Precision Planting®

PRECISION TECHNOLOGY INSTITUTE

2019 RESEARCH SUMMARY
PONTIAC, IL

2019 PTI Farm Research Summary

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INSIDE PTI

InsidePTI is a new online video series where Jason Webster and the Precision Planting Team will give an inside look into all the trials listed in this summary report in *video* form. Sign up today to receive these agronomic videos mailed directly to your email inbox. To sign up, simply go to InsidePTI.com and soon you will get a behind the scenes look at the PTI Farm!

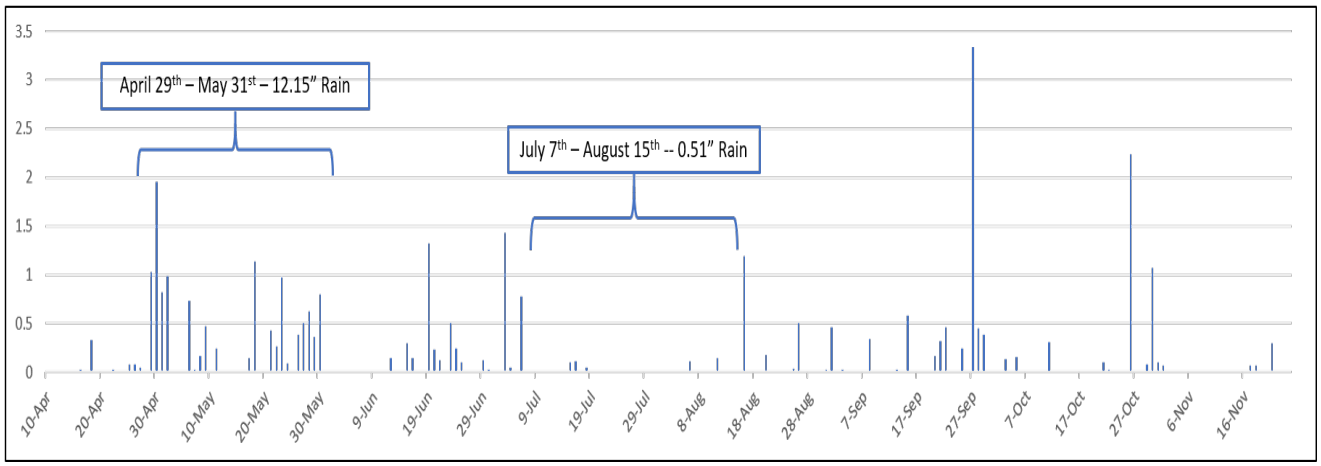
2019 in Review

The Precision Technology Institute (PTI) in Pontiac, IL continued its second year in 2019. This farm was originally acquired in the fall of 2017 and from that point, the Precision Planting® team has been working hard to design and develop the future vision of what the Precision Technology Institute should be.

During the summer of 2019, thousands of growers from throughout the United States, as well as from around the world, 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 the ride and drive area.

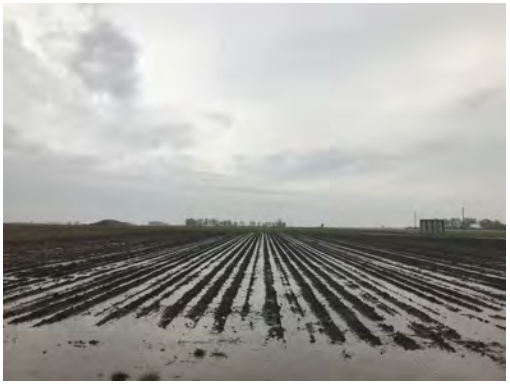
The spring of 2019 proved to be a very difficult spring, with many farmers saying it was the worst they had ever experienced in their farming careers.

Daily Precipitation (inches)



1st Plant Date | **5 weeks rain/cold** | **2nd Plant Date** | **Hot/Drought Conditions** | **Late Beneficial Rains** | **Harvest Delay**

The above chart shows daily rainfall at the PTI Farm from mid-April through mid-November. Due to cold temperatures along with frequent rain events, it was rare to have dry soils for field operations. Our first plots were planted on April 26th in marginal conditions at best. A total of 5 plots were planted during this short day and half stretch. Once these plots were planted, frequent rains coupled with cold temperatures persisted for the next 5 weeks totaling over 12" of rain. During this period, field operations came to a complete standstill.



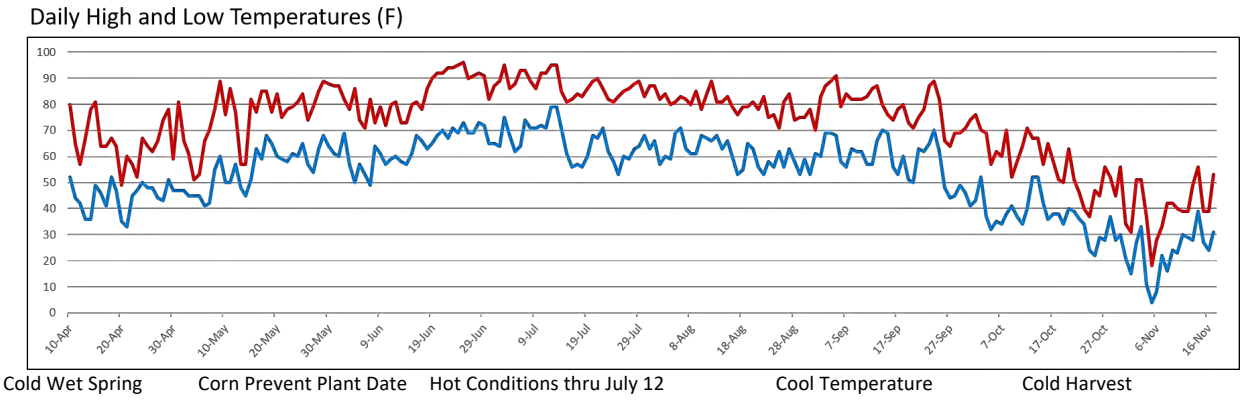
2019 in Review: Continued

Finally, on the afternoon of June 5th, planting resumed with many farmers in the area being in the field for the first time of the season. At the PTI Farm, we planted most of our remaining trials over the next 10 days to complete the planting season.

Once we finished up planting in the first half of June, then frequent rainfall became prevalent once again with heavy rains lasting until the July 4th holiday week. Temperatures during the time-frame of June 20th through July 12th saw over 90 °F temperatures each day, quickly drying soils out.

After July 12th, temperatures decreased to cooler 80 °F high temps, however the rains shut off. From July 7th - August 15th, the PTI Farm only received 0.51" of rain. These drought conditions occurred during pollination of the 1st corn we planted the last week of April.

Starting the week of August 18th, more frequent rains were received and the later June planted crops were able to benefit, as it fell very close to its later than normal pollination period. These later rains would then prove to allow our late planted corn to sustain much better yields than the first April planted corn.



In the end, corn yields varied from 130 – 285 Bu/A., averaging near 210 Bu/A. Soybeans ranged from 50 - 105 Bu/A. with averages near 70 Bu/A.

2019 was a challenging season with some of the latest planting in history, corn prevent planting in many areas near the PTI Farm, flooding conditions, record heat in July, and then drought conditions. It's pretty much safe to say that we saw just about everything Mother Nature could throw at us this past year.

2019 in Review: Continued

Through the challenges, there was plenty to learn. You will definitely want to see the results from our tile drainage and irrigation studies, as it was important at the PTI farm in 2019. This year we achieved corn yield advantages over 70 Bu/A. and soybeans up to near 30 Bu/A. by offering drainage and both the ability to recycle rain water in the form of sub-surface drip irrigation.

Precision Planting is excited to share the second year of PTI research farm results and findings. We know the findings 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 2019.

In most trials, both agronomic yield and economics are detailed to help understand return on investment. 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. For the 2019 PTI Yield Summary Data, net returns are calculated with corn prices of $3.67/Bu. and soybeans at $8.68/Bu. These prices represent average **cash** prices for new crop 2019 corn from the period of October 1st, 2018 thru October 1st, 2019.

For starter fertilizer trials, most have a $30 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 spending or over-applying more nutrients than needed. To accomplish this, we reduce our dry fertilizer rates by $30/A. to account for the re-allocation. All control tests in each study get the additional $30/A. of dry fertilizer to achieve a typical 100% program without starter fertilizer on the planter.

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

2019 Return on Investment Performers

PTI Agronomic Study:	$ ROI/A.	Page #
Top 10:		
1. 30' Pattern Tile Plus Irrigation: Corn	$273.42	30-33
2. 30' Pattern Tile: Corn	$154.51	32
3. High Yield Irrigation: Soybeans	$150.82	95-98
4. Dual Band Conceal 14-12-4-6 Irrigated: Soybeans	$84.96	117
5. 60’ Pattern Tile: Corn	$80.74	32
6. High Yield Irrigation: Corn	$54.27	34
7. Nachurs Impulse FurrowJet: Corn	$51.57	43
8. Triple Split Nitrogen Application: Corn	$50.07	69
9. Centuro Nitrogen Stabilizer: Corn	$48.18	37
10. Conceal Dual Band Potassium: Soybeans	$47.78	119
Bottom 10:		
1. Planting Date April 26th: Corn	$-247.19	8
2. Saturated Cold Germination: Corn	$-204.69	36
3. Improper Downforce, Singulation, Row Cleaners: Corn	$-144.80	29
4. Absence of CleanSweep: Corn	$-95.88	18-19
5. Shallow Planting into Dry Soil: Corn	$-79.33	12
6. 20” Rows/High Density: Corn	$-78.15	61
7. Loss of Ground Contact, Downforce: Corn	$-77.83	26-28
8. 100% Weed-N-Feed Nitrogen: Corn	$-52.58	69
9. Improper Seed Singulation: Corn	$-46.79	11
10. Improper Closing	$-37.43	23-25

Precision Planting

2019 PTI Results

Corn Planting Date Study

Objective: To evaluate various corn planting dates throughout the spring planting season to determine the optimum planting date that offered the highest yield and return on investment. Once optimum planting date is discovered, economics can then be analyzed to determine yield loss and cost per acre when planting dates were not implemented within the optimum planting window.

Results: Being one of the strangest planting seasons in history, the optimum planting window for corn at the Precision Technology Institute occurred on May 20th. Corn planted during this 3rd week of May achieved the highest yields of our planting date study at 229.1 Bu/A. (Table 1). Planting earlier during the week of April 26th resulted in yield losses near **-67 Bu/A.** due to cold and moist seedbed conditions. After the optimum planting date of May 20th, yields suffered an average yield loss of **-12.6 Bu/A**. over the next two weeks of plantings. This yield decrease equated to average losses of **-$46.24/A.** as a result of missing the optimum planting window (Table 2). The April 26th planting date resulted in the lowest overall yield with over **-67 Bu/A.** losses and consequently diminished returns of **-$247.19/A.**

Table 1.

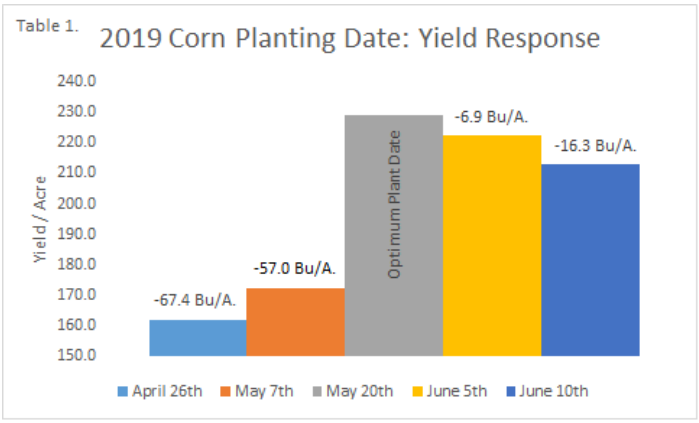
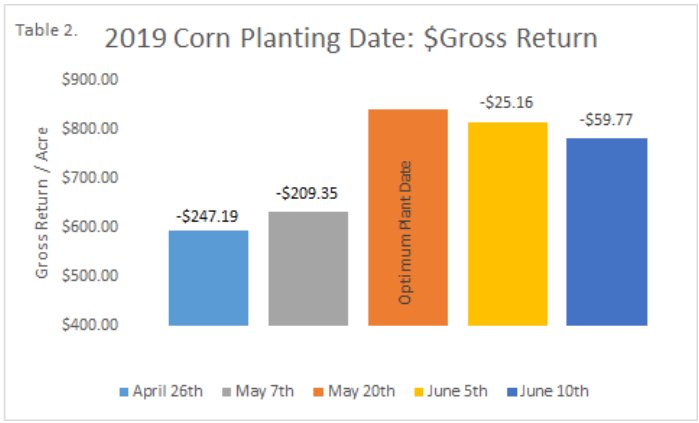


Table 2.



Planting Date: Varied *Hybrid: DKC 65-94* *Population: 36K* *Row Width: 20* *Rotation: CAB* *Corn Price: $3.67*

Corn Starter Fertilizer Response by Planting Date Study

Objective: To monitor the performance of starter fertilizer at various planting dates. When does starter fertilizer give the highest returns? Does starter fertilizer respond differently at earlier planted dates versus later? In this study we evaluate four planting dates consisting of April 26th, May 7th, May 20th, and June 5th with and without a starter fertilizer, monitoring its performance throughout the planting season.

The starter fertilizer program used for this study consists of the following:

Product	Fertilizer Analysis	Placement of Fertilizer
2 Gal/A. Triple Option®	4-13-17-1S	FurrowJet Center
1Pt/A. CropMax®	2-0-2-0.1B-0.15Cu-0.3Fe-1.5Mn-0.0005Mo-4Zn	FurrowJet Center
4 Gal/A. Triple Option	4-13-17-1S	FurrowJet Wings
1Pt/A. CropMax	2-0-2-0.1B-0.15Cu-0.3Fe-1.5Mn-0.0005Mo-4Zn	FurrowJet Center
20 Gal/A.UAN	32-0-0	Conceal Single Band
6 Gal/A. K-Fuse	Potassium Sulfate	Conceal Single Band

Figure 1. FurrowJet Placement

Figure 2. Conceal Placement

Planting Date: Varied *Hybrid: DKC 65-94* *Population: 36K* *Row Width: 20* *Rotation: CAB* *Corn Price: $3.67*

Corn Starter Fertilizer Response by Planting Date Study Cont'd

Results: Table 1. illustrates that every planting date achieved yield gains from our starter fertilizer program. However, the best yield responses from starter fertilizer came during the first two early planting dates of April 26th and May 7th. As planting dates were shifted towards later dates of May 20th and June 5th, overall yield response diminished.

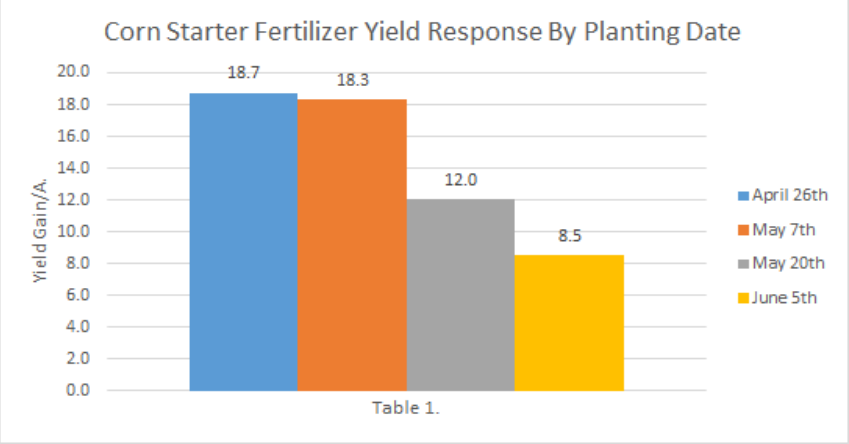


Table 1.

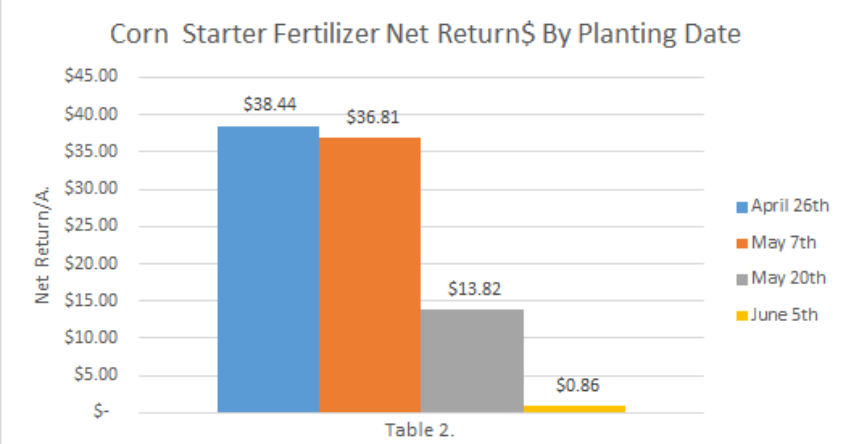
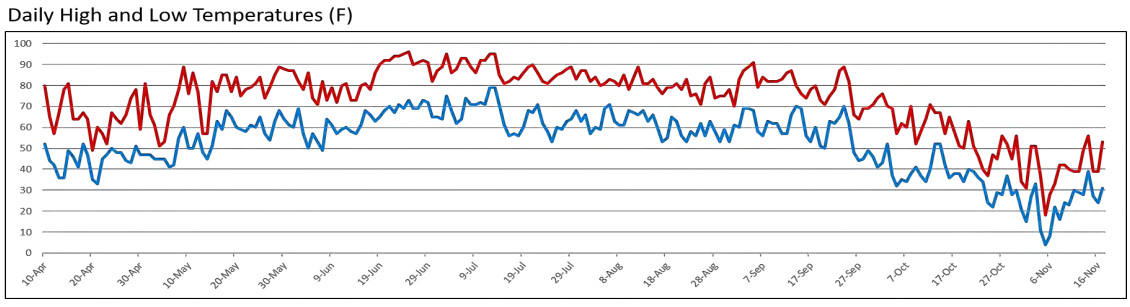


Table 2.

Our first two planting dates on April 26th and May 7th were a timeframe that generally consisted of cold and wet soils. As we planted into these cold soils averaging 45-48 °F, starter fertilizer offered yield responses of +18.3 to +18.7 Bu/A.

As planting dates shifted towards warmer soils of over 50 °F on May 20th and June 5th, starter fertilizer yield response decreased by -35% to -45% with yield gains of +8.5 to +12.0 Bu/A.

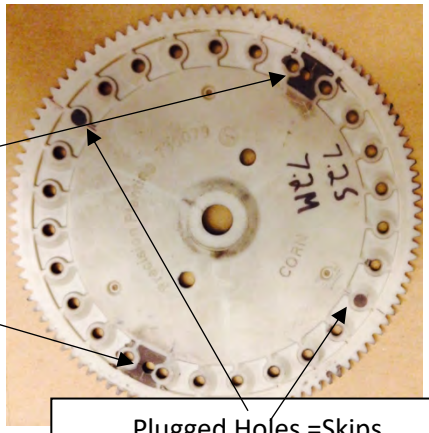
Table 2. illustrates the economics and tells us that the last planting date of June 5th only offered enough yield gain to just pay for itself at +$0.86/A. All other planting dates indicate positive returns from +$13.82 to +$38.44 respectively.



Planting Date: Varied *Hybrid: DKC 65-94* *Population: 36K* *Row Width: 20* *Rotation: CAB* *Corn Price: $3.67*

vSet Planter Singulation Study

Objective: To evaluate how improper seed singulation affects corn yield. Modified vSet seed plates with plugged and extra holes were used in order to create doubles and skips. These "goof" plates created an average of 95% spacing accuracy vs. the control at 99.5%.



Results: 95% seed singulation resulted in yield losses of **-12.7 Bu/A.** with economic losses of **-$46.79/A.** based on a corn commodity price of $3.67/Bu. In general, this equates to **-2.8 Bu/A.** for each percentage of singulation lost.

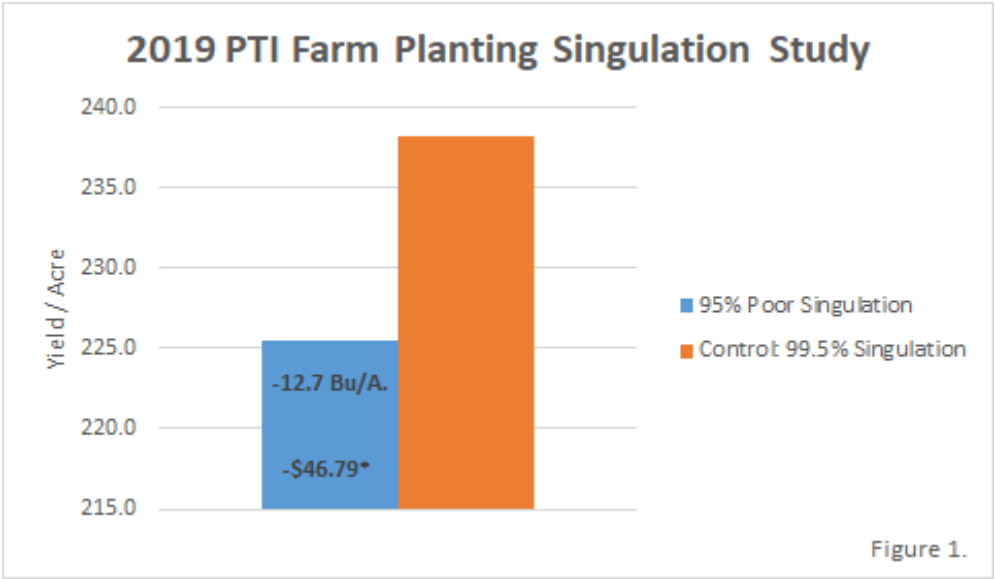


Figure 1.

Planting Date: June 8 *Hybrid: DKC 54-38* *Population: 36K* *Row Width: 30* *Rotation: CAC* *Corn Price: $3.67*

Planting Depth Study

Objective: To evaluate yield and economic performance of various corn planting depths consisting of 1" to 3.0" in ½ "increments.

Results: The deepest planting depth of 3" provided the highest yield in this study at +248.9 Bu/A. (Table 1). As planting depths were shallowed up, yields decreased by as much as **-18.2 Bu/A.**

Table 2. illustrates revenue differences up to **-$79.33/A.** by not implementing planting depth correctly.

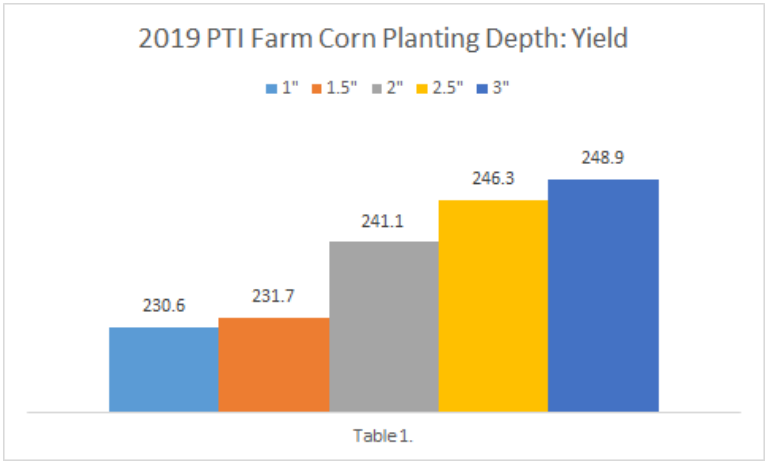


Table 1.

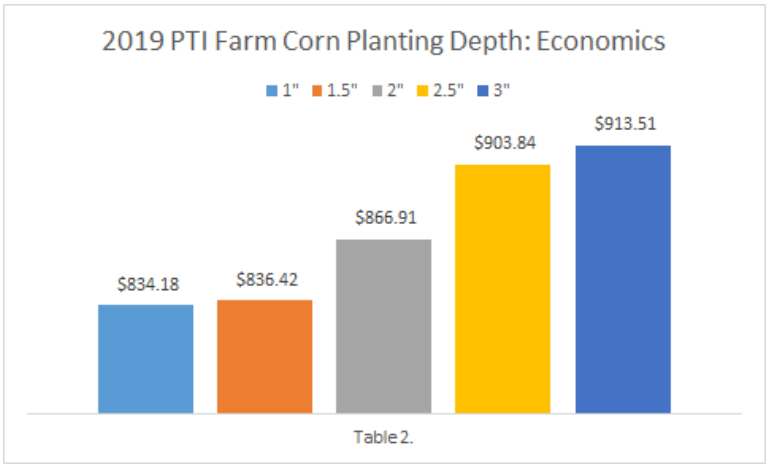


Table 2.

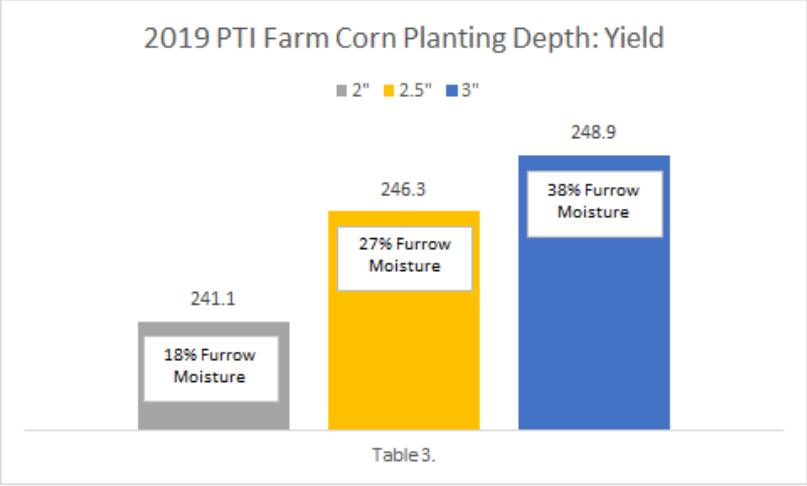
Planting Date: June 8 *Hybrid: DKC 54-38* *Population: 36K* *Row Width: 30* *Rotation: CAC* *Corn Price: $3.67*

Planting Depth Study Continued

Digging seeds is a time consuming yet important task at planting time. Getting your eyes on the furrow where the seeds are placed, will allow you to understand if those seeds are in an environment to thrive. Does the seed have adequate temperature and moisture? Has it been surrounded by clean soil, free of residue? What is the power of the soil around each seed to feed the growing plant? Until now, we didn't know this for every seed, we were unfortunately simply guessing. With SmartFirmer® you can now have eyes in the furrow. Soil moisture is a critical component for seed germination, uniform plant emergence, and ultimately crop yield. SmartFirmer gives row-by-row visibility to seed available moisture in the seed furrow, allowing farmers to choose the right planting depth as soil conditions change.

The real story with this planting depth study is the seed available furrow moisture. Table 3. illustrates that shallow planting depths were simply placing seed into dry soil, thus resulting in yield losses of **-7.8 Bu/A.** from just the 2" to 3" planting depths.

Table 3. also reveals the seed available furrow moisture reported by SmartFirmer. As planting depth was pushed deeper from 2" to 3", furrow moisture increased at each interval. 3" planting depths were the only field passes that observed at or above the 30% furrow moisture goal that we try to achieve at planting for optimum germination.



Planting Date: June 8 *Hybrid: DKC 54-38* *Population: 36K* *Row Width: 30* *Rotation: CAC* *Corn Price: $3.67*

Planting Depth Study Continued

Table 4. summarizes the revenue received, from the 2”, 2.5”, and 3” planting depths. In this scenario, a grower would have increased revenue by +$46.60/A., simply by planting deeper, and consequently into higher furrow moisture values at or over 30%.

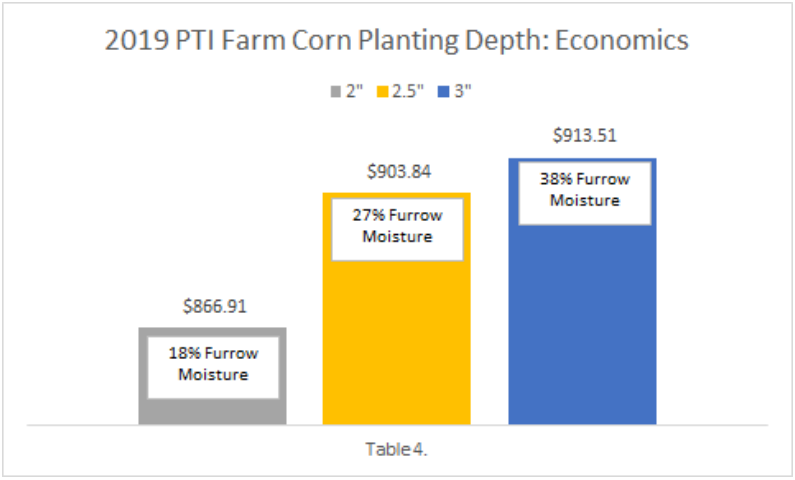


Table 4.

Using the 20|20® in tandem with SmartFirmer, we have the ability to evaluate seed available furrow moisture in real-time. Based on this real-time information, growers can make decisions based on sensing data.

Figure 2.

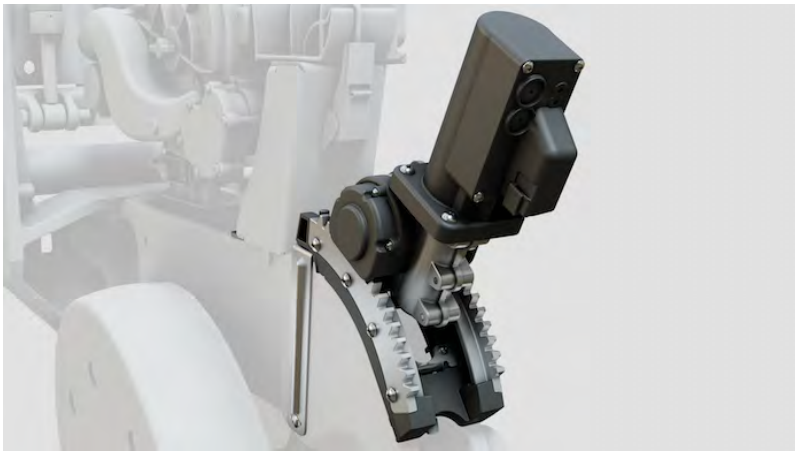


Figure 2. illustrates SmartDepth™, a new beta test product used in this study, that takes the technology one additional step further, allowing planting depth to be changed on the go while planting. This can be done manually from the tractor cab and 20|20 monitor, or automatically using seed available furrow moisture values from SmartFirmer.

Planting Date: June 8 *Hybrid: DKC 54-38* *Population: 36K* *Row Width: 30* *Rotation: CAC* *Corn Price: $3.67*

Keeton Seed Firmer Study

Objective: This study evaluates the benefits of Keeton Seed Firmers. Seeds don't always land right in the bottom of the trench where they belong. With its unique, in-the-trench design, the Keeton Seed Firmer gently firms those seeds to the bottom of the V-trench (Figure 1). The end result is even depth, correct seed-to-soil contact, and most importantly uniform germination.

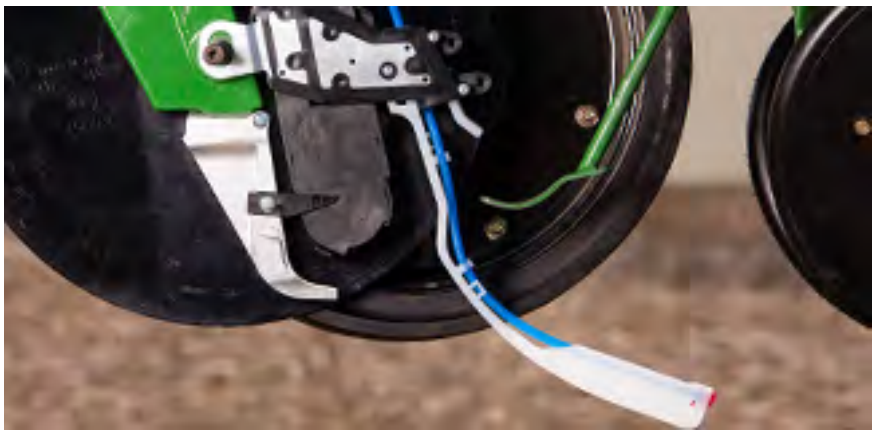
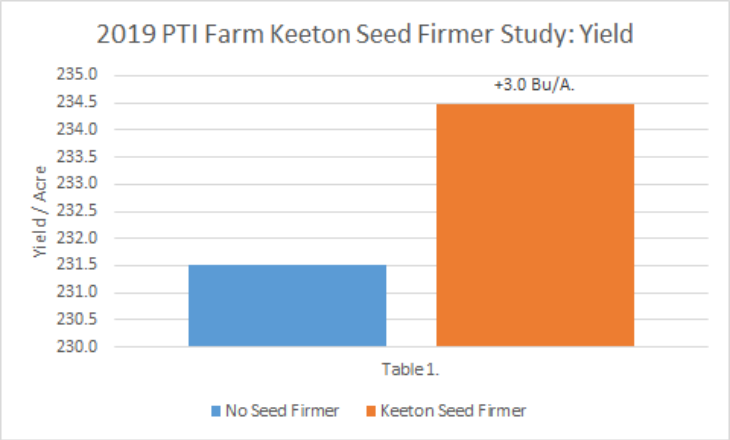
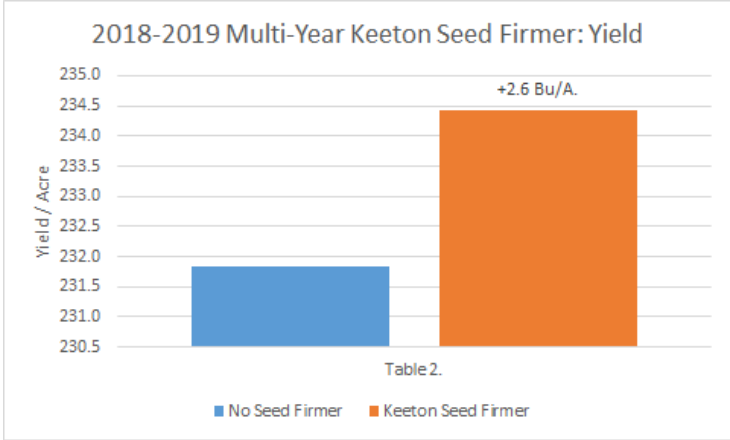


Figure 1.

Results: The presence of seed firmers resulted in yield gains of +3.0 Bu/A. (Table 1.), with gross returns of +$11.01/A. At a cost of $35/row for Keeton seed firmers and quick attach brackets for a 16-row planter, corn prices at $3.67, break-even occurs at only 51 acres.



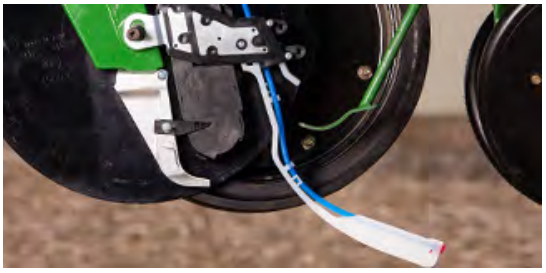


Planting Date: June 8 *Hybrid: DKC 54-38* *Population: 36K* *Row Width: 30* *Rotation: CAC* *Corn Price: $3.67*

Keeton Seed Firmer/Downforce Study

Objective: This study evaluates the benefits of Keeton Seed Firmers in an incorrect and a correct downforce setting. Seeds don't always land right in the bottom of the trench where they belong. With its unique, in-the-trench design, the Keeton Seed Firmer gently firms those seeds to the bottom of the V-trench (Figure 1). The end result is even depth, correct seed-to-soil contact, and most importantly uniform germination.

Figure 1.



Results: In this study, seed firmers in standard automatic downforce, offered yield gains of +2.9 Bu/A. (Table 1.), which replicates nicely the data included in the Keeton study included previously on Pg. 17. However, when too light of downforce was implemented and the planter began to lose ground contact causing planted depth to shallow up, the presence of seed firmers resulted in additional yield gains of +4.0 Bu/A., with increased gross returns of +$14.68/A. Assuming that too light of downforce might occur only 25% of the time we would now see the break even at only 38 acres.

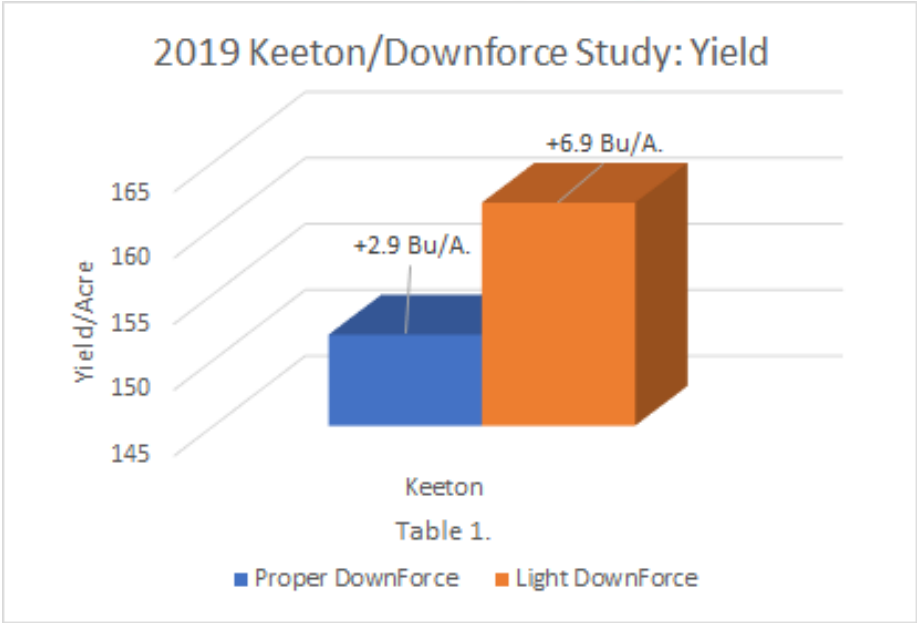


Table 1.

Planting Date: 6/8 *Hybrid: DKC 54-38* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

Corn At-Plant Film Study

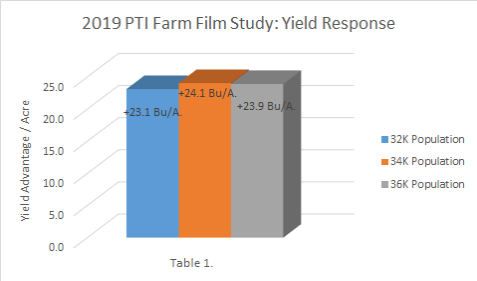
Objective: This study evaluates the use of an at-plant 90-day biodegradable film designed to create a greenhouse effect to warm soils and preserve moisture. Film was laid directly over top of a planted row and has slits at 3-inch intervals directly above the seed placement. This film traps heat from the sun, raises soil temperatures, thus increasing heat units. At the same time, the film locks moisture underneath it, preserving that water for plant uptake throughout the growing season.

Results: The at-plant biodegradable film worked excellent in early April 27th planting dates. Still having cold soil temperatures below 50 °F, the film was utilized to help insulate and warm the soil surface. Over the last two growing seasons, it has been common to see soil temperatures near 7-8 °F warmer due to the film's warming effect.

As for yield, Table 1. illustrates the biodegradable film increased yield by an average of +23.7 Bu/A. Three seeding rates were replicated and evaluated at 32K, 34K, and 36K populations, resulting in only 1.0 Bu/A. difference between them. In 2018 (Table 2.), yield gains from film averaged +15.6 Bu/A. with a spread of 12.6 Bu/A. between 32K, 34K, and 36K.

Concerning return on investment, Norseman Techni-Plant FL states that the cost for the 90-day biodegradable film is estimated at $100/A. for custom planting. With this cost structure, break-even yield would occur at 27.2 Bu/A., indicating that all film treatments fell short of profitability ranging from losses of **-$15.11**, **-$19.19**, and **-$27.19** respective to seeding rate.

2019 represents our second year of testing this technology and has offered positive yield gains each year (Tables 1-2). We look forward to testing this interesting technology and finding ways to protect and improve corn yield and profitability in the future. Special thanks to Michael Freeman for supplying the use of the film planter for Precision Planting agronomic research.



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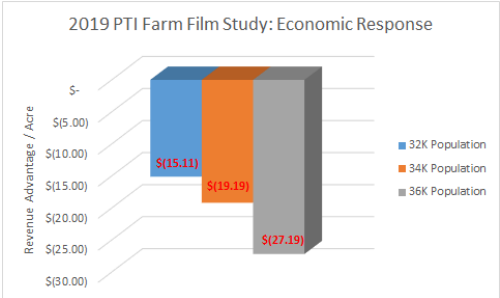


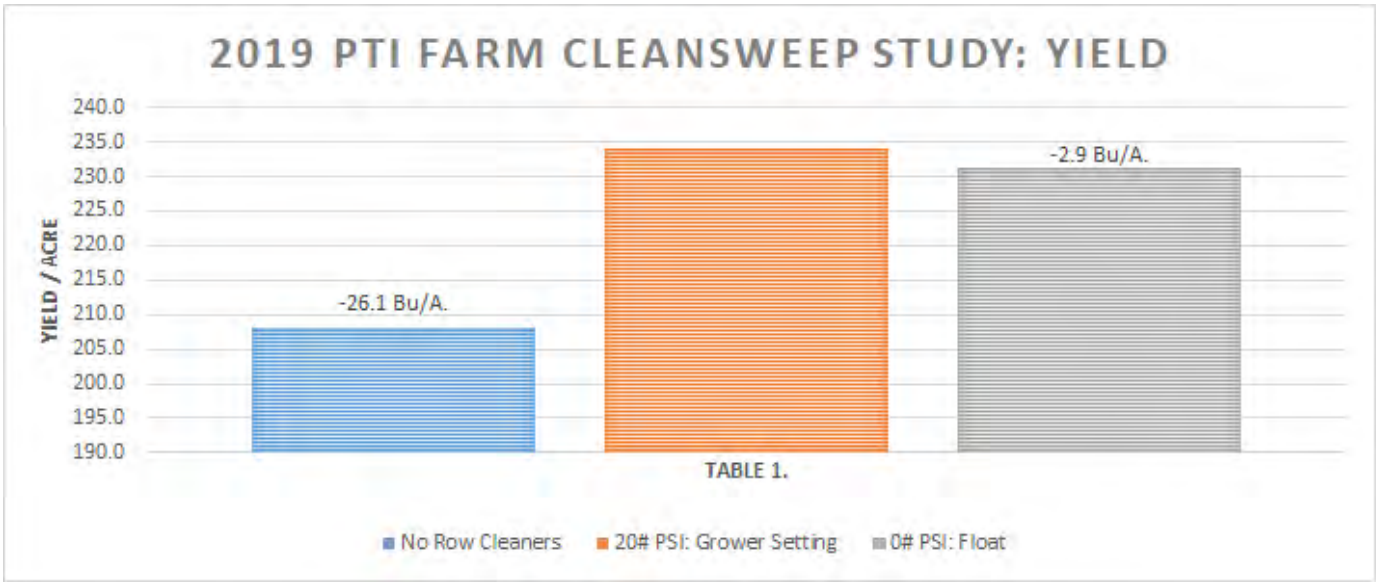
Planting Date: 4/26 *Hybrid: DKC 63-95* *Population: 36K* *Row Width: 30"* *Rotation: CAC*

CleanSweep Residue Management Study

Objective: This study evaluates the benefits of planter row cleaners equipped with CleanSweep. Residue management is a necessary part of today's operation to maximize profitability. Tough stalks and more corn-on-corn acres mean a heavier load of residue that needs to be controlled. Residue in the seed trench competes with seedlings for moisture and harbors disease. CleanSweep puts row cleaners right where they need to be, moving residue but not the soil. Continuous adjustments can be made as field conditions change with the cab-mounted controller to easily lift or make more aggressive adjustments.

Results: The absence of row cleaners resulted in yield losses of **-26.1 Bu/A.** and proved economic losses of **-$95.79/A.** compared to row cleaners with CleanSweep set at 20 psi. of lift.

Floating row cleaners resulted in **-2.9 Bu/A**. yield losses with economic net losses of **-$10.64/A**. (Tables 1-2).



Planting Date: 6/8 *Hybrid: DKC 54-38* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

CleanSweep Residue Management Study Continued

Figure 1. No Row Cleaner Stand Establishment

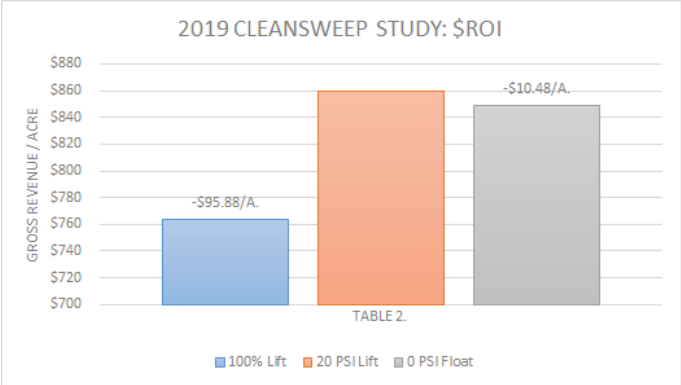
Figure 2. Residue Manager System

2019 planting conditions at the PTI farm in this particular study were very challenging. Due to early persistent wet weather followed by warm, windy and dry conditions, the conventional tillage seed-bed for this trial resulted in very cloddy conditions. These cloddy conditions required us to operate our residue managers in a more aggressive setting in order to move clods away from the row. If clods were not removed it caused the row units to ride on top of the clods thus resulting in shallower planting depths and ultimately seed being placed in dry soil. Operating row cleaners in a fully lifted position (Figure 1.), resulted in severe stand establishment issues due to less than desired germination and seed to soil contact. After planting, dry conditions persisted for two weeks until the next rain provided those seeds planted in dry soil enough moisture to finally germinate resulting in many late emergers.

Figure 3. illustrates improved stand establishment as the result of operating residue managers with CleanSweep in a more aggressive setting to properly remove clods and achieve desired planting conditions - into soil moisture.

