



2023 RESEARCH SUMMARY

PRECISION TECHNOLOGY INSTITUTE
PONTIAC, IL



Introduction and Guide to Summary Report

Precision Planting is excited to share our 6th year of PTI research farm results and findings. We hope they provide useful insights that help drive thoughtful consideration around future crop management decisions. This publication is intended to summarize and explain the many agronomic trials that were implemented in 2023. This year we added new and interesting new agronomy trials to our testing program, and we are excited to release our findings in this report.

During the summer of 2023, the PTI Farm hosted thousands of growers from throughout the United States as well as international countries including Australia, Germany, Canada, Argentina, Brazil, Hungary and the Ukraine. Farmers visited the PTI research farm to dive into agronomy field trials, see and understand real world agronomic problems, and were even able to experience some of the latest and greatest state-of-the-art technology in our ride and drive “SandBox” area. Field days started in July and lasted until the 3rd week of September.

For the 2023 PTI Yield Summary Data, net returns are calculated with corn prices of \$5.31/Bu. and soybeans at \$13.09/Bu. These prices represent average **cash** prices for new crop 2023 corn and soybeans from the period of October 1st 2022, through October 1st, 2023. This simulates how growers could sell new crops throughout the year.

At the bottom of each trial summary page, a brief explanation is listed to show Planting Date, Hybrid or Variety, Population, Row Width, Crop Rotation, and Commodity Price/Bu. and Pricing information that pertains to the products being evaluated. Most starter fertilizer trials at the PTI Farm have a \$30 to \$40 re-allocation credit applied to each product in testing. This approach allows us to use the total intended fertility needed for soil test build-up and yield maintenance but allows the planned use of both dry fertilizer in the fall and liquid product on the planter without over-spending or over-applying more nutrients than needed. To accomplish this, we have reduced our dry fertilizer rates by \$30 to \$40/A. to account for the reallocation. All control tests in each study get the additional fertilizer to achieve a typical 100% program without starter fertilizer on the planter.

Fall Dry Fertilizer: \$30-40 Reduction + At-Plant Liquid Starter



Broadcast vs Banding Dry Fertilizer Study

Objective: To evaluate yield and economics of traditional broadcast applications of dry fertilizer compared to 8" deep high concentrated strip-till banding.

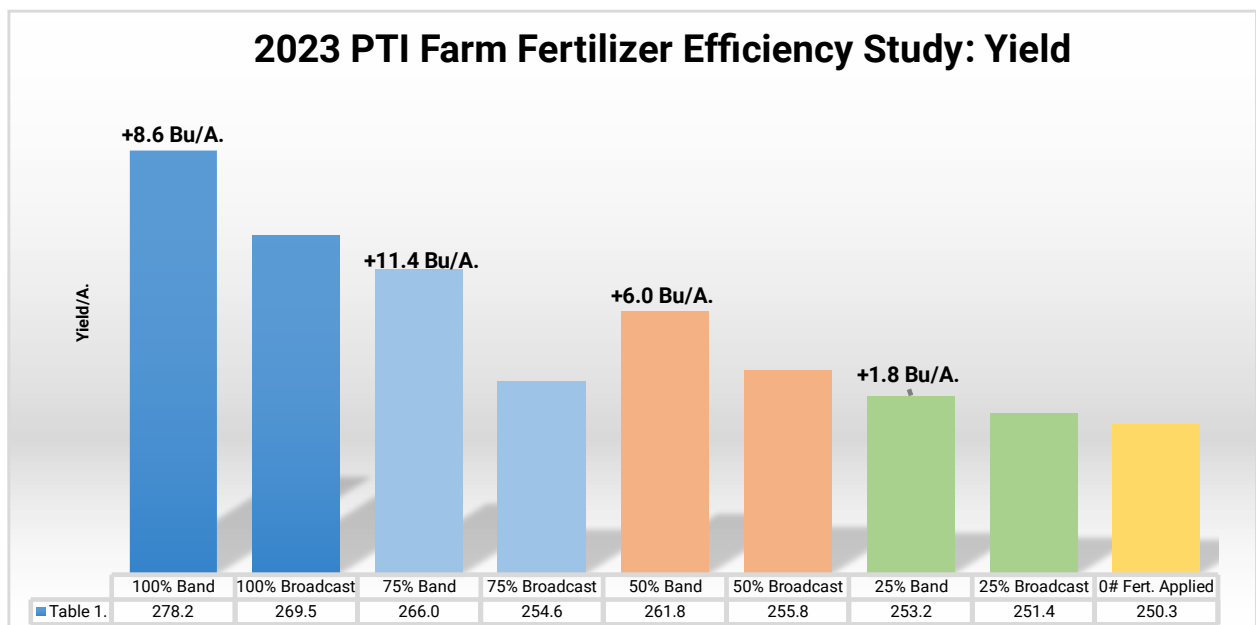
Based upon soil test results and yield goals of 250 Bu/A. corn in a corn/soybean non-irrigated rotation, a broadcast surface application was made with a traditional spinner truck (Figure 1). Using the same fertilizer rates, a strip-till bar was used to place fertilizer in high concentrated strips 8" deep on 30" corn rows (Figure 2). Corn was then planted directly into the strips above the 8" fertilizer placement. A KUHN® Krause® 1200 Gladiator® pulling a Montag® Equipment 2208 Gen 2 fertilizer cart was used to implement this testing program for 2023.

Results Table 1. illustrates banded fertilizer outperformed broadcast at every efficiency rate. 100% rates offered +8.6 yield increases, 75% at +11.4 Bu/A., 50% at +6.0 Bu/A. and 25% banded rates at +1.8 Bu/A.

Figure 1. Broadcast Dry Fertilizer



Figure 2. Strip-Till Banded Fertilizer



Broadcast vs Banding Dry Fertilizer Study Continued

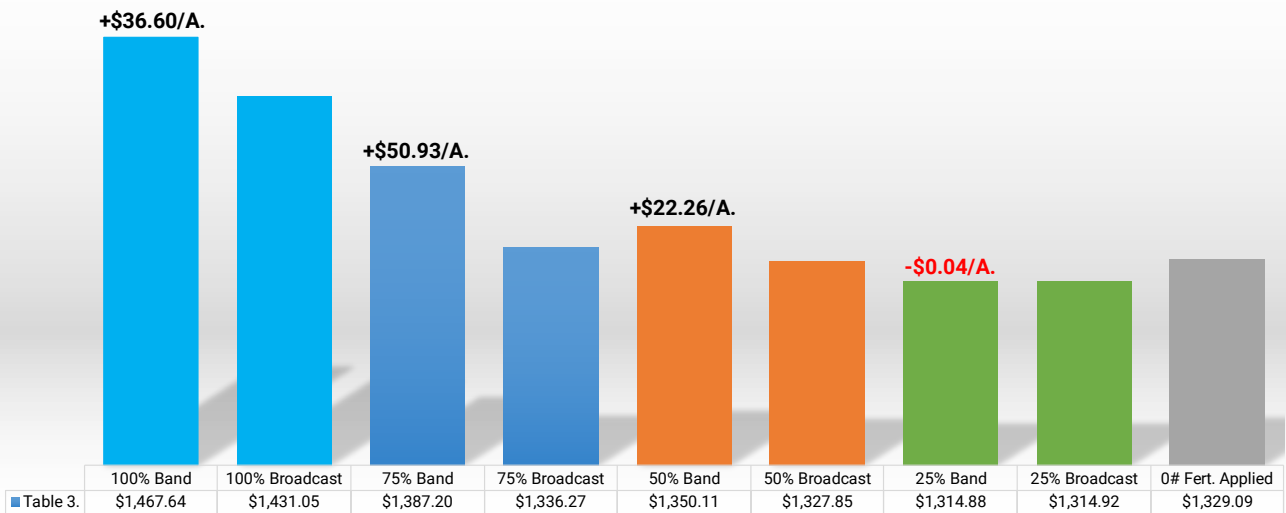
Using University of Illinois Machinery Cost Estimates in Table 2., strip-till resulted in additional costs of +\$9.60/A. in comparison to a conventional tillage program. Using this cost scenario, Table 3. illustrates the economic impact. 100% banded rates of fertilizer offered net revenue gains on +\$36.60/A., while 75% banded rates offered overall highest efficiency of +\$50.93/A. The two lowest rates of 50% and 25% at +\$22.26/A. and **-\$0.04/A.** respectively.

