

SOIL COMPACTION INFORMATION SHEET

TYPES OF SOIL COMPACTION:

- Generally soil compaction affects the top 24” of the soil
- Surface crusting – restricts seedling emergence and water infiltration, caused by raindrops on weak soil aggregates. Soils with cover crops or high-residue cover are less likely to form crusts.
- Surface compaction – can occur from surface down to normal tillage depth, and can be loosened by normal tillage, root growth and biological activity.
- Tillage pan – a compacted layer several inches thick beneath the normal tillage depth and develops when the depth of tillage is the same year after year.
- Deep compaction – occurs beneath the level of tillage. Ground contact pressure and total weight on the tire from the axle load significantly affect the amount of subsoil compaction. It is difficult to eliminate and may permanently change soil structure.
- Inherent hardpans – can form because of variations in soil particle size, consolidation of particles by rainfall, and certain organo-chemical factors. These pans are aggravated by tillage and traffic.

WHAT IS SOIL COMPACTION?

- Soil compaction occurs when wet or moist soil particles are pressed together, reducing pore space between particles. The change in pore space restricts root growth, and the gas exchange necessary for plant growth.
- Compaction restricts infiltration of water, increasing runoff and erosion, leading to the loss of valuable nutrients. Compacted soils have reduced available water capacity.
- Soil compaction is caused by working or driving on wet fields, animal traffic or natural processes. Vibrations caused by large equipment also compacts soil. Saturated soils lack strength to resist deformation caused by traffic.
- Soils with low organic content or poor aggregate stability are susceptible to compaction.
- Animal grazing on wet soils in a confined area can create compacted layers.
- Soil compaction during thinning and harvesting in forests can cause compaction detrimental to the next tree crop.
- Soil compaction leads to inefficient fertilizer and water use, and reduced yields.

SIGNS OF POSSIBLE SOIL COMPACTION:

- Dark streaks in wheel tracks caused by moisture remaining for a longer time above the compacted zone.
- Water ponding on the soil surface on nearly level ground.
- Increased runoff and soil erosion from water that cannot penetrate the soil.
- Increased load on engine or need to gear down in portions of the field to maintain speed.
- Uneven plant stands and reduced plant height, especially in wheel tracks.
- Discolored or poor plant growth. Yellowing of plants due to compaction-induced nitrogen and water deficiencies. Corn may look purple in early growth stages, and yellow during the growing season.
- Horizontal root development or shallow root system leading to wilting.
- Difficulty penetrating the soil with a firm wire (survey flag) or welding rod (18" long).

WHAT CAN BE DONE ABOUT SOIL COMPACTION?

- Manage wheel/track traffic to minimize soil compaction, minimize traffic lanes.
- Avoid working in wet soils.
- Maximize the number of axles under grain carts and slurry wagons to decrease axle load per tire.
- Minimize use of tractor-trailers or other vehicles with high inflation pressure and small footprints in agricultural fields.
- Frequently empty combines and grain carts to minimize field traffic and high axle loads.
- Select a tractor with four-wheel drive, front-wheel drive or a rubber track system that spreads load over larger surface area.
- Adjust ballast weights for each field operation.
- Reduce number of trips by using high-residue management systems (conservation tillage).
- Increase content of organic matter by reducing tillage and using high biomass crop rotations with cover crops. Organic matter improves aggregate stability which reduces soil compaction. Wetter soils have lower soil strength and are less restrictive to root growth.
- Avoid tillage such as moldboard plowing and disking, which breaks down aggregates and destroys structure.

- Reduce compaction during timber harvests by limiting the number of skid trails. Use designated skid trails that can also be used in future harvests.
- Schedule timber harvests when ground is frozen and more resistant to soil compaction.
- Because tree roots grow downward and outward, avoid passing a residual tree on more than one side.

INSTRUCTIONS FOR USING A SOIL PENETROMETER (PROBE):

Soil moisture will impact readings and should be near field capacity. If user is sure there is soil compaction, and trying to determine depth of compaction, moisture content is not critical.

- Select and install a tip (1/2" for firm soil, 3/4" for soft soil). There is a separate scale on the indicator dial for each tip.
- Insert penetrometer smoothly without jerking motions. Penetrometer should be inserted at constant rate of 1.2 inches/second. Small variations will not affect the reading. Starting and stopping will not affect the reading.
- Insert penetrometer until the cone index reads 145 psi (pounds/square inch). Stop and record depth.
- Continue insertion. When cone index reads less than 145 psi, record the depth. This is bottom layer of compacted hardpan.
- If 145 psi or greater is never reached down to 18", record maximum reading and remove penetrometer.
- A log sheet is available to record field data.
- Repeat procedure at all sample locations.
- If soil sticks to penetrometer, clean off the rod and cone with water after use.
- Return soil penetrometer to Grafton County Conservation District when finished for the next landowner to borrow. Thanks.