Fourth in a Series of Four **Orthman Looks at Roots Three Times – Why?**

April 15, 2010

Introduction:

In the last report about exhuming better developed roots in strip-till, I wrote to all of you that to understand crop development roots are significant and why or why not yields were meeting expectations. We looked at how roots tell the success story or a flop story. To the inexperienced eye – a large mass of roots in the upper 12 inches of the soil profile looks like the crop is going great guns. I know that may not be the case - especially if that is at the time period when corn is tasseling.

Roots of our cultivated crops provide anchorage, water, highways to move sugars up and down the plant, cooing of the plant, and provide nutrition to the leaves and fruit or grain. Photosynthesis is regulated by the amount of sun, heat, water and rooting capacity. Not enough roots, well the biomass capacity above the ground will be surely limited also.

In this fourth segment of the four part series from our 2009 field trials, I will offer why we look at roots three specific times during the crops growth. We will focus in on corn for now.

Purpose of the Three Observation Times ---

As mentioned before in the third report, we do three root digs with the first at 25 days after emergence (DAE), then 55DAE and last at root maturity 110DAE. Why those specific times? Let's go into that….

At 25 DAE…..

In corn the nodal roots are getting established and the total number of roots set. With good depth control during the planting and going into strip-tilled seedbeds the grower can be confidant that when seed is placed 1.5 to 2 inches deep in a clear of residue zone they will establish a strong root system. At two inches deep for the sake of this information – I have observed for 28+ years, which the first five nodal root sets have been all be below ground surface. You may ask, does that make a difference? Oh very much so. To establish a plant and gain maximum access to water and nutrients in the soil as possible to feed an 11 ft. tall corn plant with 16 to 18 leaves and 1100 to 1300 square inches of leaf area as photo cell collectors – it takes a big root system. To give this plant a real kick in the stem, 400 to 650 linear inches of roots at 25DAE will make the difference. But to find out that your corn crop has less than 12 roots not extending below 10 inches and less than 250 linear inches; well the rest of the growing season is catch up or bringing up the rear of the race.

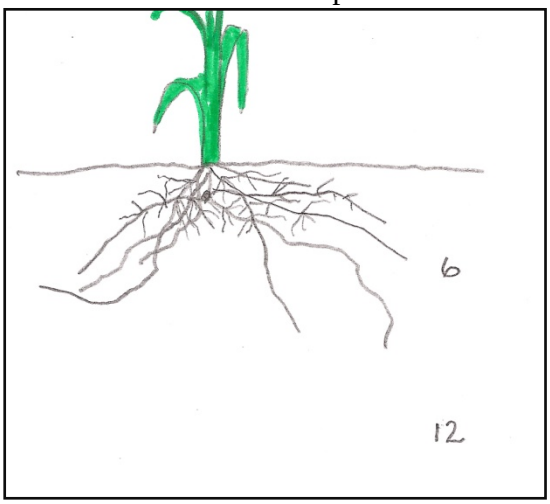

Fig. 1. 25DAE Root System – Too shallow?

At 55DAE….

The second root observation at 55DAE may seem a bit late in order to observe how well the ear is developing. The normal observation time to observe ear row number in corn is at 45DAE. However at 55DAE we can better determine the number of leaves and have a better perspective of where the 85 percentile of the root profile will be that dictates water and nutrient extraction. At this time we will see root numbers including nodal set #5 and the first adventitious roots coming on nodes 6 and 7. About 2 to 4 inches above ground in the center of the corn stem when dissected with a sharp knife, we can find the ear shank, ear and tassel. Yes it takes a powerful hand lens of dissecting microscope to see these small plant structures. Getting a chance to see, count and measure this is all phenomenal. Some of the rest of you might think this guy has been sniffing dirt too long. This root dig and set of measurements offers any of us a great vantage point in knowing if the pre-plant and starter fertilizers along with tillage did what we expected them to do. If the row count of kernels is 16, 18 or 20+, we can be very pleased of potential sound yields.