Figure 3. Improved Stand Establishment

Table 2. Revenue Differences Between Settings



Planting Date: 6/8 *Hybrid: DKC 54-38* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

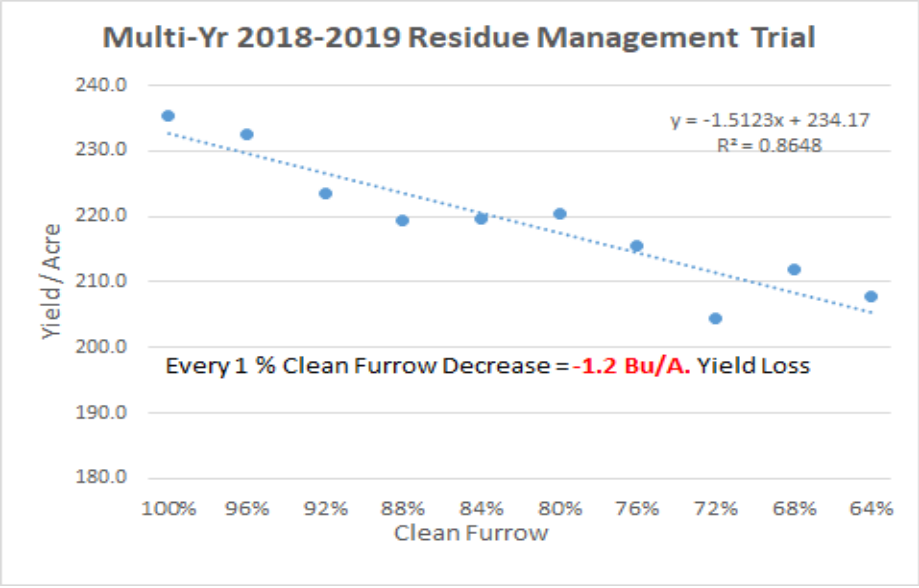
Seed Trench Residue Management Study

Objective: This study evaluates the impact of plant residue in the seed trench at planting (Figure 1). Plant residue in the seed furrow can rob moisture away from the seed, cause air pockets, and create a lower percentage of seed-to-soil-contact. All these factors can delay germination and impact corn yields. This study attempts to quantify corn yield loss from varying percentages of residue on the seed at planting.

Figure 1.

To create a controlled environment, corn residue was manually placed directly on top of corn seed in the furrow at percentages from 100% to 64% clean furrows.

Results: Table 1. illustrates the strong relationship of yield response to residue in the furrow. Two-year 2018 to 2019 data suggests that every 1% loss in clean furrow, decreased corn yield by **-1.2 Bu/A.** Corn yields ranged from 193 to 230 Bu/A., indicating losses up to **-37 Bu/A.** as a result of high amounts of residue in the furrow. It should be noted that this controlled study only applies residue directly on the seed. No other residue is distributed between the seed or elsewhere in the furrow. In typical field settings, residue would be more than likely be distributed throughout the seed furrow, thus increasing the total amount of residue and consequently causing a higher degree of corn yield loss.



Planting Date: 5/16 *Hybrid: Pioneer 1366AMXT* *Population: 36K* *Row Width: 30* *Rotation: CAC* *Corn Price: $3.67*

Multi-Year Day of Emergence Study

Objective: This 2018-2019 multi-year study evaluates the impact of yield loss when corn plants emerge from the soil surface on an inconsistent basis. Flag testing implementation (Figure 1.) was used to monitor the emergence timing of young plants. As corn first started to emerge from the soil surface, flags were placed at four different timings to identify the emergence timing of all plants within the study.

Figure 1.

Protocol:

Red Flags =	1st Initial Plants to Emerge
Yellow Flags =	Plants that emerged 18-28 hours later
White Flags =	Plants that emerged 29-42 hours later
No Flag =	Plants that emerged >42 hours later

Results: Manual ear checks were completed to calculate potential yield loss from late emerging plants. Figure 2. illustrates the ear size of the first emerging plants (within 18 hrs.), while Figure 3. represents ear sizes of plants that emerged 42 hours or later of the first initial emergers.

Figure 2.

Table 1. below summarizes the yield loss as emergence varied. Plants that emerged 18-28 hrs. later suffered **-17%** yield losses compared to the first emergers. As emergence continued later to 29-42 hrs., yield fell even more to **-24%** losses. Finally, last emergers that came up 42hrs or later proved large losses of **-47%** of total yield.

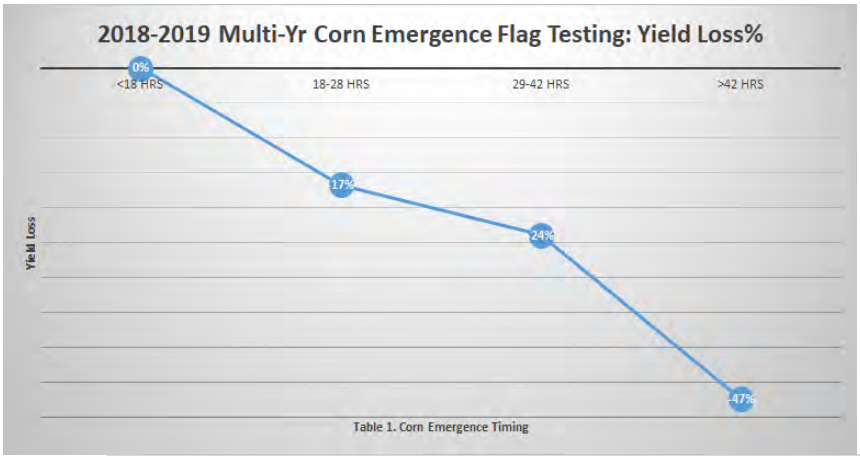
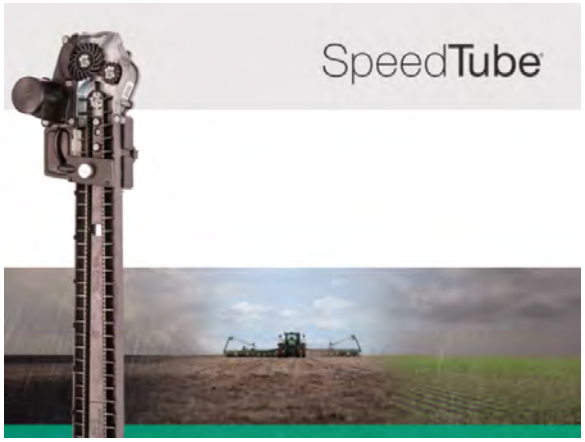


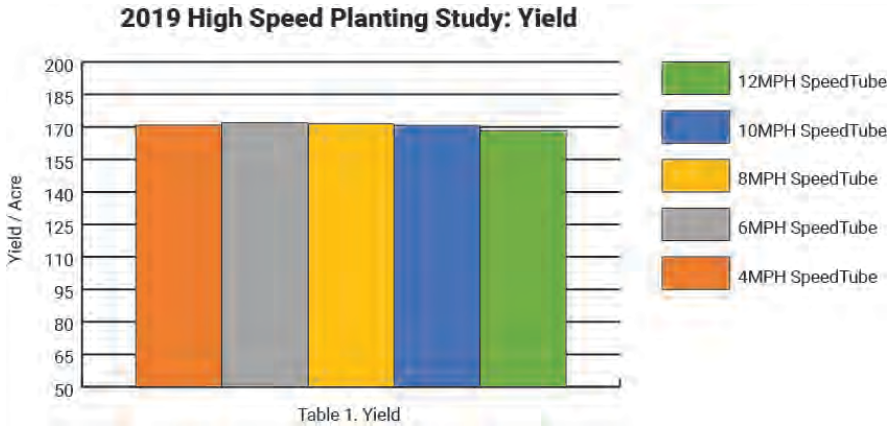
Figure 3.

Corn High Speed Planting Study

Objective: To evaluate yield response of planting speeds of 4, 6, 8, 10, and 12 MPH with SpeedTube®. This high-speed planting technology takes the place of conventional seed tubes and consists rather of a flighted belt that takes gravity out of the equation. By hand delivering each seed to the furrow, there is no opportunity for seeds to ricochet into the trench. Even at twice normal planting speeds, seed arrives safely at the bottom of the trench, spaced evenly, every time. All entries in this study utilize SpeedTube technology.



Results: Using SpeedTube technology, highest corn yields occurred at the 6, and 8 mph planting speeds. In fact, there was only a 0.5 Bu/A. difference between both of these planting speeds. With traditional planting speeds typically near 5 mph, this data would suggest that growers could plant twice as fast with SpeedTube technology without sacrificing planter performance.



Planting Date: 6/7 *Hybrid: DKC 54-38* *Population: 34K* *Row Width: 30* *Rotation: CAB* *Corn Price: $3.67*

Corn Closing Wheel System Study

Objective: To evaluate the performance of five different closing systems in three different tillage practices. Closing wheels are designed to close the seed trench, eliminate sidewall compaction/smearing, remove air pockets, all at the same time achieving good seed-to-soil contact. This study evaluates five distinct types of closing wheel systems in strip, vertical, and no-till situations.

FurrowForce® Closing and Sensing/Control System:

Advantages: Fractures sidewall, removes compaction/smear

2nd stage firms soil & removes air pocket

Sensing of soil variability

Automatic Control to ensure proper settings

Single Rubber/Yetter Cast Spike™ Closing System:

Advantages: Fractures sidewall, removes compaction/smear

Combination of sealing and aggressive Fracture

Disadvantages: Spikes can be aggressive

Dual Yetter Poly Twister™ Spike Closing System:

Advantages: Fractures sidewall, removes compaction/smear

Center ring acts as depth maintainer

Disadvantages: Lightweight wheels require increased tension

Single Rubber/Yetter Poly Twister Spike Closing System:

Combination of two systems for variable soils

Corn Closing Wheel Study: Continued

Dual Martin Dimple Spike™ Closing System:

Advantages: Fractures sidewall, removes compaction/smear

Versatile heavy wheel, great for reduced tillage

Depth Maintaining

Disadvantages: Extra weight can be aggressive

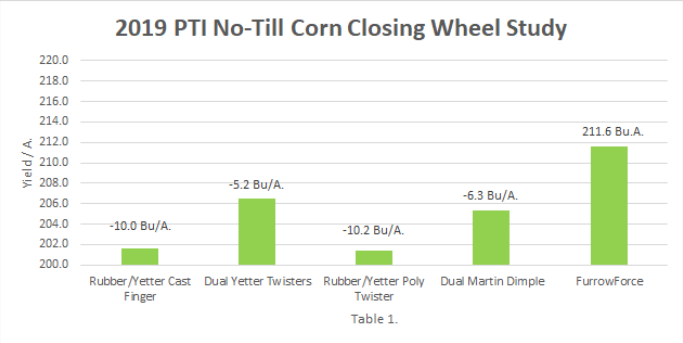


Table 1.

No-Till Results: The FurrowForce automated sensing and control closing system in a no-till environment shined with positive yield gains over all other closing systems. All the non-sensing/control systems incurred yield losses of **-5.2** to **-10.2 Bu/A.** (Table 1.) Corn priced at $3.67/Bu. equates to additional returns of +$19.08 to +$37.43/A. for the FurrowForce system.

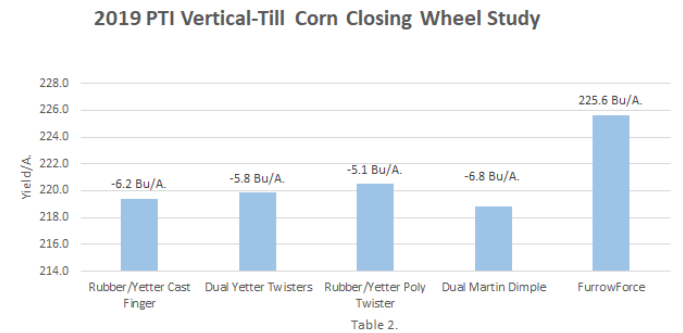


Table 2.

Vertical-Till Results: The FurrowForce automated sensing and control closing system in vertical-till environments also proved positive yield gains over all other closing systems. All the non-sensing/control closing systems incurred yield losses of **-5.1** to **-6.8 Bu/A.** (Table 2)**.** Corn priced at $3.67/Bu., equates to additional returns of +$18.72 to +$24.96/A. for the FurrowForce system.

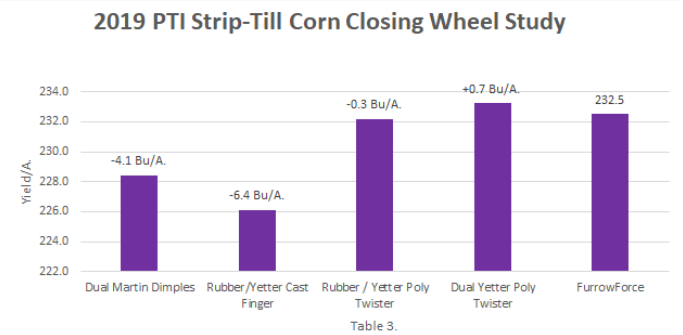


Table 3.

Strip-Till Results: The dual Yetter Poly Twister closing system proved highest yields in strip-till with a +0.7 Bu/A. advantage over the FurrowForce system (Table 3). The single Rubber/Yetter Poly Twister also performed very well. The more aggressive Dual Martins and the Yetter Cast Finger closing systems appeared to be too aggressive for the soft and mellow conditions that strip till offered.

Corn Closing Wheel Study Continued

Table 4. illustrates the yield performance of each closing wheel system as an average over all tillage environments. FurrowForce proved yield gains of +4.1 to +6.8 Bu/A. and out-performed all closing systems in the study.

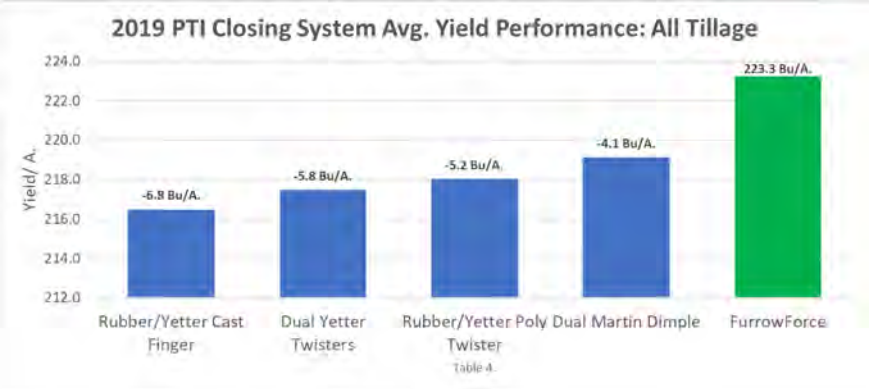
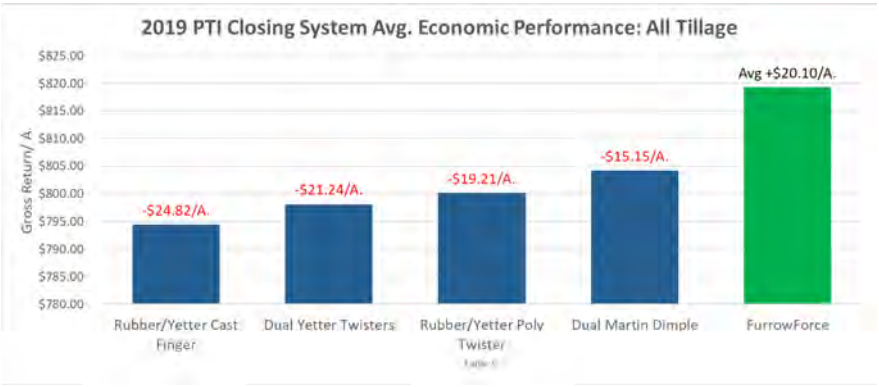


Table 5. depicts non-sensing closing wheels suffered economic losses averaging **-$20.10/A.** in comparison to the FurrowForce sensing and auto-control system.



In summary, for years planters have struggled with closing systems with manual settings that offered the inability to account for and change for varying soil conditions.

Today, we are excited that technology finally exists where farmers can use sensing technology on the planter row unit to determine how much force is needed on the FurrowForce system to address soil variability. By using FurrowForce, an automated 2-stage closing system with integrated sensing, partnered with a 20|20 monitor, farmers can be confident of closing the seed trench, eliminating sidewall compaction/smearing, and removing air pockets all while planting through various seedbed conditions on a pass-to-pass basis.

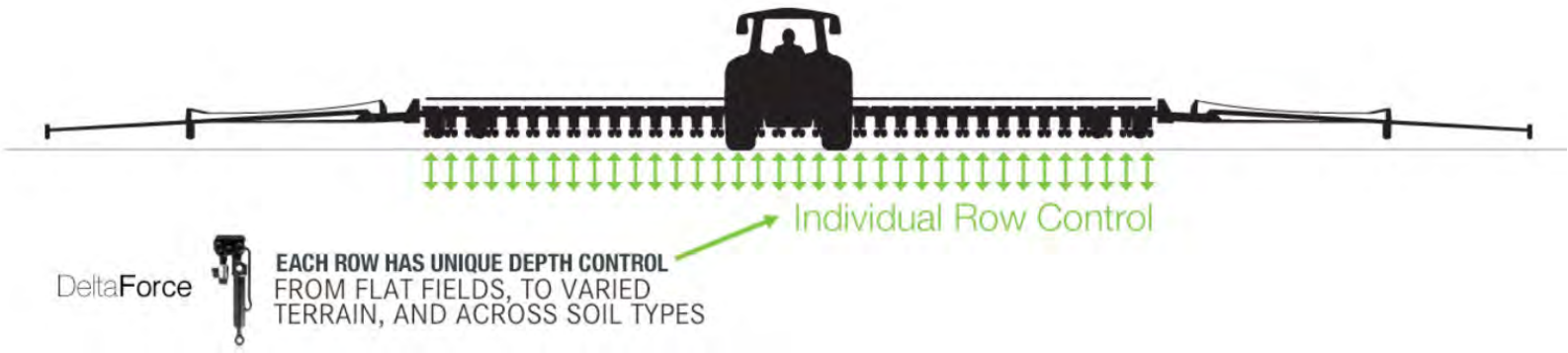
Planting Date: 5/5 *Hybrid: Wyffels 5818RIB* *Population: 36K* *Row Width: 30”* *Rotation: CAB* *Corn Price: $3.67*

DownForce Management Study

Objective: Planter row unit downforce is a common agronomic issue that often goes unaddressed. This study evaluates yield impact of implementing proper downforce compared to too light or too heavy row unit settings. When downforce matches field conditions, the depth of planting is consistent and correct. Too light of row unit downforce causes planting depth to shallow up, potentially placing seed in dry soil, creating poorly rooted plants that struggle for water and nutrients. Conversely, too much downforce can lead to furrow side-wall compaction also creating an environment that can cause limited plant access to water and nutrients.

Figure 1. DeltaForce® Cylinder

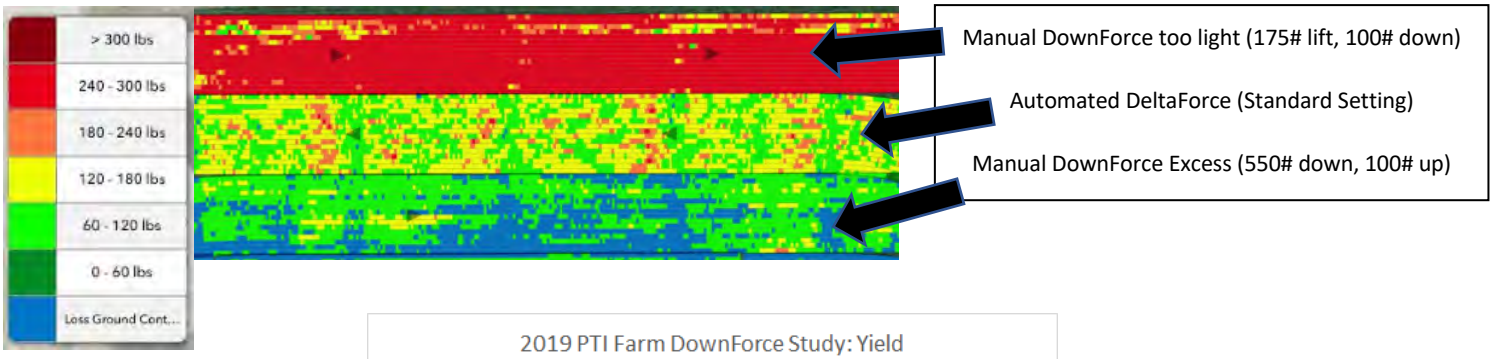
DeltaForce® replaces the springs or air bags on your planter with hydraulic cylinders (Figure 1). It automatically increases or reduces weight on each row individually, to accommodate the weight needs of that row. When one row encounters conditions different than another (wheel tracks, old road beds, clay knobs, headlands, whatever), each will adjust independently (Figure 2). Row by row, foot by foot, depth stays exactly where you want it. Row by row, foot by foot, even seed by seed, you produce an environment that fosters uniform germination, optimum growth and maximum yield.

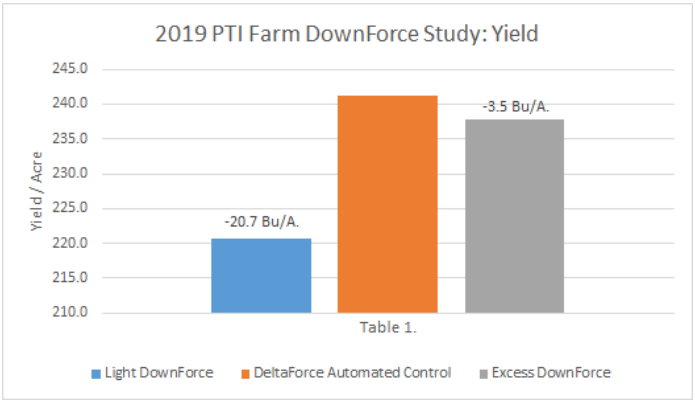


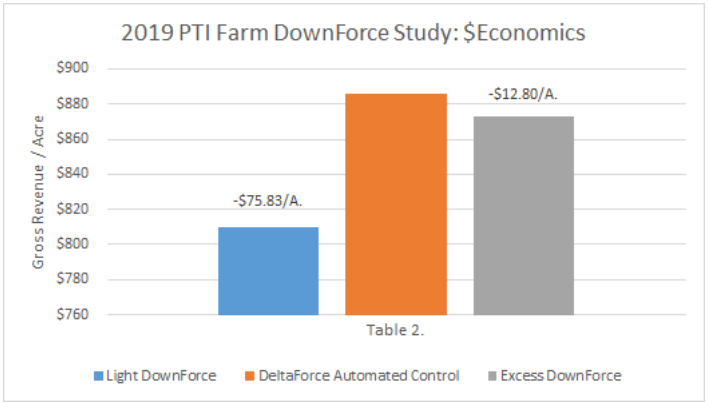
DownForce Management Study Continued:

Results: Table 1. illustrates the yield response of DeltaForce automated control compared to excess and too light downforce settings. Too light of downforce (175# lift, 100# down) resulted in the largest losses of the study with yield losses of **-20.7 Bu/A.**, while excess downforce (550# down, 100# up) offered losses of **-3.5 Bu/A.**

Table 2. reveals the economics of the automated downforce system. DeltaForce automated downforce resulted in increased revenue of +$16.87/A. compared to heavy settings **-$12.80/A.** to the light setting, ultimately averaging overall losses of **-$77.83/A.**







DownForce Management Study Continued:

Figure 1. Light Downforce

Figure 2. Good Downforce

In this particular study, planting conditions were quite difficult. Due to early persistent wet weather followed by warm/windy and dry conditions, the conventional tillage seed-bed for this trial resulted in very cloddy conditions. In these conditions, we experienced very inconsistent stands, seed to soil contact, and poor emergence as too light of downforce did not offer enough weight to keep the planter in the ground, thus allowing the row units to come up out of the ground and shallowing up planting depth into soil without adequate moisture for germination (Figure 1).

As downforce was increased, it maintained enough pressure to keep the planter row units in the ground, ensuring proper planting depth and seed planted into adequate moisture (Table 2).

Planting Date: 6/8 *Hybrid: Pioneer DKC 54-38* *Population: 36K* *Row Width: 30”* *Rotation:CAC* *Corn Price: $3.67*

Planter "All Wrong Study":

Objective: This planter trial is designed to simulate yield and economic effects when planter downforce, residue managers, and singulation are all incorrect at the same time. For this study we used too light of downforce, "goof" plates to achieve 95% singulation, and remove the use of residue managers.

Results: Table 1. reveals "All Wrong" planter settings caused yield losses of **-39.5 Bu/A.** Table 2. calculates economic losses of **-$144.80/A.** when all three planter settings are incorrect. For more information on individual performance of these attributes, please see pages 28-30 for downforce management, pages 20-21 for CleanSweep residue trials, and page 13 for Singulation studies.

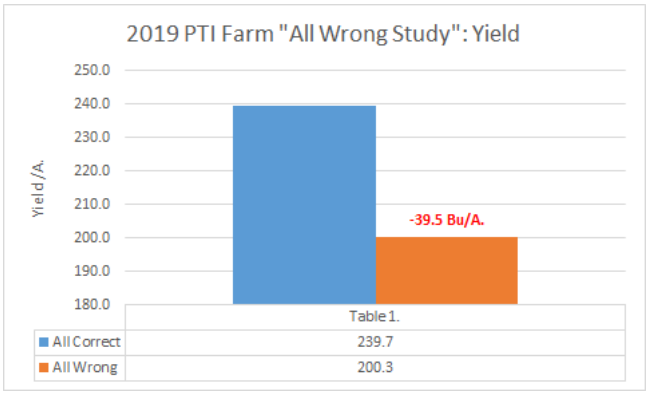


Table 1.	
All Correct	239.7
All Wrong	200.3

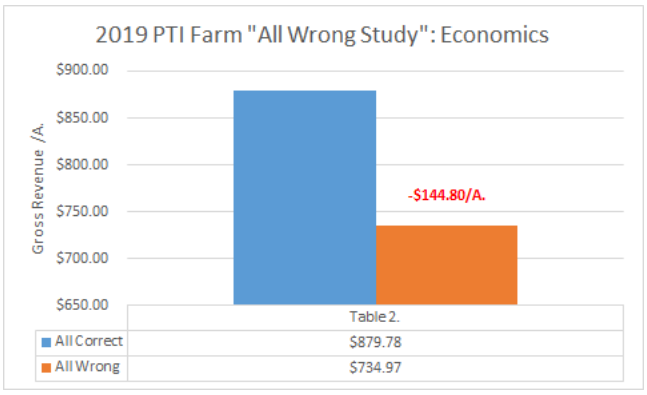


Table 2.	
All Correct	$879.78
All Wrong	$734.97

Planting Date: June 6 *Hybrid: DKC 53-56* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

Water Management and Recycling Study

Objective: When the Precision Technology Institute was acquired in the Fall of 2017, we quickly learned that our new research site was a "wet farm". We learned there was very little field tile to drain our soils to prevent yield losses. Our focus then turned to adding and installing field tile, but problems occurred with that idea as the farm had no good outlet to release the water. Interstate 55 on the west side of the farm prevents outletting water through the present road system and to make matters worse, the City of Pontiac resides on the east side of the farm, leaving no good outlet to release water without draining into municipal sewer drains.

Figure 1. Drainage Issues at PTI

Knowing that we ultimately needed to add field tile to our farm to achieve high yields and consistent research trials, we investigated how to create and sustain our own farm outlet to capture water. In the winter of 2018, we began the construction of a new "reservoir" that would be a large body of water designed to act as an outlet for our field tile installed on the farm. This reservoir is nearly 2.5 acres in size and dug near 25' deep to create enough volume to hold as much water as possible. It was dug on the lowest elevation of the farm, typically where water would stand and remove crops. This size of reservoir was designed as such to act as an outlet for 80 tillable acres. We also chose this design as an 80-acre farm is quite common in size and relatable to most farmers. As we built this system, it was our intention from day one to keep this project practical, realistic, and purposely as a system that many farmers could employ on their farms that could also have drainage issues but no outlet currently.

Figure 2. Digging of "Farm Reservoir"

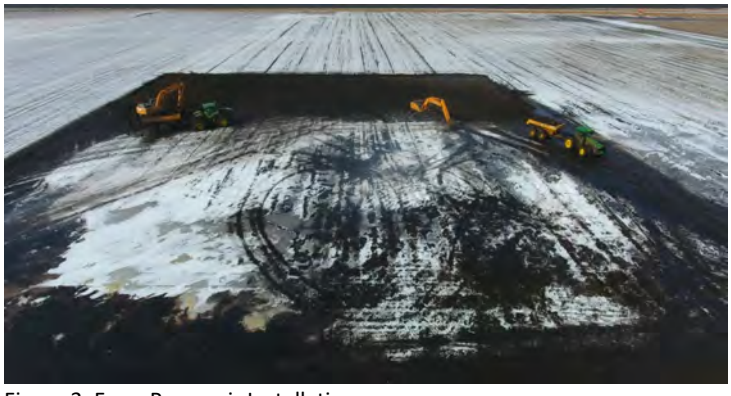


Figure 3. Farm Reservoir Installation

Water Management and Recycling Study Continued

Once the reservoir was complete, we then began the process of installing field drainage tile (Figure 4). Phase 1 of the project included field tile V-Plowed on mostly 30' or 60' patterns, but some 120' tile was installed to compare agronomic yield and economic returns of various sizes of field tile (Figure 5). It is our intention and desire to monitor this tile performance over the next two decades to understand how tile performs and how long it takes to pay for the system economically.

A very important piece to this project is water capture. Rainwater is collected from rain entering the soil profile and filtered through our field tile drainage system.

Water mains were installed around the farm reservoir to then collect and direct water from our new tile system into a station designed to "lift" water from the drainage system and deposits water to fill the reservoir.

This water in the farm reservoir is held in place until July and August where it is available to be "recycled" for irrigation purposes. The recycling of rainwater in this project is truly unique and offers sustainability advantages for farmers that have both drainage issues and the lack of water for irrigation of crops.

Figure 4. ADI V-Plow Tile Installation

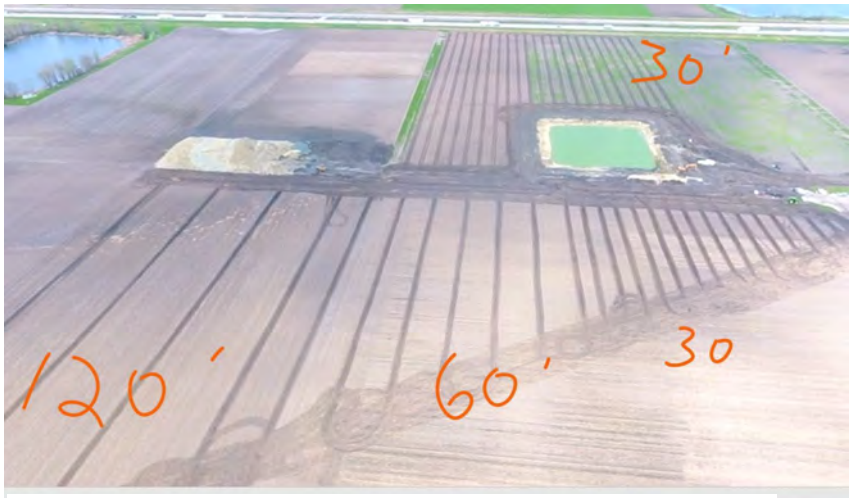


Figure 5. 30', 60', 120' Tile Patterns

Figure 6. Completed Farm Reservoir

Water Management and Recycling Study Continued:

As was discussed earlier in this study, the spring of 2019 was one that offered heavy rains, saturated soils, and record late planting. Table 1. reports the yield gains from the various pattern tile spacings that were newly installed at the PTI Farm. 30' tile spacing offered the highest yield increases in the study with +42.1 Bu/A. gains. 60' pattern tile gains +22 Bu./A., however a **-47.7%** decrease from the 30' tile spacing. 120' pattern tile only offered +3.7 Bu/A. advantage due to the wide spacing and lack of enough tile to get water away.

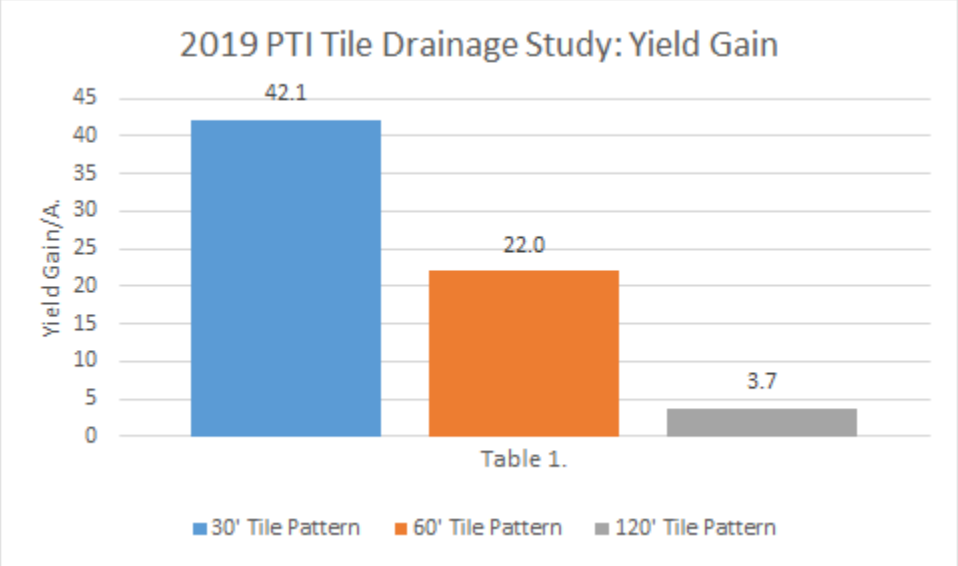
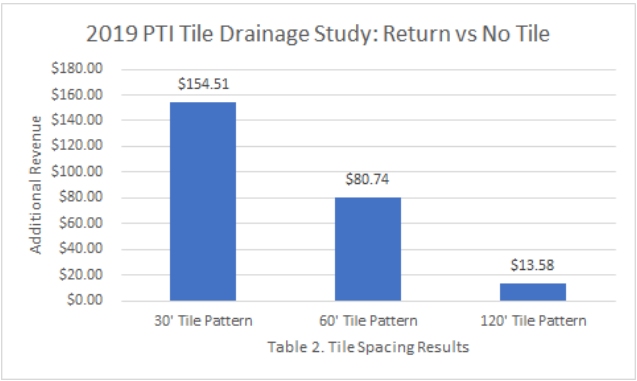
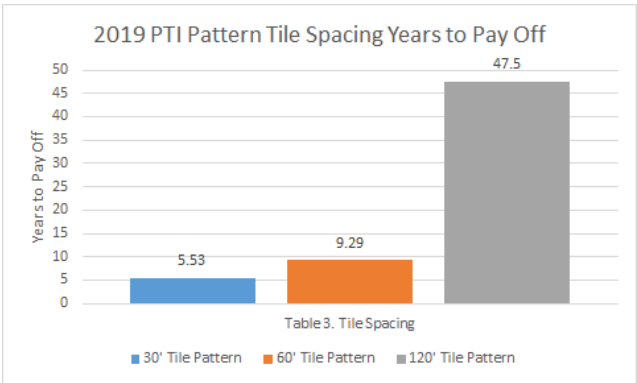


Table 2. illustrates the additional revenue received from yield gains associated from the tile. 30' tile patterns garnered +$154.51/A. additional revenue over areas without tile drainage. 60' tile patterns offered +$80.74/A. and 120' tile patterns only an additional +$13.58/A.



Using these revenue gains, Table 3. reports the number of years needed to pay for the tile installation. Given the large yield response for tile in 2019 and if this would continue year after year, 30' tile would pay back after only 5.53 years, 60' tile in 9.29 years and 120' tile would take a long 47.5 years to pay for itself.



Water Management and Recycling Study Continued:

Another very unique attribute to the PTI Farm's Water Management Project is the ability to recycle rainwater. Using the field tile to collect and deposit rainwater into the reservoir, we had millions of gallons of water to use as irrigation. As stated earlier, the PTI farm experienced a dry July and August which highlighted our need to feed the crop with water. Table 4. illustrates recycling water to use as irrigation offered yield responses of +42.5 Bu./A. We were very grateful for the +42.5 Bu/A. yield response. However, it is noteworthy that this irrigation system did not get fully installed in the field until the pollination growth stage. This late completion did cost yield due to the drought conditions in July and August. However, we look forward to seeing how far we can push corn yields in the future now that this system is in place and can be fully utilized throughout the entire growing season if needed.

Table 4. also depicts the advantages of using both tile drainage and the recycled rainwater as irrigation offering tremendous yield gains. Using both the attributes of drainage and recycled rainwater for irrigation, average corn yields were increased by +67.5 Bu/A.

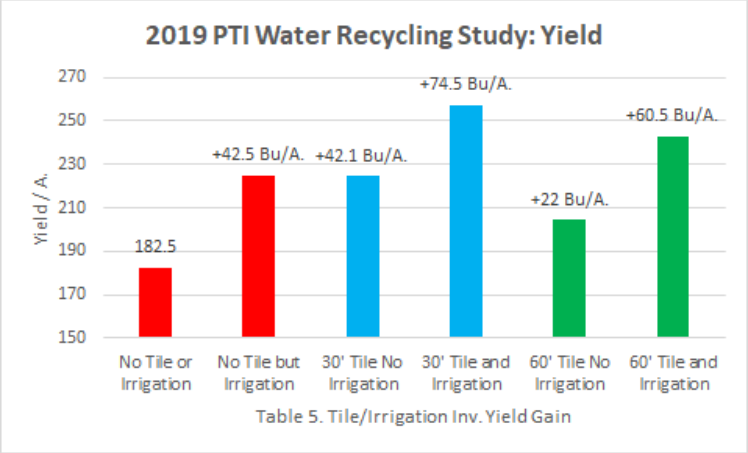


Table 5. Tile/Irrigation Inv. Yield Gain

30' Tile spacing along with irrigation offered the largest gains of +74.5 Bu/A. in the study. Widening the tile pattern to 60' along with irrigation performed exceptionally as well, with yield gains of +60.5 Bu/A.

Table 5. illustrates gross revenue advantages for each the 30' and 60' tile patterns with recycled rain water irrigation ranging from +$222.04/A. to +$273.42/A., some of the largest gains received at the PTI farm in 2019.

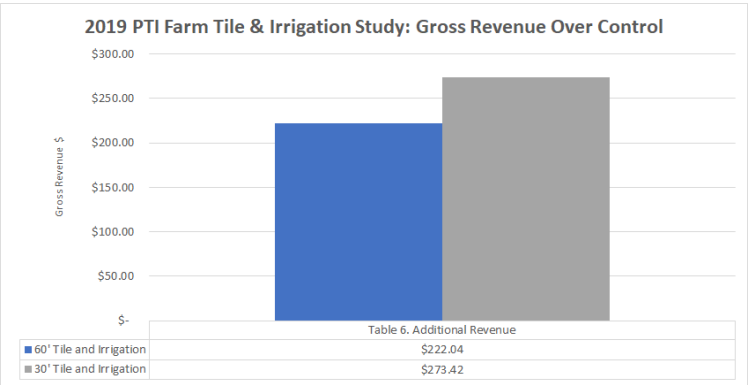


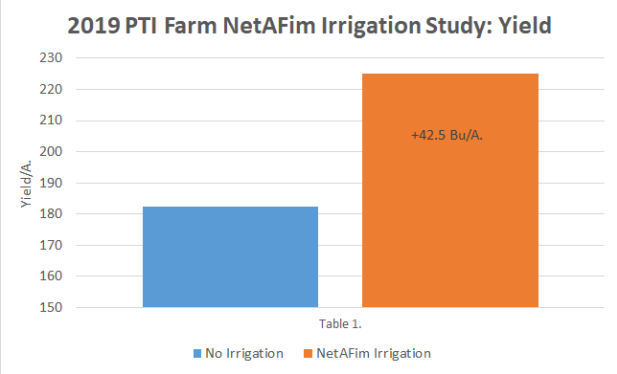
Table 6. Additional Revenue

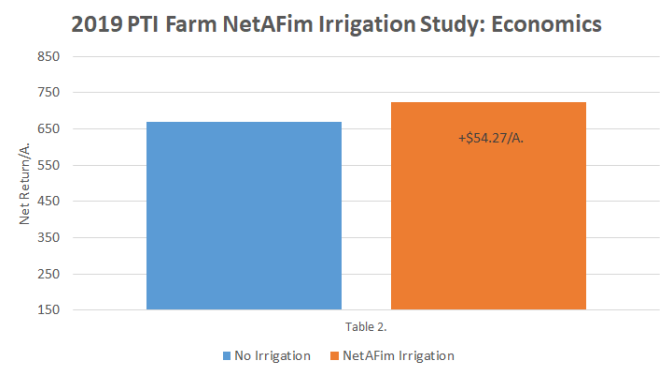
60' Tile and Irrigation	$222.04
30' Tile and Irrigation	$273.42

Planting Date: June 6 *Hybrid: DKC 53-56* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

High Yield Irrigation Study

Objective: This study evaluates NutriDrip irrigation and its ability to feed corn with water and nutrients for high yield potential. This method of irrigating a crop uses a NETAFIM™ drip tape with small pressure regulated emitters evenly spaced at 24" apart. Drip tape in this study is not sub-surface irrigation, rather the team at PTI installed this system on the soil surface to demonstrate how the system works and to have mobility with irrigating trials at the PTI farm in the future. Water was accessed from the new water recycling management program. See pages 30-33 for more details on this project.





Results: Table 1. illustrates that NutriDrip irrigation resulted in corn yield gains of +42.5 Bu/A. over the non-irrigated control. This was mainly due to drought conditions that persisted in July and August. The equivalent of 10" of rain was applied through drip irrigation. Fertigation was also implemented to apply 60lbs of additional UAN 32% ($27.28), 2pts Boron ($4.63/A.), and 5 Gal/A. Ammonium Thiosulfate ($8.80/A.). All treatments incurred additional expenses of $53/A., as well as $61/A. in pumping costs. Table 2. illustrates that NutriDrip irrigation resulted in net economic gains of +$54.27/A. It is noteworthy that this irrigation system did not get fully installed until the pollination growth stage. This late completion did cost yield due to the drought in July and August. We look forward to seeing how far we can push corn yields in the future now that this system is in place and can be fully utilized throughout the entire growing season if needed.

NETAFIM™
GROW MORE WITH LESS

Planting Date: June 9 *Hybrid: DKC 53-56* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

Saturated Cold Germination Corn Study:

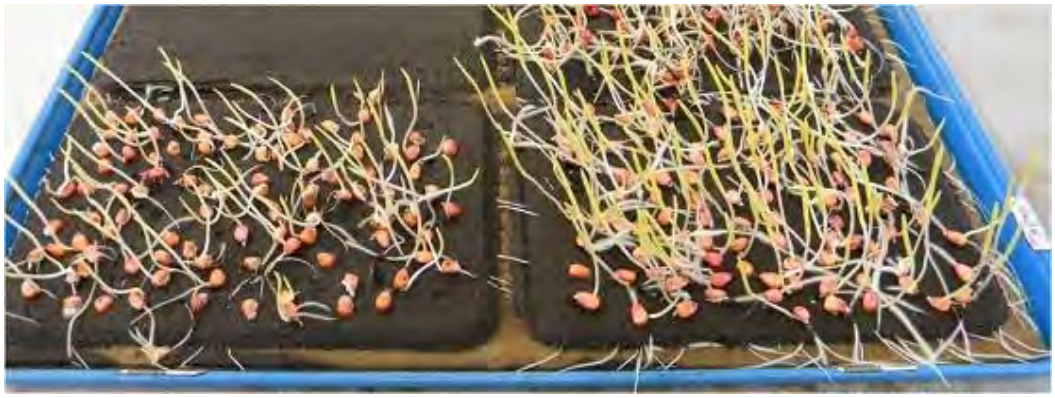
Objective: To evaluate the correlation of yield and economic response of corn hybrids that have a contrast in regard to germination scores. In general, there are three germination tests farmers can utilize to estimate emergence under various environmental conditions.

- **Warm Germ:** Seed placed in moist soil, at 77 °F for 7 days. Simulates a grower planting in ideal, warm soil temperatures. Does **not** predict how seeds will emerge under stressful, cold and/or wet soil.
- **Cold Germ:** Seed placed in cold, 50 °F soils, for 7 days, then transitioned to 77 °F soil to for 4 days. Simulates a grower planting in cold soils. Predicts how seeds will emerge under cold conditions, but does **not** account for saturated soil moisture content.
- **Saturated Cold Germ:** Seed placed in 100% saturated, cold 50 °F soil, then transitioned to 77°F soil for 4 days. Simulates a grower planting in both cold, wet soils.

This study evaluates two corn hybrids with near similar germination scores for both warm/cold germination tests, however have drastic differences in saturated cold germination scores. Table 1. illustrates the germination scores for two hybrids and indicates that Hybrid B achieved 98-99% germ scores in both warm and cold tests. However, the same hybrid had a 40% saturated cold germ score. Knowing this before planting, our goal was to evaluate each hybrid planted in the cold and wet conditions of April as well as the warm and dry conditions of June.

Table 1.	Warm Germ %	Cold Germ %	Saturated Cold Germ %
Hybrid A	99%	99%	87%
Hybrid B	98%	99%	40%

Figure 1. Germination Testing in Seed Lab

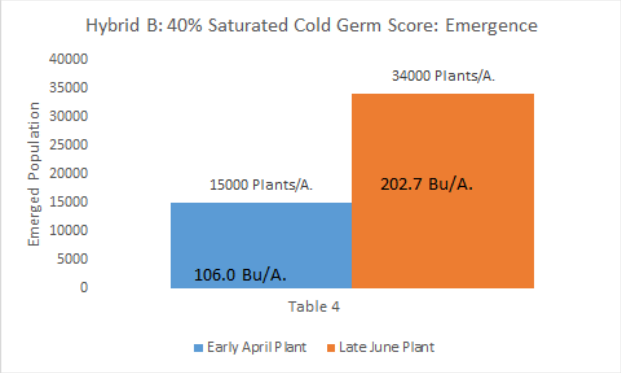


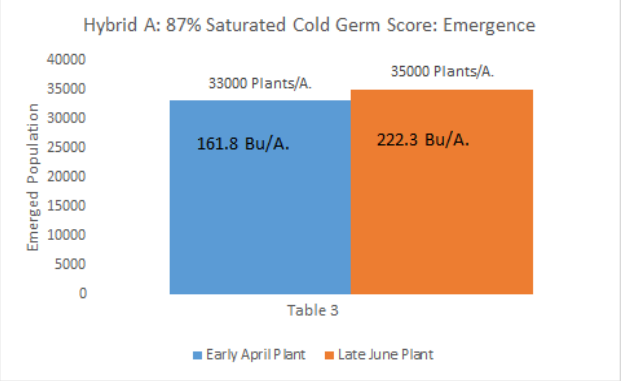
Saturated Cold Germination Corn Study Continued:

Table 2. reveals the emergence scores of both hybrids, planted in cold, wet conditions in April versus warmer, drier conditions in June. Note that Hybrid B suffered a **-56%** emergence reduction, more than likely due to a saturated cold germ score of only 40% (Table 1). In contrast, Hybrid A only suffered **-6%** emergence reductions due to the fact that it had a much-improved saturated cold germ score of 87%. The reduced emergence score of Hybrid B resulted in **-48%** yield losses (Table 4).

