ON-FARM STUDIES WITH STRIP TILLAGE
– FIRST-YEAR RESULTS –

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Introduction

It's no secret that many producers are often not satisfied with the results of no-till corn. Cold, wet spring weather certainly doesn't help to promote early growth. Corn grown under no-till often encounters a slow growth syndrome and subsequent lower performance and yield compared to more conventional tillage systems. Additionally, wet conditions during harvest can also provide challenges to prevent marking up fields, altering seedbed surface and compacting the soil profile.

Many producers who have tried to no-till corn have abandoned it due to planter problems, seedbed quality, poor planting conditions, poor seedling establishment, and often, poor yield. Now, instead of scrapping the entire system of conservation tillage and pulling all the old tillage equipment back out of the shed, there are alternatives to no-till. Tillage equipment improvements have brought new interest in the form of strip tillage (may also be called zone-tillage). Strip tillage combines the best of tillage and no-till systems. Strip tillage can promote a warm seedbed without removing all old crop residue and leaving soil vulnerable to erosion, plus save time and expense from extra trips across the field.

Using strip-till, a process typically conducted as a separate fall operation (with or without fertilizer application), a producer makes a strip with a knife, about eight or nine inches deep in the fall. The resulting strips on top of the ground end up in a two or three-inch tall mound. Strip till may also be performed in the spring pre-plant or by adding attachments on the planter.

This program allows farmers to get in the field in good time during the spring planting season and maximize time by planting, not spending time reworking the soil.

Objectives

Previous and current on-farm strip tillage research has been conducted in Illinois through the SOILS (Save Our Illinois Soils) project coordinated by the University of Illinois and Illinois Department of Ag. This project is being conducted on commercial farm fields. Other strip tillage projects in Illinois and Iowa have been sponsored by Monsanto to support their biotech products. Initial results show true benefits to adoption of strip tillage. However, Illinois and Iowa have several distinct advantages over more northern states like Wisconsin and Minnesota: seasonal temperatures, length of season, soil texture and soil drainage. My questions was, can we use a reduced tillage system like strip tillage in Wisconsin on soils generally less forgiving with respect to soil warming and drainage? Most producers don't have the time for labor expensive tillage operations.

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Additionally, with the slim margins that exist raising corn, the added expense of fuel to work ground can make profit margins shrink dramatically.

The first objective of this study was to test different tillage systems for corn production in large on-farm plots. Objective two was to integrate these different tillage systems into an on-farm corn production system including fertilizer placement and application, seedbed preparation, herbicide application, etc. to develop a productive corn system. Objective three was to utilize both weigh wagon measurements and combine-based GPS and yield-mapping technology to measure treatment differences in grain yield to better understand the relationship between weigh wagon weights and combine grain flow measurements. Objective four was to determine which production system is most economical, or which promotes the lowest production cost and ultimately promotes best profit per acre. Objective five was to utilize split-planter techniques to incorporate two additional treatments to investigate use of a seed applied insecticide. Objective six was to take treatments the next level and implement into a corn-soybean rotation for 2002.

