Pressure Relief

by Andy Holzwarth

TECHNIQUE

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For years we have heard how detrimental soil compaction is to crop yields. While no perfect solution exists, minimizing this problem is less difficult than many people realize.

No-tillers have already begun the long process of reclaiming soil health and redeveloping soil structure. Many have noticed the soil changes under no-till, including the increased infiltration and becoming more firm. This firmness is a good thing: the beginning of soil structure redevelopment and future compaction management. Over time, no-till soils can continue developing firmness and structure that is more similar to an uncompacted native prairie. Crops grow well in these soil conditions.

First, we must understand what compaction is, and how it develops. An uncompacted silt loam soil would have roughly 25% air, 25% water, and 50% solids (mineral particles and OM).[1] The air and water are in the spaces or pores between the solids. Compaction occurs whenever a pressure is applied which causes soil particles to move closer together and reduces the pore space between the particles. So the density of the soil increases (i.e., more soil particles per given volume). This increased density constrains root growth, reduces air availability to the roots (they respire, or breathe, to oxidize sugars which fuels root growth), and decreases available water to the plant. We have all observed this scenario, especially near field entrances or on headlands, where the plants are always first to show water stress.

Once a soil is compacted, only relatively slow natural processes (root growth, mycorrhizae, earthworms, and other soil life) can truly eliminate the compaction by reassembling the soil particles into aggregates by binding them with organic compounds. Freeze/thaw and shrink/swell cycles can pry apart the compacted particles, but this improvement in pore space is quite temporary unless organic processes bind the new arrangement of particles into a more permanent aggregation.[2] As a related matter, the lower the organic matter or the higher the clay content, the more easily a soil will compact. This derives from the amount of organic 'glue' present in relation to number of soil particles to be stabilized.

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Likewise, mechanical tillage alters the soil particle arrangement but does nothing to stabilize it. Deep tillage is only useful to *redistribute* a horizontal plow pan (or other compacted layer). The compacted soil particles are still compacted, but the layer is redistributed. Since roots have difficulty with sudden density changes, the redistribution of the compacted layer may, for a short period of time, allow the plant roots to penetrate the compacted region and add organic material between the soil particles, thereby allowing a very small amount of true soil structure regeneration. Since soil OM is lost due to the tillage, any net benefit is tenuous at best. The key to all compaction remediation is that once soil particles have been redistributed by mechanical means or freeze/thaw cycles, *organic material must develop between the redistributed soil particles in order for the compaction to be reduced.* This occurs quite slowly over many years. The natural soil processes described will remove deep compaction even more slowly than shallow compaction.

Photo by Ralph Holzwarth.

Heavy loads should be carried properly to reduce soil damage. Choose tire sizes and inflations to spread pressure more uniformly across lugs.

[1] At "field capacity" moisture content.

[2] Ray Ward, personal communication.

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