This is why growers should consider performing saturated cold germination tests on all seed purchased to eliminate this situation from happening, or at least indicating to a grower that this hybrid should not be planted early in cold, wet conditions but rather planted later in warmer, drier soils that could be less stressful.

Table 2.	Emergence Scores	
Planted at 36,000 Population	Hybrid A: 87% High Germ	Hybrid B: 40% Low Germ
April 26th Planting Date	33,000	15,000
June 5th Planting Date	35,000	34,000





In summary, a $25 saturated cold germ test could have prevented a potential full replant scenario or, given the situation where a grower would have left the poor germ 15,000 stand establishment, a **-55.8 Bu/A.** yield loss equating to net economic losses of **-$204.69/A.**

Centuro Denitrification Study

Objective: To evaluate Centuro, a nitrification inhibitor used to inhibit the oxidation of ammoniacal nitrogen to nitrate nitrogen. In this study, Centuro is tank mixed with 27 Gal/A. UAN 32% nitrogen and applied via dual band Conceal at 2.5 Gal/Ton.

CENTURO

Nitrification Inhibitor, Fertilizer Additive

CENTURO™ is a nitrification inhibitor. It is used to delay nitrification of ammoniacal and urea nitrogen fertilizer by inhibiting the oxidation of ammoniacal nitrogen to nitrate nitrogen.

CENTURO™ can be used for canola, corn, cotton, rice, small grains, sorghum, and wheat where a nitrification inhibitor is needed and the fertilizer nitrogen is placed on or below the soil surface.

Active Ingredients:	
Pronitridine (CAS RN 1373256-33-7)	14%
Other ingredients:	86%
Total:	100%

Contains 1.495 pounds of active ingredient per gallon

Results: Due to persistent rainfall and saturated soil conditions, Centuro offered protection to nitrogen losses and proved yield gains of +16.0 Bu/A. (Table 1).

Table 2. illustrates a positive return on investment of +$48.18/A. as a result.

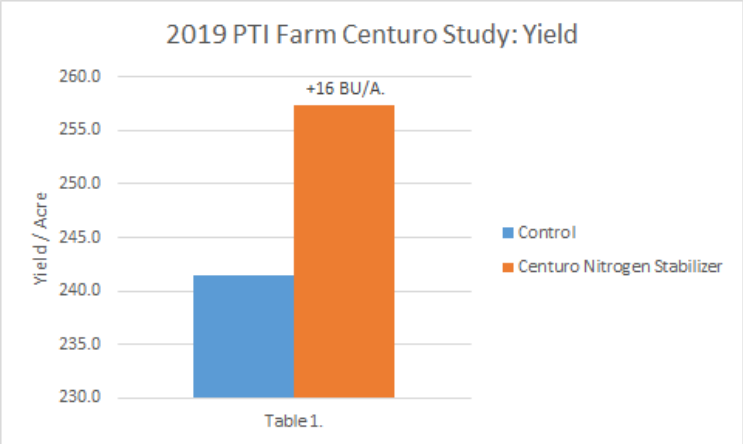


Table 1.

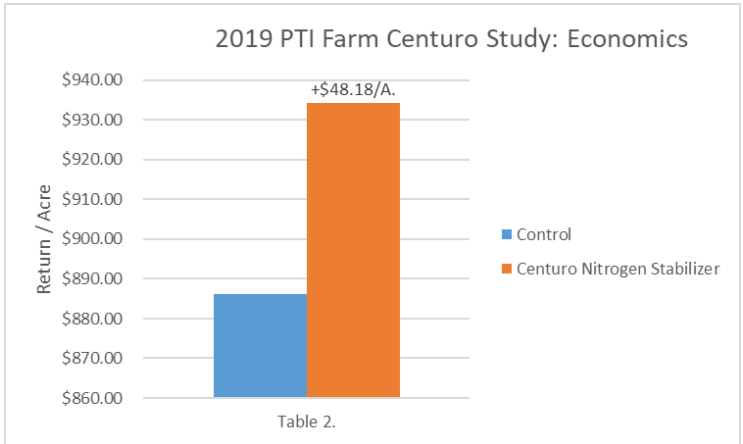


Table 2.

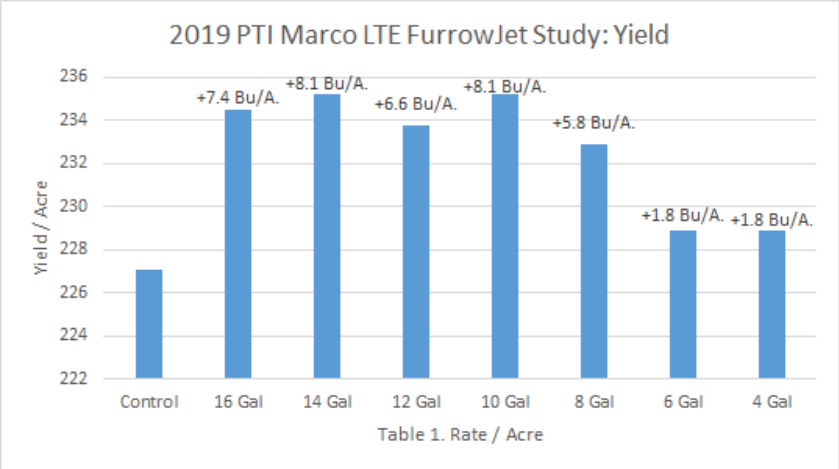
Planting Date: 6/12 *Hybrid: DKC 61-40* *Population: 34K* *Row Width: 30”* *Rotation: CAC*

Corn Price: $3.67 *Centuro: $28/Gal.*

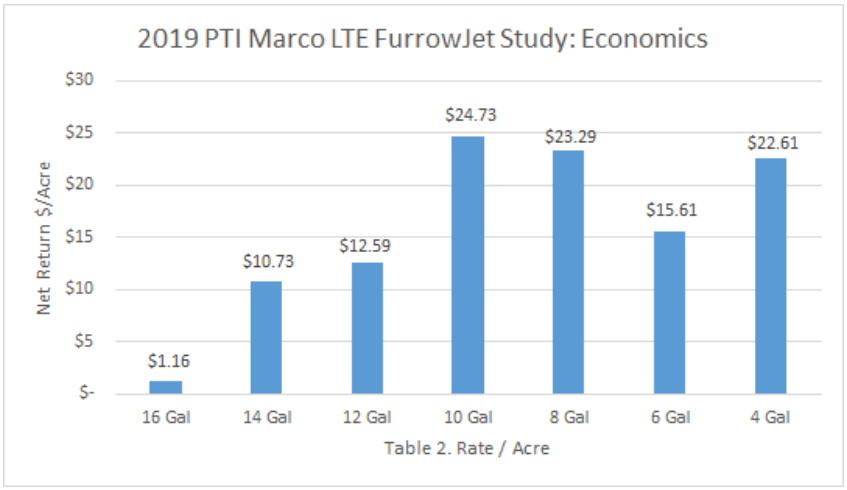
Marco QuickGrow LTE FurrowJet Study

Objective: To evaluate the yield and net return of Marco Fertilizer's QuickGrow LTE 6-20-4-.25Zn-2.7S liquid starter fertilizer. Seven different rates were used in a tri-band FurrowJet application at planting. QuickGrow LTE is a 70% polyphosphate and 30% orthophosphate formulation of nitrogen, phosphorus, potassium, sulfur, and EDTA Zn.

Results: Table 1. illustrates that 100% of FurrowJet treatments of QuickGrow LTE proved positive yield increases. Higher application rates of 8-16 gal/A. offered the largest yield increases in this study with positive gains ranging from +5.8 to +8.11 Bu/A. In regard to agronomic optimum rate, 14 Gal/A. provided the actual highest yield response of +8.11 Bu/A.



As we focus on return on investment (Table 2.), the economic optimum rate in this study proved to be 10 gal/A., netting an additional +$24.73/A. over the untreated control. All application rates proved net economic gains, however as rates were applied over 10 Gal/A., net returns started to diminish significantly due to lower individual yield response coupled with higher cost of product.



MARCO Liquid Fertility

Planting Date: 6/8 *Hybrid: DKC 53-56* *Population: 36K* *Row Width: 30"* *Rotation: CAB* *Corn Price: $3.67*

Fertilizer Pricing: Marco LTE 6-20-4-.25Zn-2.7S $3.50/Gal $30 DAP Reallocation

AgroLiquid accesS Sulfur FurrowJet Study

Objective: This study evaluates AgroLiquid's accesS, a 7-0-0-17S high-efficiency liquid sulfur fertilizer in FurrowJet wings only (Figure 2.) application at 0, 2.5, and 5 Gal/A.

Results: Table 1. illustrates yield responses ranged from +2.4 to +5.0 Bu/A. from accesS applications. As rates were pushed to 5 Gal/A., yield gains were diminished.

Table 2. economics indicates optimum rate at only 1 Gal/A. As rates climbed to 2.5 and 5 Gal/A., yield gains were not enough to offset cost of product.

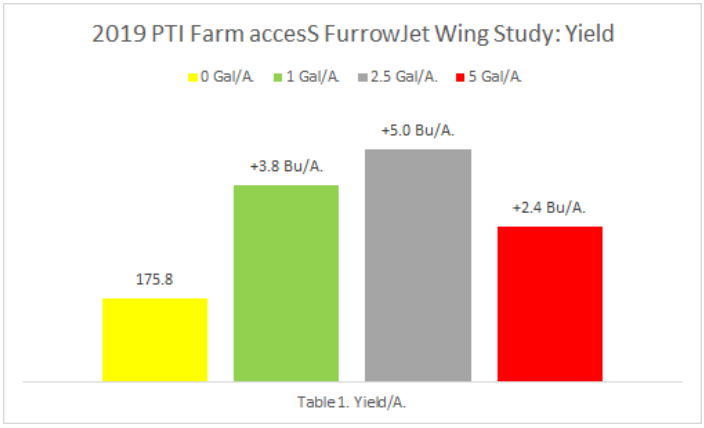


Table 1. Yield/A.

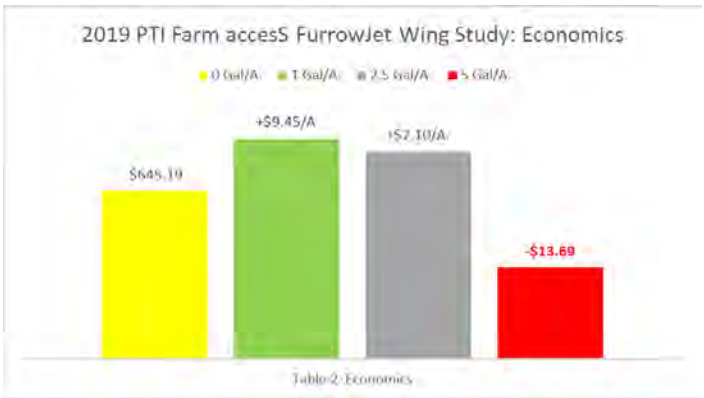


Table 2. Economics

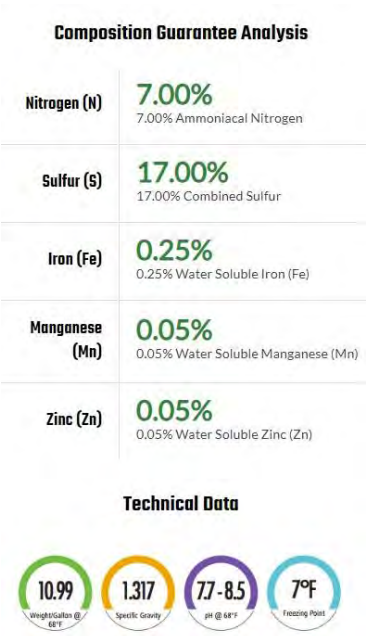


Figure 2: FurrowJet Wing Application

Planting Date: 6/8 *Hybrid: DKC 54-38* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

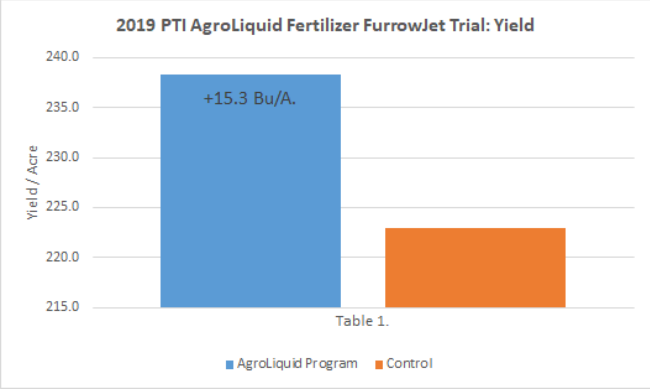
AgroLiquid Starter Fertilizer FurrowJet Study

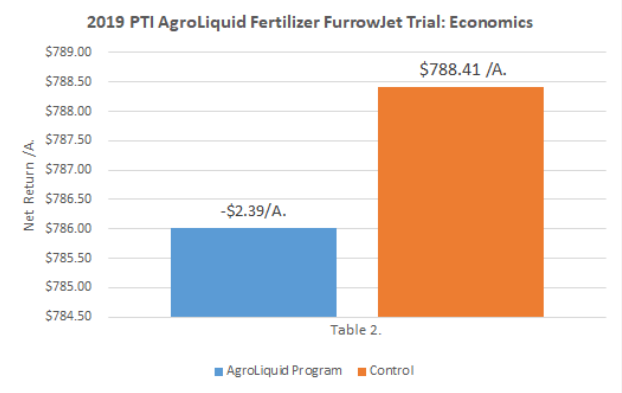
Objective: To evaluate the yield and net return of a blend of AgroLiquid starter fertilizers (Table 1). The following products are used in this in-furrow study as a single at-plant application:

Table 1.

Product/A.		Application
3-Gal Pro-Germinator	9-24-3	FurrowJet
7 Gal Kalibrate	2-1-6	FurrowJet
3 Qt Micro 500	.02B-.25Cu-.37Fe-1.2Mn-1.8Zn	FurrowJet
1 Qt C-Tech	Hydrophobic Fulvic Acid	FurrowJet
20 Gal 32% UAN	32-0-0	Conceal
2 Gal accesS	7-0-0-17S-.25Fe-.05Mn-.05Zn	Conceal
1pt Boron		Conceal

Results: Table 1. illustrates the AgroLiquid fertility program achieved excellent average yield gains of +15.3 Bu/A. However, Table 2. depicts net returns tallied **-$2.39/A.** Please note that our fertilizer re-allocation only accounted for phosphorus and should have allowed for potassium credit of $44.80/A. due to Kalibrate contribution of this study.





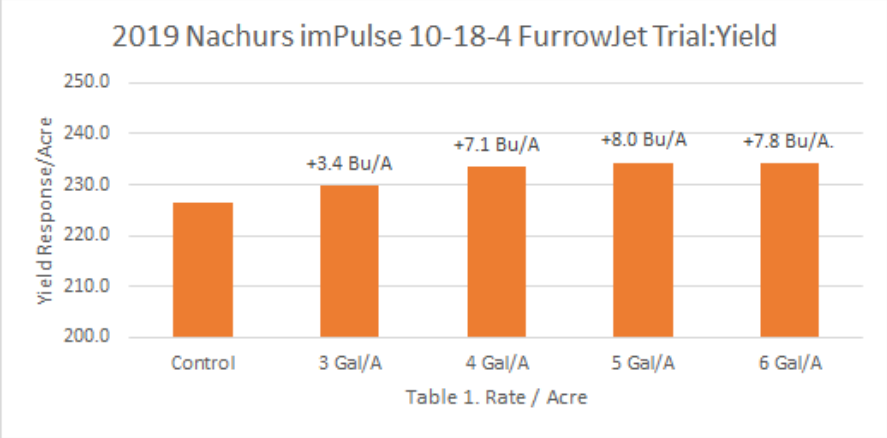
Planting Date: 6/8 *Hybrid: DKC 53-56* *Population: 36K* *Row Width: 30"* *Rotation: CAB* *Corn Price: $3.67*

Fertilizer Pricing: ProGerm $6.50 *Kalibrate: $6.40* *Micro500: $18.38* *Boron: $18.50* *C-Tech: $32* *AccesS: $4.50* *$30 P Reallocation*

Nachurs imPulse Starter Fertilizer FurrowJet Study

Objective: To evaluate the yield and net return of Nachurs imPulse liquid starter fertilizer applied at 3 to 6 gallons per acre applied through a 3-way FurrowJet band. 1 Qt/A. of CropMax (Table 2.) and 2 Gal/A. of ammonium thiosulfate was also applied as a tank mix partner.

Results: All rates of 10-18-4 achieved positive yield response (Table 1.), however 5 gal/A. proved agronomic optimum yield at +8.0 Bu/A. Economic optimum rate was achieved at the 4 Gal/A. rate with net returns of +34.90/A.



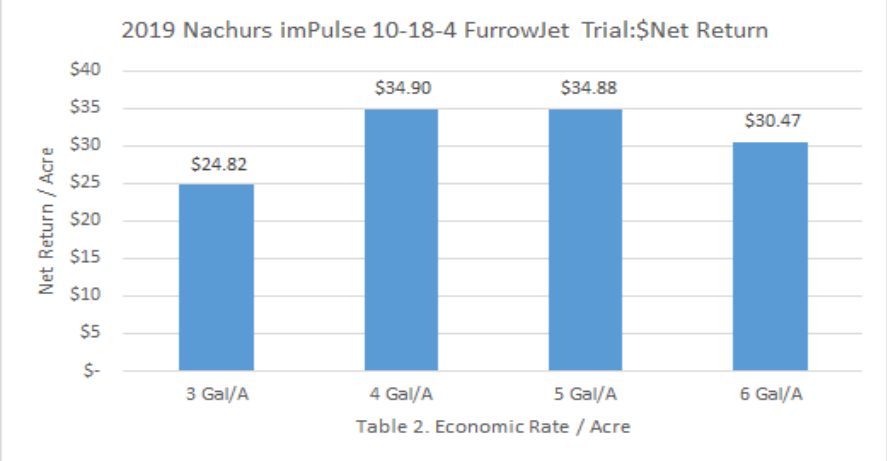


Table 2. CropMax

2-0-2-.1B-.15Cu-.3Fe-1.5Mn-.0005Mo-4Zn Liquid Fertilizer

Nutrients Supplied
(pounds per gallon)

Total Nitrogen (N)	0.204
Soluble Potash (K20)	0.204
Boron (B)	0.010
Copper (Cu) EDTA	0.015
Iron (Fe) EDTA	0.031
Manganese (Mn) EDTA	0.153
Molybdenum (Mo)	0.00005
Zinc (Zn) EDTA	0.409

Derived from: ammonium hydroxide, potassium hydroxide, boric acid, copper EDTA, iron EDTA, manganese EDTA, sodium molybdate, zinc EDTA

10-18-4 Liquid Fertilizer

Nutrients Supplied
(pounds per gallon)

Total Nitrogen (N)	1.06
Available Phosphate (P_2O_5)	1.91
Soluble Potash (K_2O)	0.42

Derived from: ammonium hydroxide, urea, phosphoric acid, potassium acetate, and potassium hydroxide.

Planting Date: 6/9 *Hybrid: DKC 53-56* *Population: 36K* *Row Width: 30"* *Rotation: CAB* *Corn Price: $3.67*

Fertilizer Pricing: $30/A DAP Re-Allocation *imPulse: $3.50/Gal* *CropMax: $14.55/Gal* *ATS: $1.76/Gal.*

Nachurs imPulse FurrowJet Wing Placement Trial

Objective: To evaluate the effect on yield when Nachurs imPulse 10-18-4 starter fertilizer is placed at 4, 5, and 6 Gal/A. in FurrowJet wing configurations only(Figure 3). For this study, FurrowJet center is not utilized. (Figures 1-2)

Results: Tables 1-2, illustrate that all rates of imPulse 10-18-4 resulted in yield gains and positive return on investment. However, 6 Gal/A. achieved agronomic optimum yield at +9.2 Bu/A. as well as economic optimum rate with a positive return on investment of +$39.76/A. As rates decreased at 4 to 5 Gal/A., yield response dropped to +6.5 and +4.4 Bu/A. respectively.

Figure 1. FurrowJet Side View

Figure 2. FurrowJet Placement

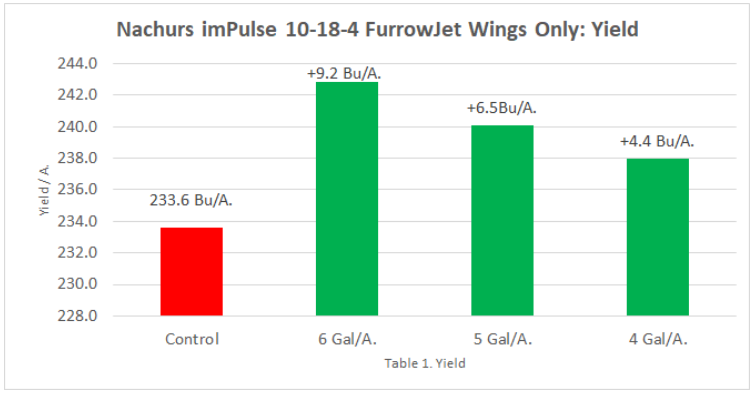
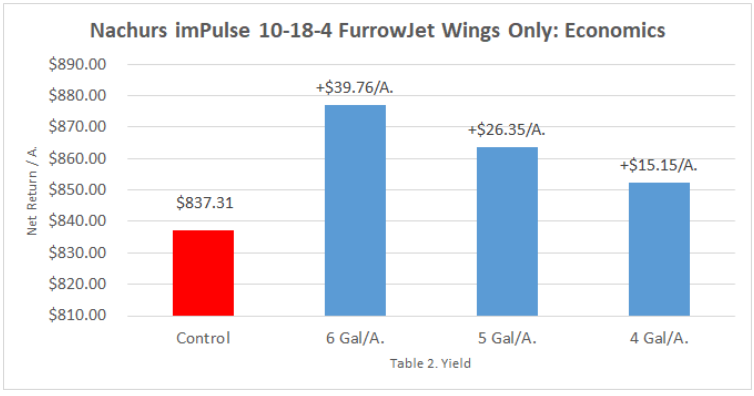


Figure 3. Nachurs imPulse Starter



10-18-4 Liquid Fertilizer

Nutrients Supplied
(pounds per gallon)

Total Nitrogen (N)	1.06
Available Phosphate (P_2O_5)	1.91
Soluble Potash (K_2O)	0.42

Derived from: ammonium hydroxide, urea, phosphoric acid, potassium acetate, and potassium hydroxide.

Planting Date: 6/9 *Hybrid: DKC 53-56* *Population: 36K* *Row Width: 30"* *Rotation: CAB* *Corn Price: $3.67*

Fertilizer Pricing: $20/A DAP Re-Allocation imPulse: $3.50/Gal

Nachurs imPulse FurrowJet Placement Trial

Objective: To evaluate the effect on yield when Nachurs imPulse 10-18-4 starter fertilizer is applied in various FurrowJet placement configurations. This study will compare the following rates and placement:

2X2 = 2 Gal FurrowJet Center + 2 Gal FurrowJet Wings

3X3 = 3 Gal FurrowJet Center + 3 Gal FurrowJet Wings

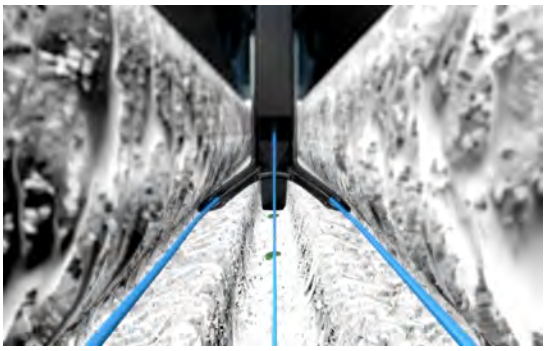
4X4 = 4 Gal FurrowJet Center + 4 Gal FurrowJet Wings

5X5 = 5 Gal FurrowJet Center + 5 Gal FurrowJet Wings

6X6 = 6 Gal FurrowJet Center + 6 Gal FurrowJet Wings

Figure 1. FurrowJet Side View

Figure 2. FurrowJet Placement



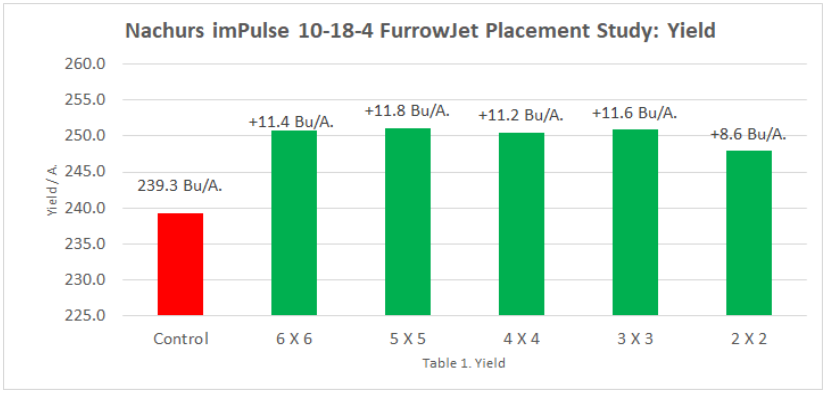


Table 1. Yield

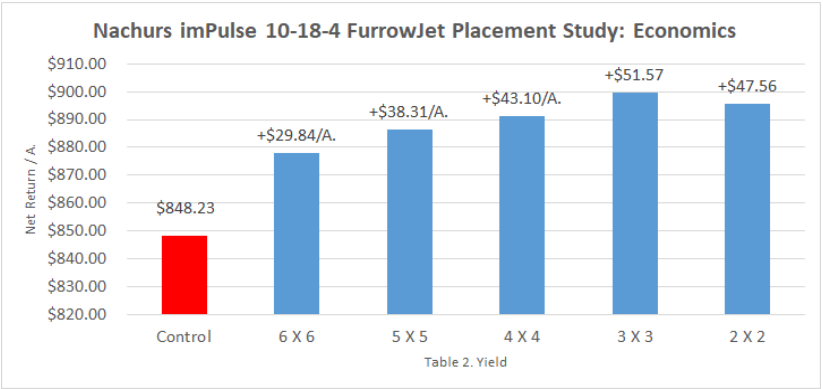


Table 2. Yield

Results: Tables 1-2 illustrate that all rates and placements of imPulse 10-18-4 proved yield gains of +8.6 to +11.8 Bu/A. and a return on investment of +$29.84 to +$51.57/A.

However, the 3X3 Gal/A. proved agronomic and economic optimum rate with gains of +11.6 Bu/A. and a return on investment of +$51.57/A.

As rates were increased over the 3X3 rate, yield gains were not received to offset the cost of the product.

Planting Date: 6/9 *Hybrid: DKC 53-56* *Population: 36K* *Row Width: 30"* *Rotation: CAB* *Corn Price: $3.67*

Fertilizer Pricing: $30/A DAP Re-Allocation imPulse: $3.50/Gal

Nachurs imPulse FurrowJet Placement Trial

Objective: To evaluate the effect on yield when Nachurs imPulse 10-18-4 starter fertilizer is applied in various FurrowJet placement configurations. This study will compare the following rates and placement:

5X10 = 5 Gal FurrowJet Center + 10 Gal FurrowJet Wings

4X8 = 4 Gal FurrowJet Center + 8 Gal FurrowJet Wings

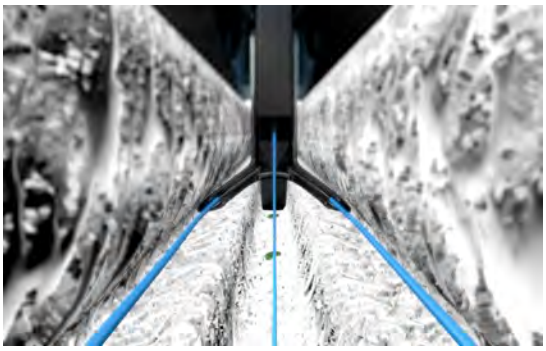
3X6 = 3 Gal FurrowJet Center + 6 Gal FurrowJet Wings

2X4 = 2 Gal FurrowJet Center + 4 Gal FurrowJet Wings

1X2 = 1 Gal FurrowJet Center + 2 Gal FurrowJet Wings

Figure 1. FurrowJet Side View

Figure 2. FurrowJet Placement



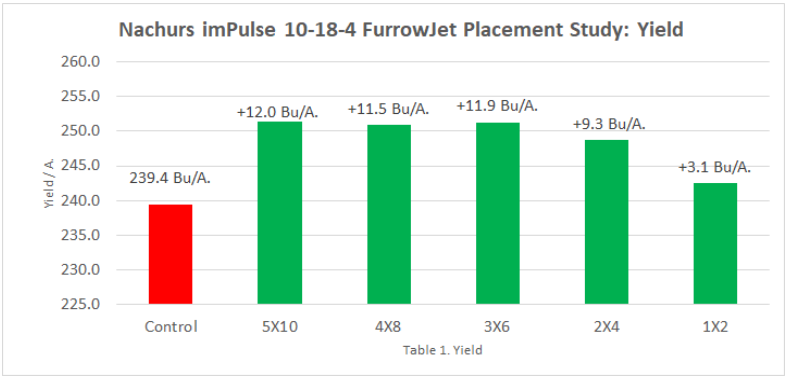


Table 1. Yield

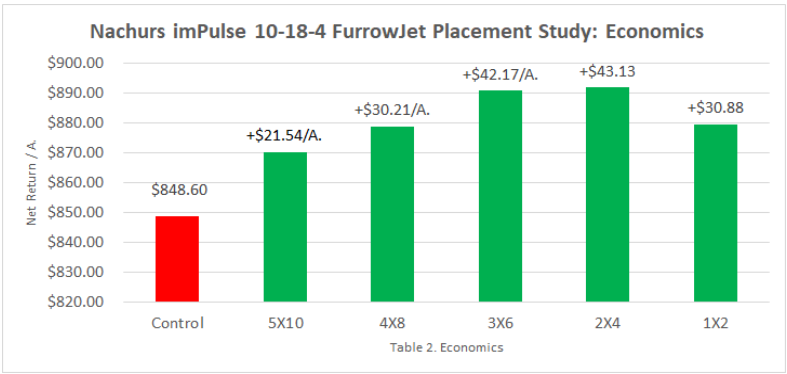


Table 2. Economics

Results: Tables 1-2 illustrate that all rates and placements of imPulse 10-18-4 proved yield gains of +3.1 to +12.0 Bu/A. with positive returns on investment ranging from +$21.54/A. to +$43.13/A.

The 2X4 and 3X6 Gal/A. rates performed similarly with yields within 2.6 Bu/A. and only a difference of $0.96/A.

As rates were increased over the 3X6 rate to 4X8 and 5X10, yield gains were not received to offset cost of product.

Planting Date: 6/9 *Hybrid: DKC 53-56* *Population: 36K* *Row Width: 30”* *Rotation: CAB* *Corn Price: $3.67*

Fertilizer Pricing: $30/A DAP Re-Allocation imPulse: $3.50/Gal

Sunrise Coop PCT Nutrition Study

Objective: To evaluate the yield and net return of PCT nutrition products in FurrowJet and Conceal at-plant applications.

Results: Table 1. illustrates PCT Nutrition products produced yield gains of +0.3 to +13.8 Bu/A. with the highest yield gains resulting from using all products in both a FurrowJet and Conceal combination program.

Table 2. summarizes net return and indicates positive net returns of +$6.70/A. to +$17.62/A with combination treatments respectively. Single Conceal applications provided net losses of -$12.90/A.

NutraBurst™ SuperBlue

GUARANTEED ANALYSIS
Total Nitrogen 18.0%
Available Phosphate (P_2O_5) 0.0%
Soluble Potash (K_2O) 0.0%
Sulfur 1.5%
Derived from: Urea, ammonium sulfate.

StandUp® Premium P Corn Starter

GUARANTEED ANALYSIS
Total Nitrogen 6.0%
Available Phosphate (P_2O_5) 24.0%
Soluble Potash (K_2O) 6.0%
Zinc 0.103%
Derived from: Urea, monopotassium phosphate, ammonia, phosphoric acid, ammonium polyphosphate, zinc oxide, EDTA and IDS.

StandUp Fertizol™ Zn

Principal Functioning Agents

Grade 4-0-0
GUARANTEED ANALYSIS
Total Nitrogen (N) 4.0%
4.0% Ammoniacal Nitrogen (N)
Zinc (Zn) 4.5%
4.5% Chelated Zinc (Zn)
DERIVED FROM: Aqua Ammonia, Zinc EDDHA and Zinc EDTA

BioBuild™ BioComplete

GENERAL INFORMATION
PCT | Sunrise BioBuild™ BioComplete contains a unique blend of over twenty beneficial microorganisms, selected species of azospirillum, bacillus, pseudomonas, streptomyces, cellulomonas, and cellulomonas and organic acids. This product is designed to increase flower production, promote healthier and more vigorous root systems along with phosphate solubilization and nitrogen fixation.

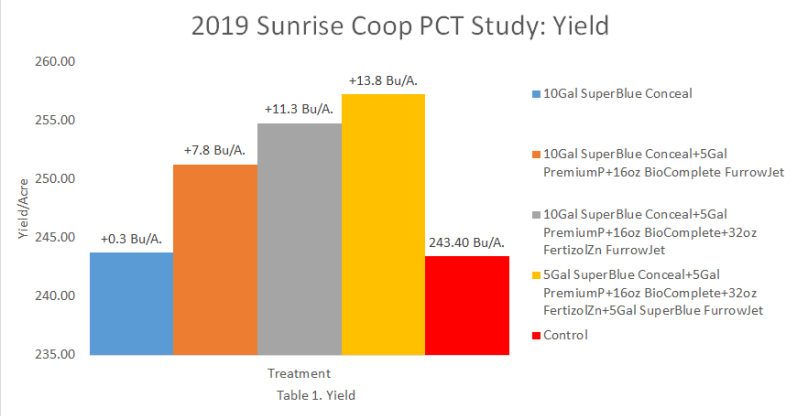


Table 1. Yield

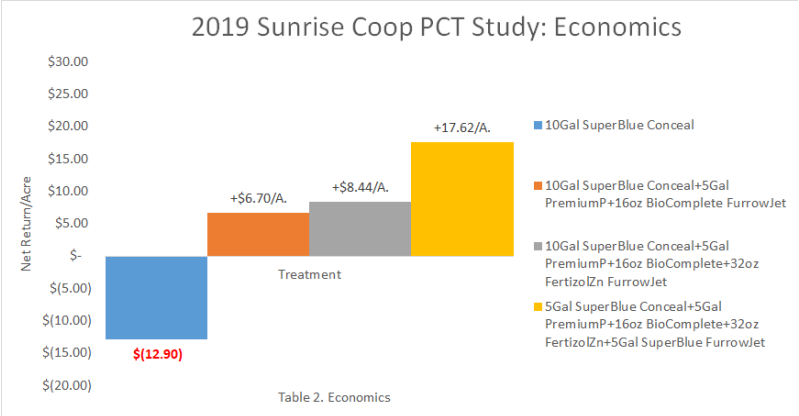


Table 2. Economics

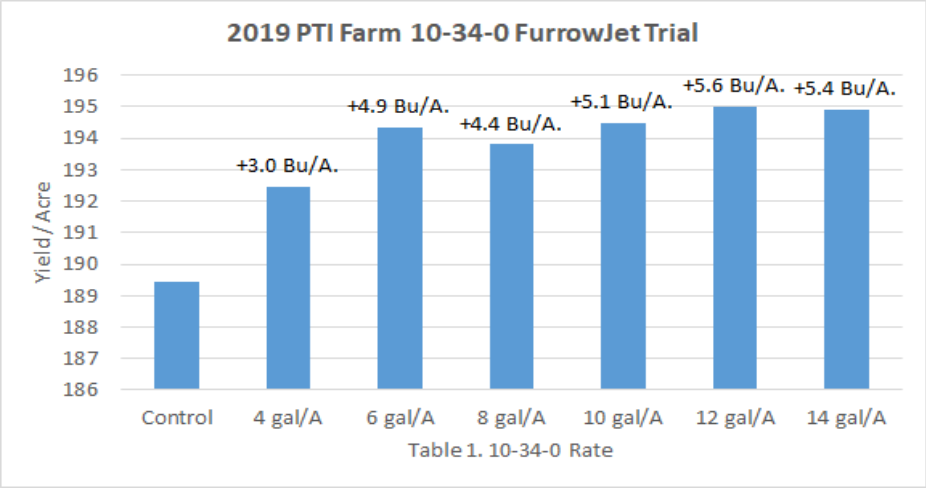
Planting Date: 6/10 *Hybrid: DKC 51-38* *Population: 36K* *Row Width: 30”* *Rotation: CAB* *Corn Price: $3.67*

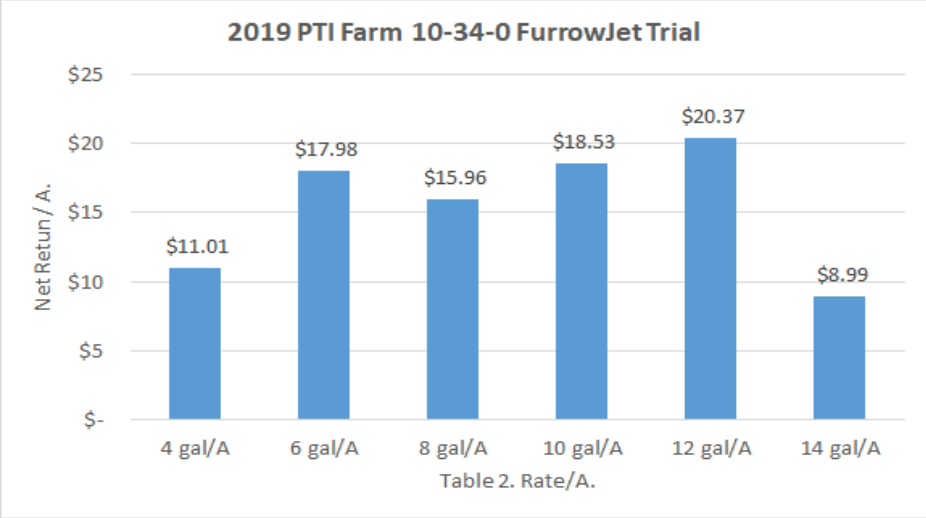
Fertilizer Pricing: SuperBlue $1.40/Gal *BioComplete: $73.39/Gal* *FertizolZn: $44.41/Gal* *PremiumP: $5.75/Gal* *$30 DAP Reallocation*

10-34-0 FurrowJet Study

Objective: To evaluate the yield and net return of 10-34-0 liquid starter fertilizer. Six different rates were used in a tri-band FurrowJet application at planting. 10-34-0 is a 70% polyphosphate formulation of nitrogen and phosphorus.

Results: 100% of 10-34-0 rates resulted in positive yield gains, however agronomic and economic optimum rates were realized at the 12 Gal/A. rate with a yield response of +5.6 Bu/A. and net returns of +20.37/A.





Planting Date: 6/10 *Hybrid: DKC 51-38* *Population: 36K* *Row Width: 30”* *Rotation: CAB* *Corn Price: $3.67*

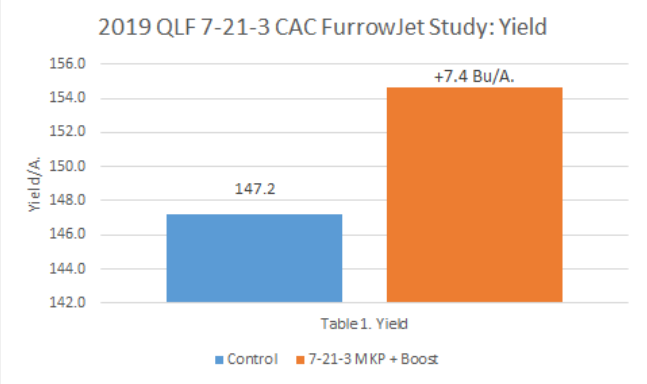
Fertilizer Pricing: 10-34-0 $2.58/Gal *$30 DAP Reallocation*

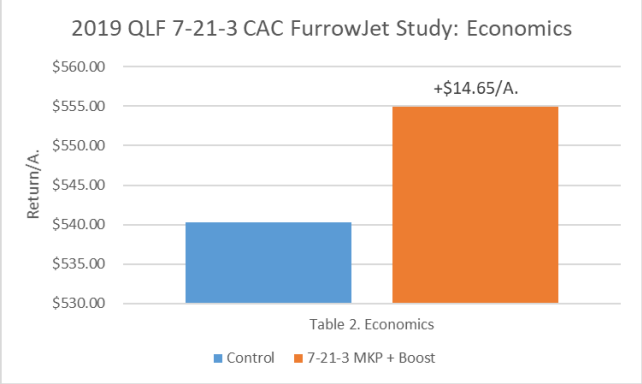
QLF 7-21-3 MKP FurrowJet Study

Objective: To evaluate the yield and net return of liquid carbon-based fertilizer (L-CBF) 7-21-3 monopotassium phosphate in a three-way FurrowJet application.

This product also contains a 4-0-3-2S sugar cane molasses that acts as a carbohydrate source and helps stimulate soil biology.

Results: Table 1. illustrates that 3 Gal/A. of QLF 7-21-3 MKP with Boost resulted in positive yield gains of +7.4 Bu/A. Table 2. depicts a positive return on investment of +$14.65/A. Please note that this study did not include our typical fertilizer re-allocation. This nutrition was a supplement to our normal 100% dry fertilizer program at the PTI Farm.





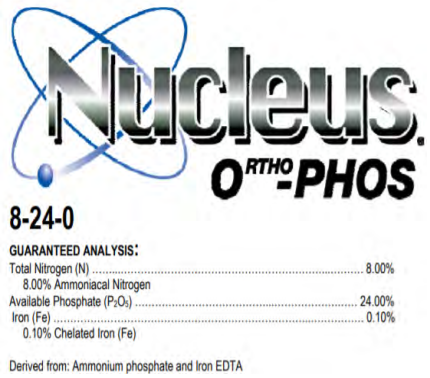
Planting Date: 4/27 *Hybrid: DKC 61-74* *Population: 36K* *Row Width: 30”* *Rotation: CAC* *Corn Price: $3.67*

Fertilizer Pricing: 7-21-3 MKP $4.15/Gal

Helena Nucleus O-Phos FurrowJet Study

Objective: To evaluate the yield and net return of Helena's Nucleus O-PHOS 100% orthophosphate 8-24-0 (Figure 1.) applied with and without 10-34-0 liquid polyphosphate fertilizer.

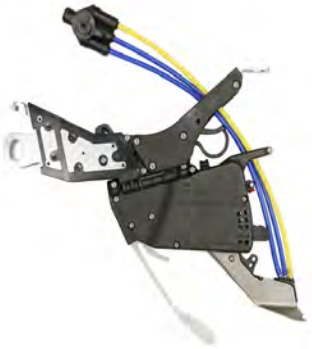
Figure 1.

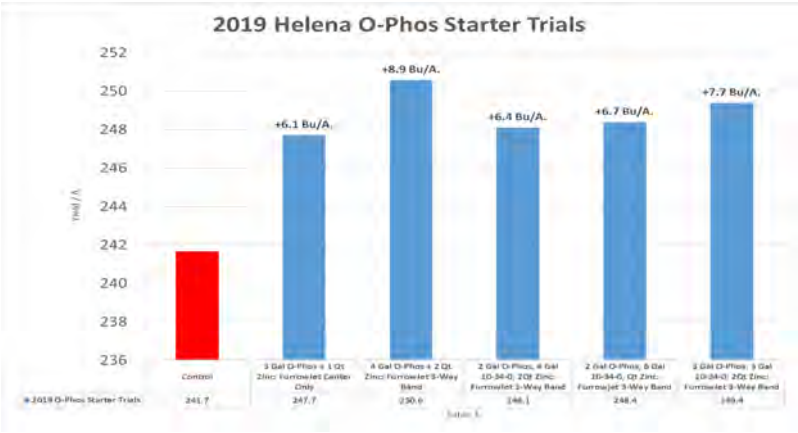


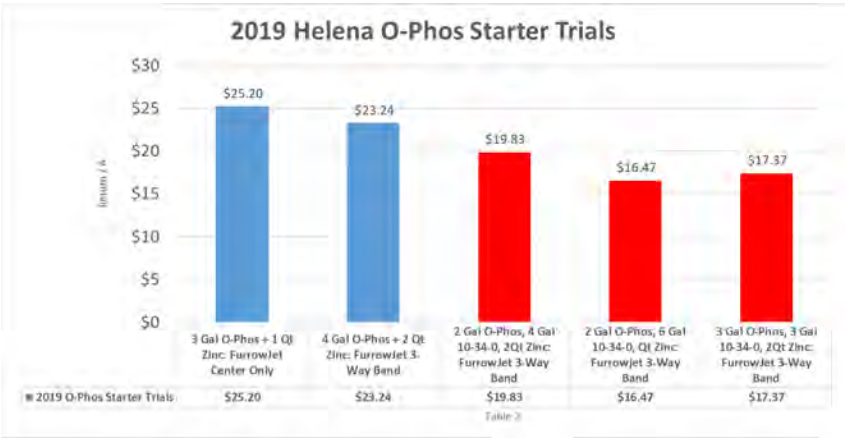
Results: All Ortho-Phos treatments proved higher yields ranging from +6.1 to 8.9 Bu/A. (Table 1) with individual O-Phos/Zinc treatments averaging +7.5 Bu/A. yield responses and economic gains +$23.34 to +$25.20/A. (Table 2).

The addition of 10-34-0 did not increase yields from stand-alone O-Phos treatments. In fact, the lack of yield response from 10-34-0 actually caused economic losses averaging **-$6.33/A.** (Table 2.)

Figure 2.







Planting Date: 6/10 *Hybrid: DKC 51-38* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

Fertilizer Pricing: 10-34-0 $2.18/Gal *$30 DAP Re-allocation* *O-Phos: $7/Gal* *Kickstand Zinc: $20/Gal*

Helena Nucleus HP FurrowJet Study

Objective: To evaluate the yield and net return of Helena's HP 50% orthophosphate/50% polyphosphate 8-24-4 applied with Zinc via FurrowJet 3-way band application (Figure 1).

