Tillage and Root Development in Corn – Is there a Connection?
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Knowing that soil temperature, density of soil layers from the surface on down into the subsoil, competition between plants, residues on the soil surface that act like an insulating blanket, nutrient availability, and moisture all effect root development in corn, sunflowers, soybeans and grain sorghum. Scientists in Europe (Liedgens & Richner) have studied decreased root densities away from the plant out into the mid-sections of the row due to tillage and crop residue management (Allmaras & Nelson).

Others (Stone et.al) at Kansas State University (1985-86) monitored root development in natural rain-fed grain sorghum during the mid-Eighties along with neutron probe results of water content change. Initially in this study the soil profile moisture began with 83% of field capacity in the first year of the study and 73% of maximum field capacity the second year. This study gives indication that grain sorghum root growth advances very rapidly 10 to 60 days after emergence. During the first 10 days after emergence (DAE) grain sorghum roots advanced at nearly ½ inch per day. During the next 10 days the rate was 1.8 inches per day, then DAE 20 to 60 it was an advancing rate of 1.0 inches per day. Maximum rooting depth in the two year study was 73 inches and the second year it was 72 inches with 87% of those roots reaching the maximum depth by mid-July.

Figure 1. Soil/Root pit to measure roots at 55 DAE

At the Irrigation Research Foundation near Yuma, Colorado in 2006 we measured total linear extension of the corn root system three separate times, 20 DAE, 55 DAE and 105 DAE. Advancing rate of corn roots in irrigated corn is different than naturally rain-fed crops. But to relate conventional tillage corn against strip-tilled corn we observed some dramatic growth differences the three time periods we observed with deep soil/root pits.

In the first 20 days there was 7 nodal roots and 1 seedling root per plant to measure to a depth of 24 inches in the strip-tilled plot. At 55 DAE we counted 33 nodal roots and 8 adventitious roots extending to a depth of 63 inches and then at 105 DAE we counted 35 nodal roots and 16 adventitious roots extending to 68 inches. Our observations in the conventionally tilled plots at 20 DAE 5 nodal roots and 1 seedling root per plant to a depth of 13 inches, at 55 DAE we counted 24 nodal roots and 6 adventitious roots to a depth of 44 inches, and at 105 DAE we counted 28 nodal roots and 12 adventitious roots reaching a depth of 54 inches.

Relating this to the Stone study in Kansas, the conventionally tilled irrigated corn at Yuma extended roots 0.65 inch per day for 20 days, for the next 35 days 1.37 inches per day, and the last 45 days 0.13 inch per day. In our strip-tilled irrigated corn near Yuma extended roots 1.2 inches per day, for the next 35 days 1.8 inches per day and the last 45 days the roots extended at 0.12 inch per day.

To look more closely at these growing dimensions; we observed total root length by segmenting roots every 12 inches to the maximum rooting depth during the three periods and counting total length, very time consuming with washing and recovering living roots from the soil matrix. In the conventionally tilled corn; 0-20DAE we observed 190 linear inches compared to 480 linear inches for the strip-tilled corn. In the next time frame, 20-55DAE the conventional corn had 10800 linear inches compared to 25920 linear inches for the strip-tilled corn. The final set of observations at 55-105DAE resulted in 15210 linear inches for the conventionally tilled corn compared to 38210 linear inches in the strip-tilled corn.

Conclusions:

These comparisons were randomly made in the different tilled plots at the Irrigation Research Foundation field. Previous 5 years of our long term Strip-Till/Conventional Till study have shown at 105 DAE the strip-till corn same Dekalb variety under full irrigation that strip-till will extend roots 10 to 18 inches deeper every year versus the conventionally tilled corn.

The advance rate of root growth in the strip-till indicates that the deeper vertical tillage has promoted earlier root extension extending the same tendency to the 55th day after emergence. The strip-tilled corn in 2006 was 61% more inches in linear length in the first 20 days, 58% more in the next 35 days and 61% more total length at 105 DAE.

The use of strip-tillage results in deeper water movement, potentially increased soil water stored at greater depths than does conventional tillage and better rooting depths. When crops have a better start early in the season, following downward in the vertical tilled zone and old remnant root channels that are not destroyed by inversion and rolling-over till systems, they will outgrow the root system of conventional tillage. Yields have increased over the 6 years of this study by 5 to 15.5% in strip-till over conventional till. Ability for the corn to handle heat stress has also been observed in these trials.

References:

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