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Switching To No-till Can Save Irrigation Water

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Nebraska farmers have experienced drought conditions for several years, particularly in western Nebraska. Bob Klein, Extension crops specialist at the UNL West Central Research and Extension Center at North Platte, reports farmers have experienced six continuous failed crops on dryland due to drought conditions. Some Natural Resource Districts have implemented irrigation water restrictions. Switching to no-till can conserve groundwater and surface water that is used for irrigation. University of Nebraska field trials have shown that using center pivot irrigation and no-till practices instead of furrow irrigation and conventional tillage can reduce irrigation need by up to half. Switching to no-till and center pivot irrigation conserves groundwater and surface water and gives farmers the maximum benefit when they irrigate.

Farmers were taught years ago that tillage was needed to prepare a seedbed. Farming today has proven this is a myth and current soils research has actually shown how tillage can break down soil structure and can cause increased soil crusting and agricultural runoff during irrigation and rainfall events. With conventional tillage and cultivation, crop residue is destroyed, which leaves soil exposed to wind and water erosion. No-till leaves crop residue on the soil surface, which allows better water infiltration into the soil and greatly decreases evaporation.

Conventional tillage, dries the soil before planting to the depth of the tillage layer. Typically, 1/3 to 3/4 inch of moisture is lost per tillage pass. In a no-till system, it is usually possible to adjust seeding depth so seed is placed into moist soil, thus avoiding an early season irrigation to ensure good germination.

Added profit from water savings: $20.64 to $34.40/acre

Seasonal crop water use is a combination of evaporation from the soil surface and water transpired through the crop. With a center pivot, soil is constantly wetted at the surface causing additional evaporation. Leaving crop residue on the soil surface can reduce evaporation significantly.

Past field trials have found that when producers switch from conventional tillage to no-till under center pivot irrigation, they can save 3 to 5 inches of water annually. This water savings reduces pumping costs and is a direct savings to the operator. No-till farming also saves labor, fuel and farming equipment costs. In areas of declining water supply, this is not only a dollar savings but a water resource savings.

Table 1 is a review of typical irrigation application depth for corn comparing furrow irrigation and pivot irrigation with or without no-till. No-till farming under a pivot can save 3 to 5 inches of irrigation water applied using best management practices compared to conventional tillage with a pivot. There is a large water savings switching from furrow to center pivot irrigation.

Nebraska is subject to thunderstorm events where rainfall intensities of 1 to 2 inches per hour are common. It is important to maintain high soil infiltration rates to minimize runoff and take maximum advantage of rainfall. Water intake rates of soils are influenced greatly depending on whether the soil is tilled or the field is in long-term continuous no-till. Farming practices can greatly influence soil water infiltration by affect-

Table 1. Effect of management practices and no-till on irrigation application–average inches of irrigation water applied for central Nebraska.

Avg. Management	*Best Management Practices*	*Irrigation Type or Practice*
20"	18"	Furrow Irrigation with Tillage
15"	13"	Center Pivot with Tillage
12"	9"	Center Pivot with No-till

Table 2. Effect on water intake in soils depending on management practice.*

Management Practice	*Wheel Track Row (in/hr)*	*Soft Rows (in/hr)*
Conventional Tillage	0.2	0.4
No-Till	0.5	> 4.0

*Research data from Paul Jasa, UNL Biological Systems Engineer.

ing changes in soil structure. Soil compaction from wheel traffic will greatly reduce water intake. Tillage breaks down soil structure and keeps water intake rates low. *Table 2* is a summary of how water intake changes depending on management practice and wheel traffic pattern.

To estimate the cost of pumping irrigation water, download a computer spreadsheet from the University of Nebraska–Lincoln Extension Lancaster County Web site at *lancaster.unl.edu/ag/crops/irrigate.htm*. The spreadsheet was used to calculate an average cost of center pivot irrigation with 130 acres, pumping water 125 feet using a system pressure of 35 psi, diesel fuel at $2.47 per gallon, drip oil cost at $3.47 per gallon and operator labor at $10.00 per hour.

In this example, under center pivot irrigation the annual operating cost (repairs, operator labor and energy) for each inch of water applied is $6.88 an acre. With no-till farming and a savings of 3 to 5 acre inches of irrigation water, the annual operating cost savings range is $20.64 per acre to $34.40 per acre. (Energy cost alone in this example for each inch of water applied is $4.75 per acre. This is a direct irrigation energy savings range of $14.25 per acre to $23.75 per acre when switching to no-till farming practices.

This author observed no-till crops being raised under center pivot at the Dakota Lakes Research Farm near Pierre, S.D. in 2002. Duane Beck, no-till farmer and researcher, demonstrated applying 2 inches of water in 12 minutes over the same spot in long-term no-till fields under crop rotation. This was with a 40-acre lateral pivot pumping 1000 gpm out of the Missouri River. The author observed little to no runoff under irrigation with the long-term no-till. Long-term no-till and crop rotation can have a significant impact on soil properties, as demonstrated by Beck's high yields for irrigated no-till corn and soybean in South Dakota.

In Nebraska, we are seeing more adoption of no-till under irrigation in a corn-bean rotation. Farmers will continue to break down the old traditions of tilling behind the combine in the fall. Instead of fall tillage, Nebraska farmers adopting no-tillage will continue to make combine adjustments in advance of harvest, better setting the stage for no-till the following year.

Adapting and using no-till can take a huge mental adjustment. Examples of no-till adjustments include parking the anhydrous rig for a few hours to allow residue to dry, eliminating soybean residue piles that can interfere with no-till planting the following year, or explaining to your neighbors that your fields are planted and you are not sick after all.

You cannot underestimate the importance of good residue distribution with the combine. On some combines with the corn header, using tapered stock rollers, slowing down the gathering chains, and adding beveled stripper plates can provide more even crop residue distribution. The less residue run through the combine, the better.

Under heavy residue situations, it is recommended to use starter fertilizer in furrow with the seed. Do not exceed recommended amounts to avoid salt injury.

The technology is here with our machinery and herbicides. The dollar savings are documented with no-till farming which has advanced greatly the past 20 years. Yes, there are challenges with handling the residue, but the main thing is a shift in attitude. For those farmers who can achieve the same yields or higher yields with no-till (compared to their neighbors who are tilling), there are real and significant savings that can be taken directly to the bank.

Extension is a Division of the Institute of Agriculture and Natural Resources at the University of Nebraska–Lincoln cooperating with the Counties and the U.S. Department of Agriculture.