Results: FurrowJet applications of 3-6 Gal/A. of Nucleus HP proved yield gains of +6.4 to +8.9 Bu/A. (Table 1.) respectively. The lower 3 Gal/A. rate coupled with an extra quart of zinc achieved highest returns of +$23.74/A. (Table 2)

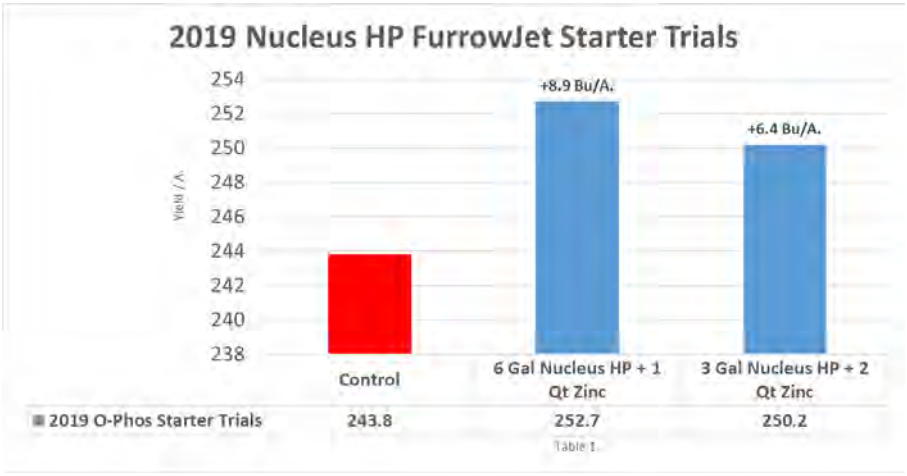


Table 1.

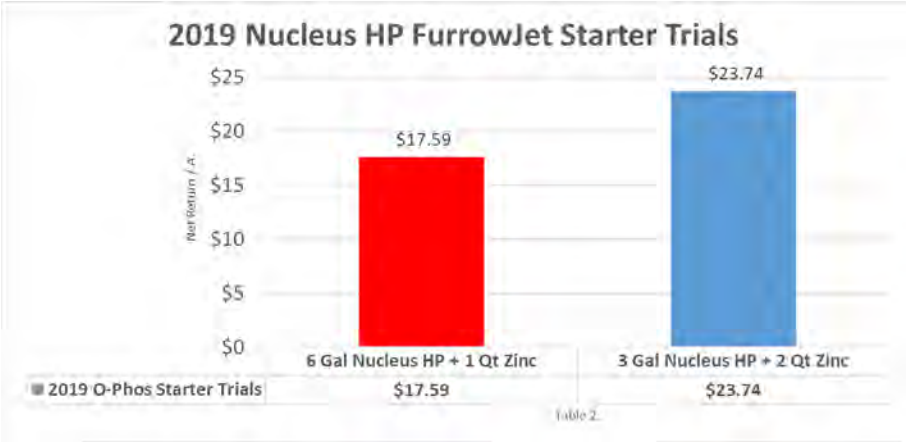


Table 2.

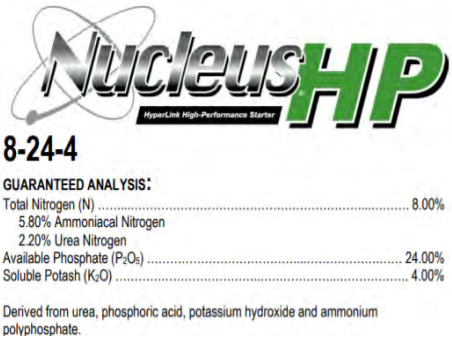
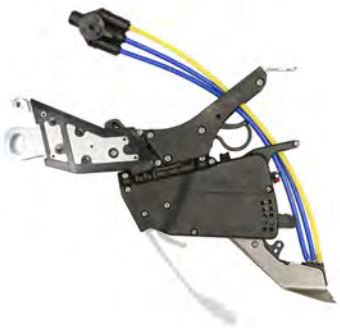


Figure 1.



Planting Date: 6/11 *Hybrid: DKC 51-38* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

Fertilizer Pricing: $30 DAP Re-allocation *Nucleus HP: $6.50/Gal* *Trefix Zinc: $18/Gal*

Manticor LFR FurrowJet Study

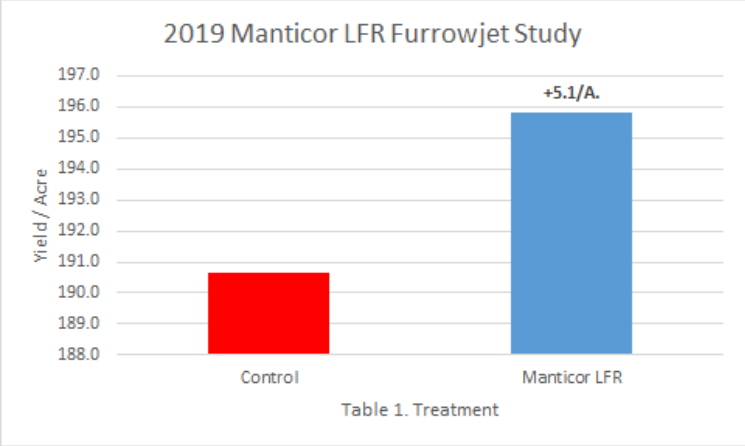
Objective: This FurrowJet application trial evaluates the yield and net return of Manticor LFR. This fungicide/insecticide is an in-furrow product for protection against early season corn diseases and below-ground insect pests, like corn rootworm, in a liquid-fertilizer-ready (LFR) formulation.

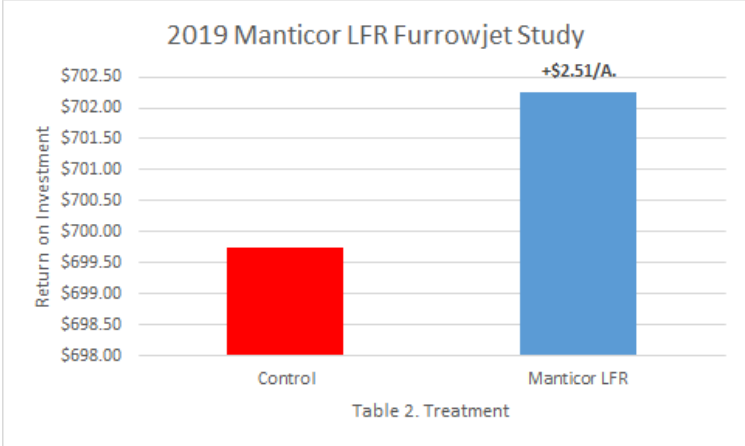
Manticor LFR combines Headline a strobilurin fungicide (0.67lbs/gal Pyraclostrobin) and Capture LFR, a pyrethroid insecticide (1.33lbs/gal Bifenthrin) (Figure 1). When applied in-furrow on corn, Manticor LFR in-furrow fungicide and insecticide provides control of seedling fungal diseases, such as Rhizoctonia solani, and soil insect pests, such as corn rootworm larvae, wireworm, grubs, seedcorn maggot, cutworm and others that can damage corn seeds and seedlings.

Figure 1

Active Ingredients:	
Bifenthrin*	14.4%
Pyraclostrobin: (carbamic acid, [2-[[[1-(4-chlorophenyl)-1*H*-pyrazol-3-yl]oxy]methyl]phenyl]methoxy-, methyl ester)	7.2%
Other Ingredients:	78.4%
Total:	100.0%

Results: Manticor LFR FurrowJet treatments resulted in positive yield gains of +5.1 Bu/A. with a small net return on investment of +$2.51/A. (Tables 1-2).





Planting Date: 6/10 *Hybrid: DKC 51-38* *Population: 36K* *Row Width: 30"* *Rotation: CAB* *Corn Price: $3.67*

Manticor LFR: $220/Ga *Rate: 9.5oz/A.*

Xanthion In-Furrow Study

Objective: This FurrowJet application trial evaluates the yield and net return of Xanthion in-furrow fungicide. Xanthion protects against damaging corn seedling and root diseases, including Rhizoctonia, Fusarium, and Pythium.

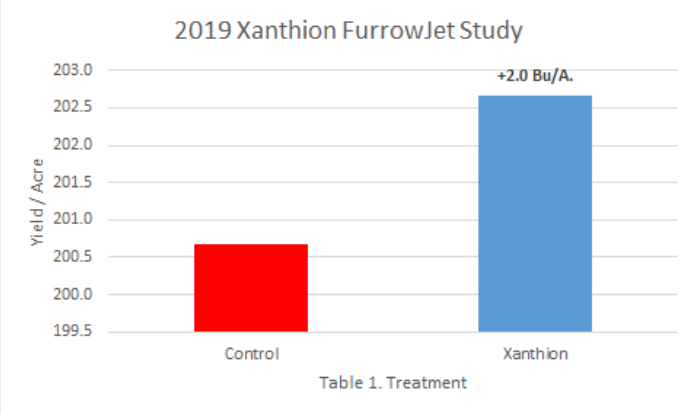
Xanthion is a combination of a chemical fungicide and a biofungicide, containing the same active ingredients as in HeadlineAlth® (Figure 1).

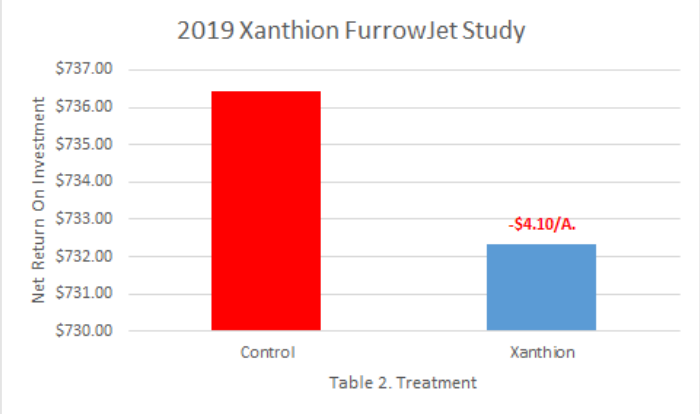
Figure 1.

Active Ingredient*: (Component A)
Bacillus amyloliquefaciens, strain MBI 600** 6.12%
Other Ingredients: 93.88%
Total: 100.00%
*Contains not less than 2.2 x 10^{10} viable spores per mL
**Formerly named *Bacillus subtilis* strain MBI 600

Active Ingredient*: (Component B)
pyraclostrobin: (carbamic acid, [2-[[[1-(4-chlorophenyl)-1*H*-pyrazol-3-yl]oxy]methyl]phenyl]methoxy-, methyl ester) 23.60%
Other Ingredients:** 76.40%
Total: 100.00%
*Equivalent to 2.09 pounds of pyraclostrobin per gallon
**Contains petroleum distillates

Results: Xanthion FurrowJet treatments offered yield advantages of +2.0 Bu/A., however failed to prove a positive return on investment at **-$4.10/A.** (Tables 1-2.)





Planting Date: 6/10 *Hybrid: DKC 51-38* *Population: 36K* *Row Width: 30”* *Rotation: CAB* *Corn Price: $3.67*
Xanthion: $11.44/A *Rate: 7.2oz/A.*

Ethos XB In-Furrow Study

Objective: This FurrowJet application trial evaluates the yield and net return of Ethos XB, an insecticide/fungicide that combines the active ingredient of Capture LFR insecticide with a broad-spectrum biofungicide. This combination defends against insect's pest such as corn rootworms, wireworms, grubs, seed corn maggots, cutworms and common stalk borers and disease defense including Fusarium, Pythium, Rhizoctonia and Phytophthora.

Figure 1.

ACTIVE INGREDIENTS:	By Wt.
Bifenthrin *	15.67%
Bacillus amyloliquefaciens strain D747 **	5.00%
Other Ingredients	79.33%
Total:	100.00%

*Cis isomers 97% minimum, trans isomers 3% maximum
** Contains a minimum of 1x 10^{10} colony-forming units (cfu) per milliliter of product.
This product contains 1.5 lbs bifenthrin per gallon.

The biofungicide in Ethos XB insecticide/fungicide forms a protective barrier on root surfaces and builds over time as spores germinate and colonize roots and root hairs.

Results: Ethos XB treatments applied through FurrowJet offered positive yield gains of +8.1Bu/A. which resulted in a return on investment of +$9.41/A. (Tables 1-2).

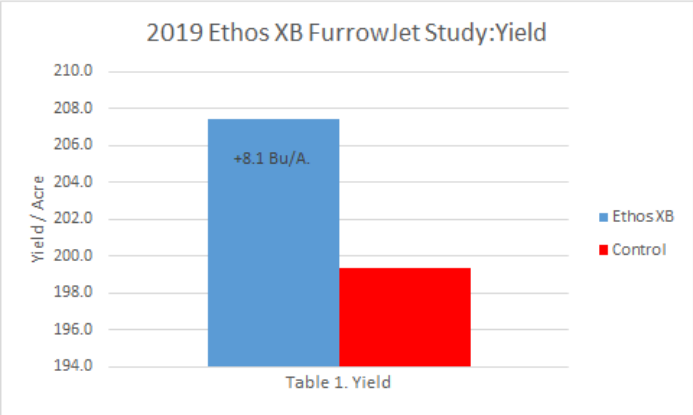


Table 1. Yield

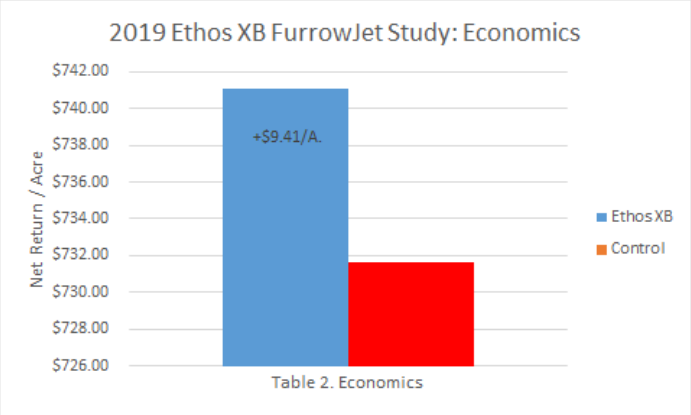


Table 2. Economics

Planting Date: 5/10 *Hybrid: DKC 51-38* *Population: 36K* *Row Width: 30"* *Rotation: CAB* *Corn Price: $3.67*

Ethos XB: $306/Gal *Rate: 8.5oz/A*

Capture LFR In-Furrow Study

Objective: This in-furrow FurrowJet application trial evaluates the yield and net return of Capture LFR, an in-furrow liquid insecticide containing the active ingredient Bifenthrin (Figure 1.) in a liquid fertilizer ready (LFR) formulation.

Figure 1.

EPA Reg. No. 279-3302	**EPA Est. 279-NY-1**
Active Ingredient:	**By Wt.**
Bifenthrin*:	17.15%
Other Ingredients:	82.85%
	100.0%

*Cis isomers 97% minimum, trans isomers 3% maximum.

This product contains 1.5 pounds active ingredient per gallon.

Capture LFR controls seed and seedling pests such as wireworm, corn rootworm, cutworm, grubs, armyworm, seed corn maggot and common stalk borer.

Results: Both rates of Capture LFR treatments performed very similar with yield gains of +5.8 to +6.7 Bu/A., however the higher 8.5oz rate did not offer enough yield gain to offset the additional cost of product. The 4.5oz rate proved economic optimum at +$12.66/A.

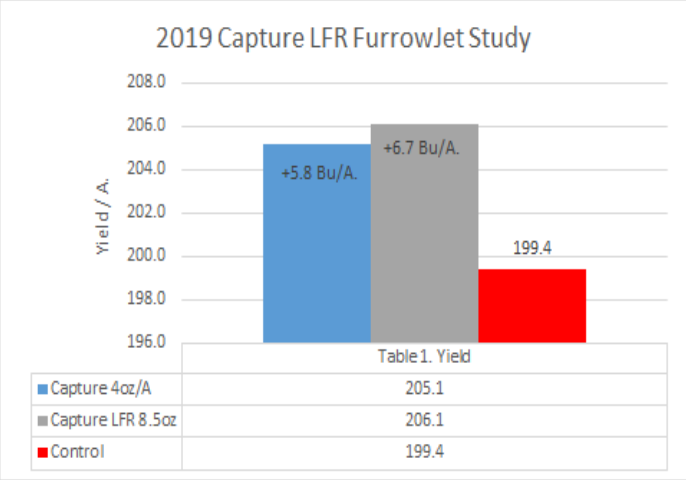


Table 1. Yield

Capture 4oz/A	205.1
Capture LFR 8.5oz	206.1
Control	199.4

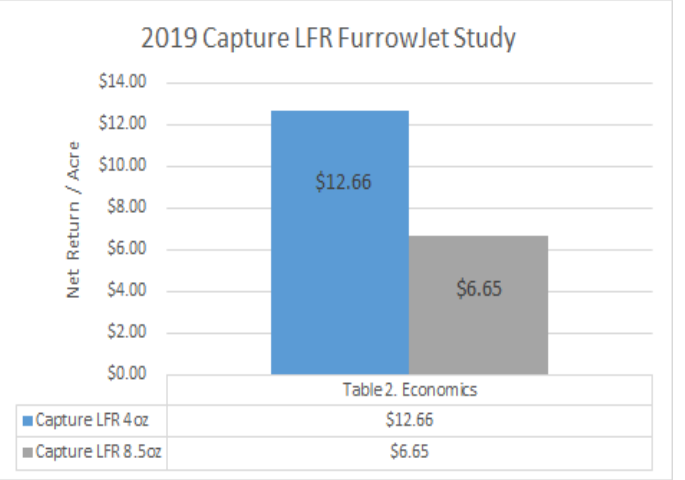


Table 2. Economics

Capture LFR 4oz	$12.66
Capture LFR 8.5oz	$6.65

Planting Date: 6/11 *Hybrid: DKC 51-38* *Population: 36K* *Row Width: 30"* *Rotation: CAB* *Corn Price: $3.67*

Capture LFR: $272/Gal

Temitry LFR In-Furrow Study

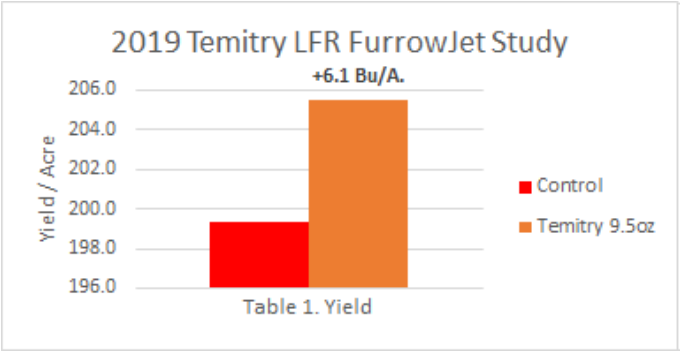
Objective: This FurrowJet application trial evaluates the yield and net return of Temitry LFR. This fungicide/insecticide is an in-furrow product for protection against early season corn diseases and below-ground insect pests, like corn rootworm, in a liquid-fertilizer-ready (LFR) formulation.

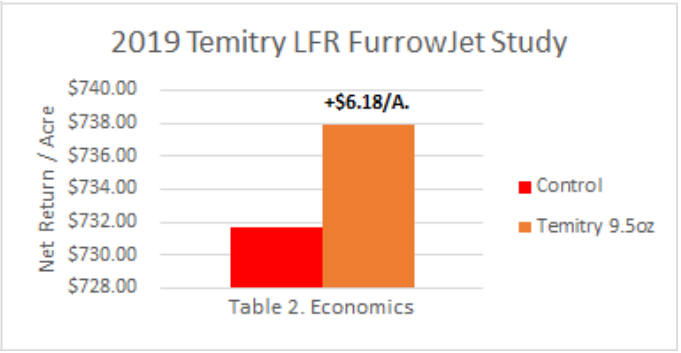
Figure 1.

ACTIVE INGREDIENTS:	By Wt.
Bifenthrin*	14.4%
Pyraclostrobin: (carbamic acid, [2-[[[1-(4-chlorophenyl)-1H-pyrazol-3-yl]oxy]methyl] phenyl]methoxy-, methyl ester)	7.2%
Other Ingredients	78.4%
Total:	100.0%

Temitry LFR combines Headline, a strobilurin fungicide (0.67#/gal Pyraclostrobin) and Capture LFR, a pyrethroid insecticide (1.33#/gal Bifentrin) (Figure 1). When applied in-furrow on corn, Temitry LFR in-furrow fungicide and insecticide provides control of seedling fungal diseases, such as Rhizoctonia solani, and soil insect pests, such as corn rootworm larvae, wireworm, grubs, seedcorn maggot, cutworm and others that can damage corn seeds and seedlings.

Results: Temitry LFR treatments resulted in average yield gains of +6.1 Bu/A. and resulted in a positive return on investment of $6.18/A. (Tables 1-2).





Planting Date: 6/10 *Hybrid: DKC 51-38* *Population: 36K* *Row Width: 30"* *Rotation: CAB* *Corn Price: $3.67*

Temitry LFR: $220/Gal

SabrEx/Excellorate In-Furrow Study

Objective: This FurrowJet application trial evaluates the yield and net return of SabrEx and Excellorate from Advanced Biological Marketing.

Excellorate is a 2-2-1 liquid blend of glucoheptonate carbohydrates, essential plant nutrients, beneficial enzymes and naturally occurring plant and soil stimulants. It represents a next generation of technology, combining complex carbohydrates, essential growth factors and is formulated to supplement biological activity (Figure 1).

Figure 1. Exellorate

Guaranteed Analysis:

Total Nitrogen (N)	2.0%
Available Phosphate (P_2O_5)	2.0%
Soluble Potash (K_2O)	1.0%
Boron (B)	0.05%
Cobalt (Co)	0.002%
Copper (Cu)	0.14%
Iron (Fe)	0.10%
Manganese (Mn)	0.10%
Molybdenum (Mo)	0.002%
Zinc (Zn)	0.05%

SabrEx is a formulation of two biological Trichoderma fungi strains. Trichoderma colonizes with the plants root system and feeds from the starches and sugars produced by the plant, while exuding beneficial enzymes and proteins for the host plants use. As a result, the plant produces a larger root system improving its nitrogen and water use efficiency (Figure 2).

Figure 2. SabrEx Root Inoculant

CONTAINS NON-PLANT FOOD INGREDIENTS
Guaranteed Analysis :
Active Ingredients: 0.10% - (Total microbial count $8x10^7$ cfu/ml *Trichoderma harzianum* 4×10^7 cfu/ml and *Trichoderma atroviride* 4×10^7 cfu/ml
Inert Ingredients: 79.9%-water, 20.0%-proprietary liquid

Results: Tables 1-2. illustrate SabrEx Corn IF treatments resulted in yield gains of +3.7 Bu/A., with a return on investment of +$7.73/A. Excellorate treatments offered gains of +2.8 Bu/A., with a return on investment of $5.88/A.

Tank-mixing both products increased yields to +3.9 Bu/A., while capturing positive net returns of +$10.67/A.

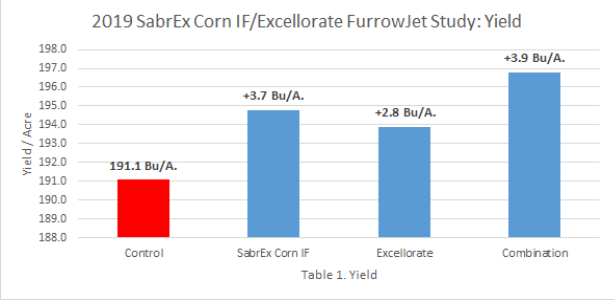


Table 1. Yield

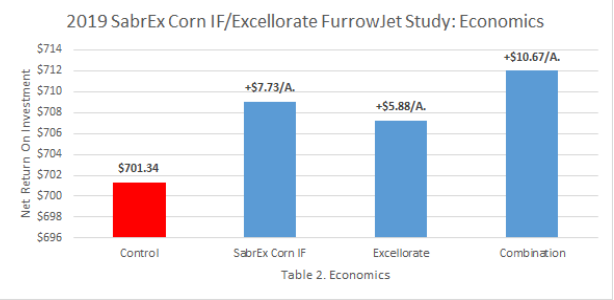


Table 2. Economics

Planting Date: 6/13 *Hybrid: DKC 51-38* *Population: 36K* *Row Width: 30"* *Rotation: CAB* *Corn Price: $3.67*

SabrEx: $5.85/A *Excellorate: $1.10/oz* *Rate: SabrEx: 1oz/A. Excellorate: 4oz/A.*

Corn Summary of 2019 FurrowJet Applications

Nachurs imPulse Placement Study Average	9.7	$	38.44
Midwestern BioAg 3gal QLF 7-21-3MPK	4.9	$	35.53
Nachurs imPulse Starter Fert 4 Gal	7.1	$	34.90
Nachurs imPulse Starter Fert 5 Gal	8	$	34.88
Nachurs imPulse Starter Fert 6 Gal	7.8	$	30.47
Helena Nucleus O-Phos 3gal+1 Qt Zinc:FJ center	6.1	$	25.20
Nachurs imPulse Starter Fert 3 Gal	3.4	$	24.82
Marco LTE 10 Gal	8.1	$	24.73
Helena Nucleus HP 3gal+2Qt Zn	6.4	$	23.74
Marco LTE 8 Gal	5.8	$	23.29
Helena Nucleus O-Phos 4gal+2 Qt Zinc:FJ 3 way	8.9	$	23.24
Marco LTE 4 Gal	1.8	$	22.61
10-34-0 12gal	5.6	$	20.37
Helena Nucleus O-Phos 2gal+4gal 10-34-0+2 Qt Zinc:FJ 3 way	6.4	$	19.83
10-34-0 10gal	5.1	$	18.53
10-34-0 6gal	4.9	$	17.98
Sunrise Coop PCT 5 Gal Super Blue Conceal+5Gal PremiumP+16oz BioComplete+32oz FertizolZn+5Gal SuperBlue	13.8	$	17.62
Helena Nucleus HP 6gal+1Qt Zn	8.9	$	17.59
Helena Nucleus O-Phos 3gal+3gal 10-34-0+2 Qt Zinc:FJ 3 way	7.7	$	17.37
Helena Nucleus O-Phos 2gal+6gal 10-34-0+1 Qt Zinc:FJ 3 way	6.7	$	16.47
10-34-0 8gal	4.4	$	15.96
Marco LTE 6 Gal	1.8	$	15.61
QLF 7-21-3 MKP + Boost	7.4	$	14.65
FMC Capture LFR 4oz	5.8	$	12.66
Marco LTE 12 Gal	6.6	$	12.59
10-34-0 4gal	3	$	11.01
Marco LTE 14 Gal	8.1	$	10.73
SabrEx/Ecellorate - Combination	3.9	$	10.67
AgroLiquid accesS Sulfur 1 Gal	3.8	$	9.45
Ethos XB	8.1	$	9.41
Furrow Jet Side Wall	2.5	$	9.18
10-34-0 14gal	5.4	$	8.99
Sunrise Coop PCT 10 Gal Super Blue Conceal+5Gal PremiumP+16oz BioComplete+32oz FertizolZn	11.3	$	8.44
SabrEx/Exellorate SabrEx Corn IF	3.7	$	7.73
AgroLiquid accesS Sulfur 2.5 Gal	5	$	7.10
Sunrise Coop PCT 10 Gal Super Blue Conceal+5Gal PremiumP+16oz BioComplete FJ	7.8	$	6.70
Capture LFR 8.5oz	6.7	$	6.65
Temitry LFR 9.5oz	6.1	$	6.18
SabrEx/Ecellorate - Exellorate	2.8	$	5.88
Manticor LFR	5.1	$	2.51
Marco LTE 16 Gal	7.4	$	1.16
AgroLiquid Starter Fertility Program	15.3	$	(2.39)
Xanthion	2	$	(4.10)
AgroLiquid accesS Sulfur 5 Gal	2.4	$	(13.69)
Average of All Application	6.2	$	15.02

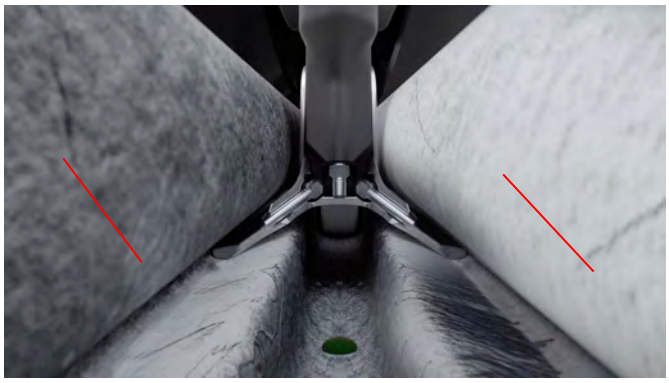
FurrowJet Side-Wall Study

Figure 1.

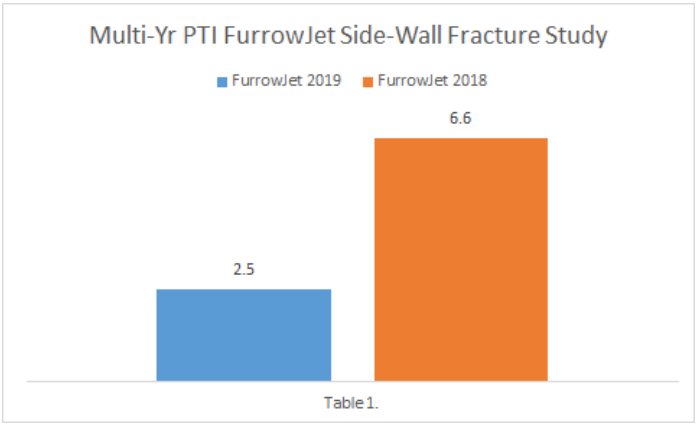
Objective: FurrowJet is a planter fertilizer attachment (Figure 1.) that enables placement of not only an in-furrow starter fertilizer, but also a dual-band of fertilizer 3/4" on each side of the seed. To achieve this dual-band placement, the wings on FurrowJet angle downward to cut into the sidewall and place fertilizer alongside the seed in a dual-band. By doing this, lifting and fracturing can occur that potentially could remove soil smearing or compaction created by disc openers. Additionally, closing wheel systems following FurrowJet wings have a better opportunity to close the seed trench, remove air pockets, and allow for good seed-to-soil contact.

This study evaluates FurrowJet dual-band wings offering the ability to remove side-wall compaction in the seed furrow. For this particular study, no liquid fertilizer was applied through FurrowJet.

Figure 2: FurrowJet Dual-Band Wings Fracturing Side-Walls



Results: Table 1. illustrates the side-wall fracture advantages of FurrowJet in both the 2018 and 2019 growing seasons. While 2018 offered +6.6 Bu/A. advantages, 2019 proved significantly less at only +2.5 Bu/A. As mentioned in the objective, FurrowJet does have the ability to assist in closing the furrow due to easier side-wall collapse. In 2019 our plot planter was fitted with FurrowForce, an automated 2 stage closing system with integrated sensing. It is our belief that this system closed the gap on FurrowJet advantages due to superior closing activity.



Planting Date: 6/8 *Hybrid: DKC 54-38* *Population: 36K* *Row Width: 30”* *Rotation: CAC* *Corn Price: $3.67*

Force 6.5G vDrive Insecticide Study

Objective: This trial evaluates the yield and net return of Force 6.5G soil applied insecticide. Force 6.5G soil-applied corn insecticide is a higher-load (2lbs/A.) granular formulation for control of corn rootworm and other soil-dwelling insect pests. This formulation was developed by Syngenta to better meet the changing needs of today's corn growers who are looking for both superior performance and increased at-plant efficiency. Four Golden Harvest corn hybrids were tested in this study to evaluate the yield and net return at a full rate of Force 6.5G.

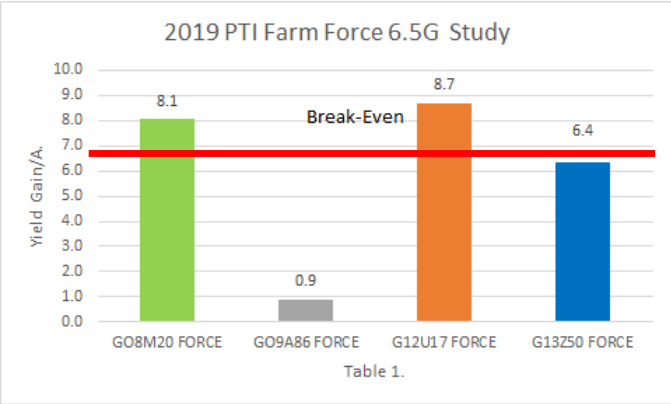
Figure 1. Force 6.5G Label

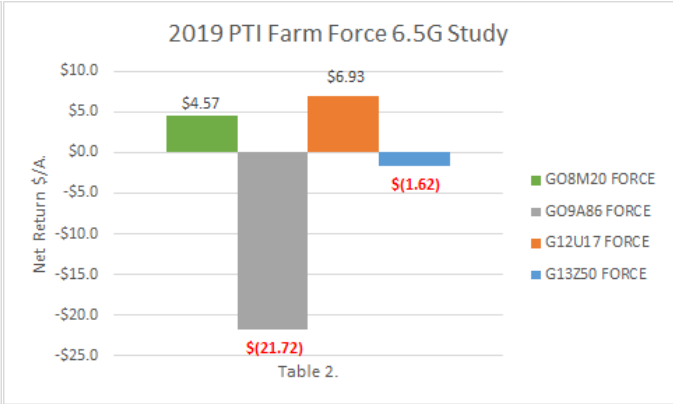
Figure 2. vDrive Insecticide

Results: Table 1. reports Force 6.5G applications resulted in average yield gains of +6.0 Bu/A., ranging from +0.9 Bu/A. to +8.7Bu/A. over the four corn hybrids tested. Yield response needed for break-even at the full rate was +6.8 Bu/A.

Table 2. illustrates that two of the corn hybrids (GO8M20, G12U17) proved economic gains from using Force 6.5G, however only minimal at +$4.57 to +$6.93/A.

Corn hybrids GO9A86 and G13Z50 proved economic losses of **-$21.72** to **-$1.62/A.** respectively.



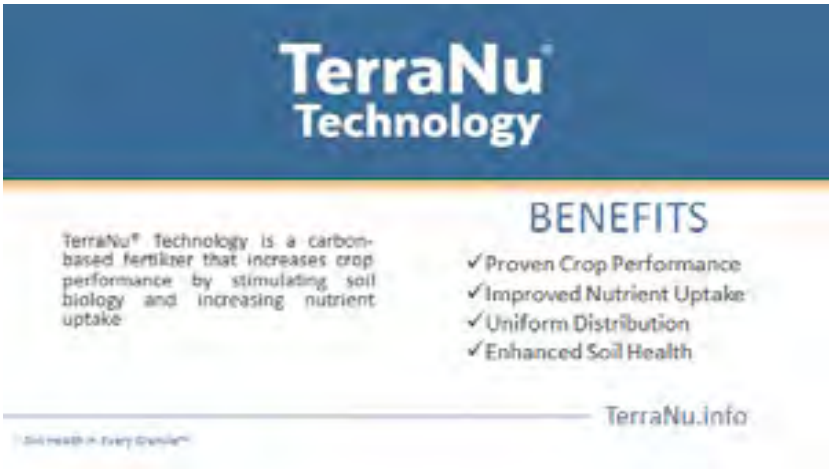


Planting Date: 6/12 *Hybrid: Varied* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

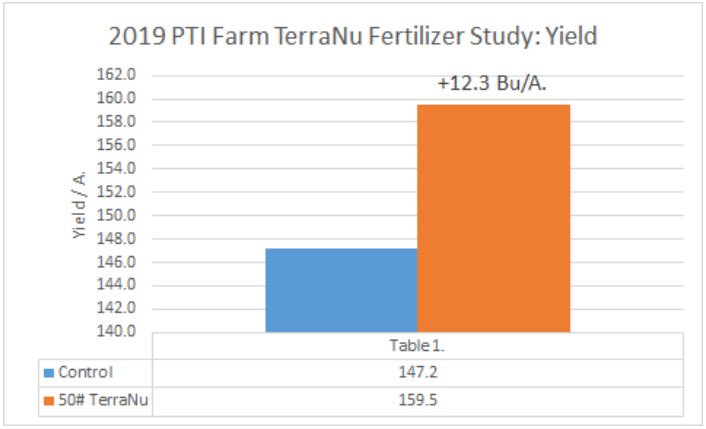
Force 6.5G: $25/A.

TerraNu Micro-Pak Study

Objective: To evaluate the yield and economics of TerraNu Micro-Pak carbon-based fertilizer. TerraNu is the PTI Farm's first product evaluating animal manure. TerraNu is granulated dairy manure digestate with an analysis of 3-3-3-7S with Mg, Ca, B, Cu, Fe, Mn, and Zn.



Results: Table 1. illustrates that 50lbs/A. of TerraNu resulted in positive yield gains of +12.3 Bu/A. Using a cost of $30/A. for 50lbs/A., TerraNu posted positive net returns of +$15.04/A.



Planting Date: 4/27 *Hybrid: DKC 61-74* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

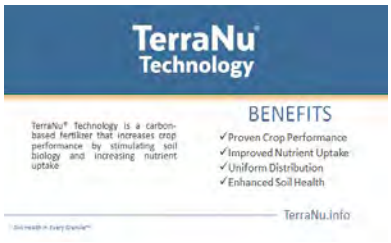
Fertilizer Pricing: TerraNu 50#= $30/A.

Midwestern BioAg and QLF Nutrition Study

Objective: To evaluate the yield and net return of the combination of two carbon-based fertilizers from Midwestern BioAg, L-CBF 7-21-3 MKP and TerrNu MicroPak.

Midwestern BioAg

QLF Agronomy

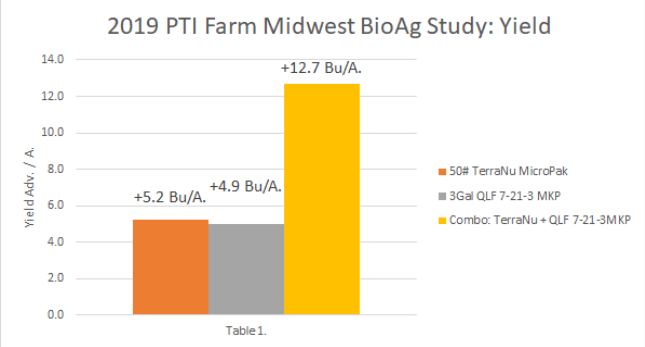


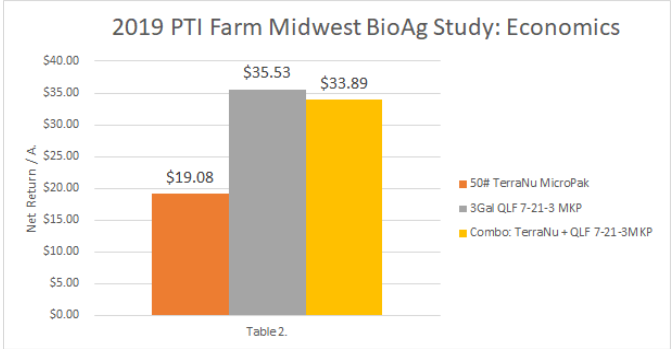
This is one of two studies evaluating TerraNu, a granulated dairy manure digestate with an analysis of 3-3-3-7S with Mg, Ca, B, Cu, Fe, Mn, and Zn.

L-CBF 7-21-3 is a monopotassium phosphate liquid fertilizer that also contains a 4-0-3-2S sugar cane molasses that acts as a carbohydrate source and helps stimulate soil biology.

Results: Table 1. illustrates that both products gained positive yield gains near +5.0 Bu/A., however the combination treatment of both products offered +12.7 Bu/A. advantages.

Table 2. tells the story by summarizing positive return on investments of +19.08/A. for TerraNu, +$35.77/A. for the QLF 7-21-3 with Boost, and +$34.04/A. for the combination of both products.





Planting Date: 4/27 *Hybrid: DKC 61-74* *Population: 36K* *Row Width: 30"* *Rotation: CAB* *Corn Price: $3.67*

Fertilizer Pricing: 7-21-3 MKP $4.15/Gal *TerraNu MicroPak: 50# = $30/A.* *$30/A DAP Re-Allocation*

Calcium Products SO4 Study

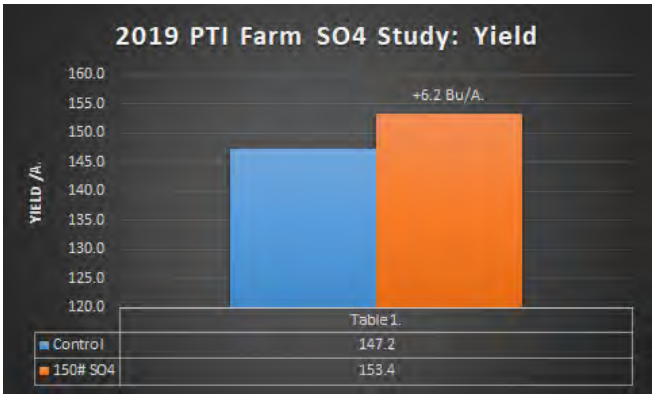
Objective: This trial evaluates the yield response and economics of pelletized calcium sulfate (SO4). SO4 from Calcium Products is a 21% Calcium (non-pH neutralizing) and 17% Sulfur dry pelletized fertilizer.

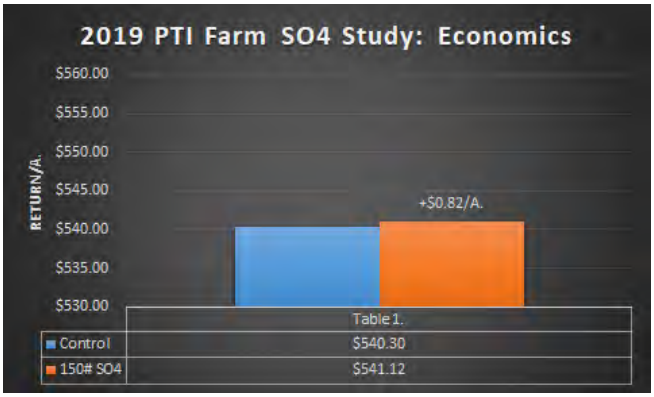
SO4™ PELLETIZED GYPSUM

CALCIUM PRODUCTS

- Sulfur is an essential component of plant growth, with key processes relying on sulfur like chlorophyll formation and protein production.
- It is often considered the fourth major nutrient behind N, P and K.
- SO4 is mined and manufactured in northwest Iowa from one of the purest gypsum sources in the world. It is finely ground and pelletized to achieve a balance between solubility and pellet strength.

Results: Spring 2019 treatments of SO4 resulted in average yield gains of +6.2 Bu/A. and resulted in just breaking even with a positive return on investment of +$0.82/A. (Tables 1-2). We look forward to continuing our long-term multi-year testing of SO4 and understanding its benefits of supplying plant nutrition, but also its effect on soil health advantages.





Planting Date: 6/10 Hybrid: DKC 65-94 Population: 36K Row Width: 30" Rotation: CAC Corn Price: $3.67 SO4: $240/Ton+$4/A Application

Precision Planting

2019 PTI Results

Narrow Row Width Corn Study

Objective: This trial evaluates the status quo of the industry standard of 30" row width corn, to a 20" narrower system at three seeding rates of 36K, 40K, and 44K. Four Golden Harvest corn hybrids consisting of G13Z50, G12U17, GO9A86, and GOM20 are used in this study to help identify differences in plant type response.

Results: Table 1. illustrates average corn yield by row width and seeding rate. Compared to 30" rows at seeding rates of 36K, 20" rows actually averaged a yield loss of **-7.9 Bu/A.** As seeding rates were pushed to 40K, 20" rows did offer yields gains compared to 30" rows at 36K, but only by +3.3 Bu/A. To evaluate even higher seeding rates, 20" rows were pushed to 44K and yield suffered by **-13.7 Bu/A.** over the industry standard 30" corn row width at 36K pops.

Table 2. summarizes the economics of the narrow 20" row width system in comparison to 30" rows at 36K. On average, 20" row width populations realized net losses at every population from **-$0.21/A** to **-$78.15/A.**

Table 3. depicts a similar overall economic response from hybrid to hybrid. G13Z50 however, was the only individual hybrid that proved economic gain over 30" rows. With this hybrid, 20" rows at 40K seeding rates offered an economic improvement of +$22.37/A.

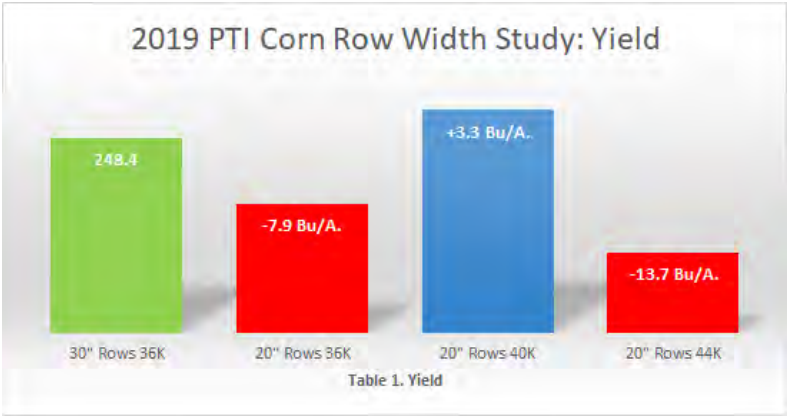


Table 1. Yield

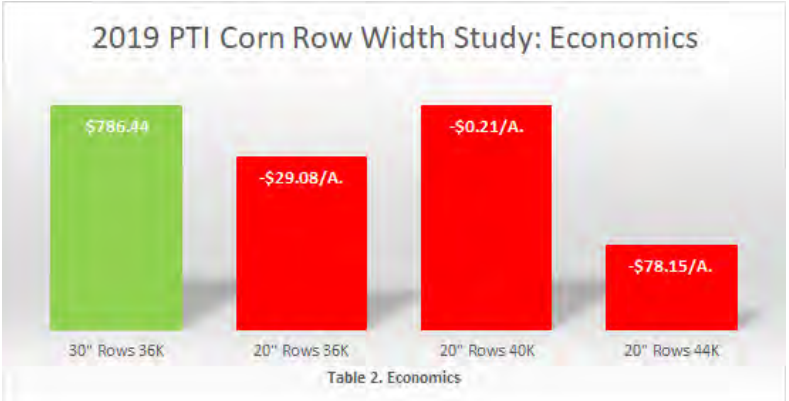


Table 2. Economics

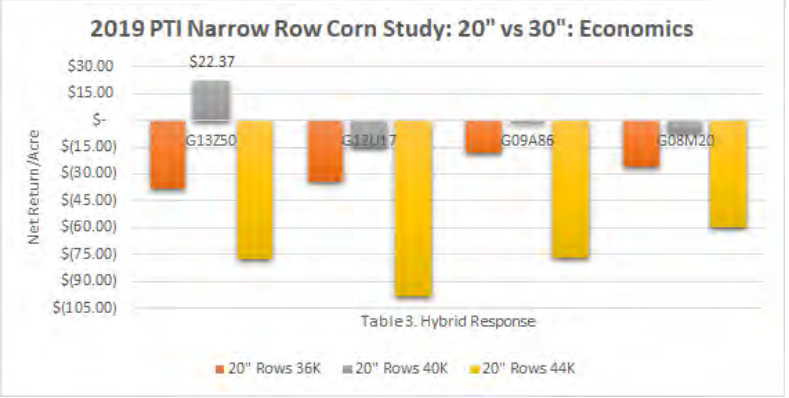


Table 3. Hybrid Response

Planting Date: 6/10 *Hybrid: Varied* *Population: 36K* *Row Width: 20-30"* *Rotation: CAC* *Corn Price: $3.67*

Seed Price: $275/Bag

Precision Planting

2019 PTI Results

20” Solar Corridor Study

Objective: This trial’s intention is to evaluate any yield or economic advantage in planting 20” row corn in a “solar corridor” method. The solar corridor is designed as 40” wide rows surrounded by two 20” rows. The theory behind this trial is to increase the distribution of sunlight wide enough that all corn leaves or chloroplasts, regardless of their vertical disposition on the corn plant, receive full access to sunlight the entire growing season. If one of the basic principles of corn yield is maximizing sunlight, could a solar corridor ultimately contribute to increased yield?

