

Corn: Strip-Till



- Zone-till Fertilizer Applications (2003)
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Experiment: Zone-till Fertilizer Applications (03-18)

Year: 2003 (03-18)

Date of Planting/Harvest: May 22 / November 11

Plot Size/Replications: 4 row ft. by 180 ft. / 2

Zone till has several different meanings, but generally refers to a form of reduced tillage where a narrow section of ground is tilled with a coulter(s) and shank, and the planter places the seed in the tilled strip. The area between the rows is left undisturbed. This differs from the action of a no-till planter due to the deeper tillage with the shank. The zone till operation is usually done in advance of planting, often in the previous fall or in the winter, depending on geography. Some zone till equipment is able to apply liquid fertilizer within the tilled zones. Used mostly in corn, nitrogen can be placed several inches below where the seed is to be placed. Some users of Agro-Culture Liquid Fertilizers will apply a portion of their High NRG-N and Pro-Germinator 9-24-3 with zone tillage, and run the remainder of the Pro-Germinator 9-24-3 (plus Micro 500) through the planter in-furrow and the remainder to the High NRG-N through their center pivot irrigation. Field performance of this practice has been excellent, and offers several advantages. The amount of fertilizer applied per acre by the planter is reduced. Fertilizer is placed in the seed zone for best utilization by the plant. The balance of the High NRG-N usually consists of a single pivot tank thereby eliminating the hassle of refilling the tank in-season. This is a further advantage considering the 40% rate-reduction benefit of High NRG-N vs. conventional UAN solutions.

Zone till research has not been conducted at the NCRS in the past. But in the early spring, NCRS supervisor Doug Summer custom built a zone till applicator for research plot work. The unit was built on an anhydrous ammonia toolbar with the anhydrous shanks attached for deep "tillage" in 4-30 inch rows. There are 3-18 inch Yetter wavy coulters per row, one out in front of the tool bar in front of the shank, and two behind it. They are followed by heavy rolling baskets to break clods. This unit is unique in that it has the ability for dual fertilizer placement: (1) 4 inches below the seed from a hose on the shank, and (2) in the seed zone from a stream nozzle behind the rear coulters. Two roller pumps mounted on the tool bar deliver the fertilizer from two toolbar-mounted tanks. Fertilizer flow rate is controlled by Raven Flow Control units. This customized zone till piece of equipment is called a *Nutri-Till™* applicator.

As previously mentioned, in this part of the country the zone till operation would be applied in the fall for the corn crop the following year. As this applicator was built in the spring, an experiment was established to evaluate different pre-plant fertilizer placement options with *Nutri-Till™* compared to the normal application of fertilizer application with planter and sidedress. The *Nutri-Till™* and planter applications were made on the same day. Also, the experiment was not in a no-till field but rather a conventionally tilled field (spring field cultivation of soybean stalks.) Drip irrigation hose was installed following sidedress.

Treatment yields appear in the following table. Despite only 2 replications, data were consistent with little variability, giving good treatment separation and a relatively low LSD value.

Fertilizer Placement and Corn Yield (Bu/A) with Nutri-Till™ and Conventional Equipment North Central Research Station - 2003									
Placement:	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7 conv.</u>	<u>8</u>	<u>9</u>
NT seed zone	0	0	3+7	0	0	0	7 APP	3+7	7
NT below seed	0	42	42	0	21+3+7	42	70 - 28%	21	42
Planter	0	0	0	3+7	0	3+7	0	0	3
Sidedress	0	0	0	42	21	0	0	21	0
LSD(0.05): 6.9	137.3	178.3	187.5	188.4	189.1	190.1	190.1	200.0	200.5

NT: fertilizer application applied pre-plant with Nutri-Till equipment.
 All treatments except 1 (check) and 7 (conventional fertilizer) are Agro-Culture Liquid:
3+7: 3 gal/A 9-24-3 + 7 gal/A Sure-K + 1 qt/A Micro 500
21 and 42: 21 or 42 gal/A of High NRG-N
 Conventional fertilizer (Trt. 7):
7 APP: 7 gal/A 10-34-0 + 1 qt/A 9% zinc; also had 150 lb/A 0-0-60 pre-plant broadcast.
70-28%: 70 gal/A 28% UAN.