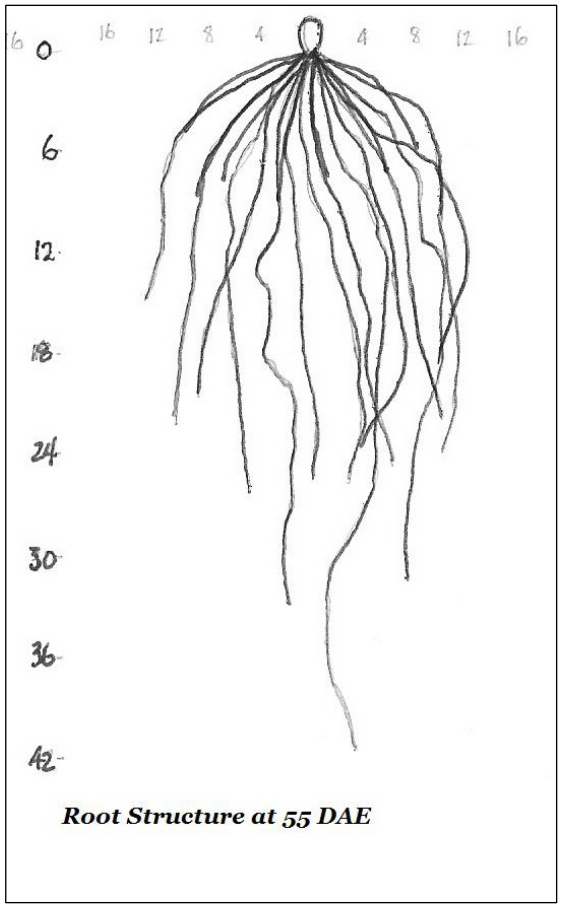

Fig.2 Roots in Strip-Till

At 110DAE….

The root system has reached its pinnacle of growth, number, soil volume explored and maximum depth. Generally this is the last week of August. During this root dig we observe the fullest potential of the corn plants absorptive capacity. Was it able to access 4000, 6000, 8000 or 10,000 cubic inches of soil volume? Because for every 1000 cubic inches of soil volume at field capacity the plant could obtain 1 gallon of water (medium textured soils). More cubic inches of soil-root interface, more nutrients are made available to the plant. Common sense reasoning says more capacity to feed the plant it should have more production potential.

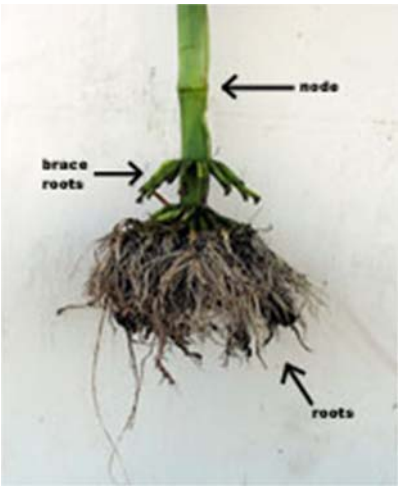

Fig. 3 Image of brace roots compared to No-Tillage system

What we usually observe under healthy strip-till plants at 110DAE we will see 40 to 60 roots from nodal set one to nodal set five and then add the adventitious roots. These 'brace' roots are predominantly for anchoring the plant (see Fig.3). Depending upon genetics, moisture and carbon resources, corn may exhibit adventitious roots from node seven.

<u>What are some of the key items we have observed at the Orthman Research Farm?</u>

<u>First at the 25DAE root dig:</u>

1] In strip-till, using the same variety – number of roots is 4 to 10 more

2] In strip-till, using the same variety – corn roots do extend deeper into the subsoil by a minimum of 6 inches compared to No-Till

3] In the No-Till system, roots did extend further laterally in the upper 6 to 8 inches of the soil profile compared to strip-till.

