UW Extension Cooperative Extension

Winnebago County Agriculture Community Based Research Summary

By Nick Schneider, Winnebago County Agriculture Agent
and Doral Kemper, Retired USDA ARS Soil Scientist

2009 Results, Issue 2
February 2010

No-till Corn Roots Deeper, Successful in Dry Year

Practice Highlights

- No-till encourages earthworm populations
- Earthworms create macropores, which are excellent water conduits
- Crop roots grow more deeply in soils with worm burrows
- Water moves in cropland soils primarily by four process:

Infiltration vs. Run-off and Evaporation vs. Transpiration

- Cropping systems that favor infiltration and later transpiration help crops better utilize water
- Research showed deeper earthworm tunnels and deeper rooting in no-till
- Deeper rooting improves extraction of soil water, potentially providing for higher yields during a dry year

Winnebago County
UW-Extension
625 E Cty Rd Y Suite 600
Oshkosh, WI 54901

920-232-1970

Background

There are many strong opinions on planting crops using no-till practices. No-till soybeans have been adopted widely across the county while the acceptance of no-till in corn has been slower. No-till corn planting has widespread use across the county in many soils and climates, yet concerns about yield reductions in corn have slowed adoption of this practice.

Tillage plays a large role in the management of water on agricultural land. No-till is known to help improve water infiltration and reduce evaporation. In environments or years where precipitation is in deficit of what crops use, no-till can help make more water available from the soil profile.

Objective

To determine the effects of no-till management on corn rooting depth and consequent yields in Winnebago County soils and conditions.

Local Research and Demonstration Methods

Retired USDA Soil Science researcher and Oshkosh resident, Doral Kemper, identified two farms west of Oshkosh to participate in this study. Two fields with similar soils, directly across the road from one another, were compared for plant growth, rooting depth and yield. Data was also collected on a third nearby farm and from multiple spots on the no-till farm. All fields were managed as production fields within the plans of the participating farmers. Specific treatment protocols were not imposed on these producers, rather measurements were taken from fields with their typical corn growing practices. Participating farmers selected their own hybrids, planting date, and fertilizer rates.

To determine maximum rooting depth in the fields, pits were dug in the fields after the corn matured. Soil was inspected for the presence of corn roots, earthworms, and macropores. The depth of roots and earthworm tunnels were measured. Emergence, height and yield data was collected from small areas within the fields.

Rooting Data Collection and Observations

In the long-term no-till soil, there was a substantial population of night crawler earthworms (10 to 40 per square yard) and most of their holes extended vertically to depths of one to two yards. Rooting depth and night crawler activity from five locations in Winnebago County are presented in Table 1. It was noted that earthworm holes extend to approximately the same depth as plant roots in the subsoil. Worms need organic matter from which they can gain energy to continue their activity. Earthworm holes and crop rooting depth are synergistic as plant roots grow deeper down worm holes, encountering little resistance compared to that in the surrounding high clay soils. Paired comparisons made of rooting depths of corn under long term no-till management and those under tilled management in Winnebago County clay loam soils found rooting depth under no-till was 86 to 100% greater than those under tillage. Night crawlers middens (small stacks of crop residue) pulled together at the top of the burrow, are abundant in the no-till fields.

About a fifth of the worm holes were inhabited by one or more crop roots.

Email: nick.schneider@ces.uwex.edu online: http://www.uwex.edu/ces/cty/winnebago/

