2007 report of Orthman/ATI-Monosem findings with TwinRow Field Research

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End of the 2007 year greetings:

I would like to offer what we set out to do with the 3 objectives with the Monosem's twin-row system: Determine crop potentials (yield) of later season root growth with twin-row corn; measure crop population density in the emergence and early growth stages of corn (emergence to V6-V8 stage) with twin-row strip-till versus conventional, and measure root length, ultimate depth. As we set out to do early on with comparison of root architecture in twin-row has us still excited.

Example of Monosem Twin-row planter in Eastern Iowa

At the Lexington Orthman we were up against some real wet planting conditions which delayed our getting the corn in on time. At the IRF we were much timelier and less wet which gave us some more reasonable stands to study.

The early (25 days after emergence [DAE]) root studies that I wrote about in your first study should be handy as you read this report also. The corn root systems took advantage of the proper spacing we achieved at the IRF in May. At the Orthman site (OMI), we were dealing with conversion from 36 inch rows down to 30 inch row spacing and root balls knocked the planter around, then the day after planting we received a deluge of rain (5 inches). On the most eastern end of the study we had 40% loss due to drowned out corn. Tough start and frustrating!

At 55 DAE I repeated the root dig to see how this selected Dekalb corn did in twin-row as well as single row at both the IRF and OMI. Compare Figures 1 and 2 from the 55 DAE and 115DAE root digs at IRF.

Note: at 55 DAE we observe roots to observe if the intended response to fertilizer placement and seed location in the previous 10 days when roots are genetically predisposed to going deep and are being stimulated properly.

Methods and Discussion...

In my 26 years of examining root architecture in W. Kansas, W. Nebraska and all over Colorado I have maintained the same approach in over 510 pits. Let me explain; by excavating with a backhoe or worse by hand, sore backs, and a spade, the pit has a vertical wall perpendicular to the row direction to a depth of 4 ft. minimum to expose plant roots. Then two narrow trenches with a tiling spade on either side of the row direction and plants approximately 15 inches away from the side of the plants. These allow me to get a better idea of the third dimension of the plant root dimensions. At 25DAE the hole is never as large due to the youthfulness of the plants size and root growth. As plants grow, the excavation increases in size and depth.

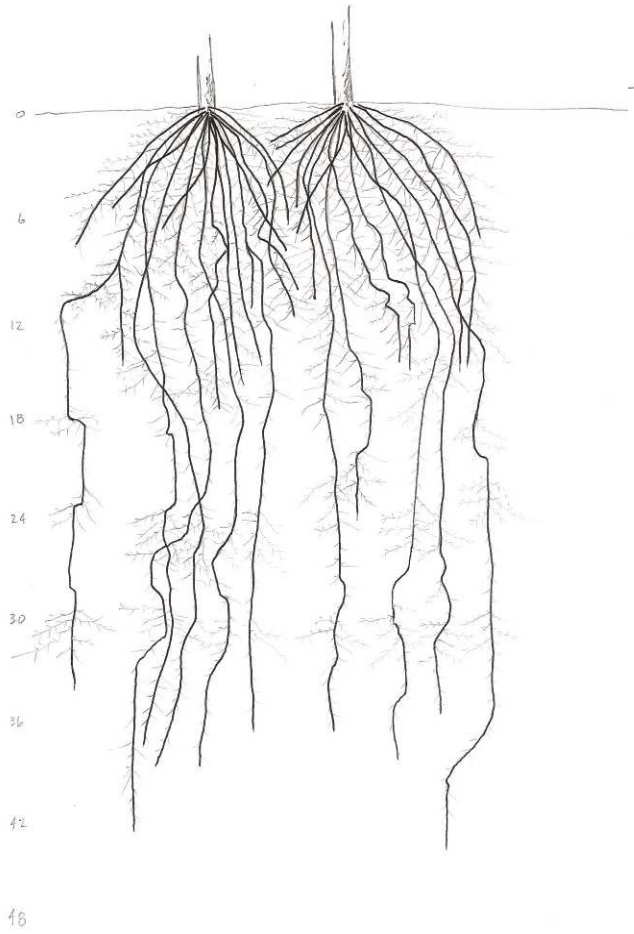

Figure 1. Monosem twin-row corn roots at 55DAE (dimensions of depth in inches on left side)