At 55DAE root dig:

1] In strip-till, consistently more roots at nodes 4 and 5 compared to No-Till

2] In strip-till, we observed deeper root systems by 20 to 36% over No-Till

3] In strip-till we observed larger diameter stalks at the first internode spacing on the stalk above the soil surface compared to No-Till by 1 to 6mm larger

4] In strip-till we observed more total numbers of roots, 18 to 33% more

At the 110DAE root dig:

1] In strip-till we counted 8 to 22 adventitious roots from nodes 6 and 7, with No-Till 6 to 15.

2] Generally, the total root-soil volume explored was 250 to over 900 more cubic inches in the strip-till versus No-Till

3] Strip-till penetrated deeper into the soil except for two plots which was ± 4 inches of the four hybrids we observed in 2009

4] Strip-till plots had in 9 out of 10 more corn kernel rows compared to No-Till

Comments and Discussion:

We realize this report depicts about what happened below ground and the rootzone. Yes, that is our focus here. Consider that when we do a better job of tillage, preparing the seedbed, placing fertilizer we are in essence giving the high priced seed a chance to strut its stuff and yield.

Looking at roots is tedious, time consuming, for some seems redundant, others think we might be a little overboard to concentrate so much on roots – three times for pity sake. Just because they are not as visible to the human eye, does not mean they are not important. Roots are the nutrient intake hoses so to speak folks. This is the way the plant feeds. More roots, more food intake – what normally happens to a growing boy of 13 who eats continuously and becomes a star linebacker at 265lbs in college and then in the pros and has 30 individual tackles and goes to the Super Bowl making VIP of the game? Yes there is genetics but it takes nutrition, water to make a plant grow to yield.

Having three close and personal looks at a plants root system tells us the story and verifies the output. Poor roots usually equate with poor to mediocre yields. Big, deep, and long roots tell us a better if not top yield. The year that we raised (2005) and harvested 275bpa strip-till corn in eastern Colorado, we measured 38,120 linear inches of roots below those plants. The root system bottomed out at 74 inches below the soil surface and we

irrigated with only 16 inches of water. At the 55th DAE the plants had 62 total roots and were 58 inches deep. The corn plants were not very tall but the ears were 20 and 22 around for row count and 38 to 40 kernels in length at maturity. Big Corn! We expected something in mid-June of 2005 and in November it yielded fantastic. The root dig at 110DAE gave us a look of promise with 3175 ft of roots per plant. It was a corn growers fantasy to stick a yield like that. But we knew something was coming most of the season long. As we looked at the above ground portion of 8.5 to 9.5 ft tall corn, 14 leaves, final population of 30,650 plants per acre the expectations were 225bpa. Now with more information, more root digs I am able to with confidence folks say when one has corn roots that exceed 10,000 linear inches in deep to very deep soils at 55DAE – you are onto a big crop.

The first root digs can indicate much towards what will say as to nutrition upfront does or did not do. But whoa there, do not think I should load the rootzone up with fertilizer before putting seed in the ground and expect wonders. Some soils do not have anything close to the cation exchange capacity to take a large charge of fertilizer and the results could be potential for loss and leaching could be tremendous. These root digs are excellent management tools and should be used to help manage throughout the season. We want you to gain the understanding that knowing your rooting profile and what can become of it is very valuable.

Be students of your soils and their potentials. Ask your field agronomist if he/she would dig roots at 25DAE and 55DAE to better gauge your crops progress. If they do not, consider getting one that will at least once. Find out about whether or not your big dollar hybrid bag of corn is the right rooter for you. Seed corn companies are becoming wiser about what their traits and genetics can do for you – can they talk about their roots beyond rootworm control? If so, quiz them and find out which will meet your needs with your tillage system, your fertility program, climate and expectations.

A point to think on….

It still is a correct statement; a farmer has to have a good seedbed to start the plant – well strip-tillage does just that folks.