



ADVANCED AG SYSTEMS'

Crop Soil News

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"It is the crops
that feed the
cows that make
the milk
which creates
the money."

Advanced Ag Systems
Research, Education, Consulting

**Genetics can open the door to higher yields
Management determines how far open that door will go
Dig for better yields.**

As we traverse corn fields chopping or combining, it is a key time to see if you have maximized yield. Several times in trials on farms I found I could pull corn plants up with no effort. The majority of roots were in the top 3 inches. Fall soil sampling (the best time) to maximize fertilizer inputs smartly and effectively, will often show the soil limitations as the probe hits compacted layer or can't go in the ground at all. Soil compaction impacts root depth and available water. It can severely limit the available nutrients. They are there but can't be reached. As farms and tractor size get bigger and "**we HAVE to get this done**" attitude, compacted soils will come up and bite you in the backside. We often blame bad weather (too much or too little rain). Use shovel to feel the compaction and to look at roots' growth and pattern.

The first layer you will see is the surface. Over tillage, no surface residue, and destroyed structure leaves the surface particles vulnerable to raindrop impact (when it did rain). Larger the drops (thunderstorm downpours) the greater the vertical speed of the rain (over 20 miles/hour) and speed times mass equals the force that it hits the surface. Multiple researchers have described this as small bombs exploding in horizontal shear that strips off and pulverizes the surface. With no protective cover and broken soil structure from excessive tillage, the surface quickly becomes a soup of small particles that plug every pore in the surface. The soil is then like a kitchen linoleum floor (picture at right) and does not absorb water quickly. It stops the precious yield producing rain from getting to the roots and seals out critical oxygen, so the roots have difficulty taking up nutrients and growing. All because of the top ½ inch of soil destroyed before the growing crop can protect the surface. Adding insult to injury, the fine surface particles leave the field in the increased runoff. The most fertile part of the soil goes first, the stones and subsoil stay behind. That is why knolls do not grow as well as valleys. It is so common that farms think of it as normal – but it is not, and it affects your yields. As you can see on the next page, corn stripped or zone tilled into winter triticale forage stubble has



Roots are the foundation or limitation of yield.



Even at the end of the season much of the soil is still sealed at the surface preventing water and air from entering.

very little of this surface sealing. The stubble breaks the force of the raindrop impact. The many hollow stems contiguous with the dying roots underneath each stem provide macropores to quickly absorb heavy rain and channel it to the roots of the next crop. An added benefit is that the macropores from earthworms are protected and can absorb major amounts of rainfall water without runoff or plugging of these holes. The same happens with fall killed sods that are no tilled in the spring.

The next layer down you often can feel with a shovel or soil auger. It slows the tool but does not always stop it – it does stop roots. As you dig with a shovel the soil often breaks horizontally at this layer (see picture at right). There are very few roots below. It is especially prevalent on fields that were chiseled and disked. You can feel the pan (shovel stops) at about 3 – 4 inches down. This is $\frac{1}{4}$ the diameter of the disk. Tandem or offset disks move large particle to the surface and sift the finer down to the bottom of the disk layer. Adding more insult to injury, the soil is often wetter as we go deeper and the disk's action smears a thin, root limiting layer at the bottom of the disk. That is why in many corn fields the stalk pulls out of the ground at 3 inches. There were few if any roots deeper than that. Many of the corn roots are growing horizontal and are flattened and distorted. A huge amount of plant photosynthesis is not going to yield but to trying to force the root through compacted soil. The result is that the corn is growing on 1/3 the volume that it could have and so needs ever higher fertility to achieve full yield. Are you growing corn on 3 inches of soil? Tillage often hides this top layer destruction. Many a field I have seen that they broke up the large blocks of soil on the surface layers to make many brick and softball size compacted lumps.



Clearing coulter on no till planter in winter triticale stubble leaves a protected porous surface to enhance the corn growth



Root/water limiting disk pan.

Root/water limiting disk pan.