- All treatments yielded significantly higher than the check (trt. 1), and all treatments with P and K fertilizer yielded significantly higher than High NRG-N only (trt. 2).
- The shaded treatment 4 is the “regular” application of fertilizer through the planter and side-dress (no *Nutri-Till™*), and the bordered treatment 7 is conventional fertilizer applied with *Nutri-Till™*. (The conventional treatment did require a separate application for the 0-0-60). There was no significant yield differences between these treatments and treatment 3, which applied 9-24-3 + Sure-K in the seed zone and High NRG-N below the seed zone with *Nutri-Till™*, and treatment 5 which applied the 9-24-3 and Sure-K and half of the High NRG-N below the seed zone.
- Two treatments yielded significantly higher than the other group. Treatment 8 applied all of the 9-24-3 and Sure-K in the seed zone and half of the High NRG-N below the seed zone with the *Nutri-Till™*. The other half was side-dressed. This contrasts with treatment 3 which applied all of the High NRG-N before planting with *Nutri-Till™*. So split application of nitrogen was a benefit here.
- Treatment 9 also yielded higher than the middle group of treatments. Here, the Sure-K was applied in the seed zone and all of the High NRG-N was applied below the seed zone with *Nutri-Till™*. Then the 9-24-3 was applied in the seed furrow with the planter. So it appears that there was a benefit to concentrating the 9-24-3 around the seed with the planter application. Putting treatments 8 and 9 together, there may be a further benefit to split application of High NRG-N like in 8 and application of 9-24-3 and Sure-K like in 9. But this wasn’t done in this experiment.
- *Nutri-Till™* did show advantages in this experiment compared to “regular” fertilizer application methods. For further evaluation, an experiment involving *Nutri-Till™* application in the fall in no-till conditions was established at the NCRS in early December of 2003. These applications will be compared to normal planter and side-dress application of nutrition in 2004.

Experiment: Fertilizer comparison in irrigated strip-till corn. Edwards County, KS

This corn comparison in Southern Central Kansas reports yields from three adjacent center pivot irrigated fields. One field used the regular conventional fertilizer program, and two fields used Agro-Culture Liquid Fertilizers. The strip till applied the fertilizer about 8 inches deep.

Conventional	Yield - 219 Bu/A
Strip Till:	2.24 gal/A 10-34-0 9.9 lb/A 0-0-62 (dissolved in water) 2.3 lb/A chelated zinc 101.7 lb/A anhydrous ammonia
Planter:	4.25 gal/A 10-34-0 6.4 gal/A 32% UAN 11.7 lb/A 0-0-62 (dissolved in water) 1.73 gal/A 12-0-0-26 0.8 lb/A chelated zinc
Irrigation:	30.8 gal/A 32% UAN 1 gal/A Sure-K 4.87 gal/A 12-0-0-26
Total nutrient applied: 230-26-26-19S-0.3Zn on 128 acres	
<u>Agro-Culture Liquid Fertilizers.</u>	
	Yield: 224 Bu/A and 247 Bu/A on 2 circles
Strip Till:	2 gal/A 9-24-3 20 gal/A High NRG-N
Planter:	2 gal/A 9-24-3 1 gal/A Sure-K 12.5 gal/A High NRG-N 2 qt/A Micro 500
Irrigation:	15.5 gal/A High NRG-N in 3 applications 1 gal/A Sure-K
Total nutrients applied: 142-11-3.3-5S-0.09Zn per acre	

Experiment: *Nutri-Till_{TM}* Fertilizer Applications for Corn

Year (Experiment Number): 2006 (06-503)

Date of Planting/Harvest: 4-27-06 / 10-25-06

Hybrid: Pioneer 36B03 RR RW

Plot Size: 6 rows x 90 ft (4 replications)

Soil Test Levels (ppm)

pH: 6.9 C.E.C.: 10.8

OM: 3.0% P1: 24 ppm

K: 40 ppm (0.9% BS)

Objective: Determine best placement and source of fertilizers for *Nutri-Till_{TM}* strip tillage. In recent years, *strip-till* or *zone-till* equipment has been developed to combine tillage strips in the seed zone with no-till between the rows for residue and moisture conservation. This has also presented an opportunity for nutrient application to reduce the need for extra application trips or application at planting or sidedress. The *Nutri-Till_{TM}* applicator was custom-built by North Central Research Station supervisor Doug Summer. What makes *Nutri-Till_{TM}* different is the ability for dual placement of liquid nutrition in the seed zone as well as below the seed. The deep shank is actually an anhydrous knife, which would place the liquid fertilizer approximately 6 inches below the surface. The seed zone placement is through a stream nozzle applied to the soil surface, and then covered by small hilling disks. Three coulters do the tillage and a rolling basket firms the



tilled strip.