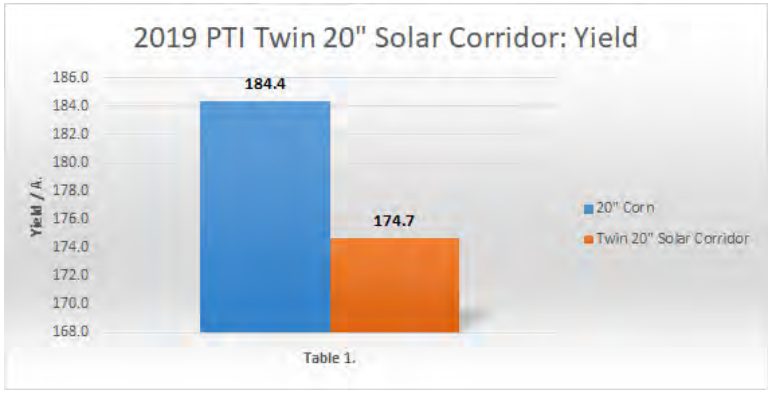


Table 1.

Results: Table 1. illustrates that the solar corridor system yielded **-9.7 Bu/A.** less than a traditional distributed seeding system.

However, Table 2. reflects the economics of the system as a positive return on investment of +$5.92/A., primarily due to lower seed expenses. In this example, seed was reduced by 1/3 thus lowering the cost of the program.

We will continue testing of this interesting study adding multiple seeding rates and even low stature cover crops in the solar corridor rows to evaluate the overall sustainability of this practice.

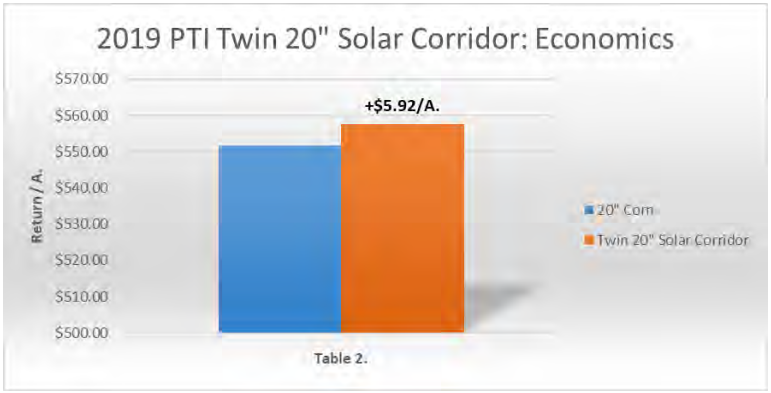


Table 2.

Planting Date: 6/18 *Hybrid: DKC 40-77* *Population: 36K* *Row Width: 20”* *Rotation: CAB* *Corn Price: $3.67*

Seed Price: $275/Bag

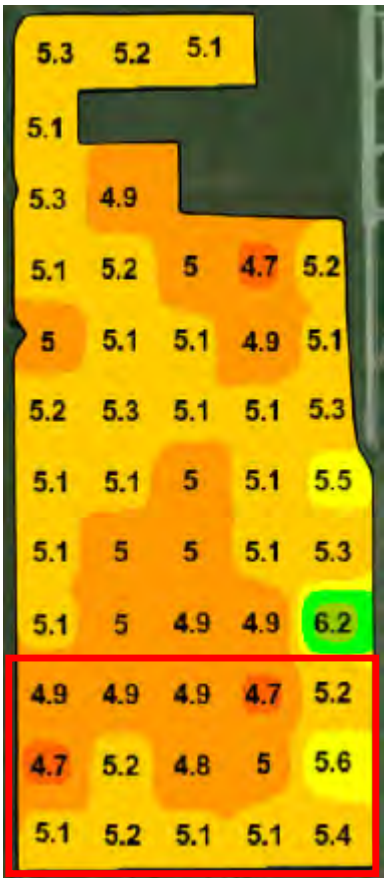
pH Acidity Study: Corn

Objective: To evaluate the long-term yield and economic impact of acidic soil pH in corn.

When the PTI farm was acquired in the fall of 2017, a soil test revealed some major issues with soil pH on a particular area of the east side of the farm. Soil test results indicated average pH values of 5.1, with lows of 4.7 pH. This acidic area offered an opportunity to evaluate the yield response of acidic soils compared to corrected basic or neutral pH soils. 3 Ton of Ag Lime was applied in 2017 and another 2.5 Ton in 2018, however plots were left without lime to represent long-term pH testing.

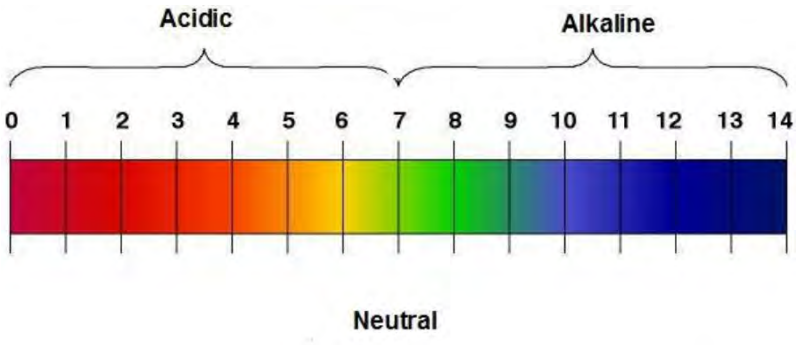
What is soil pH? The term pH stands for the potential (p) of hydrogen ions (H+) in water, and indicates a measure of the relative acidity or alkalinity of the soil solution. Soil pH is calculated on a 14-point scale, where a value of 7.0 is considered neutral or basic (Figure 2). Lower values on the pH scale denote increasing H+ ions and acidity, while higher values represent increasing hydroxyl ions (OH-) and alkalinity. Because pH is expressed on a logarithmic scale, each change of 1 pH unit actually represents a 10-fold increase in soil acidity or alkalinity.

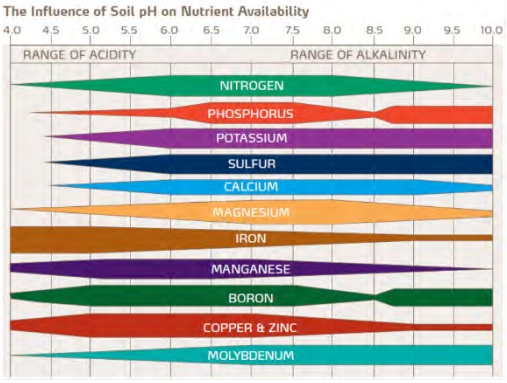
Figure 1. 2017 Soil Test pH



Limestone
Fall 2017=3 Ton/A
Fall 2018=2.5 Ton/A

Long-term Acidity Testing Area: No Ag Lime Applied





pH Acidity Study Continued

Results: Table 1. illustrates that in our first year of this soil acidity study in corn, there was no significant yield loss in acidic soils near 5.1 pH. 2018 yield data revealed only a **-1.3 Bu/A.** yield loss in a corn rotation. This year in 2019, yield performance was similar with yield losses at only **-3.5 Bu/A.** Although corn losses have been minimal in an acidic environment, soybeans have seen large losses. Be sure to check out the 2019 pH Soil Acidity Study to see these results.

Being designed as a long-term multi-year study, we will continue this trial over the years to come to monitor yield, nutrient deficiencies, or other stress factors. New soil tests will be available for 2020.

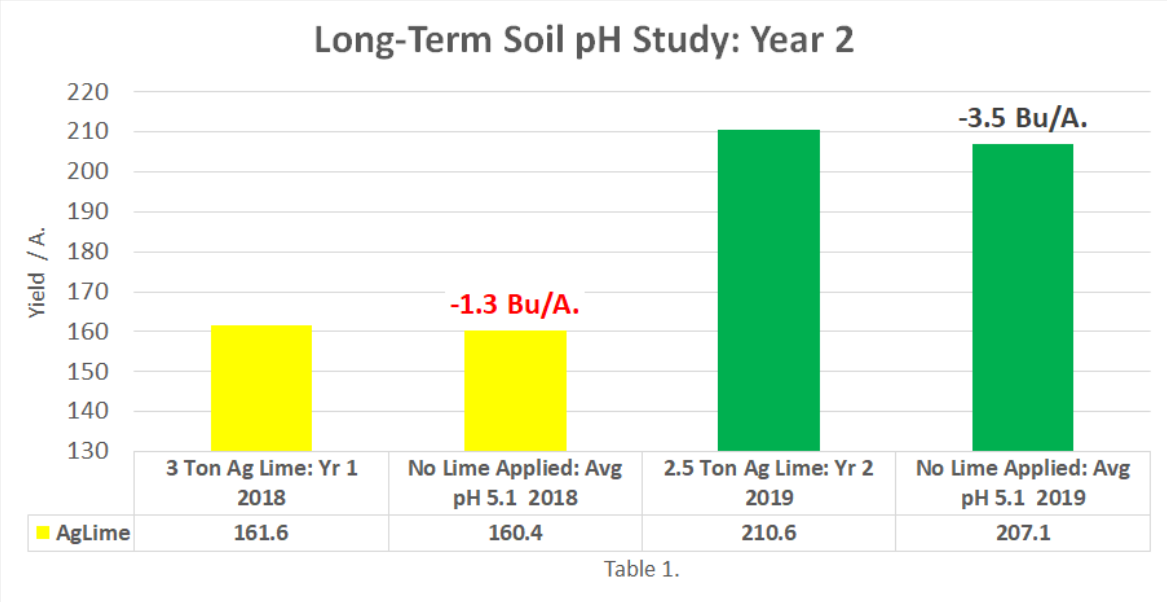


Table 1.

Planting Date: June 8 *Hybrid: Wyffels 5518SS* *Population: 36K* *Row Width: 30"* *Rotation: CAB* *Prices: Corn $3.67*

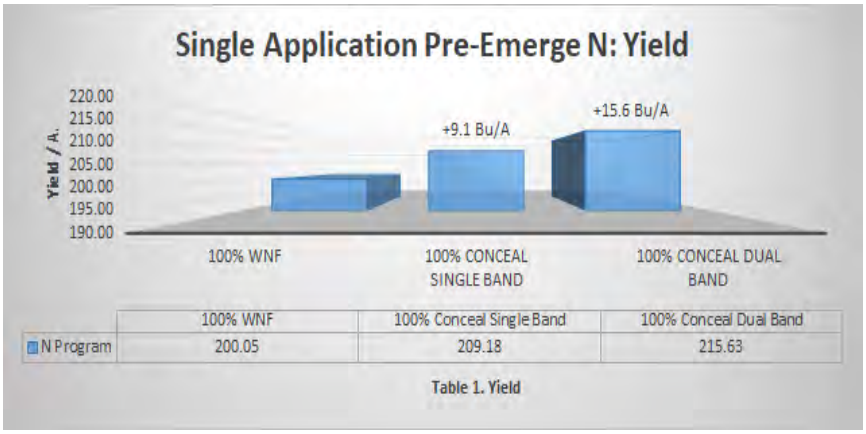
100% Single Application Pre-Emerge Nitrogen Study: Conceal vs. WNF

Objective: To compare 100% single applications of traditional surface applied broadcast Weed-N-Feed (WNF) 32% UAN treatments to Conceal dual and single band at-plant nitrogen applications. Conceal is an unique planter attachment that allows growers to place nitrogen in a high concentration dual or single band positioned 3" away from the seed trench (Figure 2.) in depths near 1.5". Conceal uses existing planter space, utilizing a backswept knife located with-in the center of the planter's gauge wheels (Figure 1). As nitrogen is applied, it is sealed within the soil profile, preventing potential volatilization losses typically seen with surface type nitrogen applications.

Results: Table 1. Illustrates that Conceal dual band applications of nitrogen out-yielded traditional WNF applications by +15.6 Bu/A.

Single band conceal treatments also out-performed traditional WNF applications by +9.1 Bu/A. over the WNF.

In summary, planter applied nitrogen offered an average yield advantage of +12.35 Bu/A. over a WNF application. These yield gains equate to additional revenue gains of +$45.32/A.



	100% WNF	100% Conceal Single Band	100% Conceal Dual Band
N Program	200.05	209.18	215.63

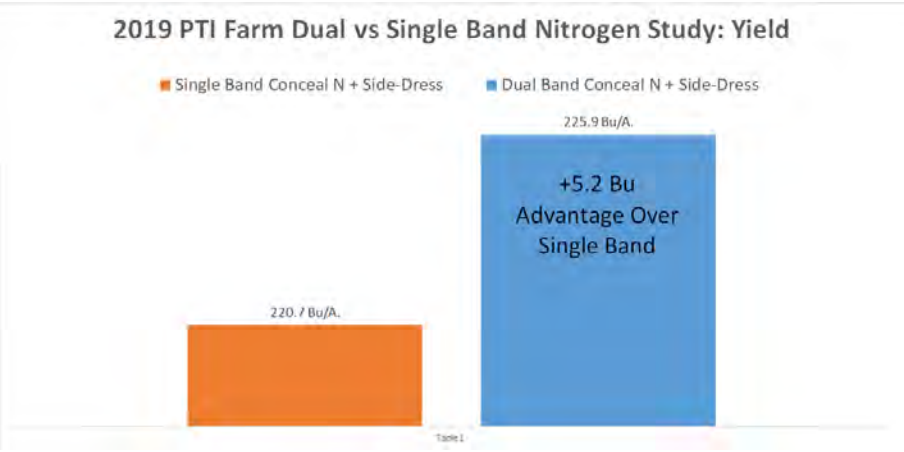
Table 1. Yield

Figure 1. Conceal Knife Design within Gauge Wheel

Figure 2. Conceal Dual Placement 3" from Seed Trench

Planting Date: 4/27 *Hybrid: GH 13Z50* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

Single Band vs. Dual Band Conceal Nitrogen Study



Objective: To compare dual band versus single band applications of nitrogen in an at-plant scenario using Conceal. Both treatments consist of 50% of 225lbs total nitrogen at planting and the remaining 50% in a V6 side-dress, all using UAN 32%.

Conceal is a unique planter attachment that allows growers to place nitrogen in a high concentration dual or single band positioned 3" away from the seed trench (Figure 1.) in depths near 1.5". If corn is planted at 2" in depth, conceal fertilizer placement is 3X-0.5X1 in single bands and 3X-0.5X2 in dual bands.

Conceal uses existing planter space, utilizing a backswept knife located with-in the center of the planter's gauge wheels (Figure 1). As nitrogen is applied, it is sealed within the soil profile, preventing potential volatilization losses typically seen with surface type nitrogen applications.

Results: Table 1. Illustrates that Conceal dual band applications of nitrogen out-yielded single band applications by +5.2 Bu/A. These yield gains consequently equated to additional net returns of +$18.94/A.

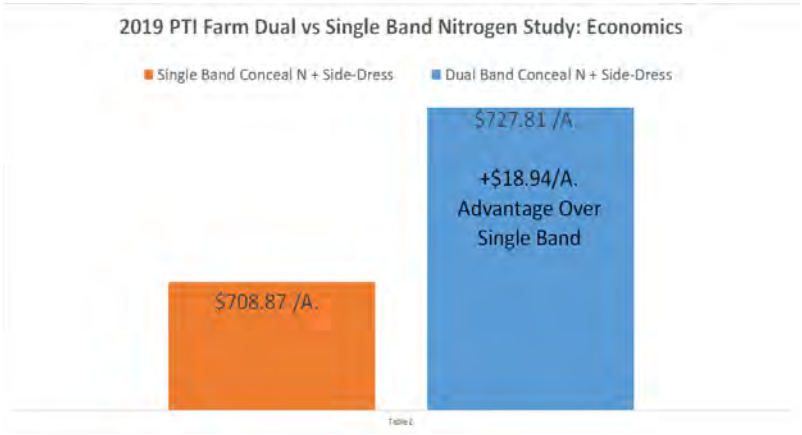


Figure 1. Conceal Single or Dual Placement 3" from Seed Trench, 1.5" in Depth

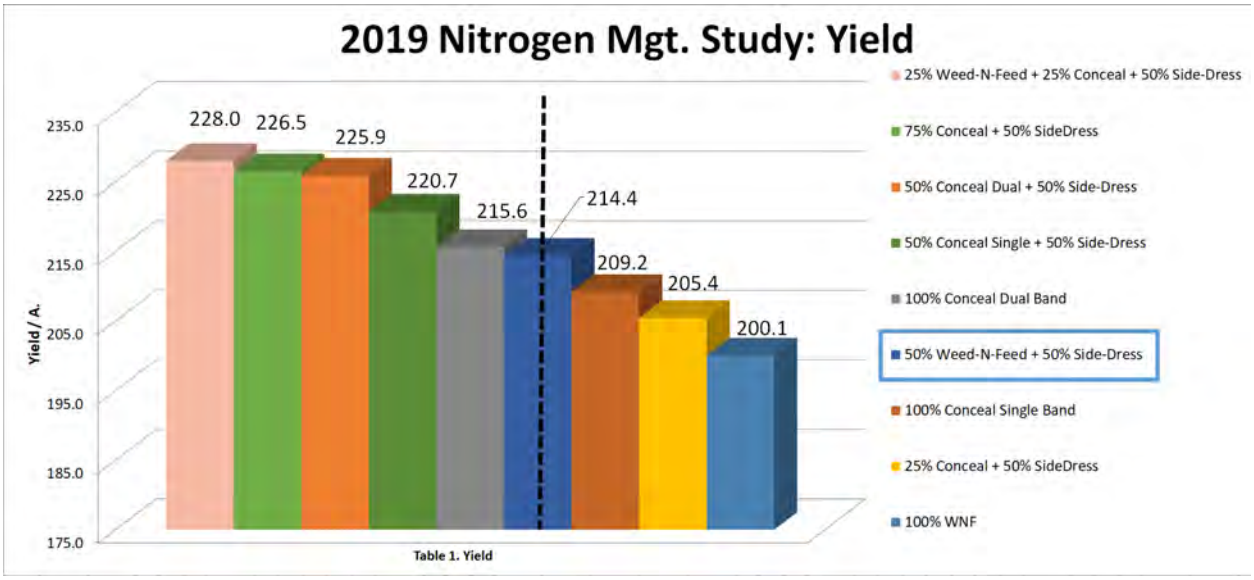
Planting Date: 4/27 *Hybrid: GH 13Z50* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

Conceal Nitrogen Rate/Placement Study

Objective: This continuous corn study evaluates the performance of nine different nitrogen rate and placement programs. These nine programs consist of single application nitrogen programs, 2-way split applications, and 3-way split programs. All treatments are applied using 32% UAN liquid nitrogen. As a baseline, the 50% WNF + 50% V6 Side-Dress (Treatment #4) will be used as the control for this trial.

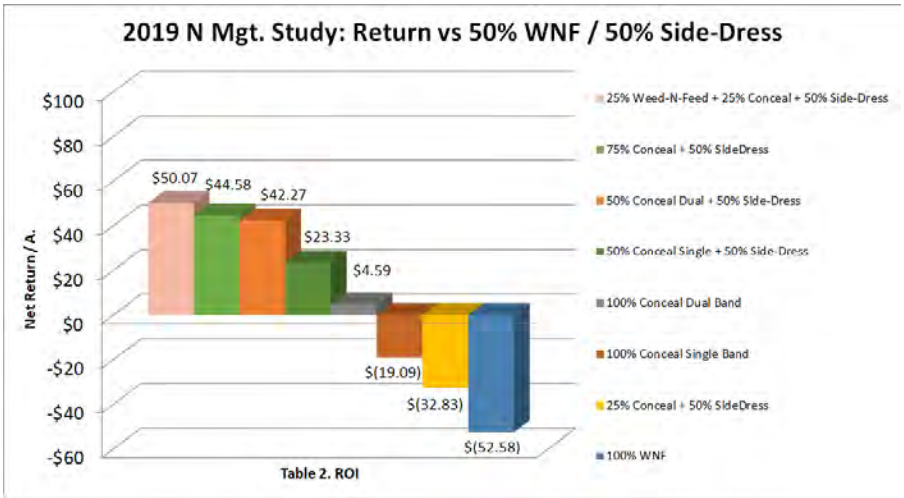
1.	100% Weed-N-Feed (WNF):	225# N applied as Surface applied 32% UAN	Single Applications
2.	100% Conceal Single Band:	225# N applied with Conceal Single Band	
3.	100% Conceal Dual Band:	225# N applied with Conceal Dual Band	
4.	**50% WNF+50% Side-Dress:**	**112# N WNF+ 113# N V6 side-dress: "Control"**	Dual Split Applications
5.	50% Conceal Single Band+50% Side-Dress:	112#N Conceal Dual Band + 113# N V6 Side-Dress	
6.	50% Conceal Dual Band+50% Side-Dress:	112#N Conceal Dual Band + 113# N V6 Side-Dress	
7.	25% Conceal Dual Band+50% Side-Dress:	56# N Conceal Dual 3" Band + 113# V6 Side-Dress (25% Under-Application)	
8.	75% Conceal Dual Band+50% Side-Dress:	150# N Conceal Dual 3" Band + 100# N V6 Side-Dress (25% Over-Application)	
9.	25% Conceal+25%WNF+50% Side-Dress:	56# N WNF + 56# N Conceal 3" dual bands + 113# V6 Side-Dress	Triple Split Applications

Results: Table 1. illustrates the overall yield results of all nine nitrogen programs. Conceal dual band nitrogen programs in general, accounted for all top five treatments in the study. In comparison to the control (50% WNF + 50% Side-Dress, Treatment #4), these top five treatments out-performed the control by an average yield of +8.9 Bu/A. All three single applications of nitrogen (Treatments 1-3), proved to have lower performance in the study. Dual nitrogen programs (Programs 4-8) out-yielded single programs by +15.7 Bu/A., while triple programs (Program 9) out-yielded single applications by +23.1 Bu/A. and dual programs by +7.4 Bu/A.



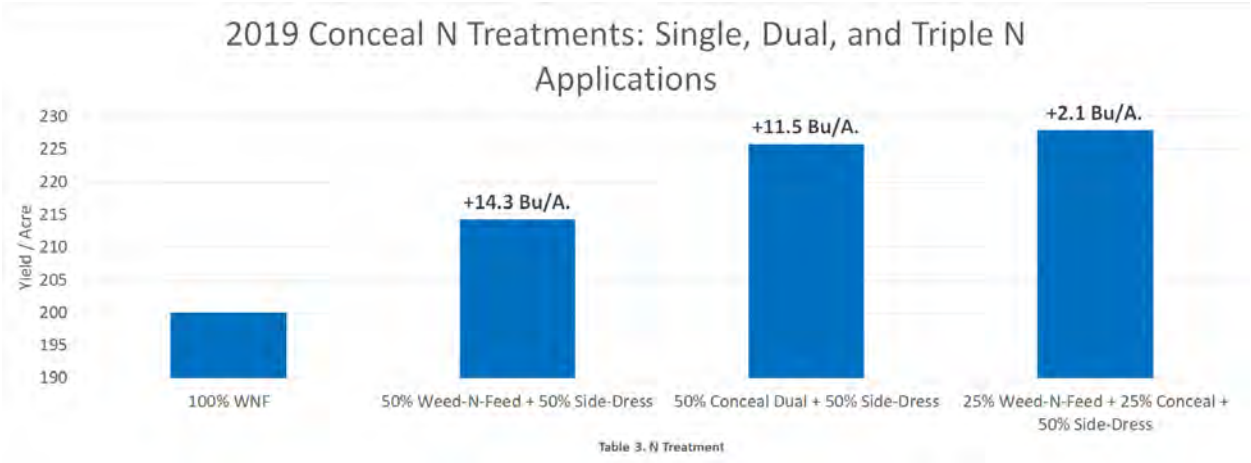
Nitrogen Management Rate/Placement Study Continued

Table 2. continues the story by calculating net return after cost of nitrogen for the 2019 growing season. The top five nitrogen programs, all with a positive return on investment consist of Conceal applications. The top nitrogen program for 2019 was the triple split application program (Treatment #9) that resulted in +$50.07 over the control. Single application programs resulted in losses of **-$19.09 to -$52.58/A.** compared to the control, with the 100% WNF treatment suffering the largest losses of the group.



To help understand the efficiency of the applications, we also evaluated adjusting the nitrogen rate by +25% and -25%. Adding 25% more nitrogen was the second highest yielding treatment in the study at 226.5 Bu/A. and resulted in the second highest net return of +$44.58/A. Lowering the nitrogen rate by 25% turned out to be detrimental as yields suffered **-9.0 Bu/A.** with and returns offset by **-$32.83/A.** compared to the control.

Table 3. helps clarify the yield advantages of split applications of nitrogen. In the past we learned that a split application program such as the control in this study (50% WNF fb 50% side-dress) has offered yield advantages. This year was no different, with gains of +14.3 Bu/A. in this scenario. The really interesting part of this study tells us that if planter applied nitrogen is utilized as part of the split nitrogen program, yields can be increased another +11.5 Bu/A. One step further would be triple application, where it resulted in additional gains of another +2.1 Bu/A.



Nitrogen Management Rate/Placement Study Continued:

Table 4. illustrates multi-year data from 2017 -2019 and the net return associated with each nitrogen program used over the past three growing seasons. Conceal at-plant nitrogen programs occupy the top three spots of the nine total programs, netting additional returns of +$36.41 to +$57.81/A. above the control. The triple application of 25% WNF + 25% Conceal dual band + 50% Side-dress took top honors at +$57.81/A. over the control treatment.

Multi-year single applications reveal net losses of **-$5.28** to **-$53.48/A.**, with 100% WNF treatments suffering the lowest returns.

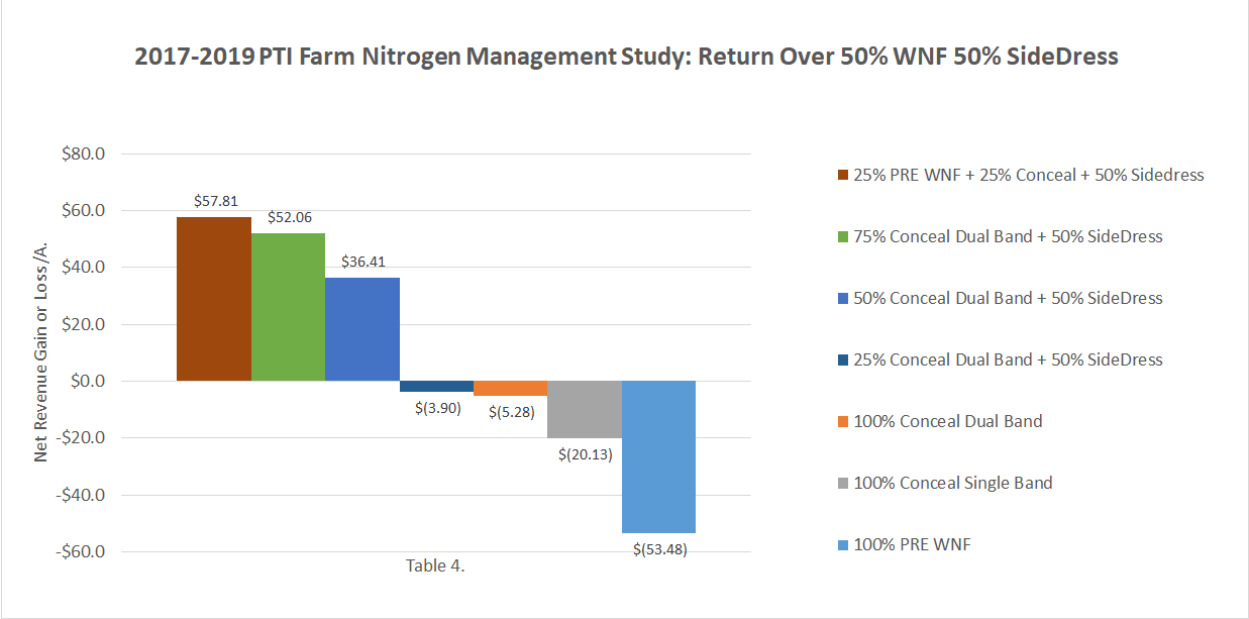


Figure 1. Weed-N-Feed Application (WNF)

Figure 2. Conceal 3" Dual Band Nitrogen

Figure 3. V6 Side-Dress Application

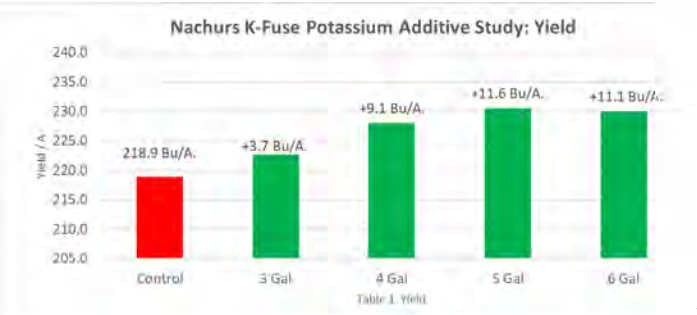
Planting Date: 4/27, 6/5 *Hybrid: GH 13Z50* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

Conceal K-Fuse Potassium Study:

Objective: To evaluate the yield and economics of Nachurs K-Fuse powered by Bio-K® (Figure 1.), a potassium/sulfur product designed to be blended with UAN fertilizer and applied on the planter or at side-dress. For this study we applied three to six gallons of K-Fuse at planting in a dual band Conceal application tank-mixed with 20 Gal/A. of UAN 32%. (Figure 2.)

Results: Table 1. illustrates K-Fuse applications reached agronomic optimum yield at the 5 Gal/A. rate. Yield response ranged from +3.7 Bu/A. to +11.6 Bu/A.

Table 2. depicts 5 Gal/A. also being economic optimum rate with net returns of +$19.82/A. The lowest rate of the study 3 Gal/A., proved losses of **-$0.07/A.** but all other rates of 4 and 5 Gal/A. proved net gains of +$15.20/A. to +$13.44/A. respectively.



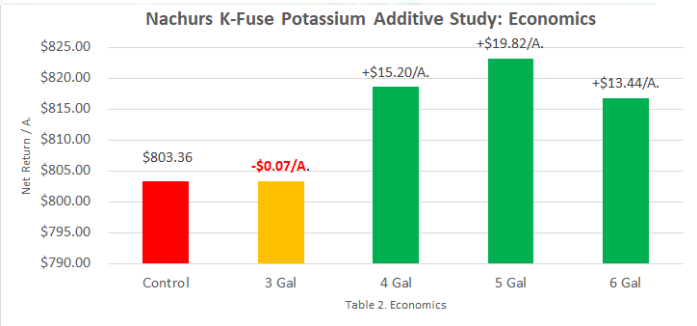


Figure 1. Nachurs K-Fuse Potassium Additive

nitrogen potassium sulfur

Higher crop yields, along with applications of potassium that haven't kept up with the crop removal pace, have left many acres in decline of available potassium. Similar decreases can be found with Sulfur since dry fertilizer manufacturing practices as well as Clean Air measures have limited or removed incidental sulfur from being part of the residual nutrient supply.

NACHURS K-fuse, by addition of potassium and sulfur to high nitrogen fertility programs will address known deficiencies as well as improve nitrogen use efficiency. **NACHURS K-fuse** is designed to be blended with various fertilizer products to provide additional potassium and sulfur needed to promote high yielding crops. Primarily, **NACHURS K-fuse** should be blended with UAN solutions for sidedress and/or fertigation application to provide two very critical elements: potassium and sulfur. It can also be mixed with APP and UAN for 2x2 and/or strip-till application to provide a more balanced nutrient program. **NACHURS K-fuse** contains a proprietary additive which is designed to be blended with various fertilizer products to provide additional potassium and sulfur needed to promote high yielding crops. Up to 32% more potassium and 93% more sulfur can be applied per acre versus potassium thiosulfate when blended with UAN.

POWERED BY bio-K®

Figure 2. Conceal Dual Placement 3" from Seed Trench, 1.5" in Depth

Planting Date: June 9 *Hybrid: DKC 53-56* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

K-Fuse: $4.55/Gal

Split Potassium Conceal Study:

Objective: To evaluate the yield and economics of split applications of Kalibrate™, a 2-0-10-6S sulfate of potash fertilizer containing nitrogen, potassium and sulfur. In this study Kalibrate is applied at 5 Gal/A. in a either a FurrowJet only, Conceal only, or combination treatment.

Each treatment contains a base program of 3 Gal/A. Pro-Germinator, 3qts/A. Micro500 via FurrowJet, 2 Gal/A. AccesS and 2 Gal/Ton eNhance via dual band Conceal.

Results: Table 1. reveals the highest yield gains of Kalibrate came from a split application. Kalibrate in a split application of 2.5 Gal/A. in FurrowJet and another 2.5 Gal/A. in Conceal proved yield gains of +11.7 Bu/A. Table 2. shows this application netting the only positive return in the study at +$10.97/A.Single applications offered lower yield responses. 5 Gal/A. of Kalibrate in a single FurrowJet application offered +4.9 Bu/A. yield gains, but failed to generate positive returns at **-$14.08/A.** The single Conceal application offered +6.2 Bu/A. but netted **-$9.21/A.**

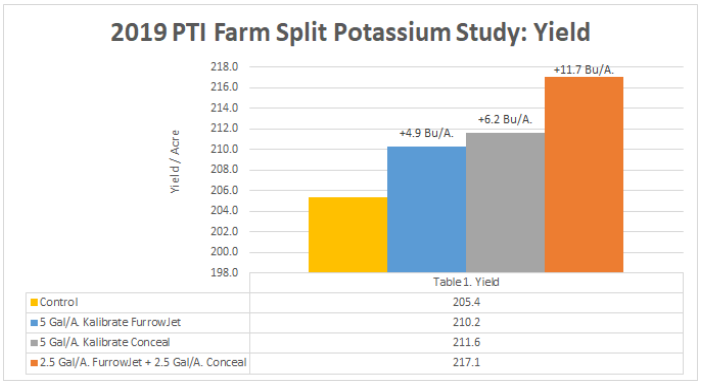


Table 1. Yield

Control	205.4
5 Gal/A. Kalibrate FurrowJet	210.2
5 Gal/A. Kalibrate Conceal	211.6
2.5 Gal/A. FurrowJet + 2.5 Gal/A. Conceal	217.1

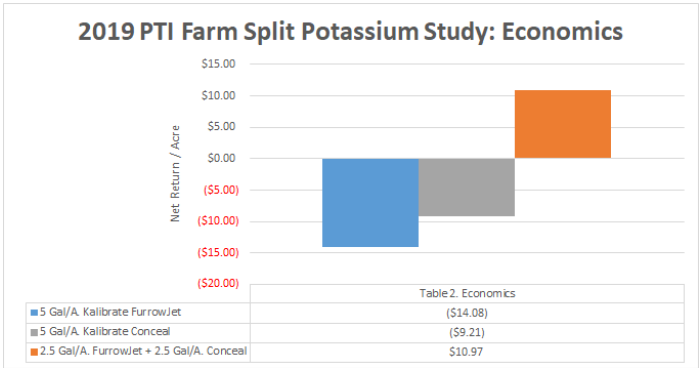


Table 2. Economics

5 Gal/A. Kalibrate FurrowJet	($14.08)
5 Gal/A. Kalibrate Conceal	($9.21)
2.5 Gal/A. FurrowJet + 2.5 Gal/A. Conceal	$10.97

Figure 1. AgroLiquid Kalibrate

Figure 2. FurrowJet Placement

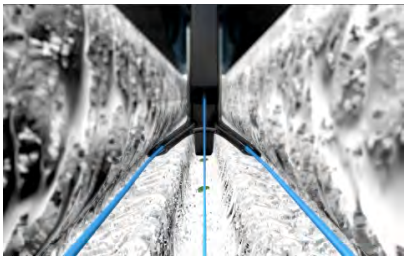


Figure 3. Conceal Placement

Planting Date: June 9 *Hybrid: Champion 58A18VT2Pro* *Population: 36K* *Row Width: 30"* *Rotation: CAB* *Corn Price: $3.67*

Kalibrate: $6.40/Gal

Nitrogen, Sulfur, Boron Conceal Study

Objective: To evaluate the yield and economic impact of tank-mixing Sulfur and Boron with at-plant nitrogen applications applied via dual band Conceal (Figure 1).

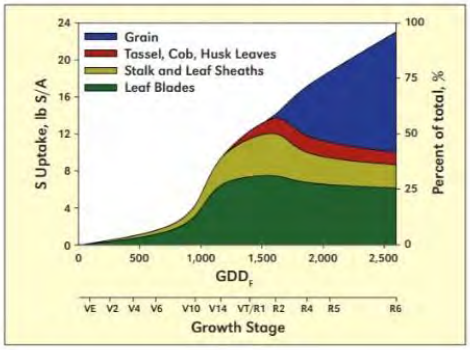
Figure 1. Conceal Dual Band Application

Sulfur (S) is an essential nutrient for corn growth, and is a critical nutrient to make required proteins. One bushel of corn typically requires 0.1 to 0.12lbs per bushel of corn produced. S uptake occurs over the entire growing season, with relatively constant uptake from the 14-leaf stage to maturity. Unlike nitrogen, only 40% to 50% of S is taken up by flowering (see Figure 2. chart below).

S is also very mobile in most soils (similar to nitrate) because it has a double negative charge and is repelled by the negative charge of the soil, unlike nutrients like potassium, calcium, or magnesium.

Due to the Clean Air Act Amendment of 1990, major emission reductions of sulfur dioxide (SO2) were put in place to the power sector. Figure 3. shows the difference in sulfur deposition over time from 2001 to 2015 as a result of this legislation. This reduction of free S in the atmosphere has created a situation where farmers may now need to apply S-fertilizer to crops for optimum yields.

Figure 2. Sulfur Uptake Graph



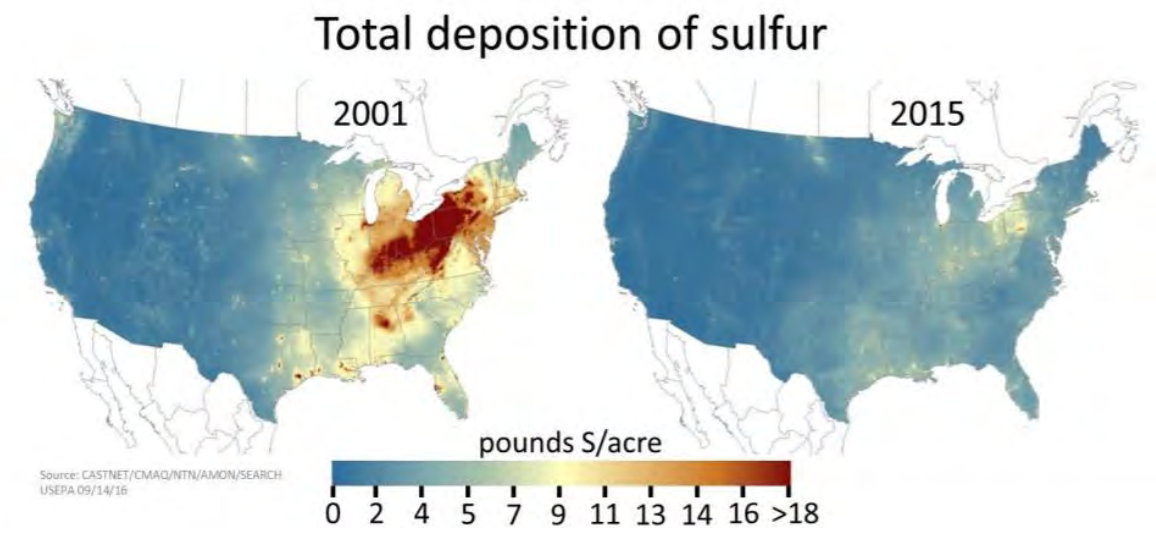
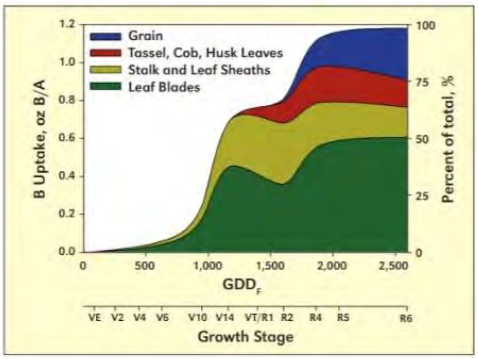


Figure 3. Sulfur Deposition Map

Nitrogen, Sulfur, Boron Conceal Study: Cont'd

Boron (B) is a micronutrient critical to the growth and health of all crops. It is a component of plant cell walls and reproductive structures.

Figure 4. Boron Uptake Graph

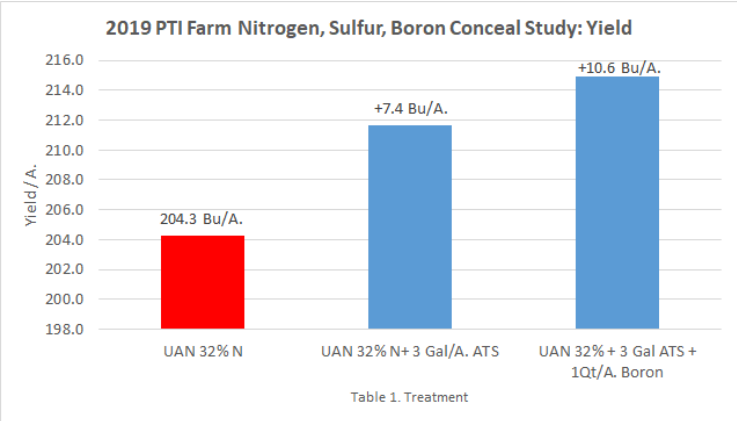


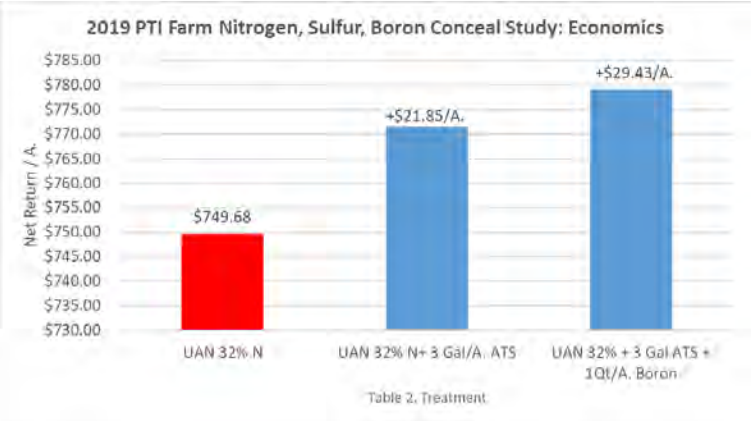
Boron, a water-soluble micronutrient, is especially prone to leaching. Because boron is a neutrally charged ion, it floats in ecosystems until it finds a substance to which it can cling. During periods of heavy rain, boron is flushed out of the soil quickly. Boron serves two primary roles. One is supporting plant cell division. And the second is during the silking stage of development, in which boron helps transfer water and nutrients from the roots up through the plant. B is required in small amounts, in fact a 200 Bu/A. crop only uptakes 0.2lbs of B.

Boron containing fertilizers typically should not be applied in close contact with seeds for any crop, since boron will injure germinating seeds.

Results: In this study 20 Gal/A. of UAN 32% nitrogen is used as a baseline control and compares adding 3 Gal/A. of ammonium thiosulfate 12-0-0-26 (ATS), as well as 1 qt. of a 5% Boron.

Tables 1-2 illustrate that 3 Gal/A. of ATS provided yield gains of +7.4 Bu/A. with a positive return on investment of +$21.85/A. 1qt. of Boron tank-mixed with the UAN and ATS, resulted in additional yield gains of +3.2 Bu/A. and net returns of +$7.58/A.





Planting Date: June 5 *Hybrid: DKC 51-38* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

ATS: $1.76/Gal. *Boron: $4.31/pt.*

Corn 2019 Summary of Conceal Applications

N Management Rate/Placement: 25% PRE WNF + 25% Conceal + 50% SD Multi Year 17'-19'	16.3	$	57.81
N Management Rate/Placement: 100% Dual Band over WNF	15.6	$	57.25
N Management Rate/Placement: 75% Conceal Dual Band + 50% SD Multi Year 17'-19'	19.2	$	52.06
N Management Rate/Placement:: 25% Conceal+25%WNF+50% Side-Dress	13.6	$	50.07
Centuro Nitrogen Stabilizer	16	$	48.18
N Management Rate/Placement: 75% Conceal Dual Band+50% Side-Dress	12.1	$	44.58
N Management Rate/Placement: 50% Conceal Dual Band+50% Side-Dress	11.5	$	42.27
N Management Rate/Placement: 50% Conceal Dual Band + 50% SD Multi Year 17'-19'	10.2	$	36.41
N Management Rate/Placement: 100% Single Band over WNF	9.1	$	33.40
Nitrogen, Sulfur, Boron: UAN32%+3gal ATS+1Qt Boron	10.6	$	29.43
N Management Rate/Placement: 50% Conceal Single Band+50% Side-Dress	6.4	$	23.33
Nitrogen, Sulfur, Boron: UAN32%+3gal ATS	7.4	$	21.85
Nachurs K-Fuse Potassium: 5gal	11.6	$	19.82
N Management Rate/Placement: Single vs Dual Band - Dual	5.2	$	18.94
Nachurs K-Fuse Potassium: 4gal	9.1	$	15.20
Nachurs K-Fuse Potassium: 6gal	11.1	$	13.44
Agroliquid Split Potassium: 2.5gal FJ, 2.5gal conceal	11.7	$	10.97
N Management Rate/Placement: 100% Conceal Dual Band	1.3	$	4.59
Nachurs K-Fuse Potassium: 3gal	3.7	$	(0.07)
N Management Rate/Placement: 25% Conceal Dual Band + 50% Sidedress Multi Year 17'-19'	-5.5	$	(3.90)
N Management Rate/Placement: 100% Conceal Dual Band Multi Year 17'-19'	-1.5	$	(5.28)
Agroliquid Split Potassium: 5gal Kalibrate	6.2	$	(9.21)
Sunrise Coop PCT 10 Gal Super Blue Conceal	0.3	$	(12.90)
N Management Rate/Placement: 100% Conceal Single Band	-5.2	$	(19.09)
N Management Rate/Placement: 100% Conceal Single Band	-5.7	$	(20.13)
N Management Rate/Placement: 25% Conceal Dual Band+50% Side-Dress	-8.9	$	(32.83)
N Management Rate/Placement: 100% WNF Multi Year 17'-19'	-15	$	(53.48)
Average of all Applications:	6.2	$	15.66

Corn Leaf Orientation Study

Objective: To study corn leaf orientation within the row and to understand the relationship of yield impact of corn leaves being positioned parallel or perpendicular to the row (Figures 1-2). Correct leaf orientation offers benefits of increased light interception, less sunlight to encourage weed suppression, cooler in-canopy temperatures, and moisture preservation.