Finally, we get to why we were digging in the field in the first place – rooting depth. Many a field we put the shovel in and thought we hit a stone in multiple spots that stopped at the same 7 – 8-inch depth. There was no stone, but a roadbed of compacted soil that completely limits rooting depth. The bottom of the chisel plow, the bottom of the moleboard plow leave a compacted deeper layer. I clearly saw this in a chisel plow tillage study on silty clay soil. Heavy rains in August had produced a perched water table on top of this layer and drowned/killed all the corn roots below 3 inches. The crop looked great from the surface. In many cases deep compaction was acerbated by spreading manure with a spreader that has to few axles for the load and to high a tire pressure to effectively support the weight (8 tons/axle; 15 psi per tire). Tire pressure is surface compaction, axle load is deep compaction. Drag hose injectors have taken off a lot of the compaction weight, but then operating was the soil is not dry will put it right back in again even with injectors.

In spite of farmer fantasy, frost does **NOT REMOVE THIS COMPACTION**. Nor does a perennial sod crop. We had a 15-year alfalfa timothy hay field (picture at right) that clearly showed compaction from the moleboard when it was originally plowed for seeding. The individual plow share marks could be seen. NO roots went below 7 inches. This was plowed with a smaller tractor when the soil was still plastic at the plow shear layer. The worst were in soils the farmers thought would not compact. I have seen these root limiting layers in sand, gravel, silt, and clay. After 10 years of no-till rotated alfalfa – corn on a gravel soil (gravel bank at the end of the field) we dug up alfalfa roots. Each plant went down 8 inches and then the tap root twisted and turned like a pig's tail as it couldn't get through the compaction. On a pure sand field, we deep tilled and then had moleboard plowed strips and planted corn. There was NO root below the 8-inch pan where we plowed. At 12 inches I could put my arm into the



15 years of freezing and thawing did not remove compaction in this alfalfa grass sod.

profile up to my elbow the soil was so loose from the deep till – yet the corn never reached that depth.

You can't solve a problem you don't know you have. This summer's drought conditions showed you that you may have a problem. A simple computer hard soil analyzer (called a shovel for us older guys) can tell you if you do. I did this at 9 one morning with a farmer that I had to convince to take 5 minutes and check his field next to the house. He reluctantly agreed, thinking it was a waste of time. At 5 in the afternoon, I said I had to go home and make supper for the kids – he kept saying "one more field". He then said he learned more about his fields and cropping in that one day of digging holes than he did at all our Extension meetings (for him a complement).

Finding compaction, the initial reaction is to look for the biggest, deepest, baddest ripper and a monster tractor to pull it, to tear it all out. As research in New Zealand found, without change in the rest of the cropping, rotation, harvest, and manure spreading, it is a **COMPLETE WASTE OF TIME**. Making it even worst, without knowing what is going on under the soil surface, you may be doing more damage than improvement. Lots of black smoke and lumps on the surface do not improve anything. Running a chisel plow deeper than it's designed depth (6—7 inch) will **horizontally compact the soil** even more. As one farmer said "removing compaction is a process we have to figure out for our farm and our soils". This was after a research trial only grew on 3 inches of soil and subsequent deep tillage ripped the shanks off the machine from the hard soil. .

Fields are improved one at a time. It takes strategic planning in the rotation to take out compaction. It needs to be done when the **ENTIRE PROFILE** is dry enough to shatter (see photo at right). One part of the process is to deep till in the fall (if dry) and immediately drill winter triticale as a winter forage. The massive winter forage roots brace the soil keeping it open to start the process of improving soil structure. Ideally in the northern areas this needs to be done the first half of September to maximize the time for the winter grain to tiller and to produce above and below ground biomass. The next spring, no till legume seeding into the newly opened soil. It will continue to improve the soil structure until you are ready to rotate to no-till corn. Another option is to strip till corn into the triticale stubble. The less trips it takes to get the crop in the more you can wait for the right conditions to work/plant the field



You don't know unless you look to see soil structure limitations to your crop. This farmer is using a penetrometer to check his fields



From the tractor seat the soil looked friable for deep tillage, it was not. Vertical compaction is now compounded by horizontal compaction.

Sincerely,

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Hand
to Better
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