Nutri-Till_{TM} implement in the raised position.

Fertilizer application and strip tillage on plots.



Planting over the *Nutri-Till* strips leaving wheat stubble residue between the rows.

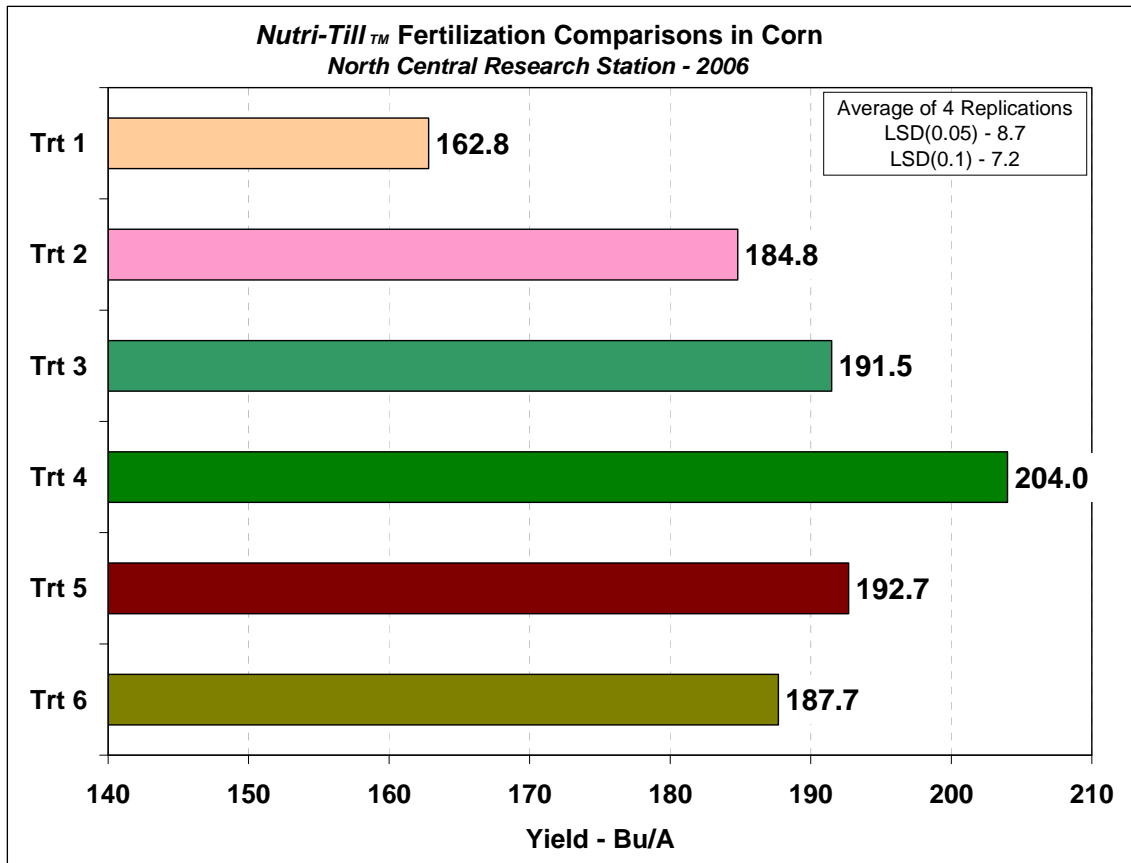
The corn experiment was established on a Sebewa loam soil, which was in winter wheat in 2005. The *Nutri-Till_{TM}* treatments were applied in the un-worked wheat stubble. The objective of the experiment was to compare fertilizer application either through the *Nutri-Till_{TM}* implement, or through the planter on top of the unfertilized strips. Additionally, three different *Nutri-Till_{TM}* applied nitrogen treatments were compared. There was also a conventional fertilizer treatment

Hi

applied with *Nutri-Till*_{TM}.