Materials and Methods

This study was initiated (year one of a proposed three years) in the fall of 2000 at three southern Wisconsin locations. Three locations were chosen with different soil textures. Location 1, high yield potential (Janesville - Plano silt loam), location 2, average yield potential (Whitewater - Kidder sandy loam), and location 3, average to high yield potential (Milton - St. Charles silt loam). Tillage treatments were 1) fall chisel plow + fall broadcast P and K + spring N as 28%N, 2) fall strip tillage + fall anhydrous ammonia + fall P and K deep banded, 3) fall strip tillage + fall P and K deep banded + spring N as 28%N, 4) no tillage with fall broadcast P and K + spring N as 28%N. Each tillage treatment was approximately 210 feet wide x 1250 feet in length (approximately 6 acres in area). Strip tilling was performed by a Yetter (Yetter Co., Colchester, IL) Strip Tiller with Generation II Maverick Openers. Corn plots were planted using large-on-farm sized plots (15 feet x 1250 feet) with a John Deere 6 row Model 7200 no-till Max Emerge II vacuum planter (Deere and Co., E. Moline, IL) with Yetter Residue Managers attached ahead of the no-till coulters at 33,000 seeds/acre on 30" row spacings at a 2" depth on April 25 (Whitewater), April 29 (Milton), and April 30 (Janesville), 2001. Corn hybrid was a 109RM RR hybrid provided by Corn States Hybrid Service, St. Louis, MO. Planter was split with three rows containing only Maxim XL, **fludioxinil,** (Syngenta, Greensboro, NC) fungicide seed treatment and the other three rows containing Maxim XL + Gaucho, **imidacloprid,** insecticide (Gustafson, Inc. Plano, TX). All plots received 200 lbs/acre 7-21-7 liquid starter fertilizer at planting. All plots were fertilized using standard WI fertility recommendations (160 units N - 40 lb N credit due to previous soybean crop - 14 lb N from starter = 106 units N). Plots receiving fall anhydrous N also included 1 qt/acre N-Serve (**nitrapyrin**) to prevent N losses). All plots received 25 lb/acre P_2O_5 and 35 lb/acre K_2O either broadcast or deep banded. Plots were kept weed-free using a combination of pre and post emergent herbicides. All plots received 1.5 pt/acre Harness (**acetochlor,** a product of Monsanto, St. Louis, MO) + 1.0 lb/acre Atrazine (**atrazine**, generic) with 106 units N/acre (379 lb) liquid N as 28%N - UAN prior to planting, (April 23, 26 and 27, 2001 at Whitewater, Milton and Janesville, respectively. No-till and strip-til plots also received 1.0 pt/acre Roundup Ultra (**glyphosate**, a product of Monsanto, St. Louis, MO) + 3.0 lb/acre ammonium sulfate May 01, 02 and 05, 2001 at Whitewater, Milton and Janesville, respectively. All plots received 1.0 qt/acre Roundup Ultra at V7/V8 (Ritchie, et al., 1989) June 09, 17 and 18, 2001 at Whitewater, Milton and Janesville, respectively. Data collected included grain yield, grain moisture, test weight, V4 plant vigor, V4 stand density, harvest stand density, and GPS yield coordinates. All expenses (these include all production costs with the exception of government payments), fixed and variable, were recorded to be used to calculate bottom-line economics. Plots were harvested October 28, November 05, and 09, 2001 at Whitewater, Milton and Janesville, respectively using an International Harvester 1460 combine (Case Corp., Racine, WI) with 6 row 963 corn head and AgLeader PF3000 yield monitor (AgLeader Technology, Ames, IA). A Parker Model 150 weigh wagon (Parker Industries, Jefferson, IA) was used for individual plot weights and yield monitor calibration.

Results and Discussion

Corn Grain Yield Response due to Tillage

Growing conditions in 2001 were generally not considered great for corn production. During June and July several weeks passed without rainfall. During these high heat periods corn showed symptoms of drought stress by rolling leaves and wilting. Despite obvious symptoms of stress, yields were generally good to excellent. At Whitewater, yields were poor where soil was prepared conventionally, demonstrated by excessive stress symptoms from dry periods (Table 1). Strip and zero tillage treatments responded much better to drought, through probable moisture conservation, where yields were 30 bushel better than the conventionally tilled plots (Table 1).

At Milton, yields where better than Whitewater (Table 2). Conventional and fall strip (with spring N) tilled plots yielded better than no till and fall strip tilled with fall N. Late season N stress was visible on strip till corn that had fall applied N.

At Janesville, where soil texture was best, yields were also highest (Table 3). Similar to Milton, conventional and fall strip (with spring N) tilled plots yielded best.

GPS yield maps demonstrate these yield effects (data not shown). Maximum yield monitor accuracy was obtained by keeping combine harvesting at a constant speed, and calibrating after each plot weight was measured by weigh wagon.

After harvest all yields and inputs were used to calculate a cost per bushel, cost per acre and net grower return per acre. Across all three locations, yields were best for fall strip tillage + spring N (180.5 bu/acre), followed by no tillage (162.0 bu/acre), then conventional tillage (159.6 bu/acre) and last by fall strip tillage + fall N (153.1 bu/acre). N stress on corn in plots where nitrogen was applied in the fall was present in fall strip tillage + fall N plots indicating a yield loss probability, then evident at harvest. Most interesting were production costs to produce one bushel of grain. Costs per bushel were $1.41, $1.50, $1.60 and $1.61 for strip till + spring N, no tillage, conventional tillage, fall strip tillage + fall N. Net profit per acre was $107.96, $82.18, $72.35, and $62.21 for same treatments. Costs savings from fewer field trips showed in calculations.

Table 1. Corn grain yield in different tillages and seed treatment. Whitewater, WI.

Tillage	Fall chisel	Fall strip + NH3	Fall strip + spring N	No tillage	LSD (P=0.10)
Grain yield bu/acre no Gaucho	119.4	148.2	n/a	148.2	**3.5 Tillage**
Grain yield bu/acre with Gaucho	121.8	152.2	n/a	155.3	**4.2 Seed treatment**

Table 2. Corn grain yield in different tillages and seed treatment. Milton, WI.