Figure 1. Correct Leaf Orientation

Figure 2. Incorrect Leaf Orientation

Results: Table 1. illustrates the multi-year results of yield checks at the Precision Technology Institute in 2018 and 2019. Individual ear weight loss associated with incorrect leaf orientation resulted in **-9%** yield loss. Table 2. depicts average yield losses of **-18** to **-22.5 Bu/A**. for each plant with wrong leaf orientation. However, occurrence factors of these incorrect oriented plants generally range from 20% to 30% of all plant population. Therefore, actual yield losses from incorrect orientation range from **-3.6** to **-6.8 Bu/A**. depending on overall actual corn yield. Work is being done to determine how to help eliminate incorrect leaf orientation. Some of this work identifies seed placement in the seed furrow in order in an effort to manipulate direction of leaf placement. Early studies indicate that incorrect leaf orientation cannot be totally prevented, but trial data does suggest that manually placing seed in certain positions in the trench can improve results by +10%. In general, seed tip directional placement has been seen to improve emergence timing, while embryo directional placement may impact leaf orientation.

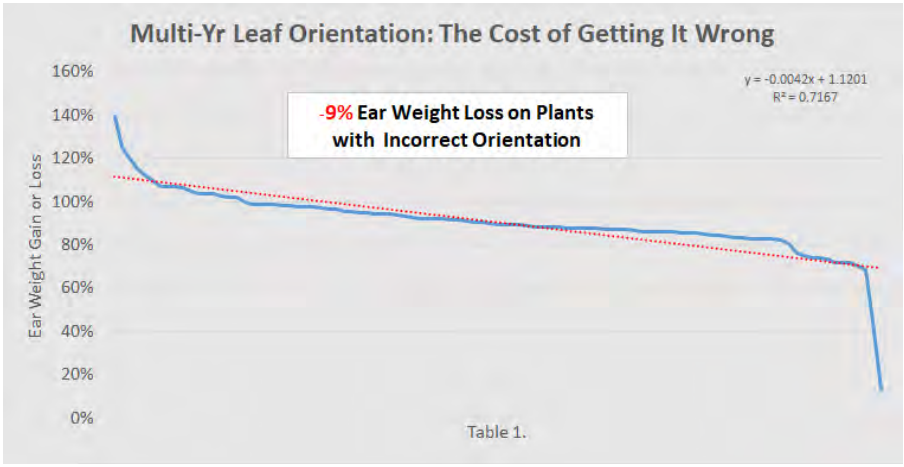


Table 2.	2018-2019		Occurrence	Factor %	
Overall Corn Yield	Ear Weight Yield	Yield Loss	20% Wrong	25% Wrong	30% Wrong
200	182.00	-18	**-3.6 Bu/A.**	**-4.5 Bu/A.**	**-5.4 Bu/A.**
225	204.75	-20.25	**-4.1 Bu/A.**	**-5.1 Bu/A.**	**-6.1 Bu/A.**
250	227.50	-22.50	**-4.5 Bu/A.**	**-5.6 Bu/A.**	**-6.8 Bu/A.**

Multi-Genetic Planting Study:

Objective: To analyze the yield and economic benefit of implementing mSet single meter multi-genetic technology to place specific corn hybrids for individual spatial management zones.

mSet® is an upgradeable product to vSet and vDrive, which couples a seed selector added to the hopper to switch hybrids, and a seed pool level sensor in the meter. The level sensor tells the seed selector when the meter needs more seed, and it drops a dose of seed into the meter. This continually happens until it is time to switch hybrids. At hybrid change, the level sensor will let the seed pool run low, then call for a dose of the other hybrid to enter the meter just in time for the change, leading to a short transition between hybrids. The seed pool is controlled by the mSet selector, providing the correct hybrid in the meter, and allowing the vSet meter to accurately singulate those seeds. The ultimate result is the hybrid you select, planted in the area of the field you select, planted with highest accuracy of singulation. Additionally, for those who want to both; plant fast, and place hybrids by spatial zone variability, SpeedTube can be used in tandem with mSet multi-genetic technology.

Figure 1. mSet Box

Figure 2. mSet Selector

Figure 3. Offensive and Defensive Spatial Zones

Offensive Zone:	Defensive Zone:
Hybrid = AgriGold 642-59VT2 RIB	Hybrid = AgriGold 6572VT2 RIB

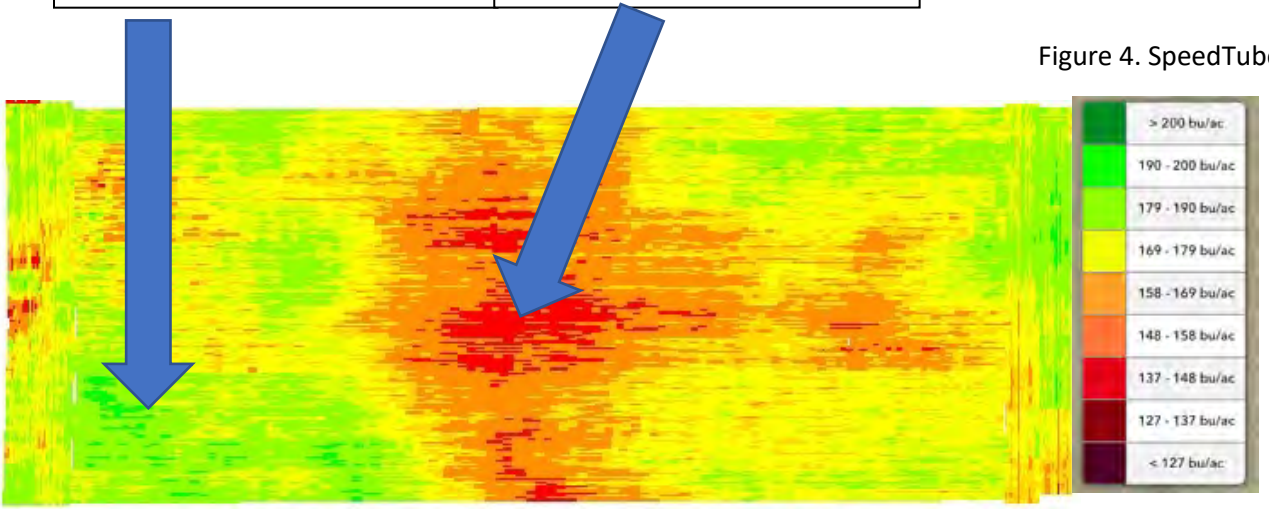


Figure 4. SpeedTube

Multi-Genetic Planting Study Continued:

Results: AgriGold 642-59VT2RIB was used as our offensive corn hybrid and 6572VT2RIB as the defensive hybrid. Each genetic package was placed into the appropriate matching spatial management zone (Figure 3). Test blocks were planted to evaluate the yield performance when hybrids were placed correctly, as well as incorrectly.

Figure 5. illustrates the results of placing an offensive hybrid (642-59VT2RIB) in higher productive and higher yielding soils. This placement resulted in yield gains of +5.7 Bu/A. compared to planting the defensive hybrid (AgriGold 6572VT2RIB) in that management zone. This yield gain corresponded to economic advantages of +$20.92/A.

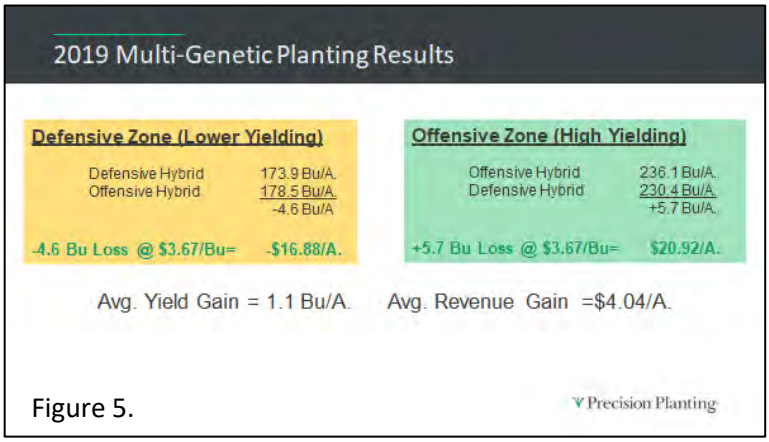


Figure 5.

Figure 5. also illustrates the results of placing a defensive hybrid (Agrigold6572VT2RIB) in the less productive and lower yielding soils. This placement resulted in yield losses of +4.6 Bu/A. compared to planting the offensive hybrid (AgriGold 642-59VT2RIB) in that management zone. This yield detriment corresponded to economic losses of **-$16.88/A.**

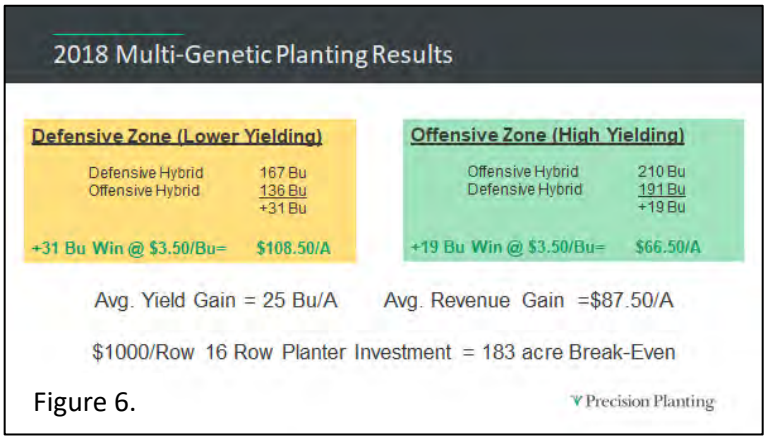


Figure 6.

Figure 6. summarizes 2018 mSet multi-genetic technology averaged yield gains of +25 Bu/A. and +$87.50/A. in increase revenue. Based on 2018 data, if a grower invested $1000/row on a 16-row planter for multi-hybrid technology, these types of yield and economic gains would result in return on investment at only 183 acres.

These yield results confirm that if used properly, a multi-genetic system used to place corn hybrids on a spatial management zone basis has the opportunity to offer yield advantages and potentially large economic gains. However, this year our offensive hybrid performed well enough in each environment.

Strip-Till Freshener Study

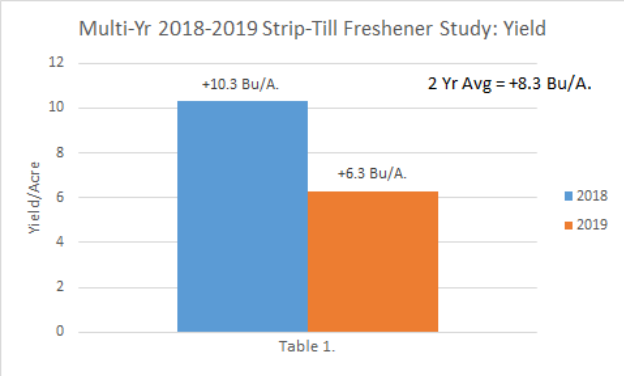
Objective: To evaluate the use of a Yetter 2984 strip-till freshener to facilitate consistent soil warming and bring existing strips to life. Fall strips made in October after harvest were freshened in April before planting (Figure 1).

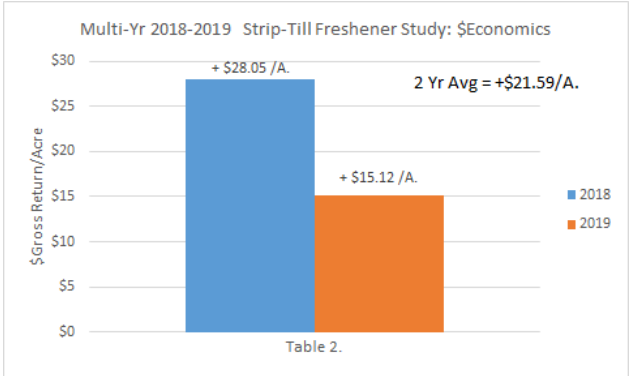
Features:

- 3-blade arrangement with rolling basket to condition strips
- Operates at 6 to 10 mph and 1 1/2" to 4" deep, depending on depth setting
- Precision Planting CleanSweep residue managers to clean rows while building strips

Figure 1.

Results: Spring strip freshening increased yield by an average of +6.6 Bu/A. and resulted in net gains of $15.12/A., using a custom cost of $8/A. for calculating cost of application. Tables 1-2. illustrate multi-year 2018-2019 average yield gains of +8.3 Bu/A. and net economic gains of +$21.59/A.





Planting Date: 6/8 *Hybrid: Wyffels 5518* *Population: 36K* *Row Width: 30”* *Rotation: CAS* *Corn Price: $3.67*

Chopping Corn Head Study

Objective: To study the yield impact of utilizing a chopping corn head in a continuous corn conventional tillage rotation. A Capello Quasar™ chopping head is used to create replicated strips of chop and non-chop residue management trials. The goal of this trial is to evaluate sizing of residue, allowing heavy stalks and residue to break down faster to advance the degradation process and in turn, reducing the carbon penalty associated with continuous corn environment.

Results: Table 1. illustrates that chopping corn residue improved corn yields by +10.1 Bu/A. and increased gross revenue by +$37.07/A. at a corn commodity price of $3.67/Bu.

Multi-year data from 2017-2019 indicate similar results with chopping advantages of +9.2, +11.1, and +10.1 Bu/A. respectively.

Table 1. 2019 Residue Mgt Trial: Chopping Corn Head

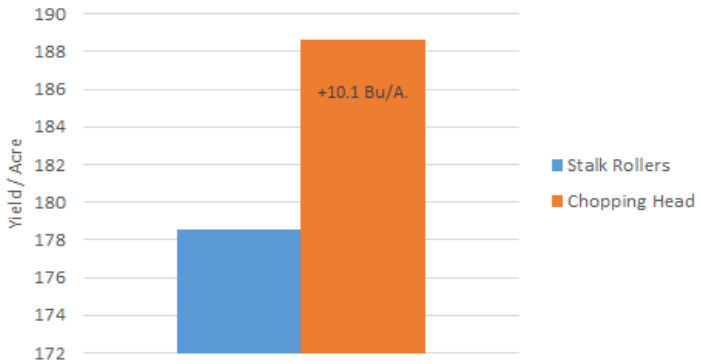
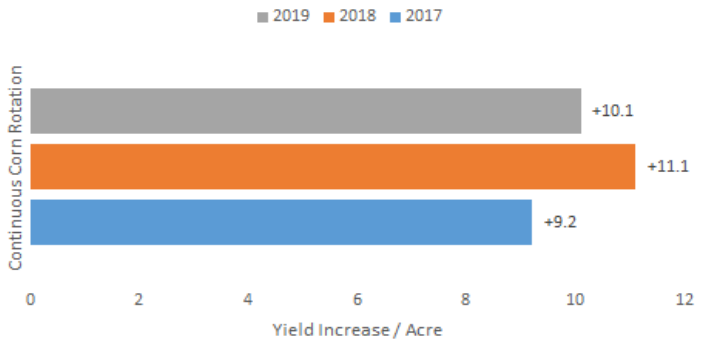


Table 2. Multi-Year Chopping Vs. Stalk Roller Advantage



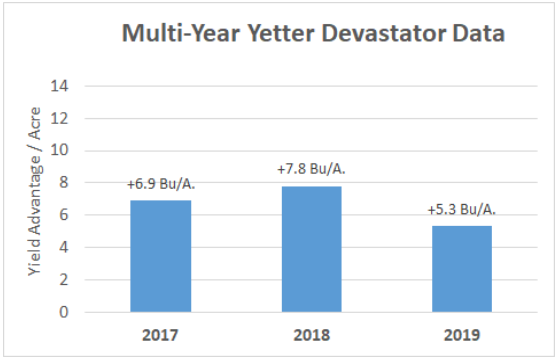
Planting Date: 6/10 *Hybrid: DKC 54-38* *Population: 36K* *Row Width: 30”* *Rotation: CAC* *Corn Price: $3.67*

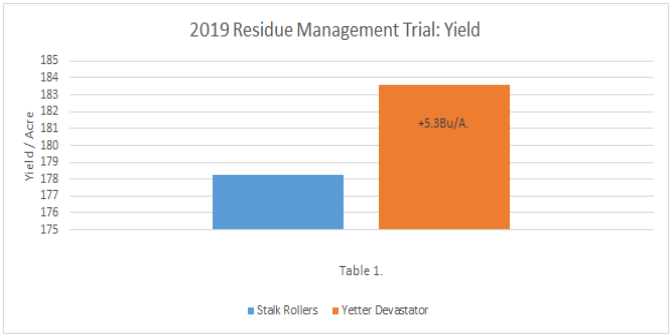
Yetter Devastator Study

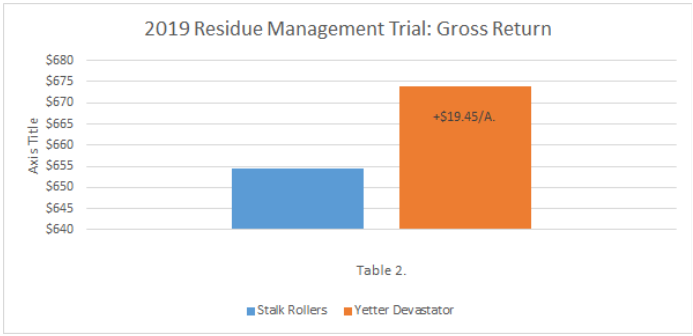
Objective: This continuous corn residue management study evaluates Yetter Manufacturing's 5000 Stalk Devastator. This corn head mounted device saves tires and tracks by knocking over and crushing stalks while leaving them attached, speeding up the cornstalk breakdown process and improving field conditions for spring planting. Features include the following:

- Prevents damage to tires, tracks, wires, and hydraulic hoses on combines, trucks, tractors, and implements
- Knocks over and crushes stalks for faster decomposition and microbial breakdown of residue
- Preserves residue cover, reducing soil erosion and keeping stalks in place in windy conditions

Results: Yetter Devastators provided +5.3 Bu/A. yield increases (Table 1.) and a return on investment of +$19.45/A. (Table 2.) and multi-year data from 2017-19 would indicate an average yield gains from +5.3 to +7.8 Bu/A. At a purchase price of $4371 for an 8 row Devastator, break-even acres would occur at 225 acres. With corn after corn rotations, residue management needs consideration and tools like this have been advantageous.







Planting Date: 6/8 *Hybrid: DKC 65-94* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

SCiO Pocket Molecular Sensor Study:

Objective: This study evaluates a new quick and easy grain moisture sensor called SCiO™ (Figure 1.). The SCiO is a pocket sized, bluetooth, micro-spectrometer that has the ability to measure moisture of shelled or unshelled grain. It's an in-field scouting tool that wirelessly connects to your smartphone via bluetooth, to provide quick and accurate moisture readings.

Figure 1. Scio in field scouting tool

Once the SCiO is connected, it can be then placed directly on the grain for moisture calculation. Five readings must be collected for every moisture SCiO scan.

Figure 2. Scio smartphone app

For this agronomic experiment, we compared the SCiO to a commonly used handheld DICKEY-john Mini-GAC plus (Figure 4).

Moisture readings can be done easily in the field without lugging large equipment or even hand-shelling ears. Using your smartphone in tandem with the SCiO, a grower can add notes and save moisture readings with the app (Figures 2 and 3.)

SCiO Pocket Molecular Sensor Study:

Results: When comparing SCiO to the DICKEY-john Mini-GAC®plus moisture sensor we realized some differences in regard to high and lower moisture corn. When corn was over 30% moisture, the SCiO averaged -4pts lower in moisture (Table 1). In high moisture corn (>30%), moisture errors ranged from -2.1 to -6.4 points in moisture discrepancies.

In corn moisture under 30%, the two moisture sensors only varied by 0.3pts of moisture and were very accurate on average. Moisture errors ranged from only -0.5 to -1.9 moisture point discrepancies (Table 2).

As an experimental product, the SCiO was an excellent tool to use in the field and looks very promising. We look forward to using this tool in 2020, utilizing it to learn more about grain moisture in relation to hybrid maturity and growing degree day accumulation.

Figure 4. DICKY-john Mini-GAC plus

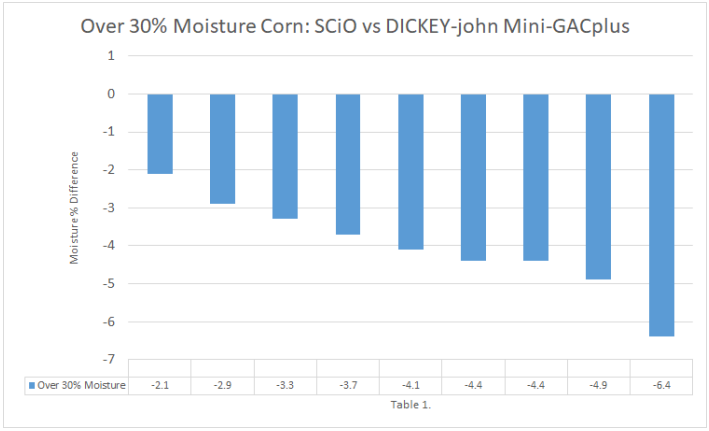


Table 1.

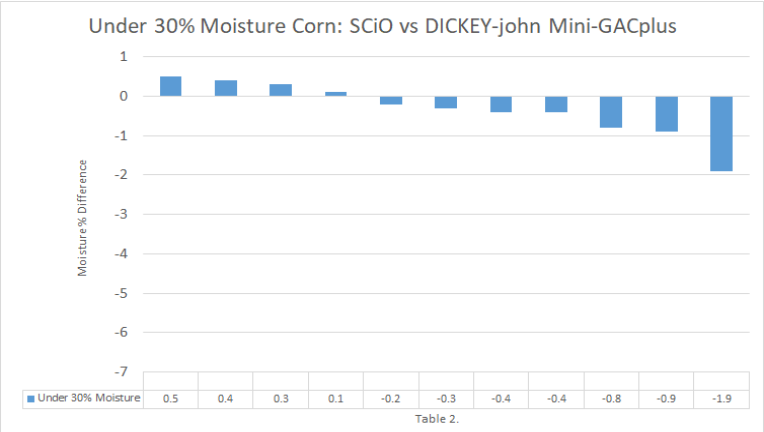


Table 2.

Bushel Plus (Harvest Loss Calculator) Study:

Objective: Understanding combine and header loss can be frustrating and very time consuming but none-the-less very important. The only indication of grain loss that is most commonly provided to the combine operator is rotor, sieve, and tailing losses which can be monitored by electronics in the cab (Figure 2). However, there is no correlation to bushel or economic loss per acre. Growers have a "feel good dial" which can adjust the system to increase or decrease sensitivity of harvest loss.

Optimize Your Combine

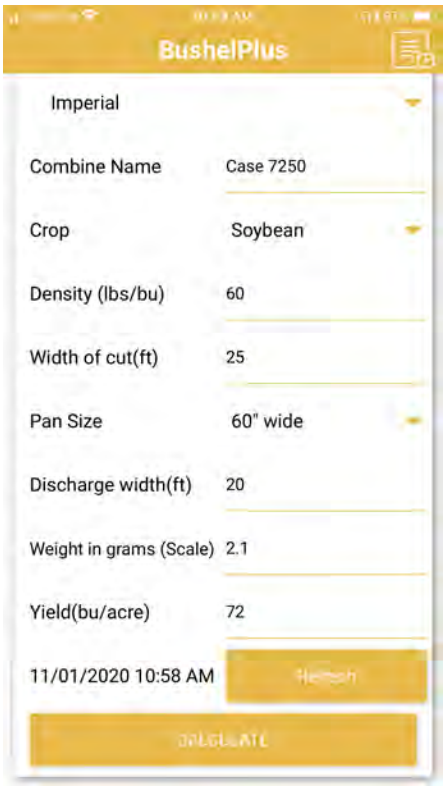
Figure 1.

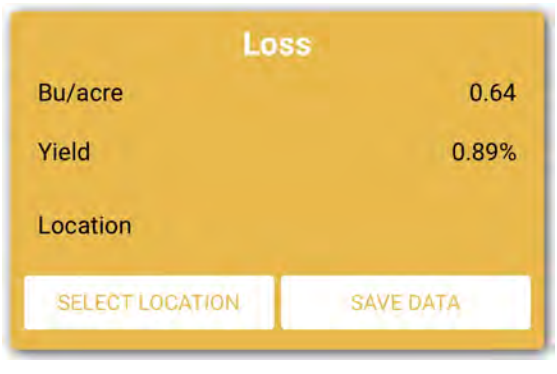
In addition, on current monitor loss systems today, header loss is not included in any grain loss calculations. This leaves a grower not fully aware of total grain losses and most importantly, where the loss is coming from.

Figure 2.

The Bushel Plus system consists of powerful, rechargeable magnets that attach a carrier unit (Figure 1.) underneath any combine. This stays mounted on the combine for testing and nested inside the carrier is an internal drop pan that can be released on the go, by a remote-control key fob while the combine is harvesting.

Figure 3.





A downloadable smartphone app provides easy quick calculation of header and machine losses in Bu/A. as well as percent loss. (Figure 3.)

Bushel Plus (Harvest Loss Calculator) Study Continued:

Results: Example 1 illustrates actual combine losses calculated from Bushel Plus. In this scenario, harvest losses exceeded our goal of less than 1 Bu/A. loss. Both machine and header losses combined totaled **-2.41 Bu/A.** Due to harvest moistures near 30% corn, initial machine settings needed to be changed to accommodate field conditions. Bushel Plus was able to confirm the harvest loss total, where the losses were at, and indicate that changes needed to be made.

Example 1. Total Corn Harvest Loss	Bushel Plus Calculation
Machine Loss	1.4 Bu/A.
Header Loss	1.01 Bu/A.
Total Loss:	**-2.41 Bu/A.**

Example 2. evaluates soybean header loss calculated from Bushel Plus. In this scenario we compare an auger platform head to a draper head. Results indicated that a draper head reduced harvest losses by .52 Bu/A., which would result in additional revenue of +$4.51/A.

Example 2. Soybean Header Loss	Bushel Plus Calculation
Auger Platform Head	0.835 Bu/A.
Draper Head	0.315 Bu/A.
Difference:	**+0.52 Bu/A.**

Bushel Plus Study Continued:

Example 3. illustrates actual corn header losses calculated from Bushel Plus technology. In this scenario we compare a Case IH 4408 non-chopping head to a Capello Quasar chopping head. Calculations indicated that the Capello head reduced harvest loss by ⅔ that of the Case 4408 head. This loss saving equates to additional revenue of +$2.45/A.

Example 3. Corn Header Loss	Bushel Plus Calculation
Case 4408 Corn Non-Chop Head	1.01 Bu/A.
Capello Quasar Chopping Head	.34 Bu/A.
Difference:	**+0.67 Bu/A.**

In summary, Bushel Plus was an excellent tool to use as a resource to not only understand what harvest losses consisted of, but it allowed our PTI Farm team to fine-tune our combine settings to minimize the harvest loss in the field. Most of today's combines do not inform the operator of actual Bu/A. losses to fully understand the economics of harvest loss.

Bushel Plus also allowed our team to understand the advantages, or shortcomings of various harvest tools currently being used in the marketplace.

Corn Tillage Study

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

Table 1. University of IL Machinery Cost Estimates

Tillage Practice	Category	Cost
Conventional Till	Ripper	$ 25.70
	Soil Finisher	$ 12.70
	Plant	$ 14.40
	Total:	$ 52.80
Strip Till	Strip	$ 16.70
	Plant	$ 14.40
	Burndown	$ 8.00
	Total:	$ 39.10
Vertical Till	Vertical	$ 11.70
	Burndown	$ 8.00
	Plant	$ 17.20
	Total:	$ 36.90
No Till	Burndown	$ 8.00
	Plant	$ 17.20
	Total:	$ 25.20

Figure 1. Sunflower® 6833 Vertical Tillage Tool

Figure 2. Kuhn® Krause Gladiator

Figure 3. AGCO Challenger® 1042 planting in No-Till

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 (Table 1). For reduced tillage programs, an $8/A. burn-down is also included.

Table 2. illustrates overall yield for each tillage segment. Yields varied only 15.2 Bu/A. between all tillage programs with strip-till offering highest yields at 225.5 Bu/A.

After applying all appropriate costs to each individual tillage segment, Table 3. depicts the economics of each system. Strip-till performed the best this year, with increases of +$17.25/A. over vertical tillage and +$55.79/A. over no-tillage.

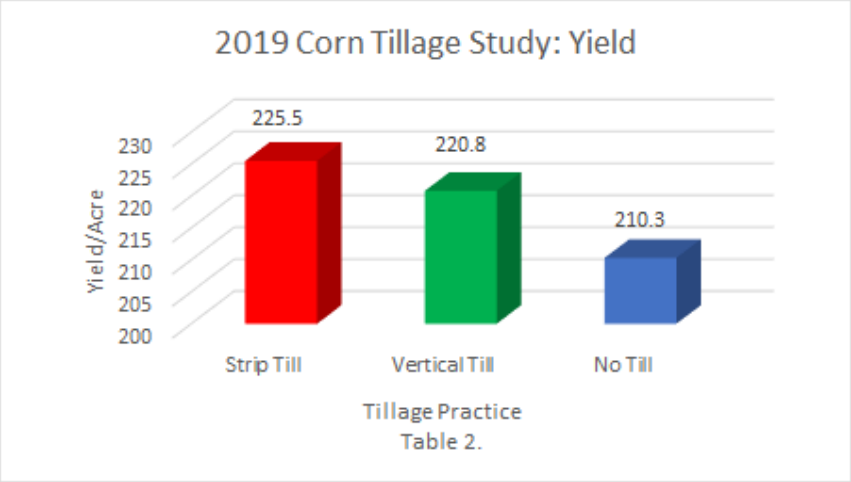


Table 2.

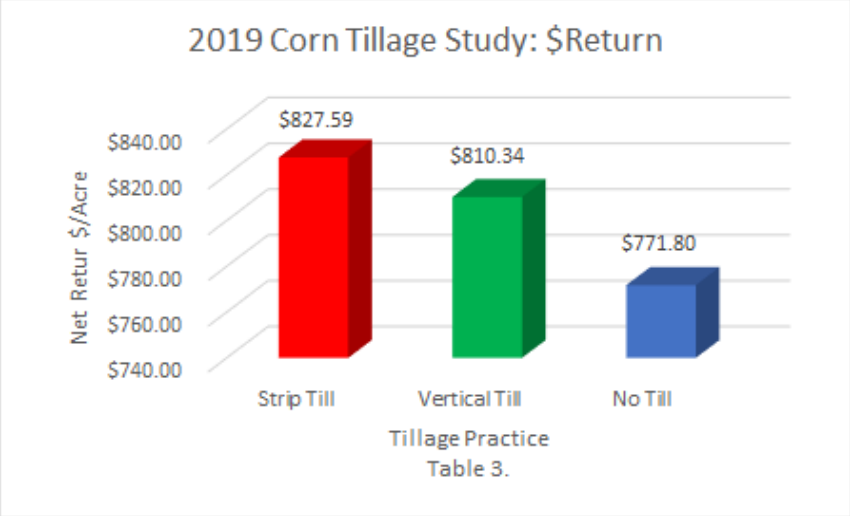


Table 3.

Planting Date: 5/5 *Hybrid: Wyffels 7696VTPro* *Population: 36K* *Row Width: 30"* *Rotation: CAC* *Corn Price: $3.67*

Pre-Harvest Yield Estimation Study

Objective: To calculate pre-harvest yield estimations and compare the accuracy levels of ear weight/moisture versus kernels/Bu. formulas.

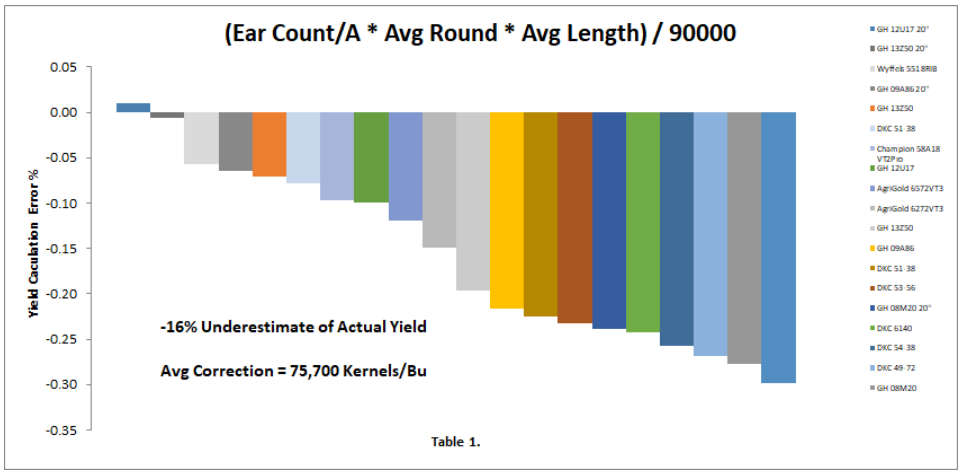


Table 1.

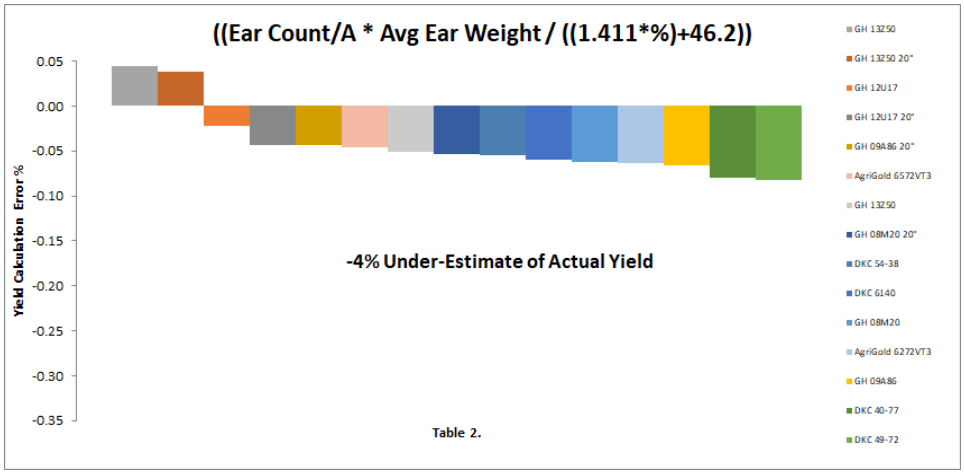


Table 2.

A common method used to perform pre-harvest yield estimations has been to calculate ear count multiplied by average kernels round, multiplied by average kernels in length, and divided by the number of kernels of a bushel of corn (Figure 1). The problem with this method has been that determining the number of kernels in a bushel of corn varies with different genetics due to size and weight of grain. Corn genetics can vary from hybrid to hybrid and even weather can commonly cause inconsistent test weights and kernel depth from one location to another.

Another pre-harvest yield estimate method is to calculate ear count multiplied by the actual average weight of the ears (Figure 2). Since a portion of the ear weight is water from the moisture level of the grain, a moisture reading must take place to differentiate the weight of the actual grain. This calculation accounts for the weight of the grain and more closely depicts yield estimation.

Results: 15 corn hybrids evaluated in this study indicate that using the traditional kernel/Bu. method of calculating corn yield at 90,000 kernels, under-estimated yield by an average of -16%. Table 1. Illustrates the wide variance of yield calculation error varying from +0.01% to -0.30%. To correct the error, an average of 75,700 kernels should have been implemented to account for an average accurate yield range depiction. Conversely, the ear weight and moisture yield estimation did a much better reflection of yield at estimating within -4% of actual yield. The interesting aspect using this formula is the very tight range of yield error, compared to the wide swings of the alternative method (Table 2.)

Over the last three years, the kernel/Bu. method has incurred average errors of -20.3% using 90,000 kernels/Bu. while the ear weight and moisture method proved better accuracy at 6.3% (+69% improvement)

Soybean Tillage Study

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

Table 1. University of IL Machinery Cost Estimates

Tillage Practice	Category	Cost
Conventional Till	Ripper	$ 25.70
	Soil Finisher	$ 12.70
	Plant	$ 14.40
	Total:	$ 52.80
Strip Till	Strip	$ 16.70
	Plant	$ 14.40
	Burndown	$ 8.00
	Total:	$ 39.10
Vertical Till	Vertical	$ 11.70
	Burndown	$ 8.00
	Plant	$ 17.20
	Total:	$ 36.90
No Till	Burndown	$ 8.00
	Plant	$ 17.20
	Total:	$ 25.20

Figure 1. Sunflower® 4630 Disc Ripper

Figure 2. Sunflower® 6833 Vertical Tillage Tool

Figure 4. Challenger® 1042 planting in No-Till

Figure 3. Case IH Steiger® Series with Strip-Till Bar

Soybean 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 (Table 1). For the three reduced tillage programs, an $8/A. burn-down is also included.

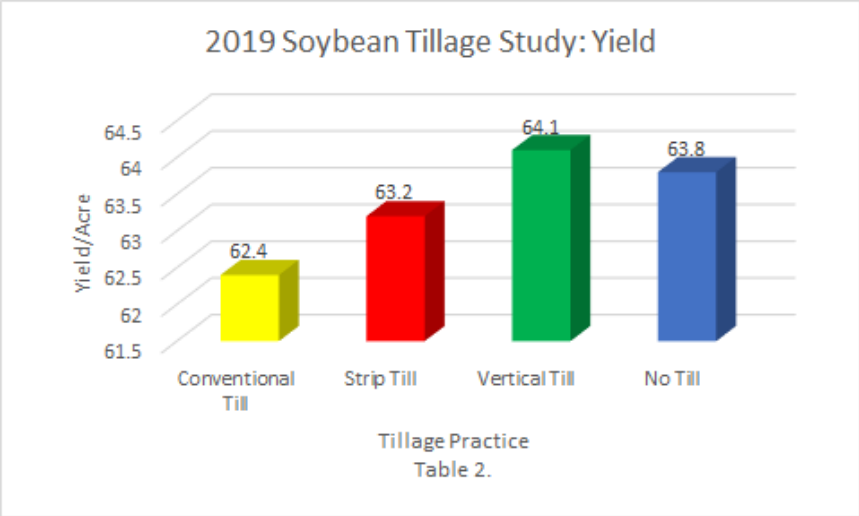


Table 2.

Table 2. illustrates overall yield for each tillage segment. Yields varied only 1.7 Bu/A. between all tillage programs with the vertical till and strip-till offering the highest yields of 64.1 Bu/A. and 63.8 Bu/A. respectively.

After applying all appropriate costs to each individual tillage segment, Table 3. depicts the economics of each system. Not only did vertical offer the highest yield in the study, but it also provided the highest economic return.

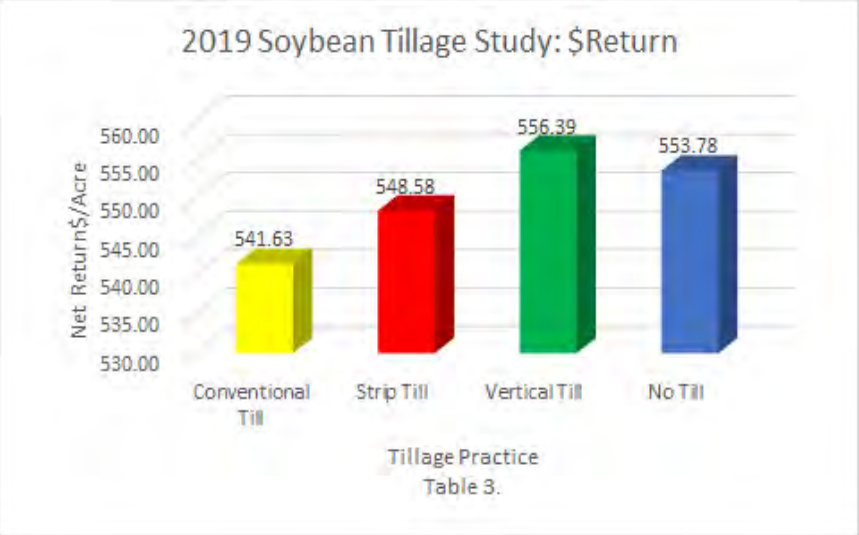


Table 3.

$14.76/A. separated the difference between all tillage systems, with conventional tillage offering the lowest overall returns in the study.

Vertical-till and no-tillage varied only by **-$2.61/A.**, while strip-till was close behind with **-$7.81/A.**

Planting Date: 5/10 *Variety: Pioneer 31A22X* *Population: 140K* *Row Width: 30"* *Rotation: BAC* *SB Price: $8.68*

Soybean Closing Wheel Study

Objective: To evaluate the performance of five different closing systems in three different tillage practices. Closing wheels are designed to close the seed trench, eliminate sidewall compaction/smearing, remove air pockets, all at the same time achieving good seed-to-soil contact. This study evaluates five distinct types of closing wheel systems in strip, vertical, and no-till situations.

FurrowForce Closing and Sensing/Control System:

Advantages: Fractures sidewall, removing compaction/smear

2nd stage firms soil and removes air pocket

Sensing of soil variability

Automatic Control to ensure proper settings

Single Rubber/Yetter Cast Spike Closing System:

Advantages: Fractures sidewall, removing compaction/smear

Combination of Sealing and Aggressive Fracture

Disadvantages: Spikes can be aggressive

Dual Yetter Poly Twister Spike Closing System:

Advantages: Fractures sidewall compaction/smear

Center ring acts as depth maintainerDisadvantages: Lightweight wheels require increased tension

Single Rubber/Yetter Poly Twister Spike Closing System:

Combination of two systems for variable soils

Soybean Closing Wheel Study: Continued

Dual Martin Dimple Spike Closing System:

Advantages: Fractures sidewall, removes compaction/smear

Versatile heavy wheel, great for reduced tillage

Depth Maintaining

Disadvantages: Extra weight can be aggressive

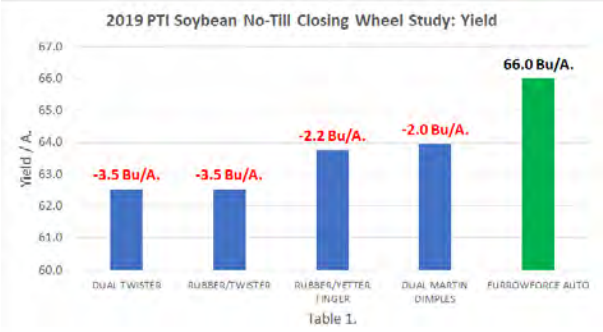


Table 1.

No-Till Results: The FurrowForce automated sensing and control closing system in a no-till environment shined with positive yield gains over all other closing systems. All non-sensing/control systems incurred yield losses of **-2.0** to **-3.5 Bu/A.** (Table 1). Using $8.68/Bu. soybeans equates to additional returns of +$17.36 to +$30.38/A. for the FurrowForce system.

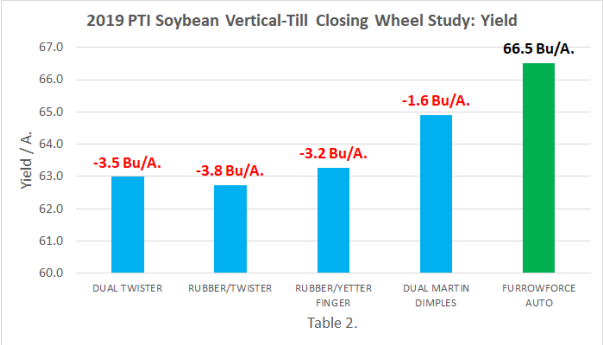


Table 2.

Vertical-Till Results: The FurrowForce automated sensing and control closing system in vertical-till environments also proved positive yield gains over all other closing systems. Non-sensing/control closing systems incurred yield losses of **-1.6** to **-3.8 Bu/A.** (Table 2). Using $8.68/Bu. soybeans equates to additional returns of +$13.89 to +$32.98/A. for the FurrowForce system.

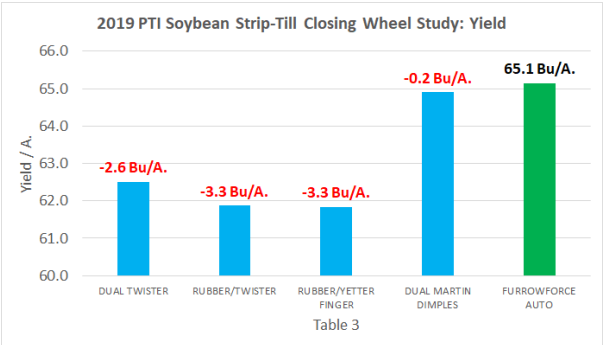


Table 3

Strip-Till Results: The FurrowForce automated sensing and control closing system in strip-till environments also proved positive yield gains over all other closing systems. Non-sensing/control closing systems incurred yield losses of **-0.2** to **-3.3 Bu/A.** (Table 3). Using $8.68/Bu. soybeans equates to additional returns of +$1.74 to +$28.64/A. for the FurrowForce system.

Soybean Closing Wheel Study: Continued

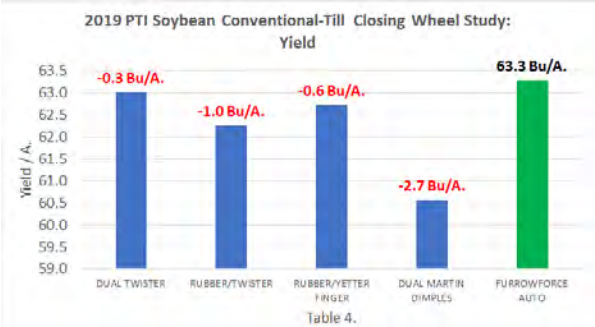


Table 4.

Conventional-Till Results: The FurrowForce automated sensing and control closing system in conventional-till environments also proved positive yield gains over all other closing systems. All the non-sensing/control closing systems incurred yield losses of **-.3** to **-2.7 Bu/A.** (Table 4). Using $8.68/Bu. soybeans equates to additional returns of +$2.60 to +$23.44/A. for the FurrowForce system.

Table 5. illustrates FurrowForce automatic sensing and control average gains of +$20.26/A. over all non-sensing closing systems.