The following table lists the treatments applied:

Nutri-Till applications in corn treatments:	
Trt 1:	(Nitrogen only) 41 gal/A High NRG-N with <i>Nutri-Till</i>
Trt 2:	Broadcast before <i>Nutri-Till</i> : 240 lb/A 0-0-60 with <i>Nutri-Till</i> : 68 gal/A 28% UAN Planter: 10 gal/A 10-34-0 + 2 qt/A 9% zinc*
Trt 3:	Planter: 4 gal/A <i>Pro-Germinator</i> + 11 gal/A <i>Sure-K</i> + 1 qt/A <i>Micro 500</i> + 1 pt/A <i>Boron</i> * Sidedress: 41 gal/A <i>High NRG-N</i>
<i>Nutri-Till</i> seedzone: 4 gal/A <i>Pro-Germinator</i> + 11 gal/A <i>Sure-K</i> + 1 qt/A <i>Micro 500</i> + 1 pt/A <i>Boron</i> * for Trts. 4, 5 and 6:	
Trt. 4:	<i>Nutri-Till</i> nitrogen: 41 gal/A High NRG-N
Trt. 5:	<i>Nutri-Till</i> nitrogen: 54 gal/A 28% UAN + <i>eNhance</i>
Trt. 6:	<i>Nutri-Till</i> nitrogen: 68 gal/A 28% UAN
* - Planter fertilizer placement was 1 inch to the side of the seed.	
Nutri-Till also ran in Trts. 2 and 3 as strip tillage only with no fertilizer applied.	



There was a significant yield increase with the addition of the Pro-Germinator, Sure-K, and micronutrients. The lower yield of Treatment 1 was likely due to the very low soil potassium level, which was addressed with the application of Sure-K.

- Application of all fertilizer with *Nutri-Till_{TM}* resulted in a significantly higher corn yield (Trt 4 vs Trt 3). It is thought that having the nitrogen placed directly under the seed provides optimum access to the corn roots.
- Of the three nitrogen treatments, the High NRG-N resulted in the highest yield followed by 28% plus *eNhance* and 28% UAN. This yield difference was higher than expected and indicates the benefit of controlled release of properly placed nitrogen.

Conclusion: Application of all Liquid fertilizer with *Nutri-Till_{TM}* before planting gave the best corn yield.

Experiment: Fertilizer Comparisons in Irrigated Strip-Till Corn
Cooperator/Location: Irrigation Research Foundation/Yuma, CO
Year: 2008
Date of Planting/Harvest: May 8 / November 9
Hybrid: Dekalb 6018
Plot Size: 4 row x 730 ft (non-replicated)

The Irrigation Research Foundation is a non-profit research facility in Eastern Colorado dedicated to the research of crop production on the high plains. In fact, Yuma County, Colorado has one of the country's highest level corn production in terms of average bushels per acre. Strip-tillage is a popular practice of reduced tillage in these light textured soils. They use an Orthman 1tRipr model strip-till unit. This places fertilizer at two depths, 4 inches and 10 inches below the surface. It isn't possible to put different fertilizers at each depth, although you can change rates.

A soil test of the experimental area appears in the following table.

Table 1. Soil test values at the strip-till test site. Irrigation Research Foundation, Yuma, CO - 2008 (according to Olsen's Agricultural Laboratory, Inc.)					
pH	% OM	CEC	nitrate-N lb/A	Bicarb P (ppm)	S (ppm)
6.8	1.4	12.3	35	15	8
			% saturation		
Ca (ppm)	Mg (ppm)	K (ppm)	Ca	Mg	K
1220	297	552	50	20	12
Zn (ppm)	Mn (ppm)	Fe (ppm)	Cu (ppm)	B (ppm)	
2.1	3.2	32.2	1.2	0.3	

The strip-till unit tracks eight rows. The planter is four rows wide, and can apply liquid fertilizers in 2x2 placement. This enabled two planter-applied treatments per strip-till pass. Two different **strip-till treatments** were applied. The Agro-Culture Liquid Fertilizer strip-till comparison was (1). 25 gal/A of High NRG-N alone compared to (2.) 25 gal/A of High NRG-N + 1 gal/A of LiberateCa. LiberateCa is a 3% calcium fertilizer that can be combined with phosphorus fertilizers. Although it was combined with High NRG-N here, with the low soil-calcium level (i.e. 50% base saturation), the hypothesis is that the corn roots would benefit. The **planter comparison** on top of these strip-till applications was to evaluate (1.) Pro-Germinator and (2.) an experimental fertilizer designated as AX-102. This nutrient material contains organic extracts and has an analysis of 4-11-1. This is approximately half of the analysis of Pro-Germinator's 9-24-3. As such, the application rate of AX-102 is double that of Pro-Germinator. These were compared to the conventional treatment which applied the same treatment to all eight rows.