Table 2. University of IL Machinery Cost Estimates

Tillage Practice	Category	Cost
Conventional Till	Soil Finisher	\$ 14.60
	Plant	\$ 21.40
	Fertilizer Spread	\$ 8.00
	Total:	\$ 44.00
Strip Till	Strip	\$ 25.90
	Burndown	\$ 6.30
	Plant	\$ 21.40
	Total:	\$ 53.60



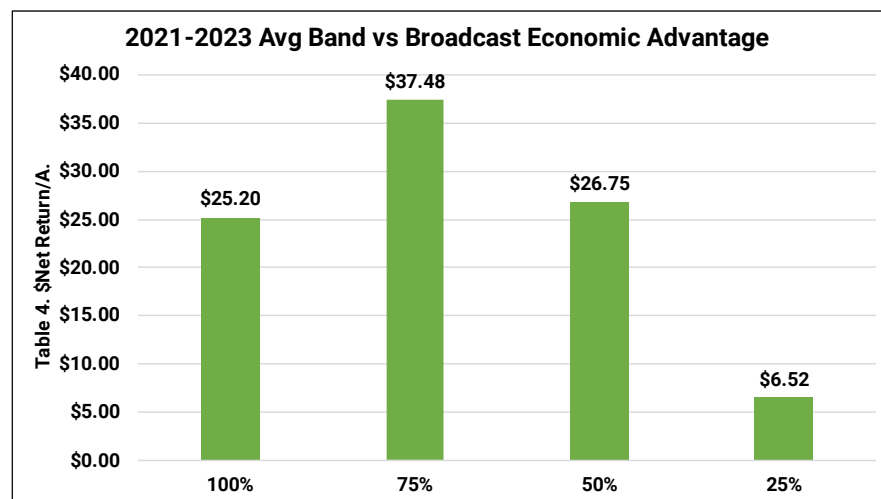
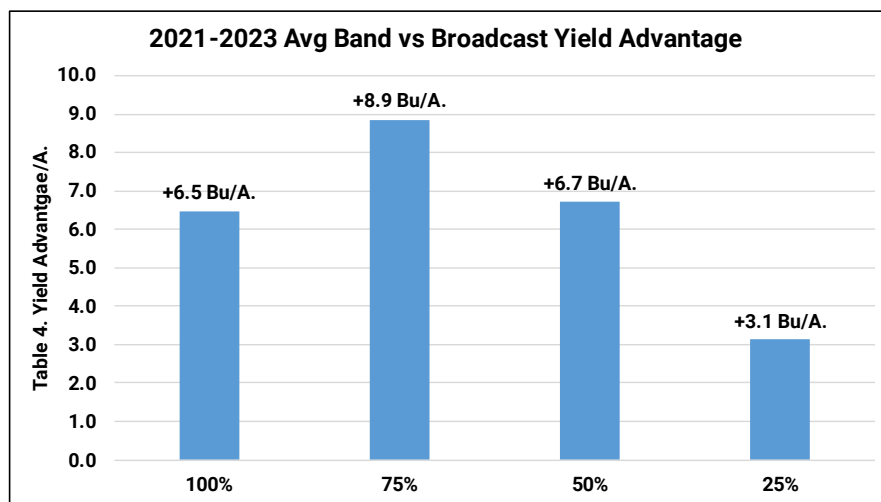
2023 Corn Band vs Broadcast Fertilizer Study: Economics



Broadcast vs Banding Dry Fertilizer Study Continued

Table 4. illustrates multi-year data from the PTI Farm over the years 2021, 2022 and 2023. Over this timeframe, banded dry fertilizer has resulted in the highest average yield gains at the 75% fertilizer rate, while 100% and 50% at +6.5 to +6.7 Bu/A. respectively. Reduced rates of 25% offered lowest gains of the study at +3.1 Bu/A.

Table 5. reflects the economics over the same 3-year time period. 75% rates has offered highest net returns at +\$37.48/A., while 100% and 50% rates just behind at +\$25.20 and +\$26.75/A. 25% rates proved lowest returns at +\$6.52/A.



Broadcast vs Banding Rate Efficiency Study

Objective: This study evaluates yield and economics of traditional broadcast applications of dry fertilizer compared to concentrated strip-till bands applied 8" in depth under the corn row. The goal of this study is to answer the question; "If I band dry fertilizer versus broadcast applying, can I use a lower rate of fertilizer without sacrificing yield and profitability"?

Based upon soil test results (Fall 2022) and yield goals of 240 Bu/A. corn in a corn/soybean rotation, dry fertilizer was applied in a traditional broadcast surface application as a spinner truck (Figure 1).

To study placement efficiency, using the same fertilizer rates, a strip-till bar was used to place fertilizer in high concentrated strips 8" deep on 30" corn rows (Figure 2). Corn was then planted directly into the strips above the 8" fertilizer placement.

A KUHN® Krause® 1200 Gladiator® pulling a Montag® Equipment 2208 Gen 2 fertilizer cart was used to implement this testing program for 2023.

To address, rate efficiency, fertilizer was applied at the following rate structure in both strip-till bands and broadcast applications:

