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How and Why to Avoid Soil Compaction

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Abstract
This spring most Iowa soils have plenty of moisture in the profile and in some areas may exceed field capacity, causing many producers to enter fields at less-than-ideal soil conditions. High soil moisture increases soil compaction caused by field traffic and machinery. Over the past decade the size of Iowa farms has increased, leading to larger and heavier equipment. However, equipment size is only one factor among many causes of the soil compaction problem.

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How and Why to Avoid Soil Compaction

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This spring most Iowa soils have plenty of moisture in the profile and in some areas may exceed field capacity, causing many producers to enter fields at less-than-ideal soil conditions. High soil moisture increases soil compaction caused by field traffic and machinery. Over the past decade the size of Iowa farms has increased, leading to larger and heavier equipment. However, equipment size is only one factor among many causes of the soil compaction problem.

Rushing to the field when the soil is wet can increase chances for severe soil compaction combined with the weight of equipment and traffic pattern in the field. Conducting field operations during wet field conditions compounds the amount of compaction occurring. Maximum soil compaction occurs when soil moisture is at or near field capacity because soil moisture works as a lubricant between soil particles under heavy pressure from field equipment.

Compaction near the surface, within the top three to six inches of the soil, is generally associated with the amount of surface pressure. Compaction below that is primarily associated with axle weight. For example, if soil a foot below the surface is at field capacity and the tractor's axle load is seven to eight tons or greater, compaction can occur at this depth, despite lower surface pressures.

Indications of soil compaction during and immediately following a normal rainfall include slow water infiltration, water ponding, high surface runoff and soil erosion. Additionally, soil compaction can be diagnosed by stunted plant growth, poor-root-system development and potential nutrient deficiencies (i.e., reduced potassium uptake). These soil compaction symptoms are a result of increased bulk densities that affect the ideal proportion of air and water in the soil.

The most efficient way to verify soil compaction is to use a tile probe, spade or penetrometer to determine a relative soil density. Soil moisture conditions can have a significant effect on penetration resistance. For example, in dry soil conditions soil penetration resistance is much higher than wet conditions because soil water acts as a lubricant for soil particles. Therefore, it is wise to determine soil compaction early in the season or compare observations and measurements from suspected areas with adjacent areas that have little chance of soil compaction due to traffic patterns.

Management decisions to minimize soil compaction

First, the most effective way to minimize soil compaction is to avoid field operations when soil moisture is at or near field capacity. Soil compaction will be less severe when soil tillage, fertilizer application and planting operations occur when the field is dry. Soil moisture can be determined using a hand ball test or observing a soil ribbon test.

Second, properly adjust tire size and air pressure. Larger tires with lower air

pressure allow for better flotation and reduce load on the soil surface. Additionally, by using larger tires that are properly inflated increases the "footprint" on the soil.

Third, use the same wheel tracks to minimize the amount of land traveled across. Most damage occurs with the first pass of the implement. Using controled traffic patterns can be done effectively by using implements that are the same width for soil preparation, planting, row cultivation, spraying and harvesting.

Soil compaction can be a serious problem for Iowa farmers, but with proper farm management, compaction can be minimized. Remember to hold-off on soil tillage operations until soil conditions are drier than field capacity and look into the benefits of conservation tillage systems.

Top 10 Reasons to Avoid Soil Compaction

1. Causes nutrient deficiencies
2. Reduces crop productivity
3. Restricts root development
4. Reduces soil aeration
5. Decreases soil available water
6. Reduces infiltration rate
7. Increases bulk density
8. Increases sediment and nutrient losses
9. Increases surface runoff
10. Damages soil structure

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