

Tillage

- 80% of soil compaction from wheel traffic occurs at the first pass.
- Soils low in organic matter and soils under excessive secondary tillage are most prone to compaction.
- Surface and shallow compaction are primarily controlled by the pressure applied at the soil surface (tire pressure).
- Deeper compaction (below the normal tillage zone) is caused by heavier axle loads and traffic over wet soils.
- Soils are most prone to compaction when moisture is near field capacity.

Dryland considerations

No-till is critical to dryland corn production in Colorado. Weed free, no-tilled seedbeds maximize the opportunity for profitable dryland corn production. Dryland corn should not be cultivated for weed control; cultivation prunes roots and increases evaporative water loss. No-till is more necessary for dryland corn production than for any other dryland crop grown in Colorado.

Compaction

An ideal soil typically contains approximately 50% pore space by volume. The rest of the volume is comprised of about 49% mineral matter (sand, silt or clay) and 1% organic matter. The pore space is filled with some combination of air and water (soil solution) that contains the nutrients and aeration for corn roots to grow. Soil compaction occurs when soil particles are pushed closer together by external forces, reducing pore size and number. Compacted soil decreases soil drainage and aeration, increases runoff and erosion potential, increases power requirements, and may inhibit root development and ultimately reduce yields.

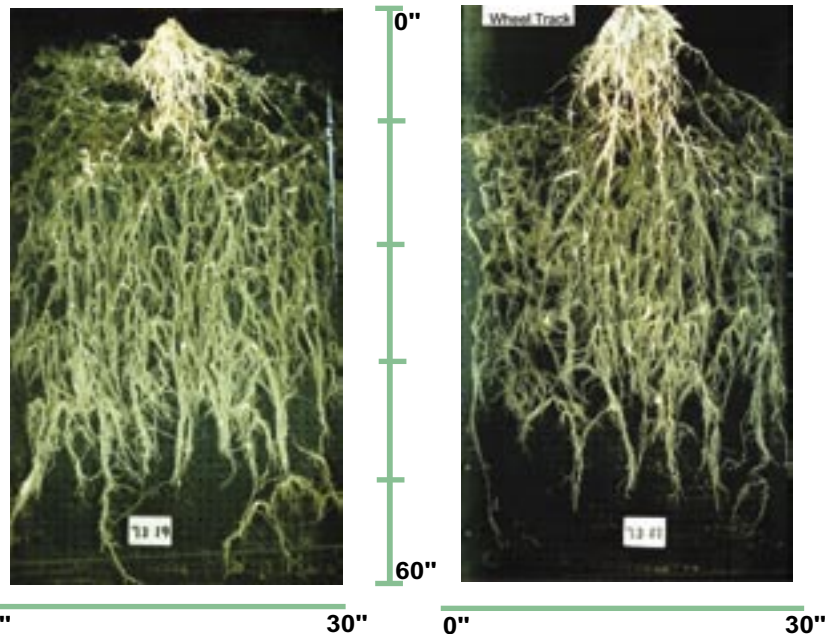


Figure 33. Effect of shallow wheel traffic compaction on a corn plant's root system under actual field conditions. The corn was sampled about 60 days after planting on a clay loam soil with fall plow - spring chisel tillage to approximately 10 inches.

Source: Ward Vorhees

The left photo shows a corn root system with no inter-row tractor wheel traffic or wheel traffic directly over the row. Root growth occurs throughout the profile close to soil surface to almost 5 feet deep. The right photo shows a root system after three passes of a tractor wheel on each side of the row with no wheel traffic over the row. Note the absence of root growth in about 60% of the tilled layer due to inter-row wheel traffic compaction, causing a negative impact on uptake of immobile nutrients such as P and Zn. This is a good example of why banding is often more effective than broadcasting these nutrients. There was still good root growth into the subsoil because a root-restricting hard pan was not present.

Strategies to avoid compaction

Some compaction is unavoidable under most corn production systems. The following are strategies that can minimize the severity of compaction to tolerable levels.

- Reduce traffic, especially on wet soil. Wet soil has less soil strength making air and water spaces easier to eliminate.
- Reduce tillage activity - over-tilling causes compaction and crusting.
- Use tractors with lighter axle weights when possible for operations with lower power requirements - subsurface compaction is increased with axle weight.
- Reduce tire pressure to reduce surface compaction - low pressure tires will spread out the weight, reducing surface compaction, but may increase the area compacted.
- Restrict equipment to specific traffic lanes in the field - ridge-till systems are an example of controlled traffic. Keep traffic restricted to field ends during harvest.
- Promote stable soil structure by maintaining organic matter by retaining crop residue or by growing small grains with grasslike root systems, green manure crops and use animal manures or other organic waste products.
- Mix tillage practices and operations every few years using a variety of implements. Periodic change in tillage systems may decrease soil compaction.
- Alternate crops that have deep tap roots (alfalfa, clover and sunflowers) creating channels for water and other crop roots to follow.



No-till ripper post harvest. Ripping is most effective in dry soils.

Photo Irrigation Research Foundation

Compaction symptoms

- smaller plants with narrower leaves
- P deficiency - Purple tinged leaves
- other nutrient deficiencies
- premature water stress
- increased lodging

Identification

- Shovels, soil probes, rods or a penetrometer can be used to identify compacted soil.
- Hard soil does not always mean compacted soil. Soil strength is a function of density and moisture as soil moisture greatly affects the resistance of a soil to a probe, penetrometer or shovel.
- Direct examination of rooting systems using a backhoe and shovel
- Consult with NRCS, crop adviser, or Extension personnel for advice.

Remediation/Alleviation

- Compaction is usually caused by mechanical forces and requires mechanical means to correct.
- Shallow (<10") compaction can be corrected with a chisel, but deep compaction may require deeper ripping or subsoiling.
- The soil must be dry to rip or the operation will be ineffective or cause more compaction.
- Subsoiling is expensive and should only be done where serious compaction exists.