- 100% Rate
- 75% Rate,
- 50% Rate
- 25% Rate
- 0% Rate

Figure 1. Broadcast Dry Fertilizer



Figure 2. Strip-Till Banded Fertilizer 8" in Depth



Figure 3. Gladiator® Strip-Till Unit with Montag® Fertilizer Cart

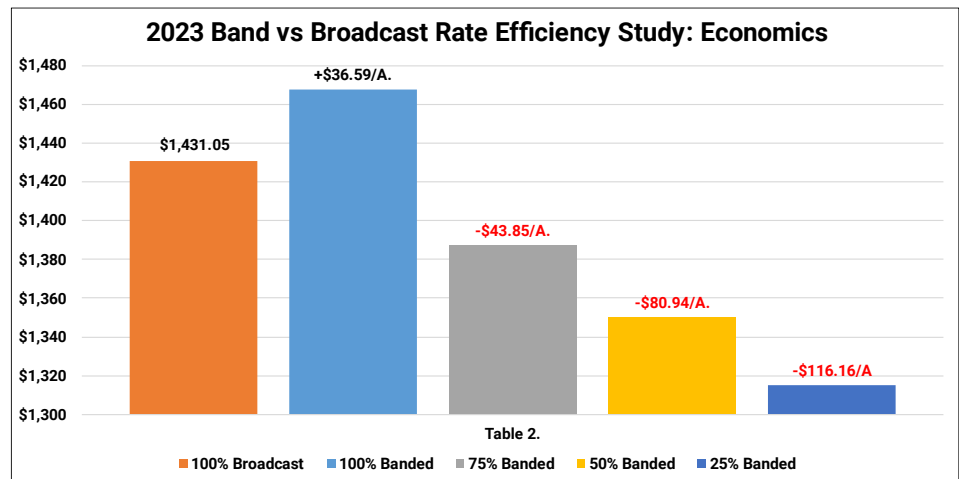
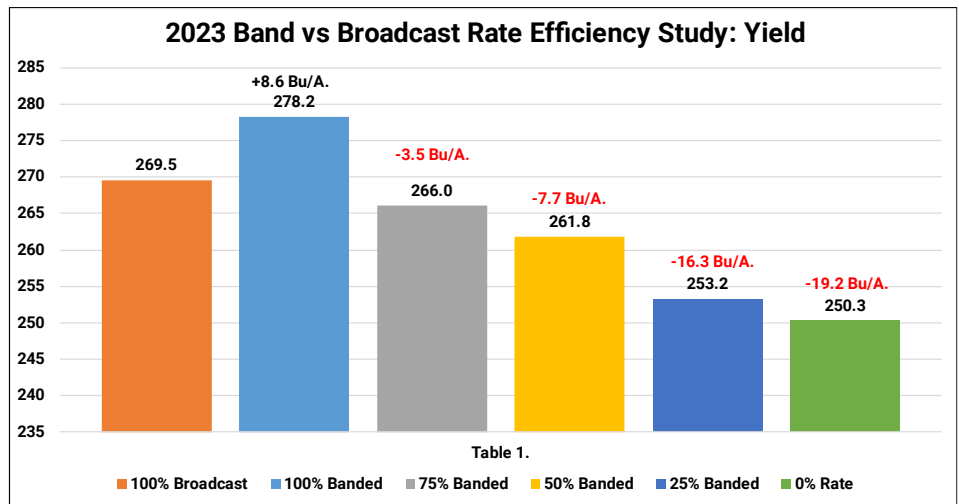


Broadcast vs Banding Rate Efficiency Study Continued

Results: Table 1. illustrates the yield of all rates in band and broadcast applications. Highest overall yield came from 100% banded application at 278.2 Bu/A., +8.6 Bu/A. better than 100% rates in a traditional broadcast application. As rates were lowered to 75% and 50% rates, yields fell by **-3.5** to **-7.7 Bu/A.** 25% bands resulted in significant losses of **-16.3 Bu/A.** Applying no fertilizer at all resulted in losses of **-19.2 Bu/A.**

Table 2. describes a telling story summarizing economics. 100% rate of fertilizer in bands resulted in net positive returns of **+\$36.59/A.**, however all other rate efficiencies tallied economic losses. 75% rates in bands resulted in losses of **-\$43.85/A.**, 50% banded rates at **-\$80.94/A.** and 25% fertilizer cost **-\$116.16/A.**

This study is part of a 10-yr study to help understand band vs broadcast and how reduced fertilizer and soil test levels could affect overall corn yield and economics. We are currently in year #3 of the study. As mentioned in our Multi-Yr Fertilizer Rate Study of this publication, it appears that one could question that reduced application rates may be drawing soil test levels down and could be hampering yield. Could early season drought be affecting the lower rates? We look forward to evaluating this over the next 7 years of this 10 year study.



Liquid vs Dry Fertilizer Fall Strip-Till Study


Objective: To evaluate yield and economic impact of dry and liquid fertilizer program in fall strip-till bands. This 1st year study compares a traditional dry 18-46-0 and 0-0-60 fertilizer program versus a replacement liquid fertilizer program. Treatments were as follows:

#1: 100% Dry Fertilizer Program:
150# 18-46-0 + 150# 0-0-60

#2: 50% Dry Fertilizer Program:
75# 18-46-0 + 75# 0-0-60

#3: Control: No Fertilizer Applied

#4: Liquid Fertilizer Program: 50% Nutrient Equivalent to Dry Program

12.5 Gal/A.	Nachurs® Throwback® 9-27-4-4S	
20 Gal/A.	Nachurs® K-flex® 0-0-19-6S	

#5: Liquid Fertilizer Program: 100% Nutrient Equivalent to Dry Program

25 Gal/A.	Nachurs® Throwback® 9-27-4-4S
40 Gal/A.	Nachurs® K-flex® 0-0-19-6S



Liquid vs Dry Fertilizer Fall Strip-Till Study

All liquid treatments were applied in the Fall made with Black Eagle Ag Solution's strip-till unit.



This bar was fitted with Pump Stack® (Figure 1.), a liquid fertilizer hydraulic pump. It was paired with EMHD®, and EM Flowsense™ (Figure 2.) to ensure a top-notch fertilizer application, as well as row control across the bar. EMHD® controls liquid application rates using an electromagnetic flow meter. This opens your options for a wider range of liquid products. EM Flowsense™ allows you to measure the rate of fertilizer you are applying on each row of the bar, to make you aware of any row-to-row variability that is occurring. With a Pump Stack® system, paired with EMHD®, and EM Flowsense™ you can be confident in your application rate across every row.



Figure 1. Pump Stack®



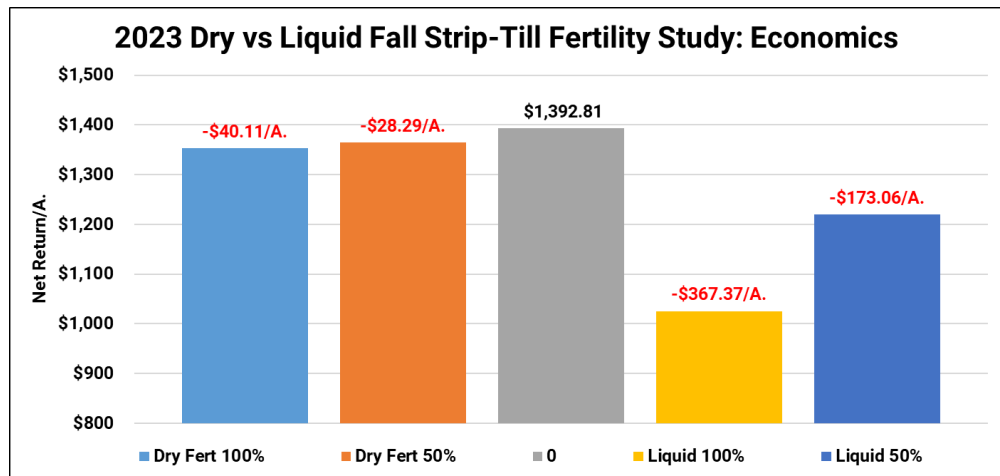
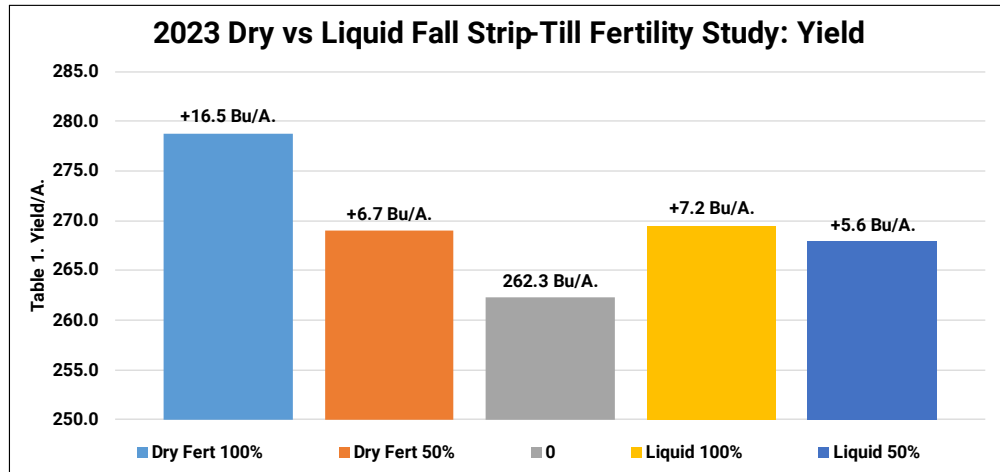
Figure 2. EMHD® EM Flowsense™