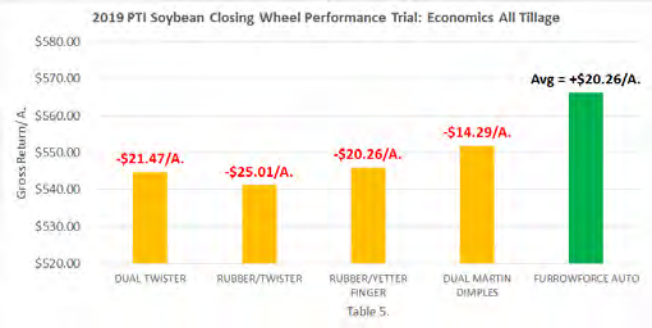


Table 5.

For years planters have struggled with closing systems with manual settings that offered the inability to account for and change for varying soil conditions. Today, we are excited that technology finally exists where farmers can use sensing technology on the planter row unit to determine how much force is needed on closing systems to address soil variability. By using FurrowForce, the automated 2 stage closing system with integrated sensing, partnered with a 20|20 monitor, farmers can be confident of closing the seed trench, eliminating sidewall compaction/smearing, and removing air pockets all while planting through various seedbed conditions on a pass-pass basis.

Planting Date: June 12 *Variety: Asgrow 36X6* *Population: 140K* *Row Width: 30”* *Rotation: BAC* *SB Price: $8.68*

High Yield Irrigation Study

Figure 1. Net-A-Fim Drip Line

NETAFIM™ GROW MORE WITH LESS

Objective: This study evaluates the use of NutriDrip irrigation and its ability to feed soybeans with water and nutrients for high yield potential. This method of irrigating a crop uses a NETAFIM drip tape with small pressure regulated emitters evenly spaced at 24" apart (Figure 1). Drip tape in this study is not sub-surface irrigation, rather the team at PTI installed this system on the soil surface to demonstrate how the system works and to have mobility with irrigating trials at the PTI farm in the future. Water was accessed from the local Walmart retention pond and pumped out through a 2" line and flexnet manifold system. Please note the soybean roots moving and following the dripline to get water and nutrients in Figure 1.

Figure 2. includes the individual treatments used in this study to try and achieve high yield, as well as the rates and placement of each product.

Figure 2. High Yield SB Plot Treatments

Treatment	Rate/A.	Placement	Supplier
1. L-CBF Boost Sugar	2 Gal	FurrowJet Center	Quality Liquid Feed
2. ProGeminator Sure-K Micro-500 C-Tech	4 Gal 2 Gal 1Qt 1Qt	FurrowJet Wings	AgroLiquid
3. 32% UAN	15 Gal	Conceal	----------
4. 14-12-4-6S	15 Gal	Conceal	Marco Fertilizer
5. Treatments 1-4	See Above	See Above	
6. Control	----------	----------	

High Yield Irrigation Study: Continued

Results: Table 1. illustrates the yield advantages of irrigation for each treatment in the high yield study. Two treatments achieved over 100 Bu/A. levels as a result of irrigation and nutrition placement. The highest yield in the study came in at 103.8 Bu./A., which consisted of a "kitchen sink approach" where all products were applied as one application. One standalone treatment was able to capture the "100 Bu/A." yield status, being a Conceal dual band application of a tank mix of UAN 32% and 14-12-4-6S yielding 100.7 Bu/A.

Figure 3. reveals the stark differences in the Conceal dual band treatments. It was very easy to see the plant health, growth stage, nodal development, and pod count advantages throughout the growing season.

Figure 3. Conceal Visual Differences

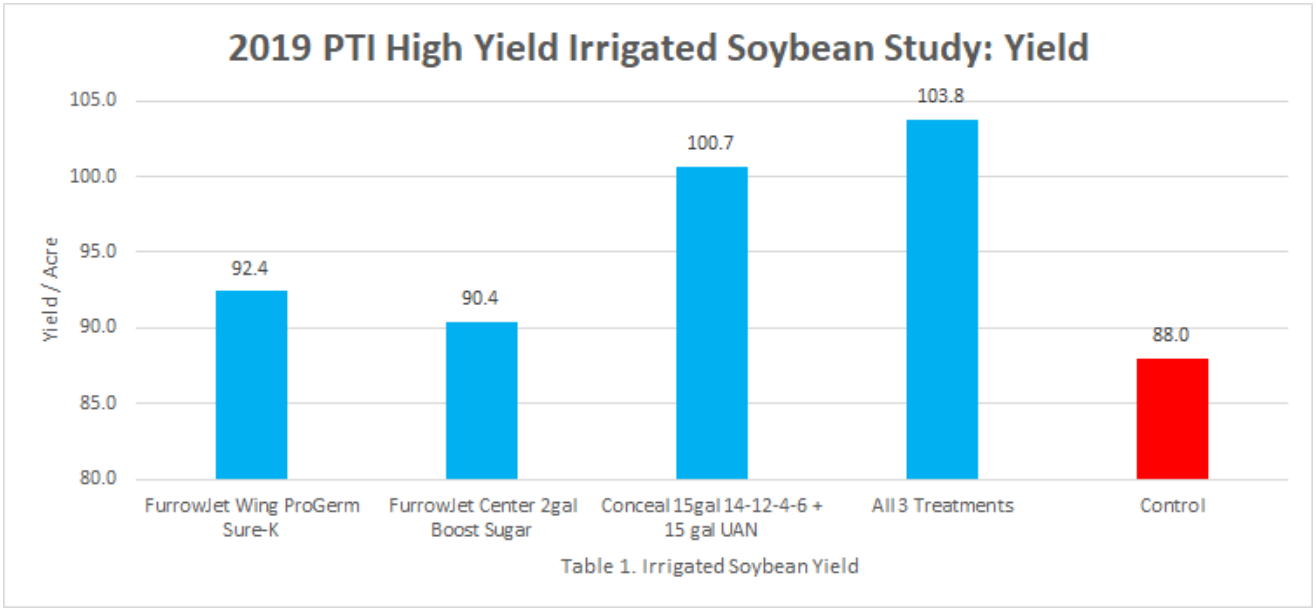


Table 1. Irrigated Soybean Yield

High Yield Irrigation Study: Continued

In general, NutriDrip irrigation resulted in average yield gains of 25.3 Bu/A. over the non-irrigated entries. This was mainly due to drought conditions that persisted for multiple weeks in July thru August. The equivalent of 9.8" of rain was applied through drip irrigation. Table 2. illustrates the yield advantages for irrigating soybeans with the NutriDrip system.

Table 3. explains the difference in yield between all treatments in the controlled irrigated environment. All treatments achieved positive yield gains, but those treatments that consisted of Conceal, garnered top yields with +12.7 to +15.7 Bu/A. advantages.

Table 4. displays non-irrigated soybeans trending overall lower yields, but individual treatments indicate the same trend of Conceal treatments taking top honors.

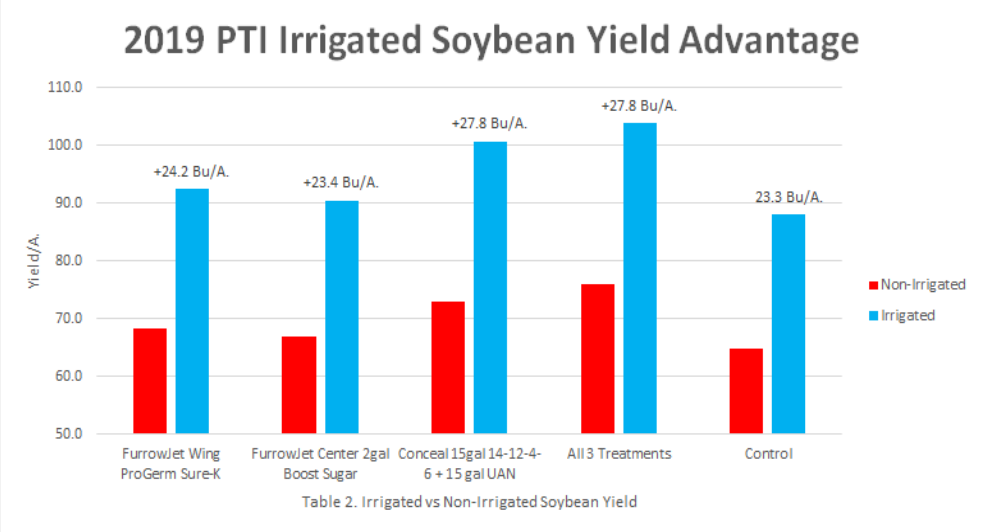


Table 2. Irrigated vs Non-Irrigated Soybean Yield

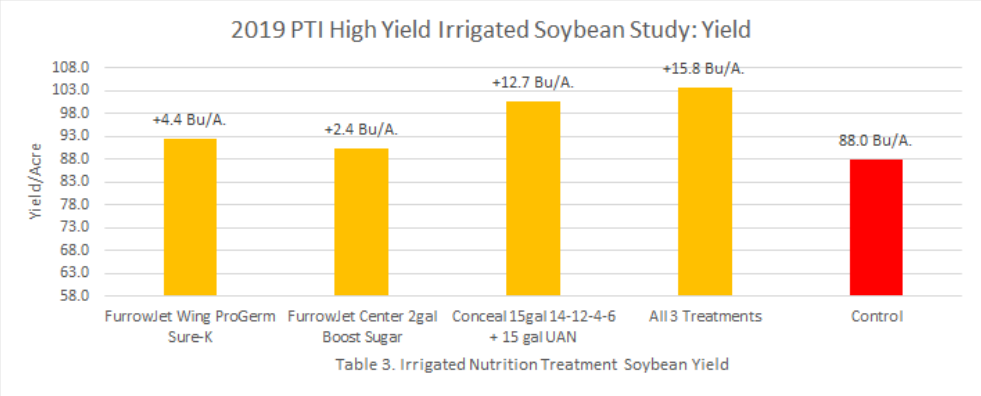


Table 3. Irrigated Nutrition Treatment Soybean Yield

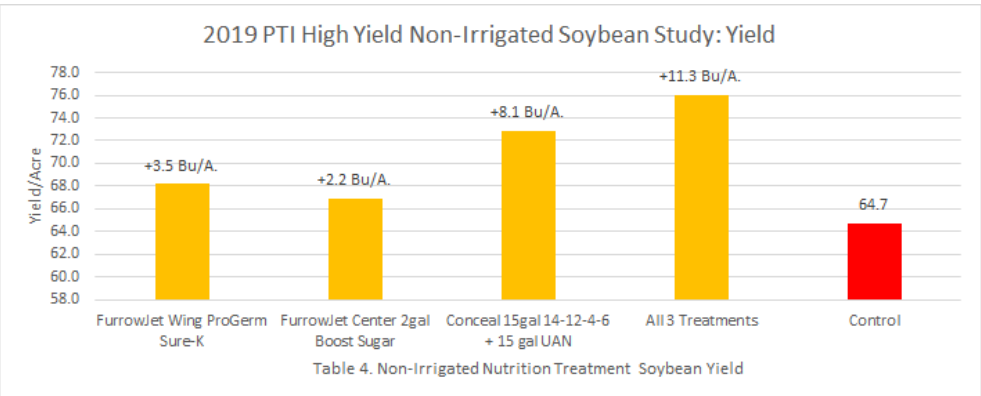


Table 4. Non-Irrigated Nutrition Treatment Soybean Yield

High Yield Irrigation Study: Continued

Table 6. depicts net return for each individual treatment in both dryland and irrigated environments. Both FurrowJet treatments offered very similar yield performances, however the irrigated Conceal treatments proved to excel and offer yield advantages over and above that of the dryland same applications.

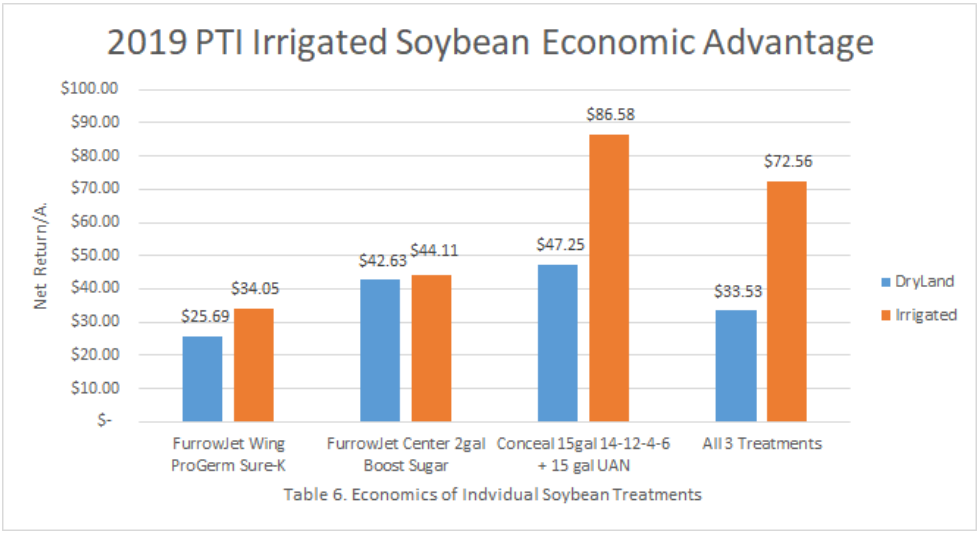


Table 6. Economics of Indvidual Soybean Treatments

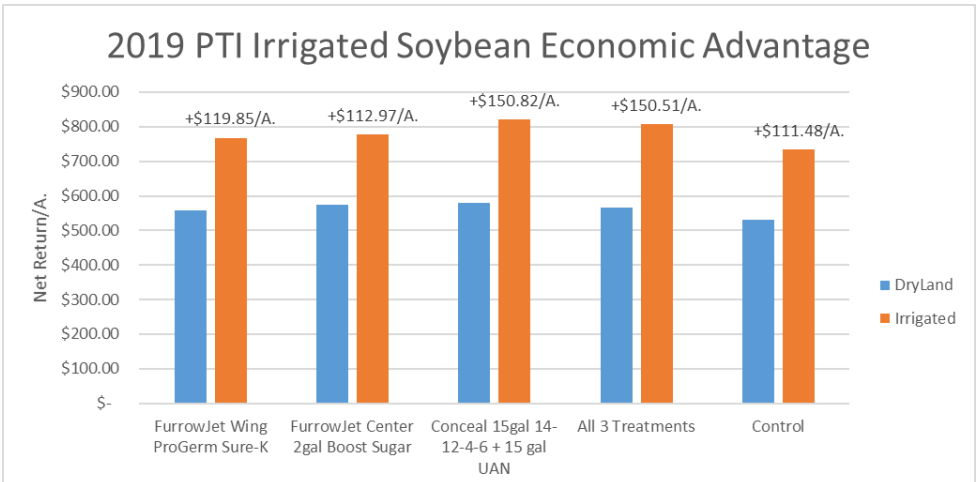


Table 7. Economic Advantage of Irrigated vs Non-Irrigated Treatments

Fertigation was also implemented to achieve high yield with drip dilutions of 5 Gal/A. ammonium thiosulfate ($8.80/A.), 2pts Boron ($4.63/A.), and 3 gallons of Nachurs K-Flex ($16.05/A.) through the Net-A-Fim drip system. All treatments incurred $61/A. in pumping costs, totaling expenses to $90.48/A. Even after these expenses, NutriDrip irrigation resulted in net economic gains of an average of +$129.13/A., but ranged from +$111.48 to +$150.82/A. in additional revenue compared to the non-irrigated treatments.

Planting Date: 6/12 *Hybrid: Asgrow 36X6* *Population: 130K* *Row Width: 30”* *Rotation: SAC* *SB Price: $8.68*

Boron: $18.50/Gal *ATS: $1.76/Gal* *K-Flex: $5.35/Gal*

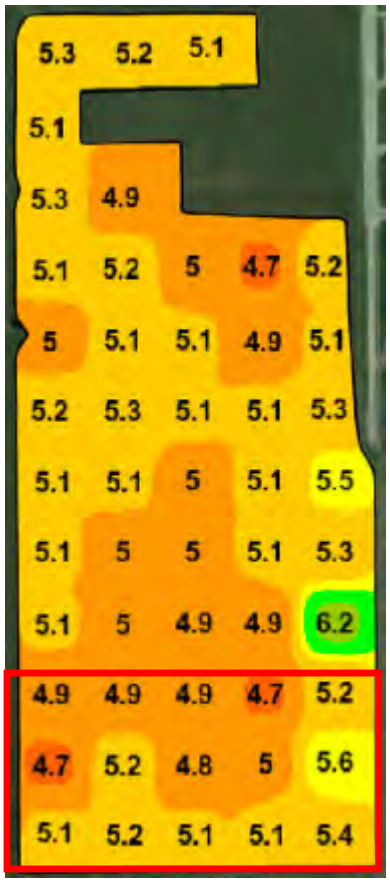
pH Acidity Study:

Objective: To evaluate the long-term yield and economic impact of acidic soil pH in soybeans.

When the PTI farm was acquired in the fall of 2017, a soil test revealed some major issues with soil pH on a particular area of the east side of the farm. Soil test results indicated average pH values of 5.1, with lows of 4.7 pH. This acidic area offered an opportunity to evaluate the yield response of acidic soils compared to corrected basic or neutral pH soils. 3 Ton of Ag Lime was applied in 2017 and another 2.5 Ton in 2018, however plots were left without lime to represent long-term pH testing.

What is soil pH? The term pH stands for the potential (p) of hydrogen ions (H+) in water, and indicates a measure of the relative acidity or alkalinity of the soil solution. Soil pH is calculated on a 14-point scale, where a value of 7.0 is considered neutral or basic (Figure 2). Lower values on the pH scale denote increasing H+ ions and acidity, while higher values represent increasing hydroxyl (OH-) ions and alkalinity. Because pH is expressed on a logarithmic scale, each change of 1 pH unit actually represents a 10-fold increase in soil acidity or alkalinity. Figure 3. indicates the influence of soil pH on nutrient availability of various macro and micronutrients.

Figure 1. 2017 Soil Test pH



Limestone
Fall 2017=3 Ton/A
Fall 2018=2.5 Ton/A

Long-term Acidity Testing Area: No Ag Lime Applied

Figure 2. The pH Scale

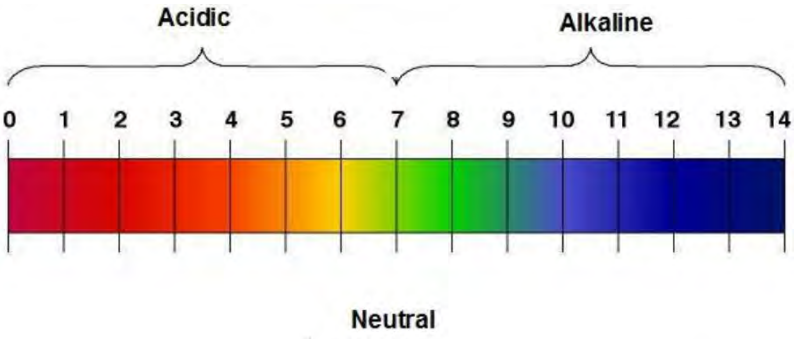
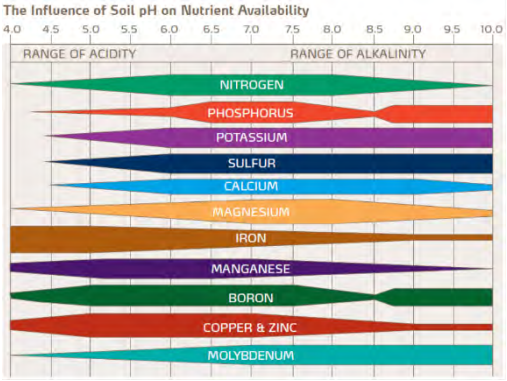


Figure 3.



pH Acidity Study Continued:

Results: Table 1. illustrates that in our second year of this soil acidity study in soybeans, there was a significant yield loss in acidic soils near 5.1 pH. 2019 yield data revealed a **-8.31 Bu/A. yield loss** in soybeans. Ag limestone applications from 2017 and 2018 (Totaling 5.5Ton) proved a return on investment of +$22.16/A., indicating that all the limestone was paid for in just year one of the study in soybeans. After applying 5.5 Ton of AgLime over the last two years, economic gains of +$28.07 have been realized after the cost of product and application.

Being designed as a long-term multi-year study, we will continue this trial over the years to come to monitor yield, nutrient deficiencies, or other stress factors.

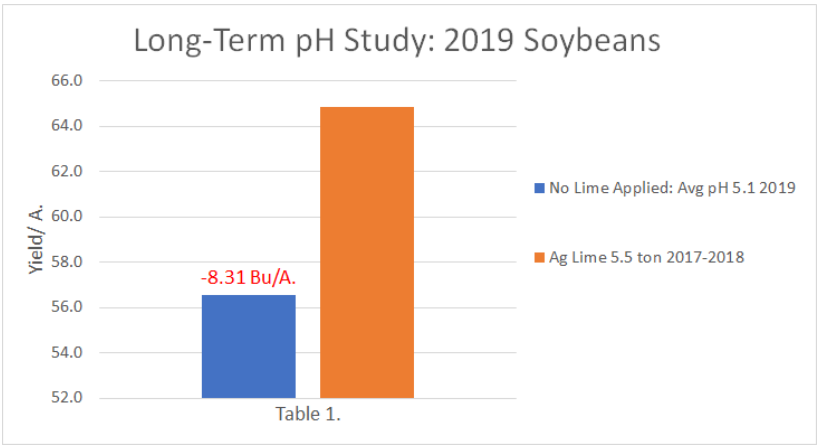


Table 1.

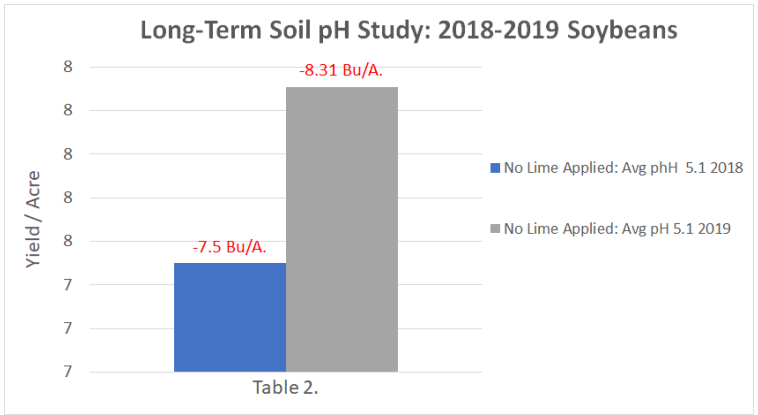


Table 2.

Planting Date: 6/11 *Variety: Asgrow 36X6* *Population: 140K* *Row Width: 30”* *Rotation: SAC*

Prices: Soybeans $8.68

Soybean Planting Date Study

Objective: To evaluate various soybean planting dates throughout the spring planting season to determine optimum planting date. Once optimum yield is discovered, data can then be analyzed to determine the deviation of yield at both early and late planting dates compared to traditional norms.

Results: With the recent trend of earlier soybean planting dates achieving higher yields, it was our intention to plant as early as possible in this study. Table 1. illustrates the results of 5 planting dates over April 26th, May 7th, May 20th, June 5th, and June 10th. Yields only varied 5.1 Bu/A. between all planting dates. In 2019, the optimum plant date occurred on May 20th, receiving the highest yield of 69.2 Bu/A. Early planting suffered this year, with both early planting dates yielding an average of **-4.8 Bu/A.** less than the optimum plant date. Planting later did offer yield decline, but only by an average of **-1.6Bu/A.**

2019 proved to be challenging in regard to getting acres planted. Evaluating the data looks even more challenging, as later planted did not suffer the normal or typical yield loss associated from late planting. In addition, the early planted soybeans suffered in yield rather than typically responding well to early plant dates. For example, in 2018 March 22 planted soybeans offered optimum plant date yields of 83.8 Bu/A.

Table 1.

Planting Date: Varied *Variety: GH3546* *Population: 130K* *Row Width: 20"* *Rotation: BAC* *SB Price: $8.68*

Soybean Starter Fertilizer Response by Planting Date Study:

Objective: To monitor the performance of starter fertilizer at various planting dates. When does starter fertilizer give the highest returns? Does starter fertilizer respond differently at earlier planted dates versus later? In this study we evaluate four planting dates consisting of April 26th, May 7th, May 20th, and June 5th with and without a starter fertilizer, monitoring its performance throughout the planting season.

The starter fertilizer program used for this study consists of the following:

Product	Fertilizer Analysis	Placement of Fertilizer
1 Gal/A. Triple Option	4-13-17-1S	FurrowJet Center
1Pt/A. CropMax	2-0-2-0.1B-0.15Cu-0.3Fe-1.5Mn-0.0005Mo-4Zn	FurrowJet Center
2 Gal/A. Triple Option	4-13-17-1S	FurrowJet Wings
1Pt/A. CropMax	2-0-2-0.1B-0.15Cu-0.3Fe-1.5Mn-0.0005Mo-4Zn	FurrowJet Center
20 Gal/A.UAN	32-0-0	Conceal Single Band
6 Gal/A. K-Fuse	Potassium Sulfate	Conceal Single Band

Figure 1. FurrowJet Placement

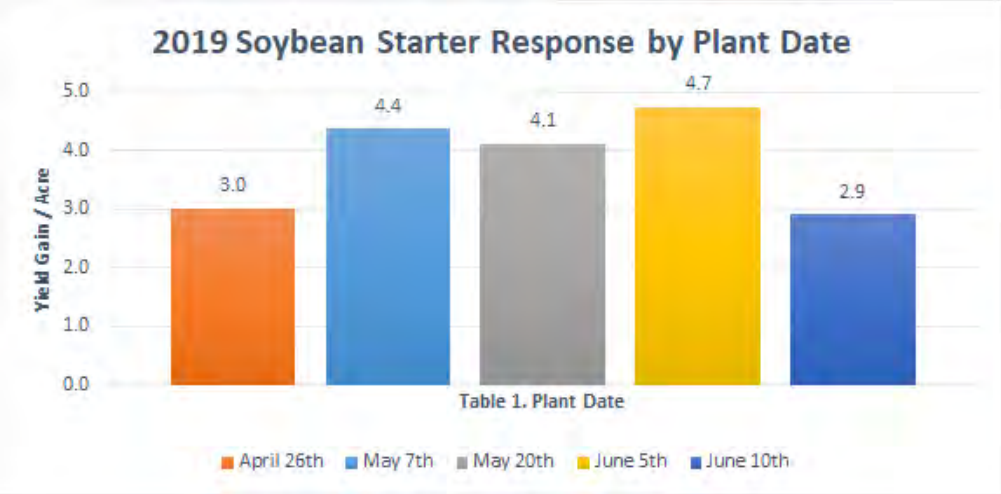
Figure 2. Conceal Placement

Planting Date: Varied *Hybrid: Pioneer 31A22X* *Population: 130K* *Row Width: 20”* *Rotation: BAC* *SB Price: $8.68*

Fertilizer Pricing: Marco LTE 6-20-4-.25Zn-2.7S $3.40/Gal

Soybean Starter Fertilizer Response by Planting Date Study:

Results: Table 1. illustrates all starter fertilizer treatments offered yield gains at each of the five planting dates. Yield gains averaged +3.82 Bu/A., ranging only +1.8 Bu/A. between all the planting dates. 2019 starter fertilizer treatments really offered minimal differences between planting dates in a strange and non-typical year focused on later than normal planting.



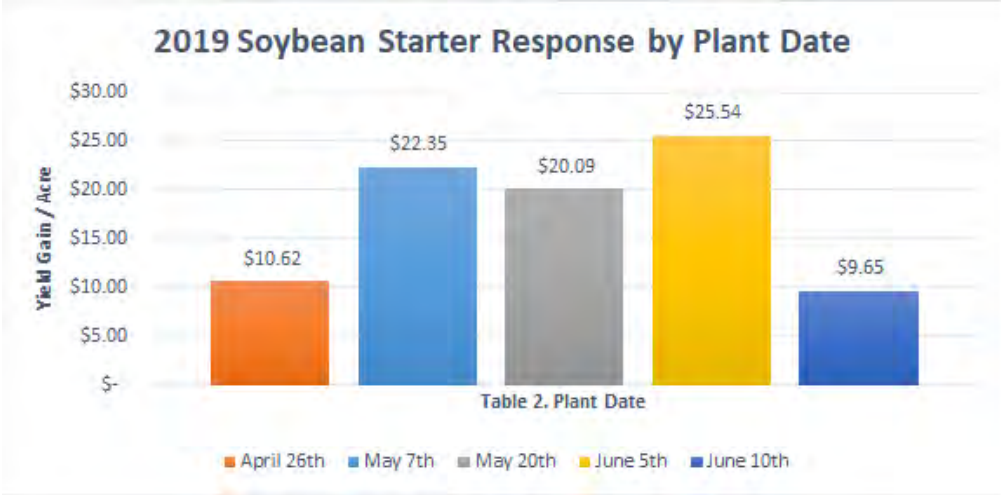


Table 2. focuses on net return on investment with all starter treatments by planting date offering average positive gains of +$17.65/A. Both the earliest and latest planting dates struggled with starter fertilizer response with yield gains of +2.9 and +3.0 Bu/A. with lower returns of +$10.62 and $9.65 respectively. These returns represent almost 50% of the returns realized from the three planting dates of 5/7, 5/20, and 6/5.

Planting Date: Varied *Hybrid:GH3546* *Population: 130K* *Row Width: 20”* *Rotation: BAC* *SB Price: $8.68*

Fertilizer Pricing: $45.64/A. *$30DAP Reallocation*

Precision Planting

2019 PTI Results

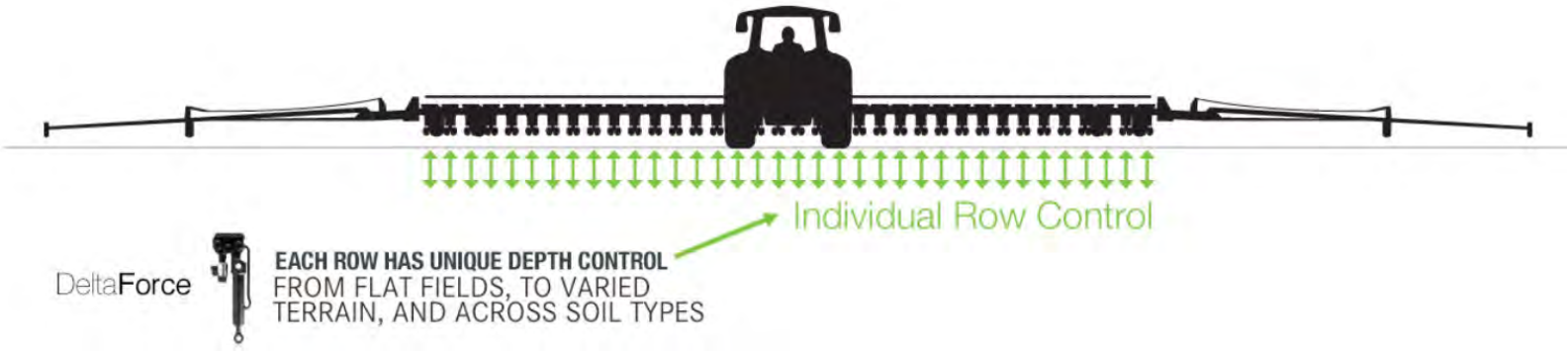
DownForce Management Study:

Figure 1. DeltaForce Cylinder

Objective: This soybean study evaluates yield impact of implementing proper downforce compared to too light or too heavy row unit settings. Planter row unit downforce is a common agronomic issue that often goes unaddressed. When downforce matches field conditions, the depth of planting is consistent and correct. Too light of row unit downforce causes planting depth to shallow up, potentially placing seed in dry soil, creating poorly rooted plants that struggle for water and nutrients. Conversely, too much downforce can lead to furrow side-wall compaction also creating an environment that can cause limited plant access to water and nutrients.

DeltaForce replaces the springs or air bags on your planter with hydraulic cylinders (Figure 1). It automatically increases or reduces weight on each row individually, ensuring that each row is performing correctly. When one row encounters conditions different than another (wheel tracks, old road beds, clay knobs, headlands, whatever), each will adjust independently (Figure 2). Row by row, foot by foot, depth stays exactly where you want it. Row by row, foot by foot, even seed by seed, you produce an environment that fosters uniform germination, optimum growth and maximum yield.

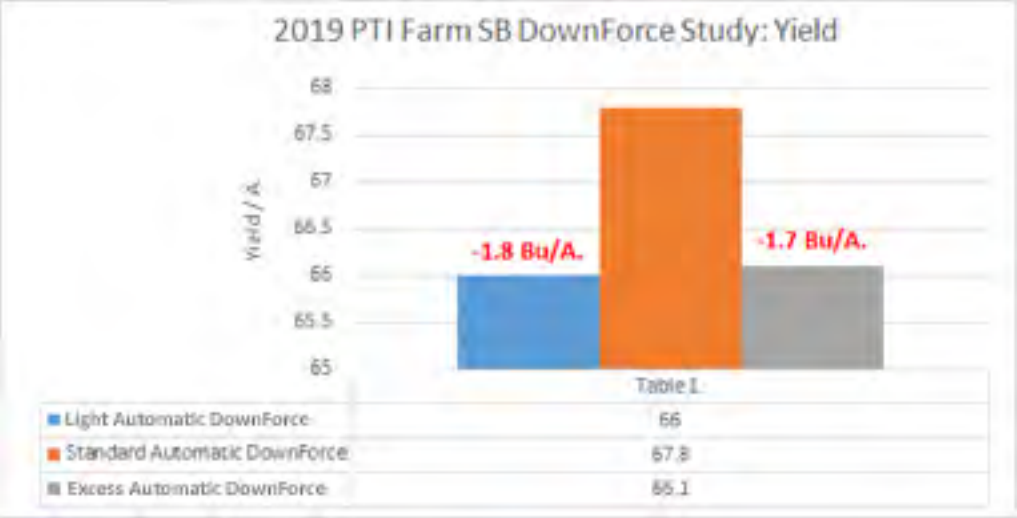
Figure 2.

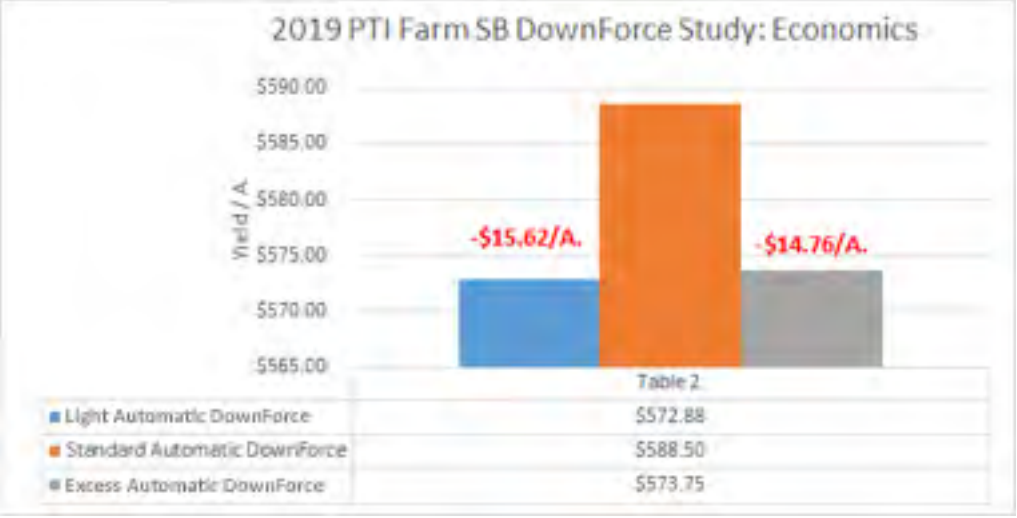


DownForce Management Study Continued:

Results: Table 1. illustrates the impact of yield of soybeans planted at 1.5" in depth in three automatic downforce settings. Automatic sensing and control in the Standard Setting out-performed both the Light Automatic and Heavy Automatic settings by 1.7 to 1.8 Bu/A. respectively.

Table 2. summarizes the economics of using the incorrect downforce target for conditions. In this PTI study, downforce in the setting of Light or Heavy, realized losses of **-$14.76** to **-$15.62/A.**

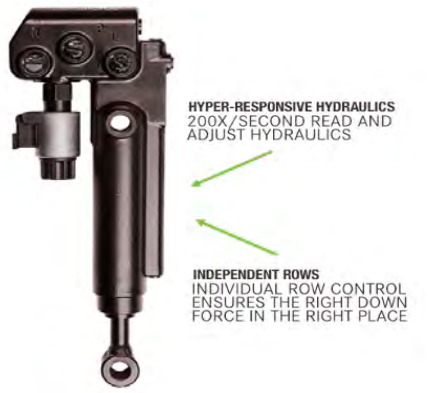




Planting Date: June 6 *Hybrid:Pioneer 31A22* *Population: 130K* *Row Width: 30"* *Rotation:SAC* *Soybean Price: $8.68*

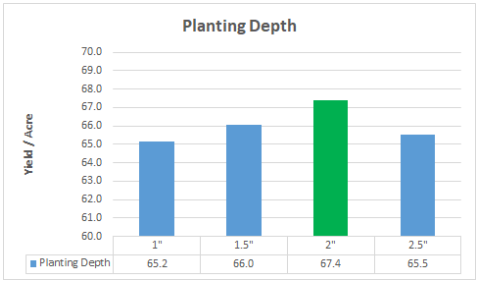
DownForce Management Study:

Figure 1. DeltaForce Cylinder

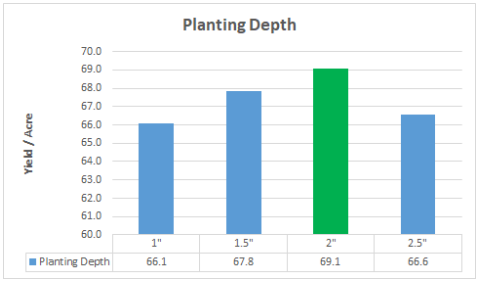


Objective: This soybean study evaluates yield impact of implementing proper downforce at planting depths of 1" to 2.5".

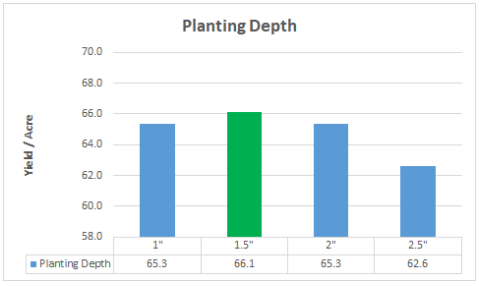
Planter row unit downforce is a common agronomic issue that often goes unaddressed. When downforce matches field conditions, the depth of planting is consistent and correct. Too light of row unit downforce causes planting depth to shallow up, potentially placing seed in dry soil, creating poorly rooted plants that struggle for water and nutrients. Conversely, too much downforce can lead to furrow side-wall compaction also creating an environment that can cause limited plant access to water and nutrients.



In Light automatic mode, yields averaged 66.0 Bu/A. Shallow planting depths at 1" resulted in **-2.2 Bu/A.** losses compared to the highest yielding depth at 2". This loss equated to **-$19.10/A.** Moving deeper to 2.5", lost -1.9 Bu/A. yield and **-$16.49/A.** in revenue.



Standard automatic mode resulted in the highest soybean yields in this study +67.0 Bu/A. Shallow planting depths at 1" resulted in **-3.0 Bu/A.** losses compared to the highest yielding depth at 2". This loss equated to **-$26.04/A.** Moving deeper to 2.5", lost -2.5 Bu/A. yield and **-$21.70/A.** in revenue.



Heavy automatic mode realized the lowest yields in this study at 64.8 Bu/A., -2.2 Bu/A. losses compared to that of Standard mode. Shallow planting depths at 1" realized -3.0 Bu/A. losses compared to the highest yielding depth at 2". This loss equated to **-$26.04/A.** Moving deeper to 2.5", lost -2.5 Bu/A. yield and **-$21.70/A.** in revenue.

Planting Date: June 6 *Hybrid: Pioneer 31A22* *Population: 130K* *Row Width: 30"* *Rotation: SAC* *Soybean Price: $8.68*

Precision Planting

2019 PTI Results

Row Width/Seeding Rate Study:

Objective: To evaluate the agronomic and economic advantage of 30” vs 20” row soybeans at seeding rates of 110K to 200K with Pioneer™ 31A22X and Champion® 26X98N soybean varieties.

Results: Soybean yields of each row width were very consistent varying only 1.0 Bu/A. in 30” rows and 2.0 Bu/A. in 20” row widths (Table 1.)

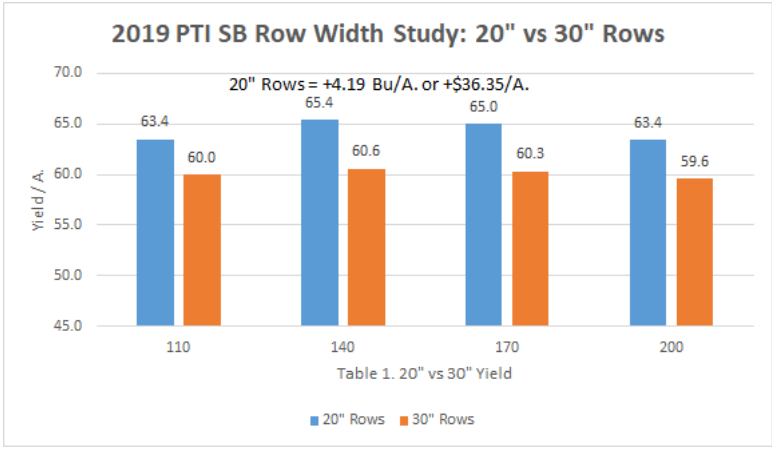
Highest yields were reached at the 140K seeding rates in both row widths at 65.4 and 60.6 Bu/A. respectively.

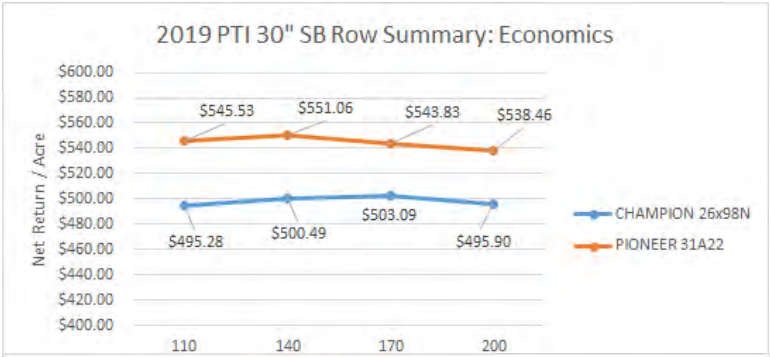
Table 2. reveals the economics of both varieties in 30” row width. Pioneer 31A22 proved economic optimum seeding rate at 140K, varying only $12.60/A. between all seeding rates. Champion 26X98N proved economic optimum seeding rate slightly higher at 170K, varying only $7.81/A.

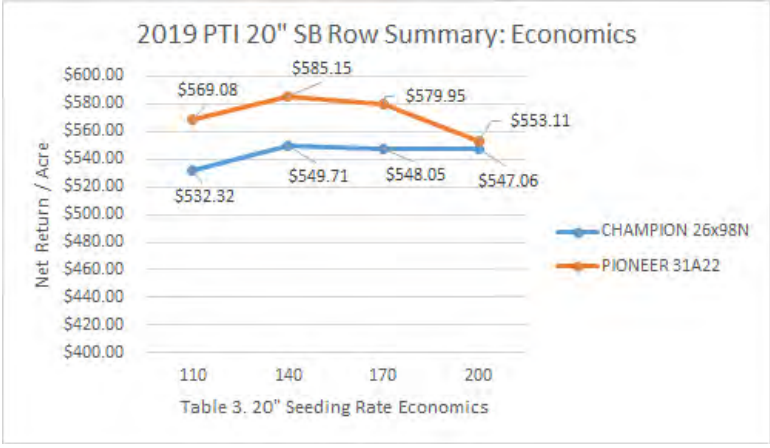
Table 3. reveals the economics of both varieties in 20” row width. Pioneer 31A22 proved economic optimum seeding rate at 140K, varying the most in this study of $32.04/A. between all four seeding rates.

Champion 26X98N similarly, proved economic optimum seeding rate in 20” rows at 140K, varying $17.38/A. between all four seeding rates.

In general, 20” row soybeans out-performed 30” rows by +4.19 Bu. This yield response equates to a net return advantage of +$36.35/A. (Table 1).







Planting Date: June 14 Hybrid: Pioneer 31A22/Champion 26X98N Population: Varied Row Width: 30”/20”
Rotation: SAC SB Price: $8.68 Seed Cost: $50

Soybean Singulation Study:

Objective: To evaluate the agronomic and economic advantage of singulating soybeans. In this study we compare the use of an 80-hole vs 56 hole soybean crop kit (Figure 1).

Figure 1.

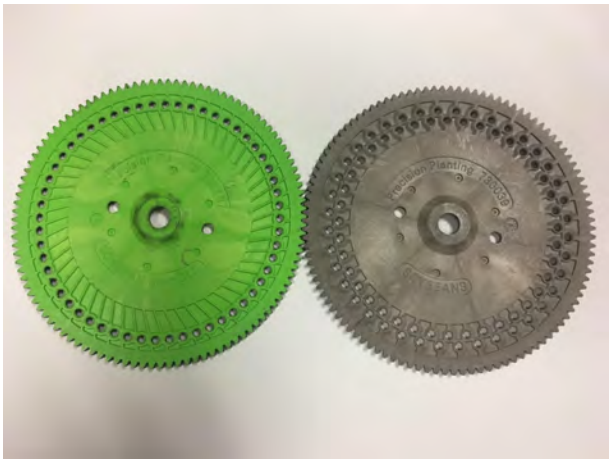


Figure 2.

Results: Planting soybeans with the green 56 hole disk did allow the ability to singulate soybeans. Figure 2. illustrates a depiction of typical spacing of soybean plants that were achieved in this study.