With the strip-till application and planter application in 2x2 placement, the conventional treatment applied 124.6 lb/A of nitrogen, 190.5 lb/A of phosphate (P₂O₅) and 6.6 lb/A of soluble potash (K₂O). This is quite a dose of fertility, especially of phosphate. An additional 140 lb/A of nitrogen in four applications of 10 gal/A of 32% UAN was applied to the entire experiment through center pivot irrigation.

Specific weather data is not provided. But it was reported that there was some hail early, heavy rains, high winds and extreme heat during the growing season. As a result, yields were around 30 Bu/A lower than in previous years. This information was suppressed by the Yuma Chamber of Commerce. Treatments and yields appear in the following table.

<i>Table 2. Strip-till and planter fertilizer comparisons in irrigated corn.</i>			
Irrigated Research Foundation. Yuma, CO - 2008			
Trt	Strip-Till	Planter (2x2)	Yield (Bu/A)
1	liquid: 20.5-35.8-0 (25 gal/A) 4": 10 gal/A; 10": 15 gal/A	30-40-3-6S-2Zn 19 gal/A	180.3
2	High NRG-N (25 gal/A) 4": 12 gal/A; 10": 13 gal/A	Pro-Germinator + Micro 500 5.5 gal/A + 2 qt/A	208.6
3	High NRG-N (25 gal/A) 4": 12 gal/A; 10": 13 gal/A	AX-102 + Micro 500 11.5 gal/A + 2 qt/A	210.3
4	High NRG-N + LiberateCa (25 gal/A + 1 gal/A) 4": 12 gal/A; 10": 14 gal/A	Pro-Germinator + Micro 500 5.5 gal/A + 2 qt/A	207.6
5	High NRG-N + LiberateCa (25 gal/A + 1 gal/A) 4": 12 gal/A; 10": 14 gal/A	AX-102 + Micro 500 11.5 gal/A + 2 qt/A	208.8

- All of the Agro-Culture Liquid Fertilizer treatments yielded substantially higher than the conventional treatment.
- The regular Agro-Culture Liquid Fertilizers treatment of High NRG-N and Pro-Germinator (trt 2) applied only 93.9 lb/A of the nutrients nitrogen, phosphate and potash through the strip-till and planter operations. This compares to 321.7 lb/A of these nutrients for the conventional treatment with strip-till and planter. This shows the high performance with responsible nutrient management of Agro-Culture Liquid Fertilizers.

For further evaluation of the main effects of strip-till and planter comparisons, yields can be averaged over the other operation. Results appear in Table 3.

<i>Table 3. Agro-Culture Liquid Fertilizer yields averaged over applications</i>	
Irrigated Research Foundation. Yuma, CO - 2008	
<u>1. Strip-till comparisons averaged over the planter treatments:</u>	
	<u>Yield (Bu/A)</u>
High NRG-N	209.5
High NRG-N + LiberateCa	208.8
<u>2. Planter fertilizer comparisons averaged over the strip-till treatments:</u>	
	<u>Yield (Bu/A)</u>
Pro-Germinator + Micro 500	208.1
AX-102 + Micro 500	210.1

- The LiberateCa did not influence yield. Perhaps in combination with the planter fertilizer it would have had an effect in the low-calcium soil.
- The planter fertilizer yields were very close, although the AX-102 did have a slight advantage over Pro-Germinator. But again, both of these were superior to the conventional treatment.

Experiment: *Nutri-Till*_{TM} Nitrogen Comparisons on Dryland Corn

Year (Experiment Number): 2008 (08-601)

Date of Planting/Harvest: May 9 / October 21

Variety: DeKalb 5044

Plot Size (replications): 15 ft x 900 ft (2 replications)

Soil Test Levels (ppm)