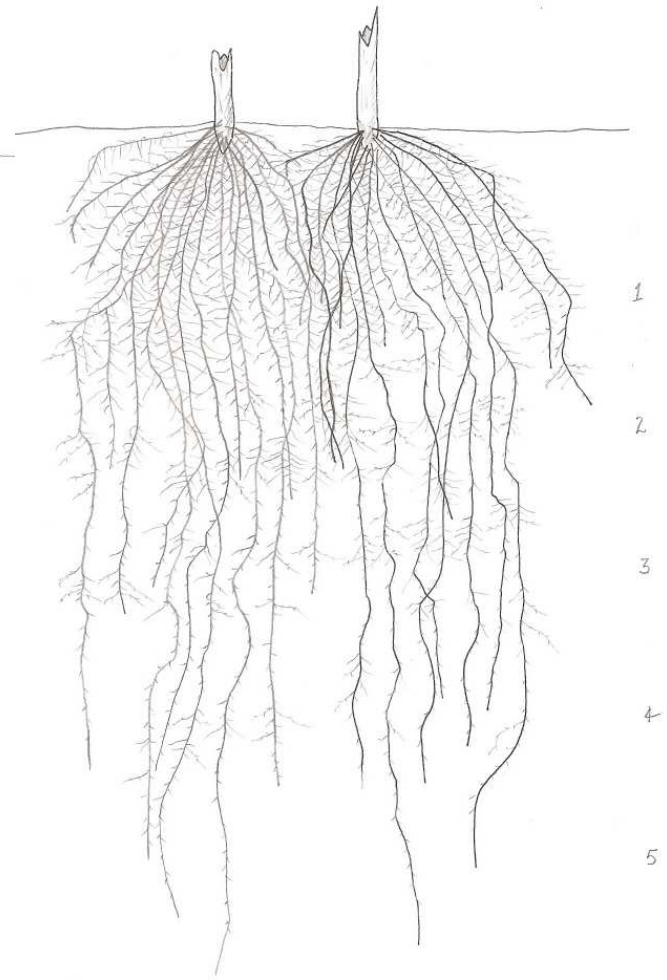

Figure 2. Monosem twin-row corn roots at 115DAE (dimensions of depth in feet on right side)

To measure root length in just the manner of extension by depth, on the vertical wall of the pit which is perpendicular to row direction, I knife and pick away gingerly soil to expose trunk roots to a depth that I find no more live, white growing roots, this I carry out all three times; 25, 55 and 105 to 115DAE. For the more intense and complete linear inches of roots examination, the 3 dimensional approach is a must. I then take sample blocks of soil and root mass of a 4 inch (10cm) area in the middle of each quartile, 1, 2, 3 and 4th from here I count and measure every 1 cm of roots. Soil is washed away from root section and roots counted. I count using a statistical factored equation to finalize the linear length for all of the roots in each quartile and to add for the final total. It is a lengthy and time consuming process which many scientists shy away from.

Because corn root lateral and vertical root development is determined by soil temperature (recent study at Univ. Georgia, 1999-2000) we observed differences where, and how many lateral roots develop off the main trunk roots. Observe in Figures 1 & 2 the skips and near blank spots where laterals develop off to the sides of the vertical roots. Most of the root system below 36 inches will be mainly vertical roots with a small amount of laterals. Georgia scientists concluded that corn roots grow vertically at soil temperatures of 55 to 63°F and lateral development is 61 to 73°F. As day and night time temperatures rise, the large soil heat sink absorbs heat and drives it deeper. Changes with daily averages – see Table 1 for an example. When using root observations by quartile to depths of 5 or 6 feet, we also examine root extension as to what is happening with moisture and soil cooling effects. It is important to note in the irrigated Western Corn Belt, when growers apply cold Ogallala Aquifer water of 48°F the rooting profile can be shallow due to the cooling down effects. With sprinkler irrigation that is not as prevalent as surface irrigation and large doses of water like 5 inches applied in gravity applications. This cooling effect can be a detriment in semi-arid and droughty

environments. In the southern latitudes of the U.S. (39°N to 29°N) the soils are much warmer and they warm deeper than (39°N to 45°N) which would be from I-70 to Fargo, ND just to provide an idea of the geography.