Liquid vs Dry Fertilizer Fall Strip-Till Study

Results: Table 1. illustrates both 100% rate dry fertilizer applications offered the highest yield response at +16.5 Bu/A. over the untreated control. Cutting rates back to 50% of dry resulted in a -41% reduction in yield down to +6.7 Bu/A. gains. Both liquid rates posted yield gains of +5.6 to +7.2 Bu/A. over the untreated control.

Table 2. reveals the overall economics of the fertilizer. All fertilizer treatments posted net economic losses, with liquid rates the highest at **-\$173.06/A.** to **-\$367.37/A.**

Dry fertilizer rates both posted negative losses of **-\$28.29/A.** to **-\$40.11/A.** Due to the high cost of fertilizer, break-even yield needed was +24.1 Bu/A., much higher than realized in the field.



Overall, the Black Eagle strip-till unit performed well in regard to tillage. However, due to high cost of fertilizer the all applications failed to achieve profitability of the dry program.

Organic Corn Study

At-Plant and Foliar Organic Fertility:

Conceal® Dual Band: (Figure 1.) 10 Gal/A. QLF® TripleThreatOption 5-5-5
20 Gal/A. Water as Carrier



V12 Foliar: BioXRG K-Ferm 0-0-12 Organic Potassium Acetate

V12: EZ Drops™ SideDress 10 Gal/A. QLF® TripleThreatOption: Carbon from Sugar Cane Molasses (TerraFed™) and available Nitrogen (3%) in Ammoniacal form, formulated in a 5:1 C:Ratio

*All products organic certified

Figure 1. Conceal® Dual Band Placement



Figure 2. Treffler Weed Tine



Figure 3. Row Crop Cultivation



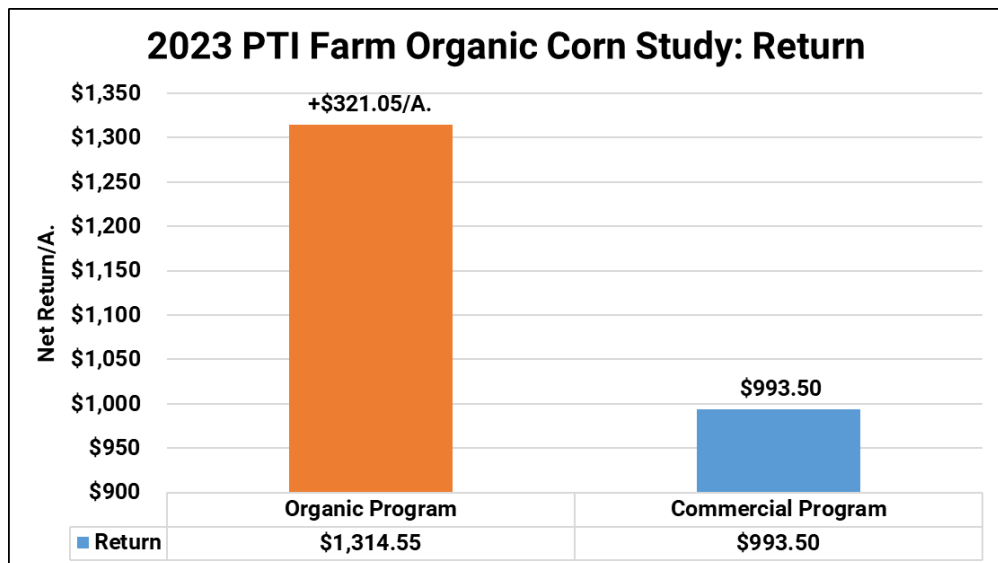
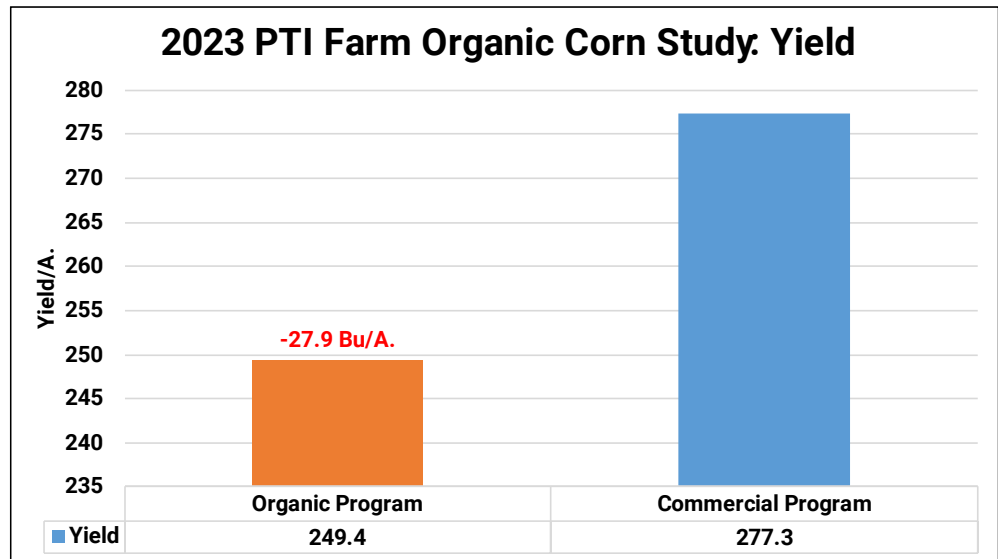
Figure 4. EZ-Drops™



Organic Corn Study

Results: The organic program proved overall yield losses of **-27.9 Bu/A**, compared to a status quo traditional commercial program. Seeing these yield losses may cause some hesitation for organic corn, however the true story lies in overall economics of the two programs. Using a \$7/Bu. sale price, organic corn posted an additional positive return on investment of **+\$321.05/A.** over the conventional program.

Overall the organic corn program was a huge success. Going into 2023, our main concern was weed control. Going into 2024, weed control will still be a major concern. However, with the use of the Treffler weed tiner and the row crop cultivation, we were able to control weeds very well. We know this could be a major problem each each year. We look forward to advancements in technology for weed control and general nutrition to improve our organic program in the future.



Planting Date: May 15th Population: 36K Row Width: 30" Rotation: CAB Corn Price: \$5.31/\$7.00

Conventional Program: \$478.97/A. Organic Program: \$431.25/A .