pH: 7.2 C.E.C.: 17.5

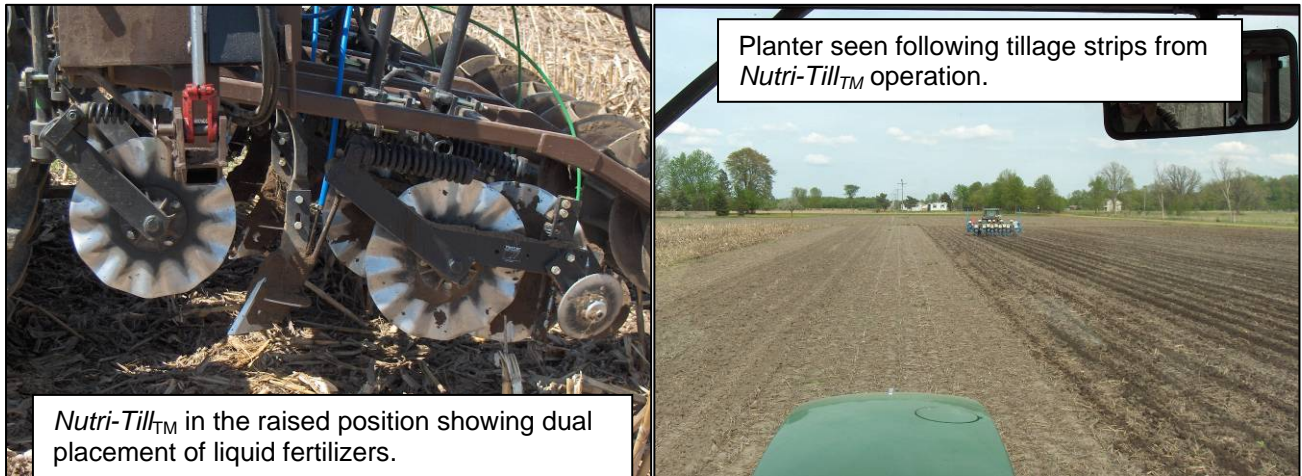
OM: 4.5% P1: 9 ppm

K: 223 ppm (3.3% BS)

Objective: Compare effects of different nitrogen sources and rates applied with *Nutri-Till*_{TM} on corn yield.

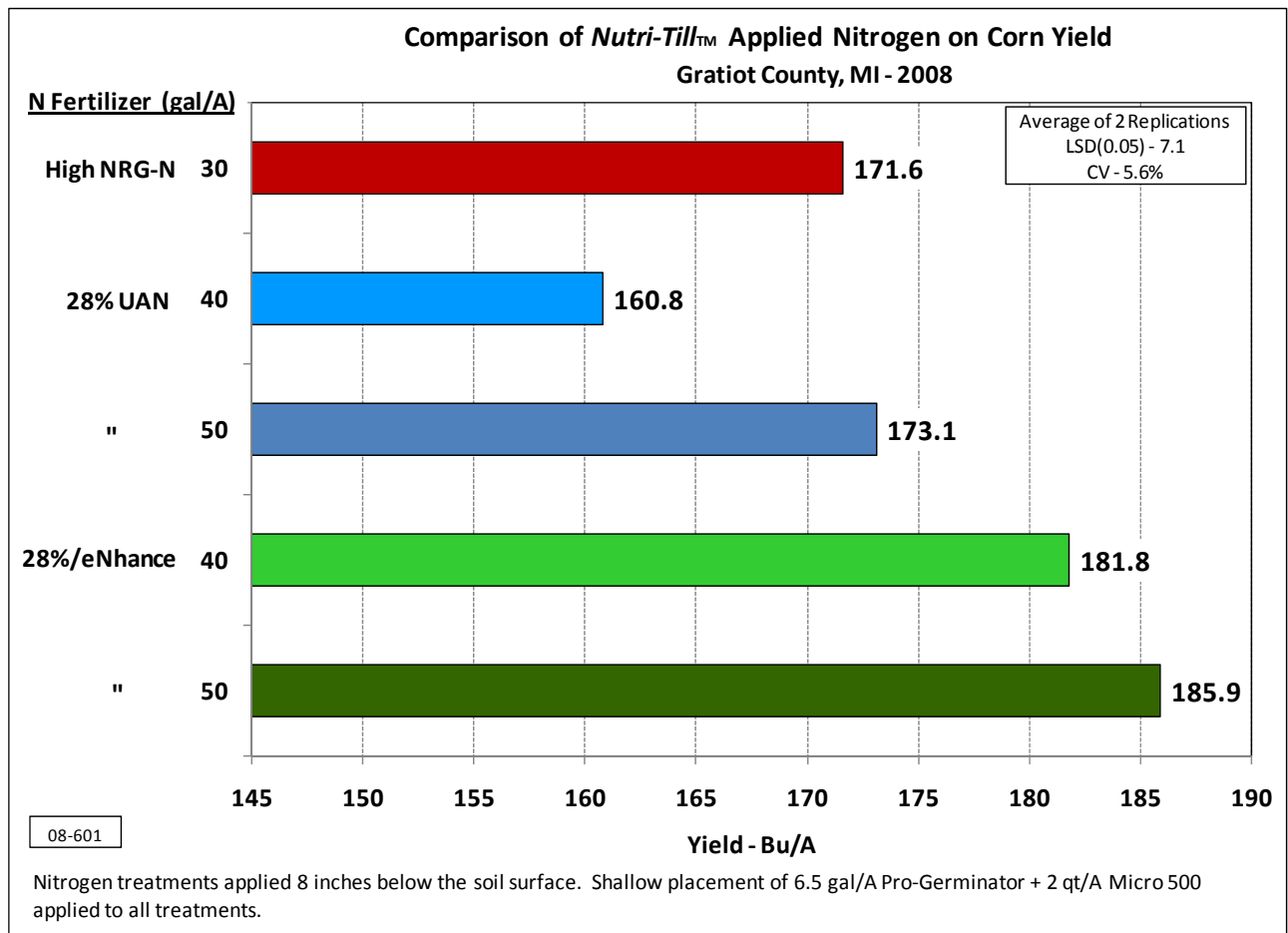
Strip-till or zone-till is becoming an increasingly popular tillage option. It combines the ability to leave residue undisturbed on the soil surface while providing tillage in the zone for the seed. *Nutri-Till*_{TM}, developed by Agro-Culture Liquid Fertilizers, allows for deep placement (8 inches beneath soil surface, or about 6 inches beneath planted corn seed) of liquid nitrogen fertilizer and shallow placement of other liquid fertilizers in the seed zone. This test was conducted some 12 miles away from the North Central Research Station and compared different nitrogen applications applied with *Nutri-Till*_{TM}. Based on a soil test for a 150 Bu/A yield goal for corn following soybeans, the *Tri-State Fertilizer Recommendation* was 147 – 85 – 0 lb/A of N – P₂O₅ – K₂O. The nitrogen recommendation would be met with 50 gal/A of 28% UAN. For the nitrogen component, the following treatments were applied: 28% UAN at 40 and 50 gal/A (120 and 150 lb-N/A); 28% with eNhanse at 40 and 50 gal/A (also 120 and 150 lb-N/A); and 30 gal/A of High NRG-N (86 lb-N/A). The same shallow-placed fertilizer rate was used for all treatments: 6.5 gal/A Pro-Germinator + 2 qt/A Micro 500.

