AGRONOMIC Spotlight
Technology Development by MONSANTO

Reducing Soil Compaction This Spring

Soil compaction can be a serious concern in moist soils, especially this spring when getting ready to start fieldwork. Compaction has become a problem in recent years due to an increase of field equipment size and weight. Damage to soil structure occurs when working too moist of soil. Compaction can negatively impact plant growth and development, and may ultimately reduce yield potential. Reducing the potential for compaction this spring can help avoid/prevent the negative impact of soil compaction on crops during the growing season.

Causes of Compaction

Soil is composed of organic matter, minerals and pore spaces. Soil aggregates are surrounded by pore spaces that hold air and water. Under dry conditions, air fills the pore space, while under saturated soil conditions water fills the pore space. Both air and water fill the pores under moist conditions.

The potential for soil compaction increases as vehicle traffic increases on moist soils. Tillage equipment such as a moldboard plow, disk, and sweep-type tools shear the soil and can create a layer of compacted soil.

The degree of compaction is determined by the moisture content of the soil at the time of using field equipment and the weight of the equipment. Water in the soil acts as a lubricant between soil aggregates, allowing the aggregates to become more tightly packed together. Soils compact easily when soil moisture is at or near Field Capacity (FC), which is the point at which soil becomes saturated and cannot absorb any more water.

Usually, this occurs the first day that a tractor can drive across the field after a rain. Due to increased compaction at FC, it is best to wait an extra day or two before planting or tilling a moist field. When equipment loads are greater than 10 tons per axel, the compaction of moist soils can extend to a depth of two feet or more.

Effects of Soil Compaction

Compaction is not always undesirable, some compaction may have a positive impact on plant growth.

Positive Impact

Slight compaction can improve seed germination due to good seed–to-soil-contact. Moderate compaction can help preserve soil moisture, prevent evaporation, and dry out the soil around a germinating seed. Moderate compaction may also enhance plant root branching and the formation of secondary roots, in turn increasing nutrients uptake.

Negative Impact

Excessive compaction prevents root growth and limits root expansion (Figure 1). This effect can decrease water and nutrient uptake, causing drought stress and nutrient deficiency. Roots in compacted soil are stubby, twisted or thin and flattened. Shallow roots in compacted soil may grow horizontally instead of vertically. Excessive compaction can cause stunting and also plants may be prone to disease problems.

In wet years, soil compaction decreases aeration, which increases nitrogen denitrification (nitrate-nitrogen loss to the atmosphere).

The ultimate result of all the above effects of compaction

Figure 1. Effect of soil compaction on corn root growth. This field had a compaction layer 3 to 4 inches below the surface that restricted root growth. The roots proliferated in the slot created for starter fertilizer placement.

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may be a reduction in yield potential. Fields with compacted soils can have as much as 10 to 20% reduction in yield potential. It has been reported in Indiana that a severely compacted silt loam soil caused a corn yield reduction of 110 bushels, compared to non-compacted soil. The impact of compaction persisted, as four years later the same compacted soil was still producing 25 bushels per acre of corn less than the non-compacted soil[1].

Additional research from Iowa State University stated that if heavy traffic continues over moist and compacted soils, corn yield losses over time could be 4 to 6 bushels per acre and soybean yield losses could be 2 to 3 bushels per acre.

[1]*Kansas State University Extension. MS 7-96-5M*

Avoid/Prevent Soil Compaction

Consider the following practices to minimize compaction:

Avoid working the soil when it is too moist. Soil is most susceptible to compaction when water in the 3 to 6 inch soil profile is at or beyond FC. Before starting any fieldwork, test soil moisture. Mold soil from the 3 to 6 inch depth into a ball and drop it onto a hard surface. If the ball does not break or crack, it indicates that soil is too moist for field operations. Proceed only when proper soil moisture conditions exist.

Increase organic matter (OM). Soil with high OM can help increase soil nutrient mineralization and nutrient availability for plant growth and development, such as nitrogen, phosphorus, and micronutrients. Adding animal manure, green manure crops, or leaving crop residues in the field can increase OM content of the soil.

Reduce tillage. Greater amounts of crop residue can be left on the soil surface using reduced tillage systems. Residue can intercept raindrops and prevent soil surface sealing and compaction.

Adjust tillage implements. Reduce weight on each axel, choose wider tires, and adjust air pressure to reduce the load on the soil surface and prevent compactions. Iowa State University research showed that using equipment with 6 pounds per square inch (psi) of surface pressure yielded 9 bushels per acre more than that of equipment with 16 psi of surface pressure.

Select tillage implements. Using implements with shearing action, such as moldboard plows and disks, can smear the wet soil and cause compaction.

Since most damage occurs on the first pass through a field, control the traffic patterns by using implements that are the same width and by using the same wheel tracks to minimize the amount of land traveled.

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Reducing Compaction

- *Stay off too moist of soil*
- *Increase OM*
- *Reduce tillage*
- *Reduce load on soil surface*
- *Select the right implements*