Corn Tillage Study

Objective: To evaluate the yield and economic impacts of various tillage programs in a corn after soybean rotation. Tillage programs include conventional till, strip-till, vertical till, no-till and in-line rip.

Figure 1. KUHN® Krause Gladiator®



Figure 2. Sunflower® 4630 Disc Ripper



Corn Tillage Study Continued

Figure 6. Univ. of IL Machinery Cost Estimates

Tillage Practice	Category	Cost
Conventional Till	Ripper	\$36.40
	Soil Finisher	\$14.60
	Plant	\$21.40
	Total:	\$72.40
Strip Till	Strip	\$25.90
	Burndown	\$10.00
	Plant	\$21.40
	Total:	\$57.30
Vertical Till	Vertical	\$17.60
	Burndown	\$10.00
	Plant	\$21.40
	Total:	\$49.00
No Till	Plant	\$21.40
	Burndown	\$10.00
	Total:	\$31.40
In-Line Ripper	V-Ripper	\$33.70
	Soil Finisher	\$14.60
	Plant	\$21.40
	Total:	\$69.70

Figure 4. Planting in No-Till



Figure 1. Kuhn® EXCELERATOR® XT 8010 Vertical Tillage



Figure 5. Sunflower® 4608 In-Line Ripper



Corn Tillage Study Continued

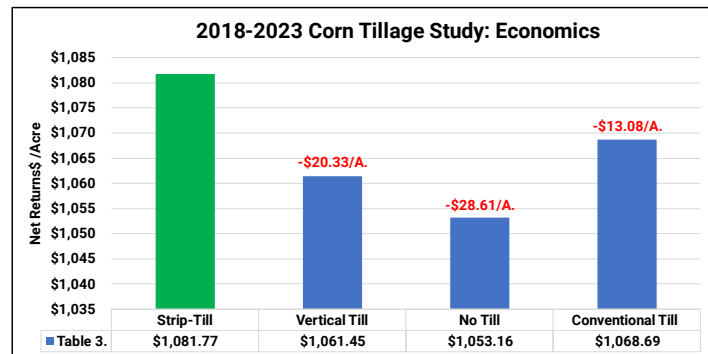
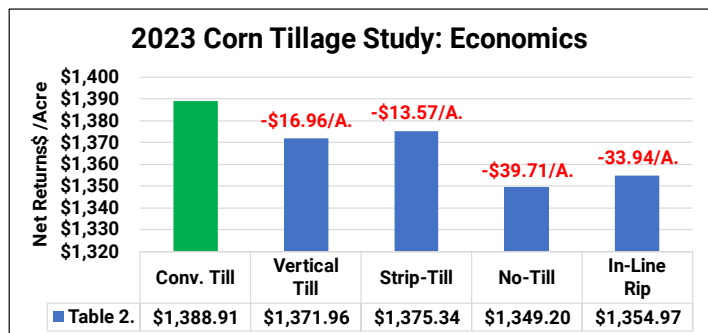
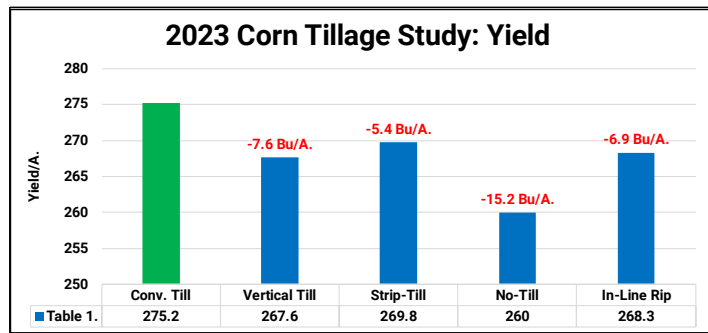
Results: To understand both yield and economics, the University of Illinois Machinery Cost Estimate Summary is used to calculate individual cost of each tillage program (Figure 6). For the three reduced tillage programs, an \$10/A. burn-down is also included.

Tables 1-2. illustrates yield and economics for each tillage segment.

After applying all appropriate costs to each individual tillage program, conventional till offered the highest overall yield and revenue in this tillage system study.

Compared to conventional tillage, strip-till offered losses of **-5.4 Bu/A.** and **-\$13.57/A.**, vertical tillage **-7.6 Bu/A.** and **-\$16.96/A.**, in-line ripping losses of **-6.9 Bu/A.** and **-\$33.94/A.** and finally no-till at **-15.2 Bu/A.** and **-\$39.71/A.**

Table 3. illustrates multi-year data from the PTI Farm from 2018-2023. Strip-till over this time period has provided the highest overall net returns, with conventional till behind by **-\$13.08/A.** Vertical and no-till have resulted in losses of **-\$20.33** and **-\$28.61/A.** respectively.



Broadcast vs Banding Dry Fertilizer Study

Objective: To evaluate yield and economics of traditional broadcast applications of dry fertilizer compared to 8" deep high concentrated strip-till banding.

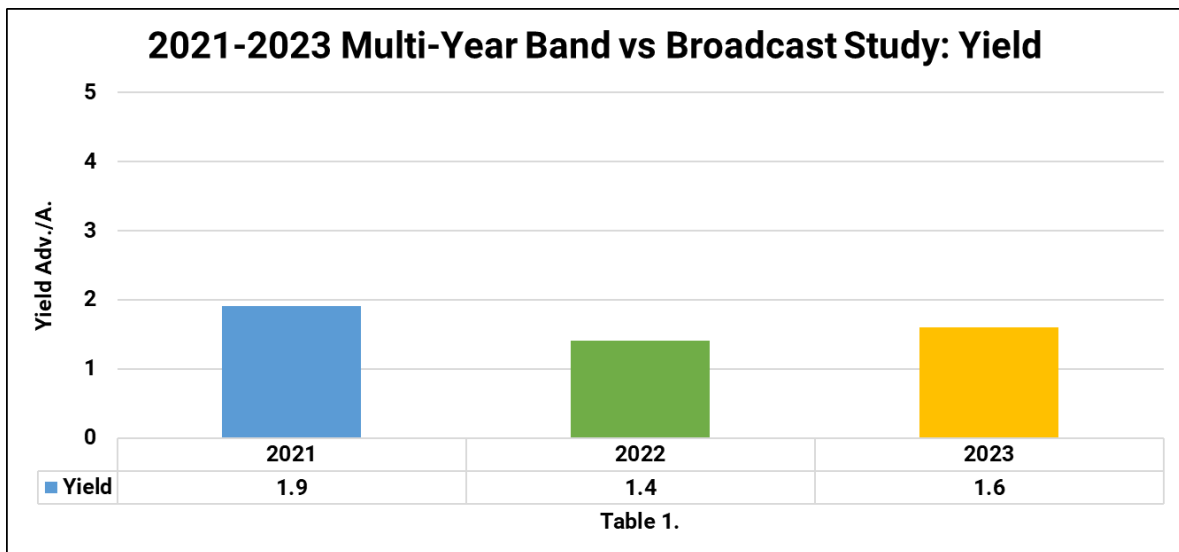
Based upon soil test results and yield goals of 70 Bu/A. soybeans in a corn/soybean non-irrigated rotation, 18-46-0 and 0-0-60 was applied in a traditional broadcast surface application made with a traditional spinner truck (Figure 1). Using the same fertilizer rates, a strip-till bar was used to place fertilizer in high concentrated strips 8" deep on 30" corn rows (Figure 2). A KUHN® Krause® Gladiator® pulling a Montag® Equipment 2208 Gen 2 fertilizer cart was used to implement this testing program for 2023.

