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# Plowpans and Claypan Soils

While the names are often interchanged, claypan soils and plowpan soils are two different things. One is a natural soil classification while the other has been created from years of tilling wet soil. Claypan soils are those that are characterized by heavy clay beneath a layer of lighter silt clay soils. The claypan layer will have a higher soil density and lower permeability. Claypan soils are natural and intrinsic to parts Southeastern Kansas and Western Missouri. However, erosion from years of tillage have brought the claypan much closer to the soil surface by reducing the overlaying silty layer.

Plowpans however, are completely manmade. They were created by crushing the structure of the soil into dense plates from years of tillage and heavy equipment. Plowpans also are characterized by high soil density and low water permeability. The two are connected because natural claypan soils often end up with very dense and problematic plowpans, but not all claypan soils will have a plowpan and not all fields with a plowpan are technically claypan soils. Claypan soils can be very productive farmland if managed correctly, in large part, by reduction of the plowpan. Plowpans restrict root penetration and nutrient uptake, increase erosion by reduction of water percolation, and are both poorly drained and more susceptible to drought. The plowpan is a physical feature within a soil that took years to slowly create and will take years to remove.

**Surface compaction vs subsoil compaction**

Surface and subsoil compaction are similar in that the loss of soil aggregation and both surface and subsoil compaction are a result of over tillage. Subsoil compaction which is characterized by compaction below 6 to 8 inches, the common plow depth (aka plowpan). Surface compaction however isn't always a dense compaction of the soil because tillage breaks it up. Surface compaction can sometimes be seen in cloddy soils and later with pronounced crusting. The temporary solution to surface compaction is more tillage, fluffing the soil to allow pathways for air and water. This of course, reduces aggregation farther and increases subsoil compaction.

Most publications describe this as the downward spiral of tillage. Tillage creates the need for more tillage.

**Ripping: A possible first step**

Subsoiling, usually with a ripper and a tractor large enough to pull it, can be a first step in tearing up a plowpan. Ripping isn't a cure-all though. It uses a lot of diesel, only partly breaks the plowpan, and the effects can be temporary. Once ripped, a field will be more susceptible to re-compaction. Proper ripping should follow the contours of the land and is done when soil moisture is below 50 percent field capacity. Too wet and the ripper will smear the soil and won't shatter the plowpan. It is also important that the shanks are set to the right depth within the lower side of the plowpan. An ideal ripper is one that has minimal disturbance to the field surface. It's important to remember that ripping doesn't take out the plowpan. It only shatters it, so roots and water grow into it.

**Plowpan reduction over time**

If operations go back to a normal of tilling, planting, or harvesting when the subsoil it too wet, then the plowpan will quickly reform. The real process of reducing the plowpan requires time and intention. Any reduction of tillage can be beneficial; reduced tillage, surface tillage, strip tillage, and of course, full no-till. Every tillage passes not made is less compaction.

Better load distribution is the use of equipment with a bigger footprint and less psi on the ground. On average, the weight of farm equipment has doubled every twenty years and this increase has certainly increased the effects of compaction. Tracked machines, more axels, wide tires, and even reduced tire pressure can spread out the weight of the machine.

Compaction is not caused consistently with each wheel pass. While pressure upon dry soils has some level of compaction, it takes a certain amount of soil moisture for the clay particles to slide and aggregates to condense. Even if the soil surface is dry, the plowpan layer might be wet enough for compaction. Cover crops can help even out the soil moisture by pulling the moisture from deeper depths and not relying entirely on evaporation to dry the soil (Figure 15.8 from SARE).

Cover crops have a lot of effects when it comes to reducing compaction. While ripping can shatter a plowpan temporarily, roots are needed to grow into the cracks of the plate-like plowpan clods to break them up. While the cover crops are growing, they are increasing the soil microbiology as they pump organic compounds to the microbes near their roots. The microbes create the 'glue' that holds the aggregates together and alter the structure of the soil. When terminated, the roots decay and leave channels for air and water. It has been well demonstrated that cover crops can reduce the need for tillage by suppressing weeds and delaying weed

germination in spring. And for those that plant directly into standing cover crops, the cover crops actually help cushion the weight of the tractor.

In summary, while many of our fields can be considered claypans, and they always will be, there is nothing to say that plowpans are a permeant part of the field as well. Subsoil compaction often goes unrecognized but is responsible for a lot of yield loss and erosion. Plowpans reduce water infiltration during the spring rains but then restrict water and root movement during the dry months. Plowpans formed over years of farming operations on wet soils and only years of intentional conservational farming can reduce the soil compaction. However, like most issues in farming, the best solution is easier said than done, and the process of reducing compaction is a big one. If you have any questions about soil compaction identification or reduction, please contact James Coover, Crop Production Agent, jcoover@ksu.edu or (620) 724-8233.

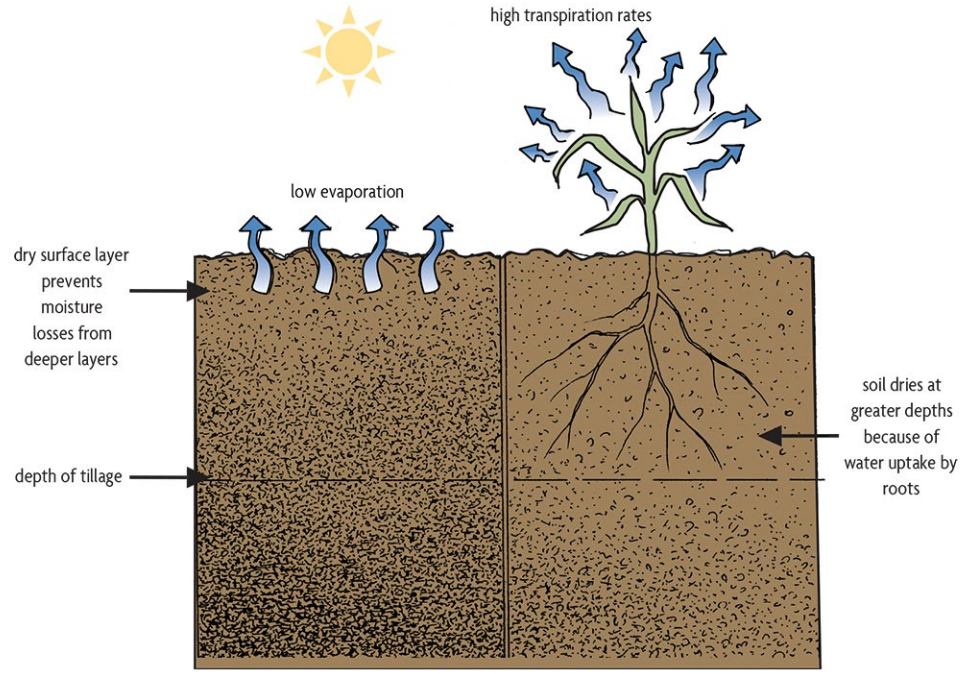


**Figure 15.8.** Cover crops enhance the drying of a clay soil. Without cover crops (left), evaporation losses are low after the surface dries. With cover crops (right), water is removed from deeper in the soil because of root uptake and transpiration from plant leaves, resulting in better tillage and traffic conditions.

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