Tillage	Fall chisel	Fall strip + NH3	Fall strip + spring N	No tillage	LSD (P=0.10)
Grain yield bu/acre no Gaucho	166.8	159.0	169.7	154.8	**5.0 Tillage**
Grain yield bu/acre with Gaucho	177.5	159.7	174.0	157.1	**3.6 Seed treatment**

Table 3. Corn grain yield in different tillages and seed treatment. Janesville, WI.

Tillage	Fall chisel	Fall strip + NH3	Fall strip + spring N	No tillage	LSD (P=0.10)
Grain yield bu/acre no Gaucho	182.5	n/a	188.1	166.5	**5.3 Tillage**
Grain yield bu/acre with Gaucho	189.7	n/a	191.7	183.4	**4.3 Seed treatment**

Stand Establishment Effects due to Tillage and Seed Treatment

An additional treatment in these studies was to investigate the effect of Gaucho insecticide seed treatment on early stand establishment and plant vigor. Tables 4, 5 and 6 illustrate the effect Gaucho had on early growth. In all tillages and across all locations Gaucho improved stand density and early plant vigor (data not shown for vigor). These Gaucho treated plots exhibited more rapid growth and generally taller plants (data not shown). Additionally, later season during drought stress, those plots treated with Gaucho showed lesser effects due to drought stress. Never were any obvious insect problems detected (such as wireworm, cutworm, etc.), yet the insecticide seed treated corn plots always looked better than those not receiving the insecticide seed treatment. Across all treatments, locations and tillages Gaucho treated corn outyielded non Gaucho treated corn 167.1 to 160.8 bu/acre. GPS yield maps clearly demonstrate this yield effect (data not shown).

Table 4. The effect of Gaucho on early stand establishment and grain yield. Whitewater, WI.

Tillage	Fall chisel	Fall strip + NH3	Fall strip + spring N	No tillage	Mean
Plant density no Gaucho	30691	30776	n/a	30894	**30787**
Plant density with Gaucho	31957	32236	n/a	32168	**32120**
Gaucho pop. increase	**1266**	**1460**	n/a	**1274**	**1333**

Table 5. The effect of Gaucho on early stand establishment and grain yield. Milton, WI.

Tillage	Fall chisel	Fall strip + NH3	Fall strip + spring N	No tillage	Mean
Plant density no Gaucho	30204	30151	29991	29781	**30032**
Plant density with Gaucho	31416	31201	31265	31347	**31307**
Gaucho pop. increase	**1212**	**1050**	**1274**	**1566**	**127**

Table 6. The effect of Gaucho on early stand establishment and grain yield. Janesville, WI.

Tillage	Fall chisel	Fall strip + NH3	Fall strip + spring N	No tillage	Mean
Plant density no Gaucho	29484	n/a	29511	29935	29643
Plant density with Gaucho	31499	n/a	31008	31106	31204
Gaucho pop. increase	2015	n/a	1497	1171	1561

Conclusions

Problems exist that may limit the adoption of strip tillage. These include: purchasing the required equipment, timing of each operation, how to handle severally altered fields from harvesting traffic, etc.; excessively moist soil that may limit performance of strip tiller; or strip tillage in a corn on corn rotation.

Despite these negatives, the benefits are evident: better stands, improved early growth, dryer and warmer soil in the row compared to no-till, increased yield over no-till, improved soil erosion control, less field trips, reduced fuel inputs compared to conventional tillage. Like any new operation it takes some practice to perform tillage in the best soil conditions. Adjustments on the strip tiller also take time. Planters also need some preparation to be properly matched to the strip tiller. Strip tilling into corn ground requires some patience and practice to reduce trash plugging from heavy residue corn. Also, what about soybeans? In a narrow row situation, this would not match up well with 30" wide strips. For 2002, I will compare strip tilled soybeans with drilled soybeans in both no till and conventional tillage programs.

Use of Gaucho was decided soon before planting. I thought it could be advantageous for use in reduced tillage scenarios. I had used Gaucho on a limited basis in 2000 and decided to expand comparisons to really test the performance of Gaucho. Yields demonstrated its' effectiveness.

For 2002, two of the original locations and two new locations will be used for further study. Each location has had fall strips and chiseling performed, for 2002 planting each tillage will have both corn and soybean plots.

Based on one year of data, the benefits of adopting a strip tillage program are visible, fewer trips across the field, warmer soil temperatures, good yields, and improved production costs and net profit per acre. The next year of data will hopefully support these early findings and provide producers with a viable alternative to full width tillage and no tillage problems.

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Additional information may be obtained from the following:

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