Results Table 1. illustrates strip-till fertilizer has resulted in average yield gains of +1.6 Bu/A. over traditional broadcast applications.

Figure 1. Broadcast Dry Fertilizer



Figure 2. Strip-Till Banded Fertilizer

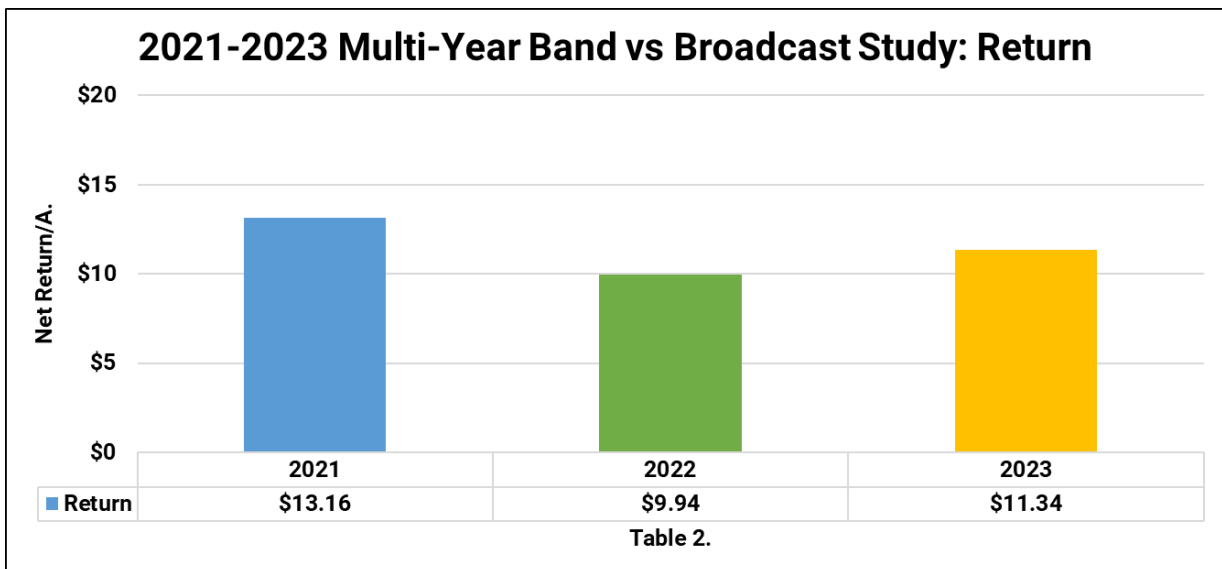


Broadcast vs Banding Dry Fertilizer Study Continued

Using University of Illinois Machinery Cost Estimates in Figure 3., strip-till resulted in additional costs of +\$9.60/A. in comparison to a conventional tillage program. Using this cost scenario, Table 2. illustrates the economic impact from our 2023 study. Strip-till, with its tillage and fertility system, posted positive economic gains of +\$11.34/A. over a conventional tillage system. 2021 and 2022 saw similar net returns of +\$13.16 and +\$9.94/A.

Figure 3. University of IL Machinery Cost Estimates

Tillage Practice	Category	Cost
Conventional	Soil Finisher	\$ 11.10
	Plant	\$ 17.20
	Fertilizer Spread	\$ 3.00
	Total:	\$ 31.30
Strip Till	Strip	\$ 17.30
	Plant	\$ 17.20
	Burndown	\$ 6.40
	Total:	\$ 40.90



Broadcast vs Banding Rate Efficiency Study

Objective: To evaluate yield and economics of traditional broadcast applications of dry fertilizer compared to concentrated strip-till bands applied 8" in depth under the corn row.

To study placement efficiency, dry fertilizer was applied in a traditional broadcast surface application as a spinner truck (Figure 1.) and soybeans were planted into strip-till tillage program.

Using the same fertilizer rates, a strip-till bar was then used to place fertilizer in high concentrated strips 8" deep on 30" corn rows (Figure 2). Soybeans were then planted directly into those strips above the 8" fertilizer placement.

A KUHN® Krause® Gladiator® pulling a Montag® Equipment 2208 Gen 2 fertilizer cart was used to implement this testing program for 2023.

To then study rate efficiency, fertilizer was applied at the following rate structure in both strip-till bands and broadcast applications:

- ✓ 100% Fertilizer Rate
- ✓ 75% Fertilizer Rate
- ✓ 50% Fertilizer Rate
- ✓ 25% Fertilizer Rate
- ✓ 0# Rate

Figure 1. Broadcast Dry Fertilizer



Figure 2. Strip-Till Banded Fertilizer with Montag® cart



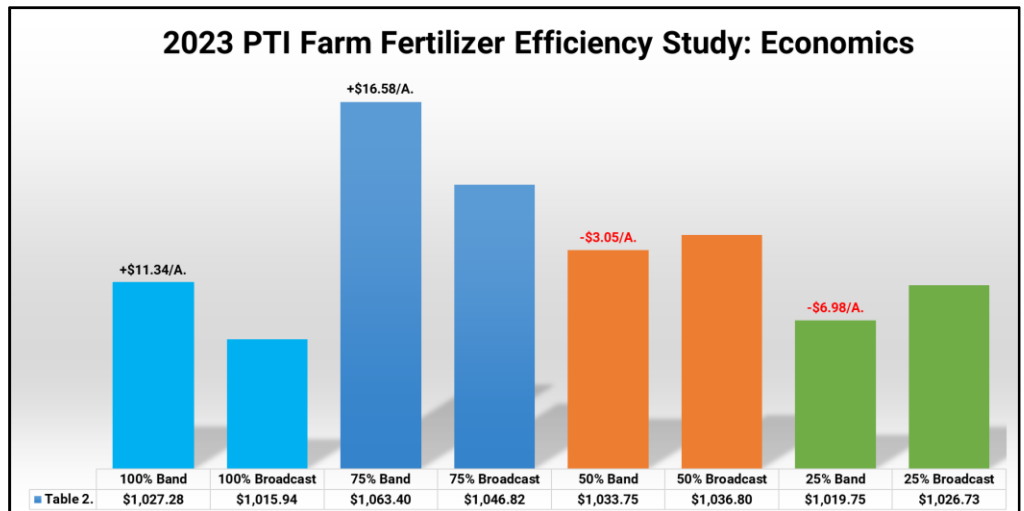
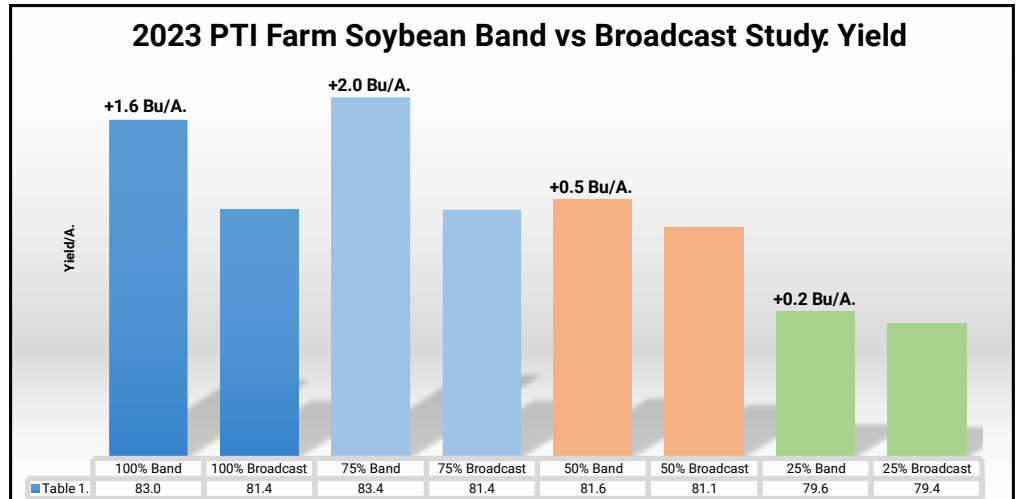
Figure 3. KUHN® Krause® strip-till unit