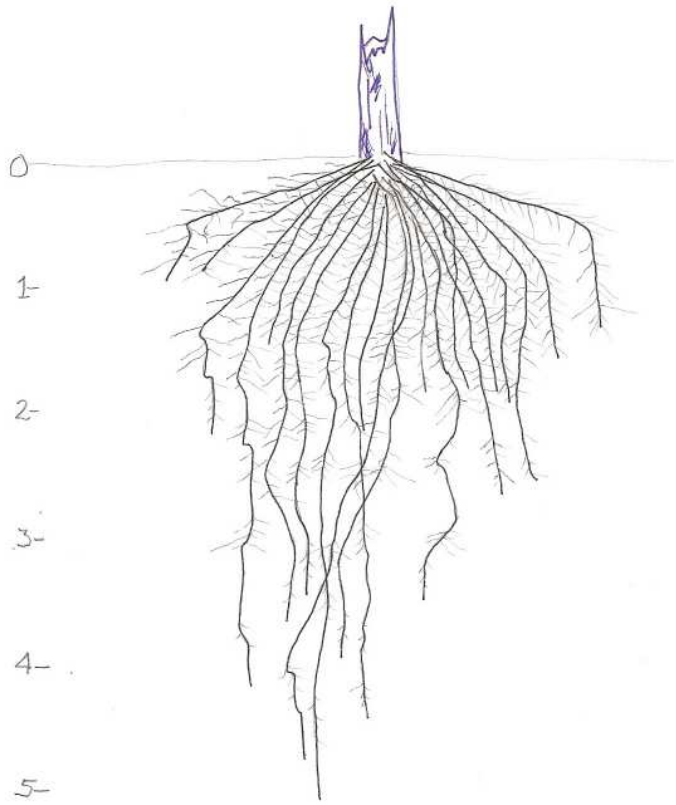

Figure 3. Single row corn at OMI Farm-Lexington

Why is this important? In single row corn compared to twin-row, we are ascertaining how to gain every inch of potential from seed positioning, fertilizer placement, then subsequent root growth to extract moisture and nutrients. If a grower can not take advantage of the root medium (soil), his yields will either be so-so or result in poor yields and loss of revenue.

Table 1. Example of soil temperatures from E. Colorado 8 year (1982-1989) Study in loam textured soils mid-June. *Site near Woodrow , Colorado*

Soil Temp	Soil Depth(in.)
73	6
70	12
65	18
63	24
60	30
57	36
55	40

Each year that I have dug soil pits to examine roots I am able from the visual indications of lateral root development tell you whether or not the summer was hot and dry or cool and wet or the grower added large amounts of water cooling the soil down too many thus causing roots to remain shallow.

Results:

What did we see this summer of 2007? From the observations of root development all things were coming up rosey - yields – well less than we hoped for.

Table 2. Yields from IRF Strip-Till Study Single row versus Twin-Row

Study Plots	row#	length	lbs grain	% moist	Bu/acre Yield	lbs/bushel
Strip-Till - single row	4	3685	8242.0	14.7	174.6	58
Convention chiseled	4	3413	7226.0	16.5	161.8	57
Twin-row-Strip-tilled	4	3420	7398.0	16.1	166.1	58

The corn variety was same in twin-row, chisel fertilized and strip-till, a Dekalb 111 day relative maturity corn. At 25 and 55DAE the corn in all three plots appeared as though we were heading for some great corn. Our fertilizer program at the IRF was the same, 210N-40P-10K-5S. At 75DAE (±July16th), I saw a slight visual difference in the top leaves size and color and thought nothing of it. At the time of the IRF Farm Show (Aug.22-23) the corn was in R3 stage of kernel dough. The ears we counted for kernel number were quite similar: 16-18 rows around in the single row strip-till and 14-16 around in the conventional and strip-tilled twin-row. Pollination on the ear was even from bottom to top. We maintained even moisture of the soil throughout the season in all three plots via the center pivot irrigation. Our populations were even from strip-till single row to twin-row, 31,400 to 32,000 plants.

When I draw some conclusions of the Orthman Farm and IRF studies, 1) we are pleased that the root zones in the strip tilled twin-row are deeper because the plants maintain a shading and cooler soil factor than that of single row corn, twin-row canopy is quicker by 8 days even planted the same day. 2) in 2007 the amount of soil explored by single row is 15-20% less than the twin-row for a 30 inch spacing set of plots – 11,310 cu inches for twin-row compared 9720 cu. inches single row. 3) Root depth for the twin-row was 69 inches versus 60 for the single row (at IRF same Dekalb 111 day corn). 4) The twin-row had a deeper 1st, 2nd and 3rd quartile of roots than the single row, refer to Figures 1, 2 & 3. Twin row had the first 85% of the total root mass to the 40 inch depth and the single row was to 28 inches in 2008. Agronomically, the Twin-row system has many pluses; use of fertility, extracting nutrition and water from a better portion of the soil profile, canopying quicker, cooler soils for better rooting depth which we observed this year, crop support after crop maturation so stalks stand well in fall winds or wet snows and more sunlight capture. It is important to note however, if fertility is not placed accurately and in enough quantity, the twin-row corn can run out of a nutrient food source especially in low CEC soils and fall behind its potential. A good sound fertility program is essential in a twin-row cropping system. All of this is important to good corn or soybean yields at harvest.

At the Orthman farm with late planted corn, partial flooded out corn which did cause N leaching too deep, 20% green snap in June, less than stellar 108 day length corn, a miss in spraying grassy weeds in a timely manner, we were overcome by Johnson grass and yellow foxtail – yields were not up to expectations! Roots were likened to what I have offered in this report however. A couple of hard lessons to learn.

In 2008 at the Orthman Farm we have plans to conduct more studies with the Monosem planter; soybean trials as well as twin-row corn for fertility placement and fertilizer types at planting time. Keep watching what is happening on the www.precisiontillage.com website and contacting your local Orthman representative.

May your 2008 be a banner year!

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