Winnebago County Agriculture
Community Based Research Summary

No-till Corn Roots Deeper, Successful in Dry Year continued…

2009 Results, Issue 2

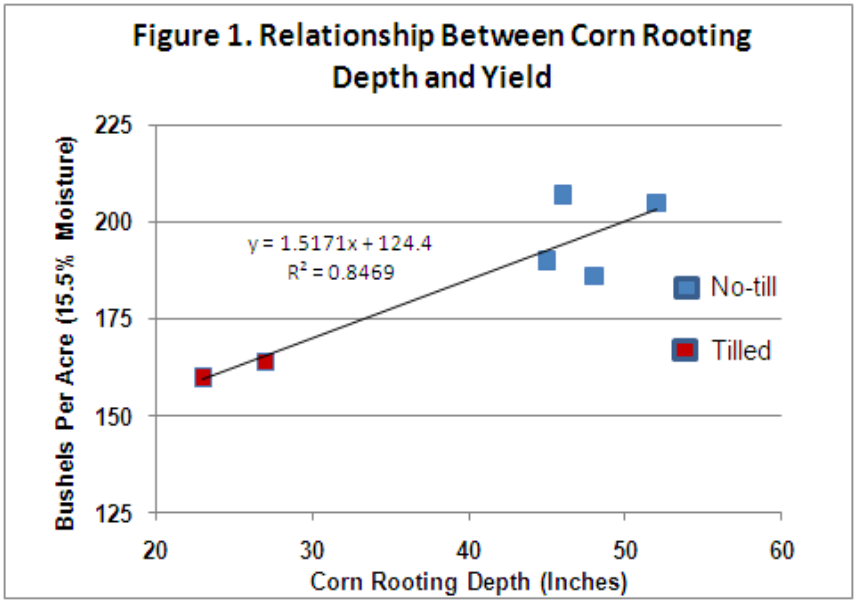
Table 1. Depth of Rooting and Night Crawler Activity Under Tilled and Long Term No-till Management

Date	Location	Management	Rooting Depth (inches)	Worm Burrow Depth (inches)	Worm Middens (per yd2)
2008	Oshkosh	No-till Wheat	59	56	29
		Tilled Wheat	30	24	0
2009	Oshkosh	No-till Corn	56	56	43
		Tilled Corn	29	26	0
2009	Omro	No-till Corn	41	40	16
		Tilled Corn	22	none	0
2009	Oshkosh	No-till Corn	48	47	22
		Tilled Corn	25	none	2
2009	Oshkosh	No-till Corn	52	50	29
		Tilled Corn	26	none	0

No-till locations had a minimum of eights years without tillage.

Figure 1. Shows the relationship between yield and rooting depth found in the paired tilled and no-tilled fields. A third field within the same watershed but managed with higher fertility, 20" row spacing, and tillage had a similar pattern from four locations in that field. In the third field we found locations with rooting depth of 23", 36", 40", and 42" and yields of 126, 239, 220, and 245 bu/acre respectively. Due to only a single year of data, it is important not to draw conclusions; however the relationship between rooting depth and crop yield looks encouraging.

Yield measurements have an error of +/- 5% due to the moisture tester accuracy.



Water Management of No-till

There are four main processes concerning farmers that influence soil held water. Immediately after rainfall, the runoff-infiltration tradeoff takes affect. If the soil is saturated or the surface pore openings are sealed, water is more susceptible to runoff. In order for the soil to store water to provide for crop growth later in the season, water infiltration is the preferred route. Earthworm burrows are excellent water conveying conduits, thereby helping store more water in the soil profile. In the event of soil saturation, macropores will also help soil water reach drain tile quickly.

The other competing water processes are evaporation and transpiration, both forms of water loss. Evaporation is desirable when surface dryness is necessary for field operations. Frequently, this is why fields are tilled…to open up the soil for drying and warming. After planting and spraying is complete, water loss through the plant as transpiration is the better route of water loss as this process helps provide for the most basic plant functions.

As a result of earlier planting and soil temperature averaging about 4˚F warmer, corn started more quickly on the tilled field than the no-till fields. By June 13, no-till corn planted on May 20 was two days behind in growth than corn planted on May 4. Negligible precipitation from June 21 to July 21 forced the corn on all of these fields to depend on the stored profile water reachable by roots. Figure 1 shows corn in the no-till field had greater rooting depth and yield than the tilled area. In particular, the paired field plots averaged 162 bu/acre with tillage and 186 bu/acre in no-till.

Summary

Insufficient water is one of the most common factors limiting crop production. Cropping systems, such as no-till, that encourage more water infiltration and later transpiration are especially beneficial during dry growing seasons. Undisturbed earthworm tunnels create macropores and are excellent conduits for water infiltration and plant root penetration. Access to additional water stored in the soil profile enables crops to continue growth better in drought periods, potentially resulting in higher yields.