Broadcast vs Banding Rate Efficiency Study Continued

Results: Table 1. summarizes banding advantage over broadcast applications at all individual rates. Banding outperformed all broadcast applications at every rate, with 100% and 75% offering the highest advantages at +1.6 to +2.0 Bu/A. As rates fell to 50% and 25%, banding advantages were reduced to only +0.2 to +0.5 Bu/A.

Table 2. illustrates that banding fertilizer offered additional returns of +\$11.34 to +\$16.58/A., with 75% fertilizer rate offering highest efficiency.

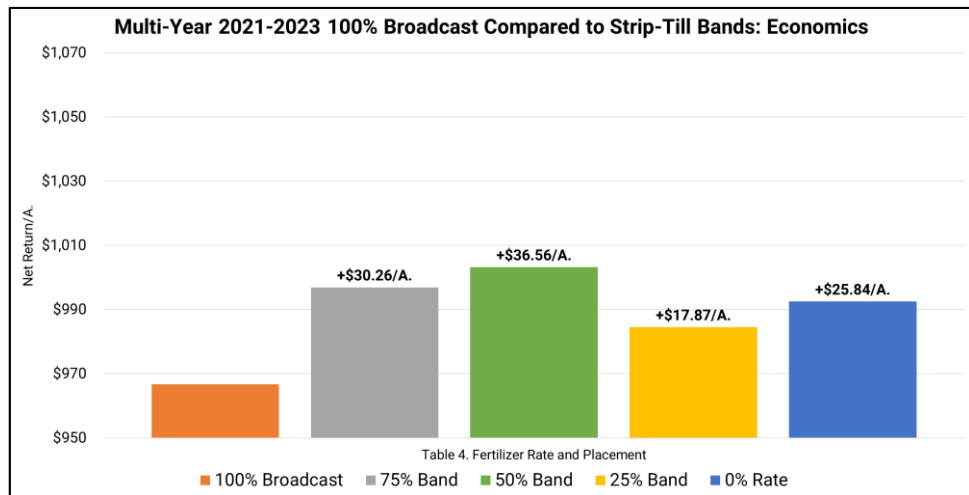
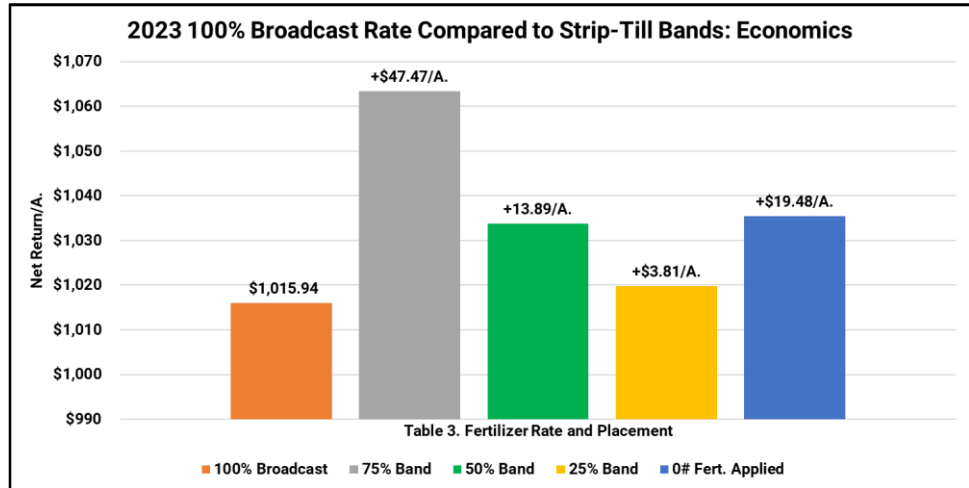


Lowering fertilizer to 50% rate in bands proved losses of **-\$3.05/A.**, while 25% reduced banded rates at **-\$6.98/A.** Each of these losses were a result of little yield difference, but higher equipment cost for application.

Broadcast vs Banding Rate Efficiency Study Continued

Table 3. helps answer the question surrounding banding efficiency. In other words, if I place fertilizer in bands, can I reduce the rate due to its efficiency? In 2023, banding 75% of recommended fertilizer rate, netted an additional +\$47.47/A. compared to traditional broadcast spreading. As fertilizer rate was reduced to 50%, it offered +\$13.89/A. over 100% broadcast rates and 25% near break-even at +\$3.81/A. However, what's disturbing is that applying 0% rate fertilizer offered advantages over the 100% broadcast rate by +\$19.48/A. This simply means that there was not enough yield advantage from fertilizer to offset the high price of dry fertilizer.

Table 4. summarizes multi-year data over 2021-2023. Banding 75%-50% rates of fertilizer have led to returns of +\$30.26 to +\$36.56/A. over traditional broadcast spreading. However, just as 2023 revealed, 0% rates were very close at +\$25.84/A.



As part of a 10-year study, this will be interesting to evaluate over the next 7-year period to analyze yield and economics as fertilizer prices hopefully fall back to somewhat normal levels.

Liquid vs Dry Fertilizer Fall Strip-Till Study

Objective: To evaluate yield and economic impact of dry and liquid fertilizer program in fall strip-till bands. This 1st year study compares a traditional dry 18-46-0 and 0-0-60 fertilizer program versus a replacement liquid fertilizer program. Treatments were as follows:

#1: 100% Dry Fertilizer Program:

150# 18-46-0 + 150# 0-0-60

#2: 50% Dry Fertilizer Program:

75# 18-46-0 + 75# 0-0-60

#3: Control: No Fertilizer Applied

#4: Liquid Fertilizer Program: 50% Nutrient Equivalent to Dry Program

12.5 Gal/A. Nachurs® Throwback® 9-27-4-4S

20 Gal/A. Nachurs® K-flex® 0-0-19-6S



#5: Liquid Fertilizer Program: 100% Nutrient Equivalent to Dry Program

25 Gal/A. Nachurs® Throwback® 9-27-4-4S

40 Gal/A. Nachurs® K-flex® 0-0-19-6S



Liquid vs Dry Fertilizer Fall Strip-Till Study

All liquid treatments were applied in the Fall made with Black Eagle Ag Solution's strip-till unit.



This bar was fitted with Pump Stack® (Figure 1.), a liquid fertilizer hydraulic pump. It was paired with EMHD®, and EM Flowsense™ (Figure 2.) to ensure a top-notch fertilizer application, as well as row control across the bar. EMHD® controls liquid application rates using an electromagnetic flow meter. This opens your options for a wider range of liquid products. EM Flowsense™ allows you to measure the rate of fertilizer you are applying on each row of the bar, to make you aware of any row-to-row variability that is occurring. With a Pump Stack® system, paired with EMHD®, and EM Flowsense™ you can be confident in your application rate across every row.



