure as much. But regardless of your tillage system, before making any pass through the field, the essential question should be, Is this trip really necessary?

**Conclusions**

Compaction is a significant issue on Iowa farms, but it can be addressed through better management. Avoid field operations on wet soils, use deep tillage if necessary when soil is dry enough to shatter, and look into the overall benefits of conservation tillage. For more information, call your local Iowa State University Extension office and request publication PM 1901b, *Resource Conservation Practices: Understanding and Managing Soil Compaction* [1].

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