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Management Strategies to Minimize and Reduce Soil Compaction

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Management Strategies to Minimize and Reduce Soil Compaction


This NebGuide will help you understand how natural processes and management practices can reduce existing soil compaction and minimize its further development.

Nature has some built-in processes that reduce soil compaction. They include cycles of wetting and drying, and freezing and thawing.

In the last 20 to 30 years, farming practices have changed drastically. These farming changes have made it more difficult for nature to rejuvenate the soil environment to an optimum condition for crops. Performing field operations on wet soils, using multiple field operations to grow the same crop continuously, and eliminating meadow crops from crop rotations contribute to more extensive and deeper compaction.

Each farmer has the opportunity to make decisions that can keep soils from becoming compacted.

Adoption of management strategies to minimize soil compaction, such as controlled traffic, may require a bit of planning; staying off wet soils may require little planning. If you have soil compaction that is limiting production, measures such as deep tillage might be needed to help loosen and shatter the compact soil layer.

Management Strategies

Stay Off Wet Soils. Compaction of any soil is greatest when the three to six inch soil depth is near field capacity. Field capacity is only a guideline to identify optimum moisture conditions for compaction.

Clay content and organic matter content also influence the compactibility of each soil. The water content of a soil can be determined using the feel-and-appearance method (NebGuide G83-690).

You also may check the soil water content by digging up a portion of soil from the three- to six-inch depth. Mold the soil in your hand and drop the soil ball onto a hard surface. If it does not break or crack on impact it is too wet for field operations.

Perform field operations in your driest fields first. This allows more drying time for fields that tend to remain wet.

Some years field operations may have to be conducted when the soil is near field capacity to remain timely. Minimizing the axle load and increasing tire size will help reduce deep compaction in these situations. The larger tire will compact more of the soil surface, but the lower pressure will help reduce the depth to which the high compactive forces will penetrate.

Reduce Tillage. Tillage for many years contributed to the breakdown of soil structure. Each individual tillage operation using a disk, chisel, sweep, harrow, moldboard plow or combination of these tools breaks down soil structure by compressing and breaking soil aggregates. A soil aggregate is a mixture of clay, silt, sand and organic matter bound together to resemble a crumb. Soil aggregates are necessary for good air and water movement and root growth. Soils that have been tilled are more susceptible to compaction than are soils receiving little tillage.

Tillage systems with a reduced number of operations leave greater amounts of residue on the soil surface. This surface residue helps prevent surface sealing, a form of compaction, by intercepting raindrops before they hit the soil surface.

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Add Organic Matter to the Soil. Organic matter is added to the soil in the form of crop residues, animal manure, sludge, or green manure crops. Organic matter promotes the development of good soil structure and decreases soil bulk density. It helps bind soil particles together as aggregates so they are not as easily cracked, split or compressed by tillage or wheel traffic. Adding organic matter to the soil also increases soil nutrient availability for crop growth. Nitrogen, phosphorus, sulfur and trace elements especially are increased with high
soil organic matter.

**Rotate Crops.** Fields in crop rotations that include alfalfa, clover or grass usually have soils that are less compact than soils in fields without these rotations. This is true for most soils because once these crops are seeded, 1) there generally is no tillage operation after seeding, 2) trips across the field tend to be associated with hay harvesting when the soil is dry and less likely to be compacted, and 3) the deeper rooting depth and large taproot of alfalfa and clover keeps the soil more porous (Fig. 1) and removes large amounts of water which helps dry the soil and increases cracking.

**Alter the Tillage Depth.** If you till the soil, till deeper in dry years. Vary the tillage depth in subsequent years to minimize the development of a “tillage pan” or compacted zone.

Tillage to a constant depth will cause a dense layer to develop where the implement shears the soil. A commonly used example of this is the moldboard plow pan which is created by plowing at the same depth for several years. As farmers switch their tillage system from the moldboard plow to the disk or the field cultivar, a “disk pan” can be created. This pan may be less dense than the plow pan but it is closer to the soil surface.

**Control Wheel Traffic.** Compaction will be localized if all equipment tires are restricted to particular “tracks” or row middles in the field, but the rest of the field is essentially uncompacted (Fig. 2). Only soil in the untrafficked row and row middles will receive compaction caused by tillage and planting equipment. Tillage systems which have different width implements make it difficult to control traffic. Controlled traffic can be practiced most easily in ridge plant and no-till systems.

**Deep Tillage.** Yield reductions attributed to compaction also may be associated with disease, fertility or other problems. To guarantee that any observed yield reductions are associated with compaction, soil investigations are necessary.

Soil investigations also help ensure that a deep tillage
Figure 2. Random wheel traffic patterns (above) create compaction over the majority of the field as compared to controlled wheel traffic (below).
operation is successful. Deep tillage may be warranted if soil compaction is limiting yield. Subsoiling or other tillage to alleviate compaction should be needed only when crop roots have been inspected visually and shown to be restricted by a compacted zone (See NebGuide G87-331).

The depth of yield-limiting soil compaction will determine the required depth of tillage and tillage tool selection. If compaction occurs in the top six to eight inches of the soil, tillage tools such as a chisel plow or moldboard plow can be used to shatter the compacted layer. However, if compaction is below about eight to 10 inches, tillage tools such as a subsoiler, ripper or paraplow may be needed (Fig. 3).

Many types of subsoilers are available. Most are chisel-like tools having curved or straight shanks. Each shank will require at least 20 to 30 PTO horsepower for deep tillage. It is suggested that the subsoiling depth be about 50 percent deeper than the compacted layer, and that the shank spacing be equal to the tillage depth for greatest shattering.

This tillage should be performed in the late summer or fall when the entire soil profile is fairly dry and can be shattered easily. This subsoiling operation, when performed properly below the depth of compaction, will displace and shatter a V-shaped section (Fig. 4).

Additional Reading:

Figure 3. Deep tillage can be performed with a subsoiler (shown) or other implement depending upon the depth of compaction.

Figure 4. A subsoiler shank shatters a V-shaped section of soil from the base of the shank upward toward the soil surface.