Figure 1. Pump Stack®

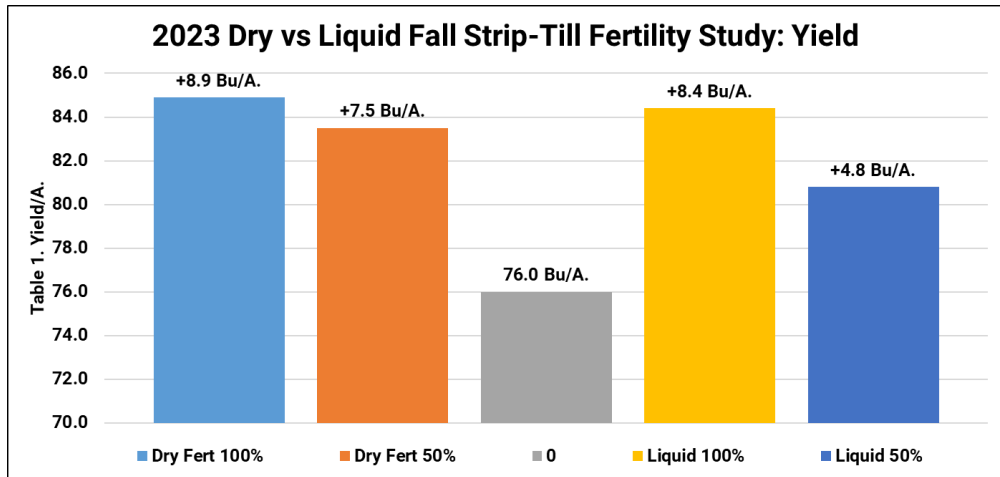


Figure 2. EMHD® + EM Flowsense™

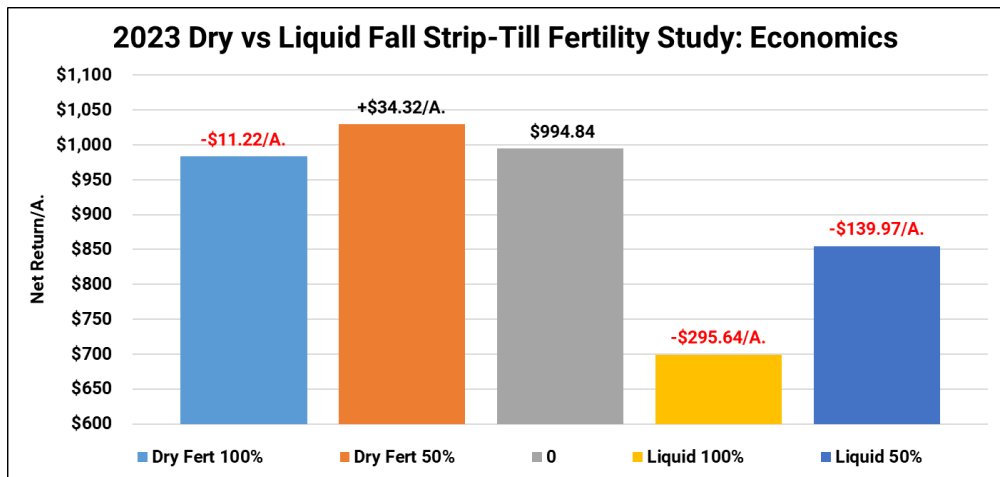
Liquid vs Dry Fertilizer Fall Strip-Till Study

Results: Table 1. illustrates 0# control treatments resulted in soybean yield of 76.0 Bu/A. Both 100% rate dry and liquid rates offered nearly similar performance, with yield increases of +8.9 and +8.4 respectively. 50% dry rates proved +7.5 Bu/A. yield gains; however 50% liquid rates fell to gains of only +4.8 Bu./A.

Table 2. reveals the overall economics of the fertilizer study and proved significant losses at both 50% and 100% rates of liquid fertilizer at **-\$139.97** to **-\$295.64/A.**



100% dry rates of fertilizer also proved losses of **-\$11.22/A.**, while the only entry to garner positive return on investment was the 50% rate at **+\$34.32/A.**



Overall, the Black Eagle strip-till

unit performed well regarding tillage. However, due to the high cost of fertilizer the liquid applications failed to achieve profitability of the dry program.

Come Experience Field Days at PTI

So what can you expect when attending summer field days at PTI? Whether you are a frequent visitor or looking forward to your first visit, PTI field days are a high energy, information packed, learning experience. Here are some of the one of a kind experiences you can choose to take advantage of all provided by Precision Planting at the Precision Technology Institute.

- **The Driver’s Seat**

In our 27-acre sandbox, you take the wheel. Here, we hand YOU the keys to different tractor/planter combinations and allow you to run the equipment in real time, learning more in depth about how each piece works and the technology behind it. Precision Planting Support Technicians will be co-piloting in the buddy seat at this time, to answer any questions that may come about throughout your experience.

- **Core Principles and Planting Fundamentals**

This hands-on demo is led by the Precision Planting Regional Managers walking the growers through the importance of planter maintenance and furrow creation. Growers can see in person correct and incorrect furrow creation from two different planter row units. During this time, growers can interactively measure and correct the furrow created throughout the different planting conditions.

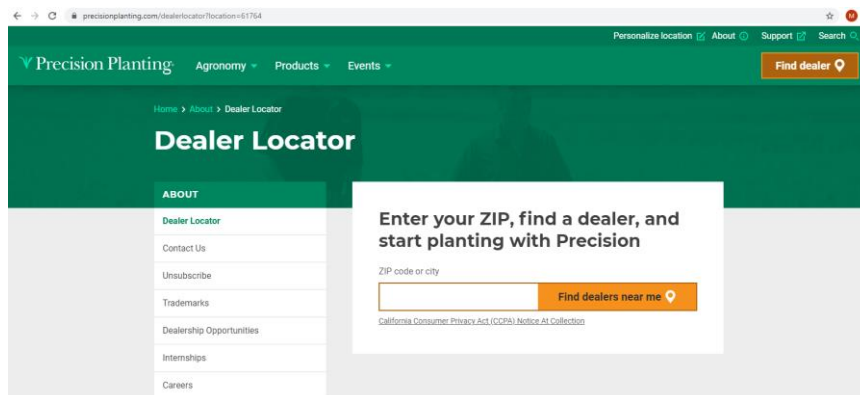
- **Agronomy Tour**

Lead Agronomist and PTI Farm Director, Jason Webster, takes you out into the field to dive deeper into the innovative agronomy and technology that we use each season throughout the different plots. You will learn about our new water recycling and tile drainage system, research tools, and technology/products available to implement on your farm.

- **Industry Days**

Each year, we invite industry partners to use PTI as an avenue to showcase their products and technology during the year. These customer focused field days are led by the industry partner’s employees. If you are interested in hosting an industry day or becoming an industry partner of Precision Planting, contact the PTI Team at ptipontiac@precisionplanting.com.

For more information regarding attendance of a PTI Field Day or Industry Day, reach out to your Precision Planting Premier Dealer or visit our website at precisionplanting.com/events to schedule a visit.



Acknowledgements and Legal Statement

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