The nitrogen fertilizer additive eNhanse is combined with 28% UAN solutions at a rate of 2 gallons per ton. This nutritional material adds sulfur, manganese and zinc, plus nitrogen stabilizers, and has worked well in research plots as well as grower fields.



These were large sized plots and the stands were very uniform. Yield data was consistent across replications giving validity to results.

Yield results appear in the following chart.



- All nitrogen treatments resulted in yields far in excess of the 150 Bu/A yield goal.
- Both rates of 28%/eNhance produced yields significantly greater than the higher rate of 28% UAN without eNhance.
- There was a significant rate response with 28% UAN, but not with 28%/eNhance, where the yield produced with 40 gal/A of 28%/eNhance (80% of recommended rate) was not significantly different than that with the 50 gal/A recommended rate.



Experiment: *Nutri-Till* Fertilizer Application for Corn Following Winter Wheat (09-308)

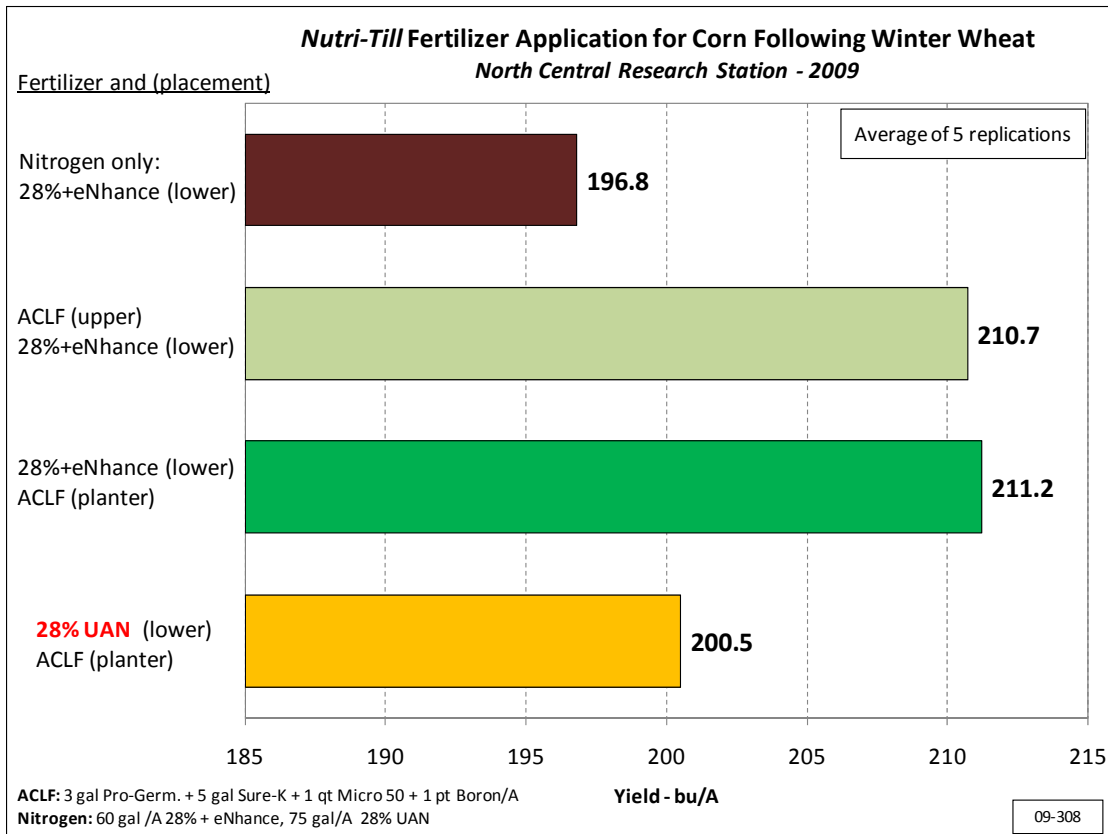
Planted: 4/24/09	Hybrid: DKC50-44	Population: 35,000
Plot Size: 15' x 210'/130'	Replications: 5	Harvested: 11/5/09
Nutri-Till: 4/24/09		

Soil Test Values (ppm):													
pH	CEC	% OM	Bicarb	K	S	% K	% Mg	% Ca	% H	% Na	Zn	Mn	B
7.5	6.3	1.5	14	76	6	3.1	16.4	76.9	0	0.9	1.0	4	0.4

Objectives: 1. Determine the effects of a complete program versus nitrogen only on corn yield. 2. Evaluation of application of *Pro-Germinator + Sure-K+ Micro 500 + Boron* applied either through the *Nutri-Till* application in the seed zone, or in-furrow by the planter; and 3. Compare effects of 28% UAN + eNhance at 60 gal/A and 28% UAN at 75 gal/A for effect on corn yield.

Explanations: *Nutri-Till* is a form of strip tillage where the complete fertilizer program can be optimally placed. The *Pro-Germinator*, *Sure-K* and micronutrients are placed in the seed zone and the nitrogen is placed approximately 6 inches below where the seed is to be planted. In this test, the *Nutri-Till* application was the same day as planting.

Results:



LSD(0.1): 9.1. CV: 5.7%



Responsible Nutrient Management : Bushels produced per lb-N applied				
28%+eNhance	60 gal/A	211.2 bu	180 lb-N	1.2 bu per lb-N applied
28% UAN	75 gal/A	200.5 bu	225 lb-N	0.9 bu per lb-N applied

*See *Product Descriptions* in the introduction for more information on ACLF products used.

Conclusions:

- The addition of *Pro-Germinator + Sure-K* + micronutrients resulted in a significant increase in corn yield compared to the nitrogen-only treatment.
- Application of *Pro-Germinator + Sure-K* + micronutrients was equally effective with both the *Nutri-Till* and the planter. This improves options for the grower.
- The corn yield with the higher rate of 28% UAN was significantly lower than that of the lower rate of 28% + enhance. In fact, the effects of the P, K and micronutrient fertilizers were negated as the yield was not significantly different than that of the 28% + *eNhan*ce applied alone. It is possible that in this instance, the 75 gallon rate of 28% UAN was too high for such placement below the seed.



Nutri-Till applicator in the raised position showing placement of the nitrogen (blue tube) and *Pro-Germinator*, *Sure-K* and micronutrients (green tube).



Nutri-Till application and planter operation are shown for this experiment.