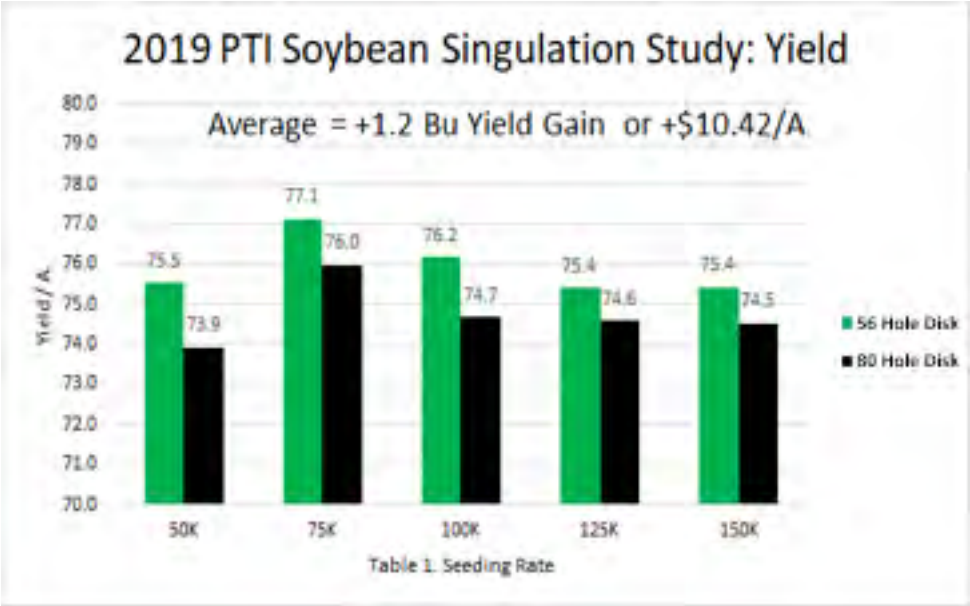
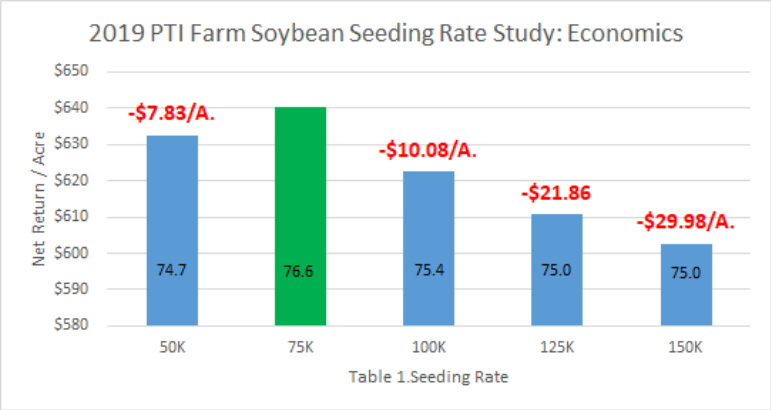


Table 1. summarizes the yields of both the 56 hole and 80 hole crop kits at seeding rates from 50K to 150K/A. 56 hole crop kits realized +1.2 Bu/A. yield increases from the ability to singulate soybeans. At $8.68/Bu. soybeans, this equates to an economic advantage of +$10.42/A.

Planting Date: 6/8 *Hybrid: GH 3546X* *Population: Varied* *Row Width: 30”* *Rotation: SAC* *Soybean Price: $8.68*

Soybean Seeding Rate Study:

Objective: This trial evaluates the agronomic and economic impact of planting soybeans at seeding rates ranging from 50K to 150K in 30" rows.



Results: Soybean yields only varied by 1.9 Bu/A. between all seeding rates, however economic optimum planting rate was recorded at 75K seeds/A. As populations decreased to 50K, **$7.83/A.** was lost. As seeding rates were increased to 100, 125, and 150K, returns again fell by **-$10.08, -$21.86, and -$29.98/A.** respectively.

Figure 3. illustrates the branching and lateral architecture (450 total beans) of the 50K seeding rate, while Figure 2 depicts the lack thereof from 150K rates (184 total beans).

More work needs to be done to fully understand seeding rates in various row widths with today's soybean trait platforms. However, it does appear that if a grower lowers seeding rates, singulates those soybeans, and selects a soybean with proper architecture appropriate for row width, that great yield potential could exist while reducing seeding expense.

It is important to note that low seeding rates need special attention to weed control. In narrow rows (<30") it may be less of a concern, but with the 30" rows in this study we did have more weeds creep through late in the season due to increased sunlight and less overall shading within the soybean canopy.

Figure 1. 50K Density

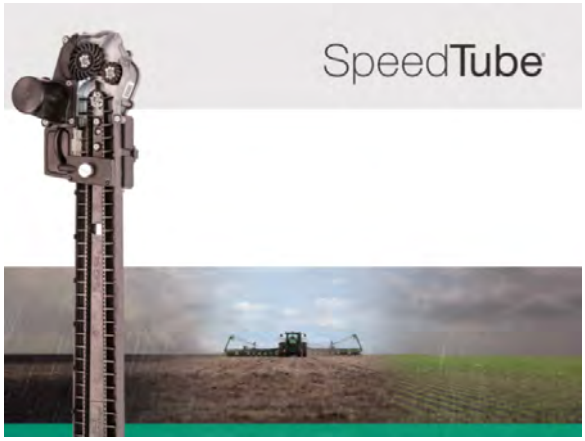
Figure 2. 150K Density returns fell -

Planting Date: 6/8 *Hybrid: Asgrow 36X6* *Population: Varied* *Row Width: 30"* *Rotation: SAC* *Soybean Price: $8.68*

Precision Planting

2019 PTI Results

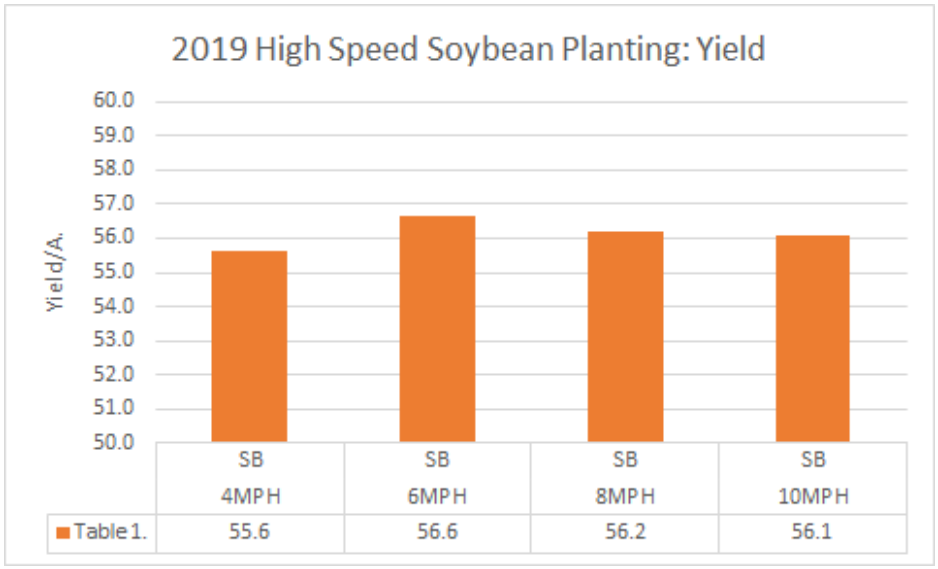
High Speed Soybean:



Objective: To evaluate yield response of planting speeds of 4, 6, 8, and 10 MPH with SpeedTube. This high-speed planting technology takes the place of conventional seed tubes and consists of a flighted belt that takes gravity out of the equation. By hand delivering each seed to the furrow, there is no opportunity for seeds to ricochet into the trench. Even at twice normal planting speeds, seed arrives safely at the bottom of the trench, spaced evenly, every time.

Results: Using SpeedTube technology, there was only a 1.0 Bu/A. range difference between all planting speeds.

This data would suggest that growers can plant at higher speeds with SpeedTube technology without sacrificing planter performance.



Planting Date: 6/8 *Variety: Pioneer 31A22* *Population: 130K* *Row Width: 30"* *Rotation: SAC* *Soybean Price: $8.68* *Seeds/#: 2800*

56 Cell Soybean Disk with Soybean Singulator

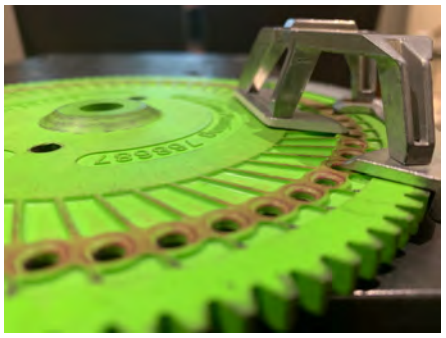
High Speed Soybean Singulator Study:

Objective: To evaluate yield response of planting speeds of 4, 6, 8, and 10 MPH with SpeedTube, using a 56 hole soybean disk equipped with either a corn or soybean singulator.

High-speed planting technology takes the place of conventional seed tubes and consists of a flighted belt that takes gravity out of the equation. By hand delivering each seed to the furrow, there is no opportunity for seeds to ricochet into the trench. Even at twice normal planting speeds, seed arrives safely at the bottom of the trench, spaced evenly, every time. All entries in this study utilize SpeedTube technology.

Figure 1. SB Singulator

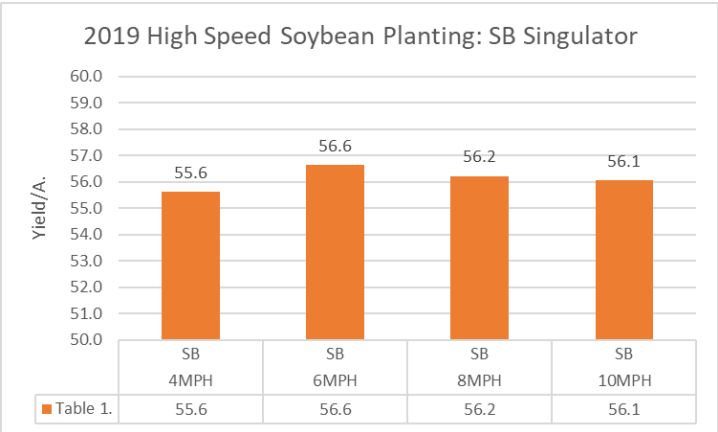
Figure 2. Corn Singulator

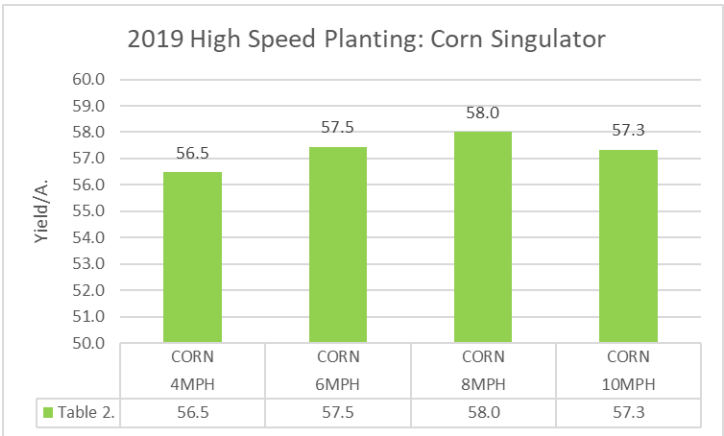


Results: Averaging all planting speeds, the corn singulator on the 56 hole soybean disk out-performed the soybean singulator by +1.2 Bu/A.

The soybean singulator only varied by 1.0 Bu/A., while the corn singulator varied by 1.5 Bu/A.

More research needs to be done evaluating varying soybean seed sizes to determine what singulator may be the best planting option. In this study, soybeans were sized at 2800 seeds/#.





Planting Date: 6/8 *Variety: Pioneer 31A22* *Population: 130K* *Row Width: 30"* *Rotation: SAC* *Soybean Price: $8.68* *Seeds/#: 2800*

Marco QuickGrow LTE FurrowJet Study

Objective: To evaluate the yield and net return of Marco Fertilizer's QuickGrow LTE 6-20-4-.25Zn-2.7S liquid starter fertilizer. Three different rates were used in a wing only FurrowJet application at planting. QuickGrow LTE is a 70% polyphosphate and 30% orthophosphate formulation of nitrogen, phosphorus, potassium, sulfur, and EDTA Zn.

Results: Marco LTE starter treatments were applied at 2, 4, and 6 Gal/A. as a FurrowJet wing treatment only. 6 Gal/A. treatments proved both agronomic and economic optimum rate with yield advantages of +4.9 Bu/A. with a return on investment of +$22.40/A. (Tables 1-2).

All three rates of Marco LTE provided both positive yield and economic gains. Perhaps a higher rate needs to be added in the future to obtain a bell curve to help establish the point of diminishing returns.

MARCO Liquid Fertility

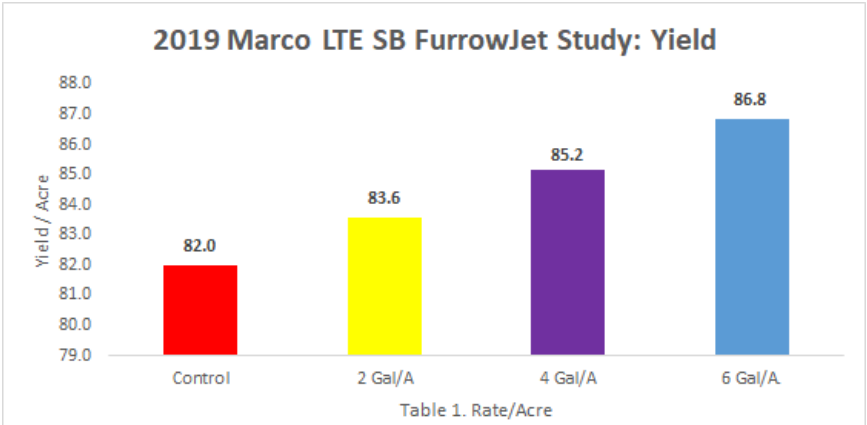


Table 1. Rate/Acre

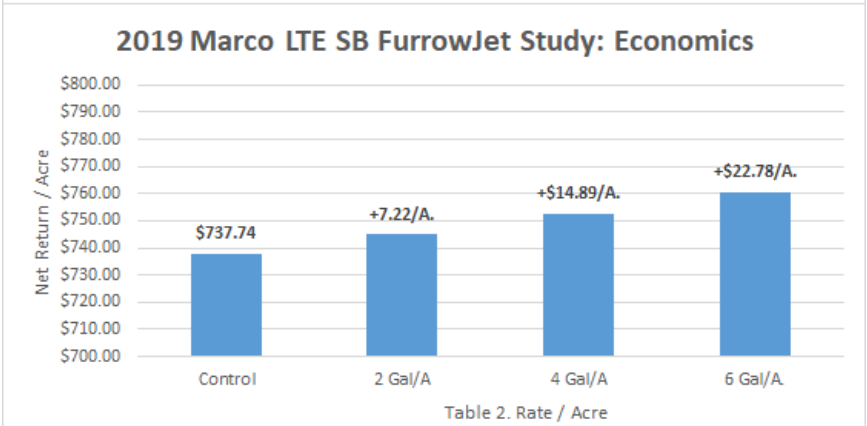


Table 2. Rate / Acre

Planting Date:June 12 *Hybrid:Asgrow 36X6* *Population: 130K* *Row Width: 30"* *Rotation:BAC* *SB Price: $8.68*

Marco LTE: $3.50/Gal

Nachurs Soybean Fertilizer Study

Objective: To evaluate the yield and net return of Nachurs Triple Option (Figure 1.) liquid starter fertilizer applied through FurrowJet in soybeans.

The products used, rates, and application timings are as follows:

Product	Timing	Rate/A.
CropMax	At-Plant FurrowJet	1 Qt/A.
Triple Option 4-13-17-1S	Foliar V3	3,4,5 Gal/A.

NACHURS®

4-13-17-1S Liquid Fertilizer

Nutrients Supplied
(pounds per gallon)

Total Nitrogen (N)	0.45
Available Phosphate (P_2O_5)	1.46
Soluble Potash (K_2O)	1.91
Sulfur(S)	0.11

Results: Table 1. illustrates minimal yield response in this study from FurrowJet applications of Triple Option. Yields only varied **-0.1 to 0.5 Bu/A.** However, Table 2. summarizes net return taking into account our nutrition re-allocation program. In this study, $20/A. is reduced from our dry fertilizer program to account for the liquid at-plant Triple Option program. This is a great example of how starter fertilizers should be integrated into a fertility program, without extra cost or sacrificing nutrition.

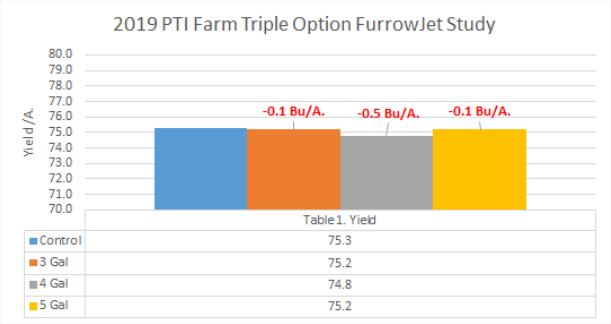


Table 1. Yield

Control	75.3
3 Gal	75.2
4 Gal	74.8
5 Gal	75.2

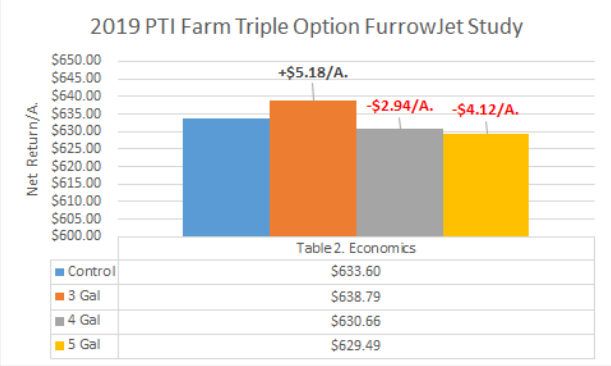


Table 2. Economics

Control	$633.60
3 Gal	$638.79
4 Gal	$630.66
5 Gal	$629.49

2-0-2-.1B-.15Cu-.3Fe-1.5Mn-.0005Mo-4Zn Liquid Fertilizer

Nutrients Supplied
(pounds per gallon)

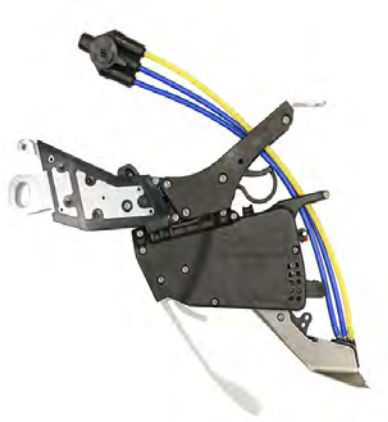
Total Nitrogen (N)	0.204
Soluble Potash (K20)	0.204
Boron (B)	0.010
Copper (Cu) EDTA	0.015
Iron (Fe) EDTA	0.031
Manganese (Mn) EDTA	0.153
Molybdenum (Mo)	0.00005
Zinc (Zn) EDTA	0.409

Planting Date: 5/8 *Variety: Asgrow 36X6XR* *Population: 130K* *Row Width: 30"* *Rotation: BAC* *Soybean Price: $8.68*

Fertilizer Pricing: CropMax: $14.55/gal *Triple Option: $4.90/Gal* *$20 Re-Allocation*

AgroLiquid Fertilizer FurrowJet Soybeans Study:

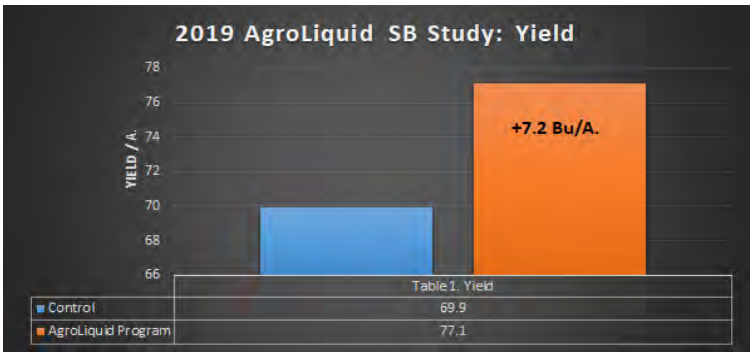
Objective: To evaluate the yield and net return of a blend of AgroLiquid starter fertilizers. The following products are used in this in-furrow study as a single at-plant application, as well as a foliar post program:

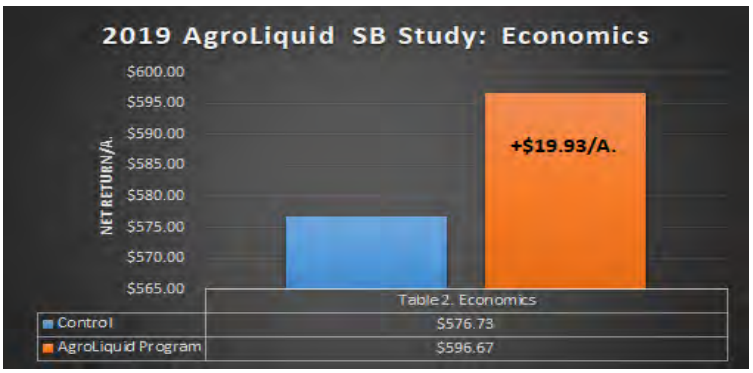


Product/A.		Application
2-Gal Pro-Germinator®	9-24-3	FurrowJet
4 Gal Sure-K	2-1-6	FurrowJet
1 Qt Micro 500	.02B-.25Cu-.37Fe-1.2Mn-1.8Zn	FurrowJet
1 Qt C-Tech	Hydrophobic Fulvic Acid	FurrowJet
1 Gal Ferti-Rain®		Foliar Post
2 Gal Sure-K	2-1-6	Foliar Post
1pt Boron		Foliar Post
1qt Manganese		Foliar Post

Results: Table 1. illustrates that in-furrow and foliar AgroLiquid nutrition treatments increased average soybean yields by +7.2 Bu/A. across all replications (Table 1).

At prices listed below, this yield increase translates into a positive return on investment of +$19.93/A. (Table 2).





Planting Date: 6/13 Hybrid: Asgrow 36X6 Population: 130K Row Width: 30" Rotation: CAB
SB Price: $8.68 C-Tech: $32 ProGerm: $6.50 Sure-K: $5.45 Micro500: $18.38
FertiRain: $7.10 Boron: $2.31 Manganese: $4.85

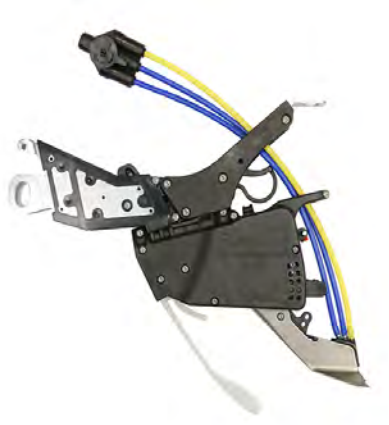
Precision Planting

2019 PTI Results

AgroLiquid Fertilizer Irrigated Soybeans Study:

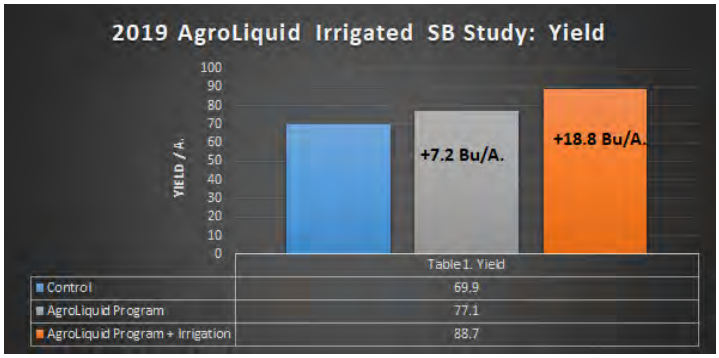
Objective: To evaluate the yield and net return of a blend of AgroLiquid starter fertilizers in an irrigated and non-irrigated environment. The following products are used in this in-furrow study as a single at-plant application, as well as foliar post program:

NETAFIM™ GROW MORE WITH LESS

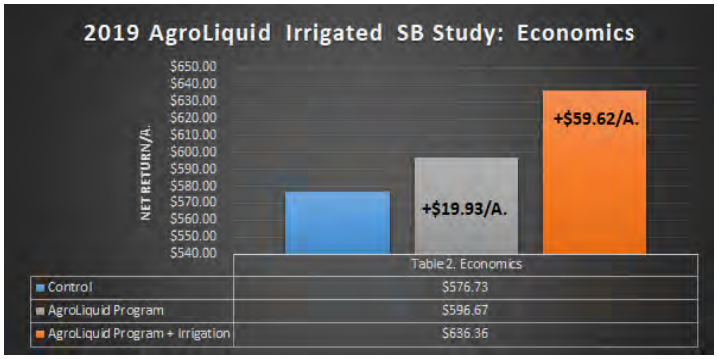


Product/A.		Application
2-Gal Pro-Germinator	9-24-3	FurrowJet
4 Gal Sure-K	2-1-6	FurrowJet
1 Qt Micro 500	.02B-.25Cu-.37Fe-1.2Mn-1.8Zn	FurrowJet
1 Qt C-Tech	Hydrophobic Fulvic Acid	FurrowJet
1 Gal Ferti-Rain		Foliar Post
2 Gal Sure-K	2-1-6	Foliar Post
1pt Boron		Foliar Post
1qt Manganese		Foliar Post

Results: In general, AgroLiquid nutrition treatments increased average soybean yields by +7.2 Bu/A. in non-irrigated environments and +18.8 Bu/A. in the Nutri-Drip/Net-A-Fim drip irrigation system. Irrigation itself contributed to additional yield gains of +11.6 Bu/A.



At prices listed below, non-irrigated yield increases translated into a positive return on investment of +$19.93/A. with the prices listed below, this yield increase results into a positive return on investment of +$39.69/A.



AGROLIQUID

Planting Date: 6/13 Hybrid: Asgrow 36X6 Population: 130K Row Width: 30" Rotation: CAB
SB Price: $8.68 C-Tech: $32 ProGerm: $6.50 Sure-K: $5.45 Micro500: $18.38
FertiRain: $7.10 Boron: $2.31 Manganese: $4.85

Calcium Products SO4 Study:

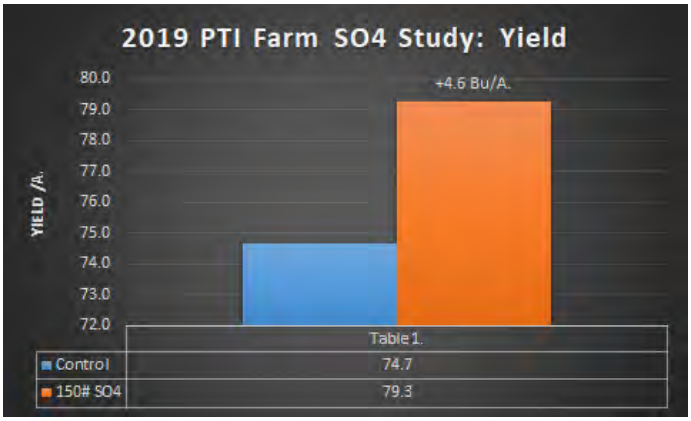
Objective: This trial evaluates the yield response and economics of pelletized calcium sulfate (SO4). SO4 from Calcium Products is a 21% Calcium (non-pH neutralizing) and 17% Sulfur dry pelletized fertilizer.

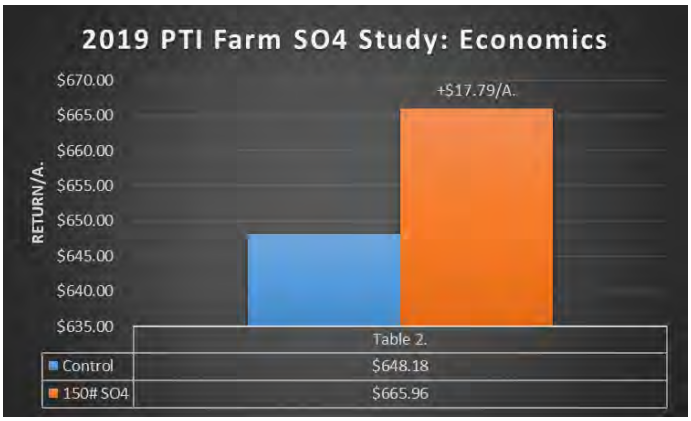
SO4 PELLETIZED GYPSUM

CALCIUM PRODUCTS

- Sulfur is an essential component of plant growth, with key processes relying on sulfur like chlorophyll formation and protein production.
- It is often considered the fourth major nutrient behind N, P and K.
- SO4 is mined and manufactured in northwest Iowa from one of the purest gypsum sources in the world. It is finely ground and pelletized to achieve a balance between solubility and pellet strength.

Results: Spring 2019 treatments of SO4 resulted in average yield gains of +4.6 Bu/A. and resulted in a positive return on investment of $21.79/A. (Tables 1-2). These returns are much higher than what we experienced in corn (see Page 58), where returns were minimized to +$0.82/A. We look forward to continuing our long-term multi-year testing of SO4 and understanding its benefits of supplying plant nutrition, but also its effect on soil health advantages.





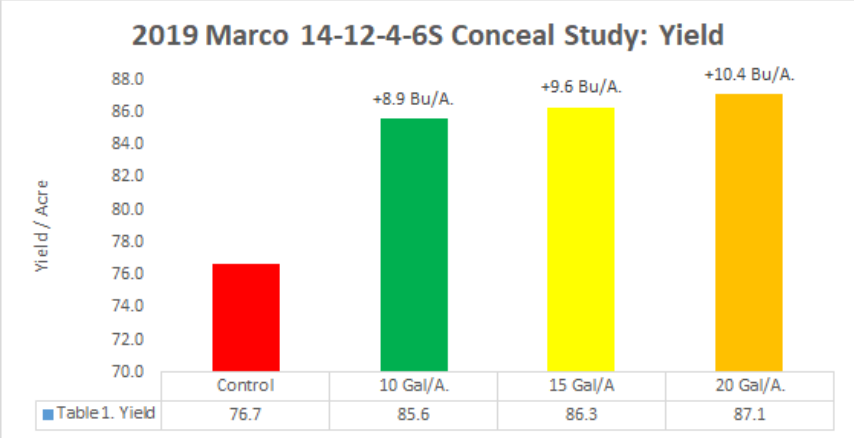
Planting Date: 6/10 *Hybrid: Champion 26R36N* *Population: 130K* *Row Width: 30"* *Rotation: SAC* *Soybean Price: $8.68*

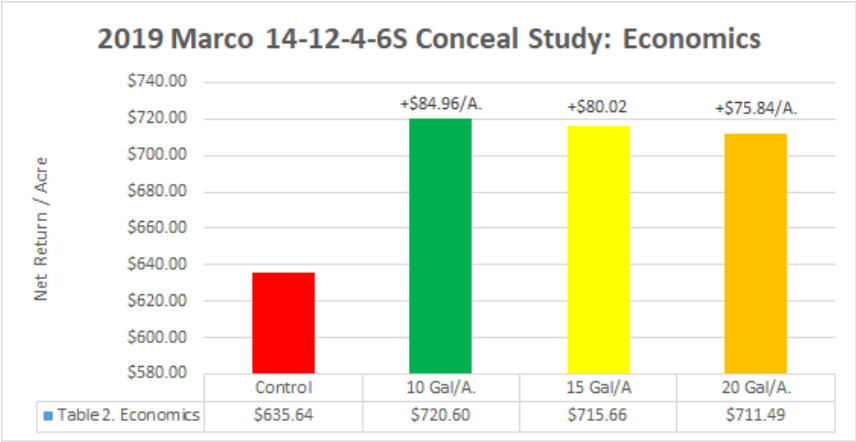
SO4: $240/Ton + $4/A Application

Conceal 14-12-4-6S Study:

Objective: This irrigated soybean application trial evaluates the yield and net return of Conceal dual band treatments of NutriStart™ 12-12-4-6S at 10, 15, and 20 Gal/A. This liquid fertilizer is a 70% polyphosphate and 30% orthophosphate formulation designed for non-in furrow applications in soybeans. NutriStart products are manufactured with Marco 10-34-0, Potassium - soluble potash (K2O), Sulfur - Ammonium Thio-Sulfate and Zinc - 9% EDTA or ammoniated.

Conceal is an ideal placement (3" from seed) for this product as it's far enough away from the seed furrow to prevent seed injury, but yet close enough to enable access to seedling nutrition (Figure 1).





Results: Tables 1. illustrates that all rates of 14-12-4-6S proved positive gains from +8.9 Bu/A. to +10.4 Bu/A.

Table 2. reveals economic optimum rate at 10 Gal/A. with a positive return of +$84.96/A. This is one of two studies at the PTI Farm where 14-12-4-6S has shown stellar performance. (See High Yield SB Study)

Figure 1. Conceal Dual Placement 3" from Trench

Planting Date: June 12 *Hybrid: Asgrow 36X6* *Population: 130K* *Row Width: 30"* *Rotation: SAC* *SB Price: $8.68*

14-12-4-6: $2.20/Gal

Conceal K-Fuse Potassium Study:

Objective: To evaluate the yield and economics of Nachurs K-Fuse powered by Bio-K (Figure 1.), a potassium/sulfur product designed to be applied on the planter or at side-dress. For this study we applied one and three gallons of K-Fuse at planting in a dual band Conceal application (Figure 2.)

Results: Table 1. illustrates dual band K-Fuse Conceal applications proved yield increases of +2.7 to +4.4 Bu/A. from 1 to 3 Gal/A. respectively. Table 2. summarizes healthy returns of +$18.99/A. to $24.54/A.

*Please note this trial does not implement a fertilizer re-allocation program.

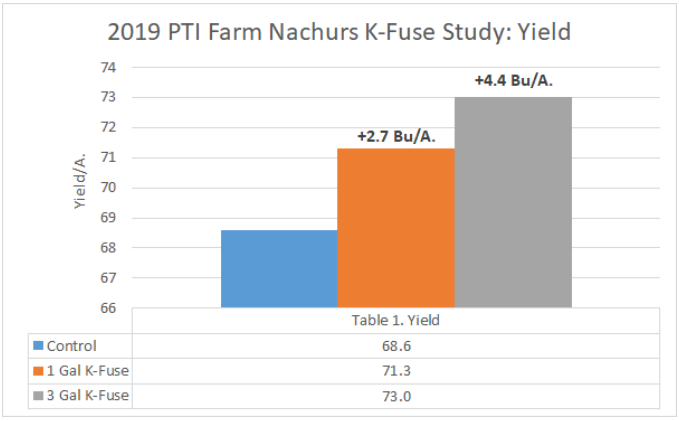


Table 1. Yield

Control	68.6
1 Gal K-Fuse	71.3
3 Gal K-Fuse	73.0

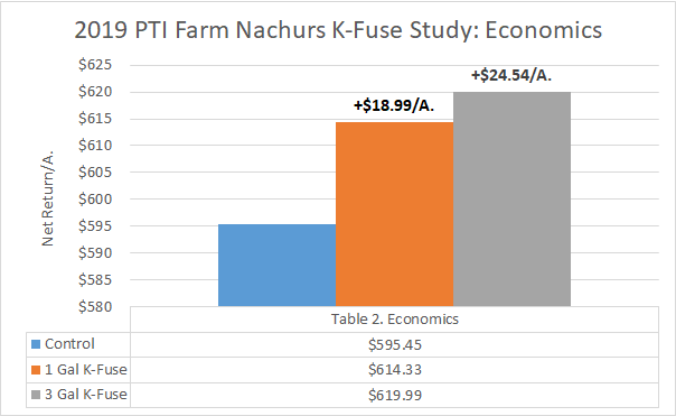


Table 2. Economics

Control	$595.45
1 Gal K-Fuse	$614.33
3 Gal K-Fuse	$619.99

Figure 1. Nachurs K-Fuse Potassium Additive

nitrogen potassium sulfur

Higher crop yields, along with applications of potassium that haven't kept up with the crop removal pace, have left many acres in decline of available potassium. Similar decreases can be found with Sulfur since dry fertilizer manufacturing practices as well as Clean Air measures have limited or removed incidental sulfur from being part of the residual nutrient supply.

NACHURS K-fuse, by addition of potassium and sulfur to high nitrogen fertility programs will address known deficiencies as well as improve nitrogen use efficiency. **NACHURS K-fuse** is designed to be blended with various fertilizer products to provide additional potassium and sulfur needed to promote high yielding crops. Primarily, **NACHURS K-fuse** should be blended with UAN solutions for sidedress and/or fertigation application to provide two very critical elements: potassium and sulfur. It can also be mixed with APP and UAN for 2x2 and/or strip-till application to provide a more balanced nutrient program. **NACHURS K-fuse** contains a proprietary additive which is designed to be blended with various fertilizer products to provide additional potassium and sulfur needed to promote high yielding crops. Up to 32% more potassium and 93% more sulfur can be applied per acre versus potassium thiosulfate when blended with UAN.

POWERED BY bio-K®

Figure 2. Conceal Dual Placement 3" from Seed Trench, 1.5" in Depth

Planting Date: June 9 *Hybrid: Asgrow 36X6* *Population: 130K* *Row Width: 30"* *Rotation: SAC* *SB Price: $8.68*

K-Fuse: $4.55/Gal

Conceal Potassium Acetate Study:

Objective: To evaluate the yield and economics of Marco Fertilizer's 0-0-29, a potassium acetate fertilizer applied at 2, 4, and 6 Gal/A. via dual band Conceal (Figure 2).

Results: Table 1. illustrates yield responses ranged from +5.7 to +8.2 Bu/A. with the 4 Gal/A. rate offering the highest yield response.

Table 2. summarizes highest net returns with the 4 Gal/A. rate at +$47.78/A. All rates of 0-0-29 offered both positive yield response and net returns.

Figure 2. Conceal Dual Placement 3" from Seed Trench, 1.5" in Depth

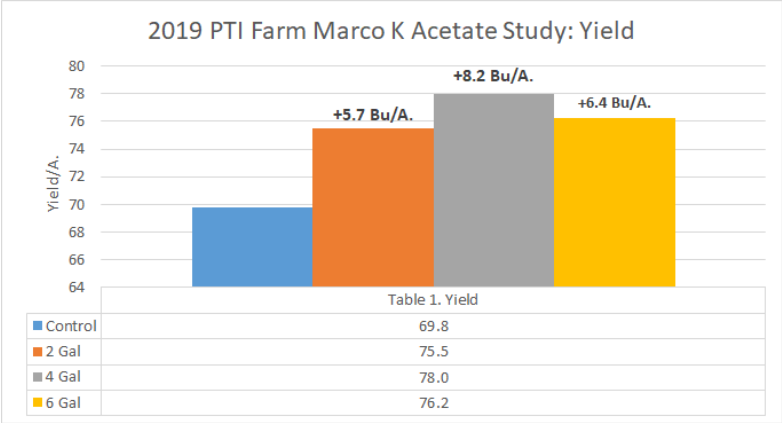


Table 1. Yield

Control	69.8
2 Gal	75.5
4 Gal	78.0
6 Gal	76.2

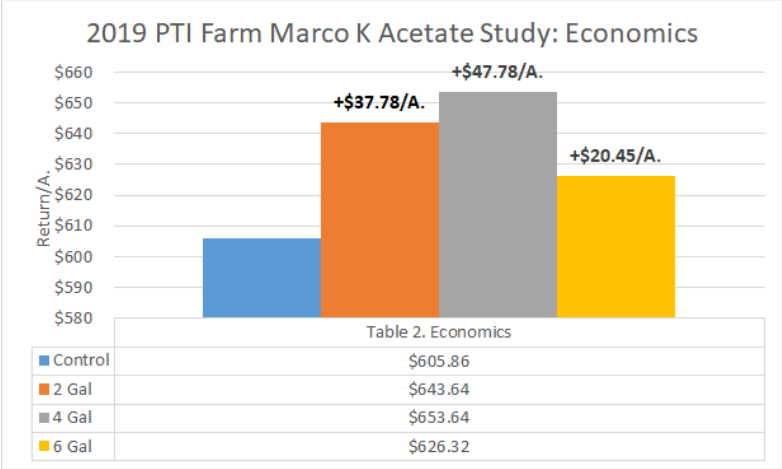


Table 2. Economics

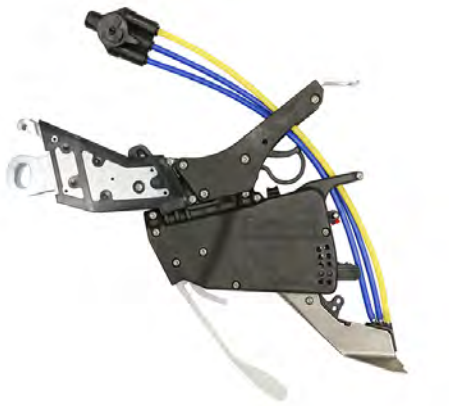
Control	$605.86
2 Gal	$643.64
4 Gal	$653.64
6 Gal	$626.32

Planting Date: June 9 *Hybrid: Asgrow 36X6* *Population: 130K* *Row Width: 30"* *Rotation: SAC* *SB Price: $8.68*

0-0-29: $5.85/Gal

Soybeans Summary of 2019 FurrowJet Applications

Nachurs Soybeans Fert	6.2	$	33.76
Marco LTE Soybeans: 6 gal	4.8	$	22.78
Agroliquid SB 2gal ProGerm, 4gal Sure-K	7.2	$	19.93
Marco LTE Soybeans: 4 gal	3.2	$	14.89
Marco LTE Soybeans: 2 gal	1.6	$	7.22
Average of all Applications	4.6	$	19.72



Soybeans Summary of 2019 Conceal Applications

Soybeans Marco Nutristart 14-12-4-6S: 10 Gal	8.9	$	84.96
Soybeans Marco Nutristart 14-12-4-6S: 15 Gal	9.6	$	80.20
Soybeans Marco Nutristart 14-12-4-6S: 20 Gal	10.4	$	75.84
Marco Potassium Acetate 4gal	8.2	$	47.78
Marco Potassium Acetate 2gal	5.7	$	37.78
Soybeans Nachurs K Fuse 3 gal	4.4	$	24.54
Soybeans Marco Potassium Acetate 6gal	6.4	$	20.45
Soybeans Nachurs K Fuse 1 gal	2.7	$	18.99
Average of all Applications:	7.0	$	48.82

Chopping Head Study: Soybeans

Objective: To study the yield impact of utilizing a chopping corn head in no-till soybeans. A Capello Quasar chopping head (Figures 1 and 2) is used to create replicated strips of chop and non-chop residue management trials. The goal of this trial is to evaluate sizing of residue (Figure 3) and allowing heavy stalks and residue to break down faster to advance the degradation process.

Results: Chopping corn residue improved soybean yields by 2.9 Bu/A. and increased gross revenue by $25.52/A. (Table 1). If this yield gain was sustainable each crop year, Table 2. illustrates multi-year yield increases averaging +3.1 Bu/A. during 2018-2019 from chopping corn stalks ahead of soybeans.

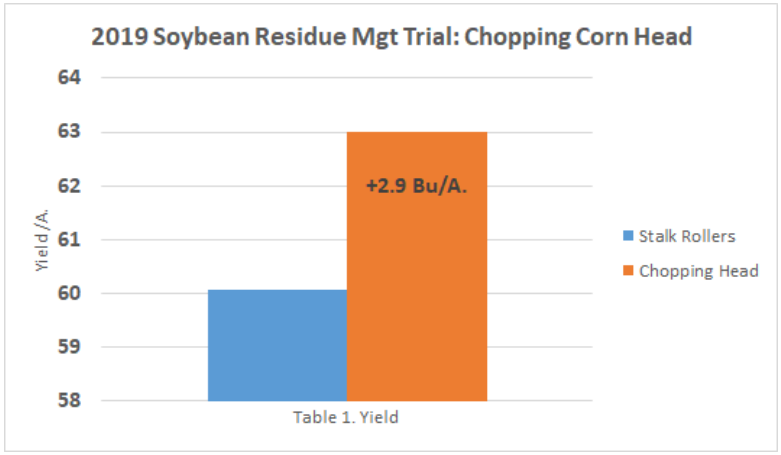


Table 1. Yield

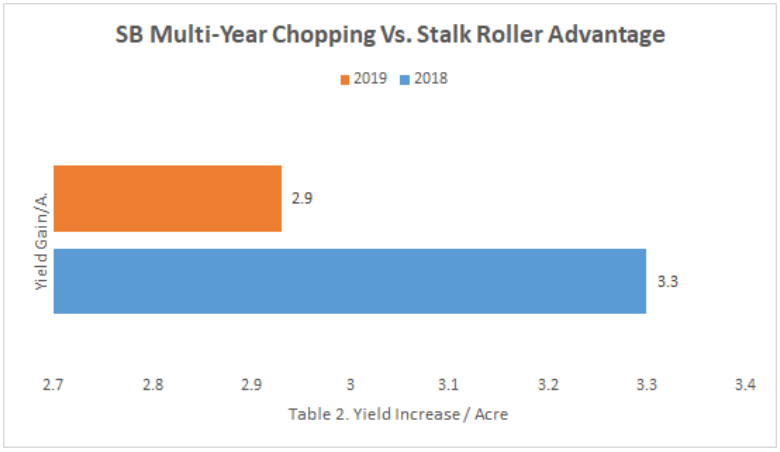


Table 2. Yield Increase / Acre

Planting Date: June 12 *Variety: Asgrow 36X6XR* *Population: 130K* *Row Width: 30"* *Rotation: SAC* *Soybean Price: $8.68*

Wrap Up:

Precision Planting is excited to share our 2019 PTI research farm results and findings. We know they provide useful insights that help drive thoughtful consideration around future crop management. The The PTI research farm is working diligently to continue with long-term studies that provide multi-year data analysis for decision-making purposes. We will continue to work with our Precision Planting premier dealers to identify opportunities to find new research objectives, driving new thought processes and the development of new solutions in the field. Precision Planting continues to find new ways to provide commitment to the research of on-farm insights that allow for the highest yield and ROI opportunities for your farm and family.

One of our goals at the PTI Farm is to continue to bring new, fresh, and unique ideas, so that when growers visit the farm they see and experience new technology. "Challenging the Status Quo" is an important concept to us and we always want to offer the opportunity for growers to experience, challenge, and compare their traditional ways of farming to other practices. We all know that change is inevitable, but knowing what and when to change is critical to a business. At the PTI farm, we are excited about all of the agronomic trials slated for 2020, but we are also proud to announce some major renovation, conservation, and state of the art agronomy implemented at the farm for this next summer. You will not want to miss our upcoming field days and we look forward to seeing you in July-September at the Precision Planting Precision Technology Institute at Pontiac, IL.

Precision Planting would like to extend our sincere gratitude to the support and dedication of our Precision Planting Premier Dealers. Precision Planting Premier Dealers are world-class certified precision agriculture experts, with rigorous training and knowledge of the industry and issues facing farmers today. Our Premier Dealers are experienced professionals helping you know and yield more.

The ability to provide unbiased and objective insights into the agronomic research is important to us and we appreciate all Premier Dealers who scheduled and invited growers to the farm in 2019. If you are interested in visiting the PTI Farm in 2020, please contact a Precision Planting Premier Dealer to schedule your visit to the PTI Farm. For your convenience, click here to use our Dealer Locator to find the Precision Planting Premier Dealer nearest you. http://www.precisionplanting.com/#dealer_locator/

Premier Dealer

Acknowledgements and Legal Statement:

The University of Illinois Machinery Cost Estimates provided by The University of Illinois Farm Business

Precision Planting®

PRECISION TECHNOLOGY INSTITUTE

The ONLY place YOU can test drive farm equipment AND see the results of what it can do.

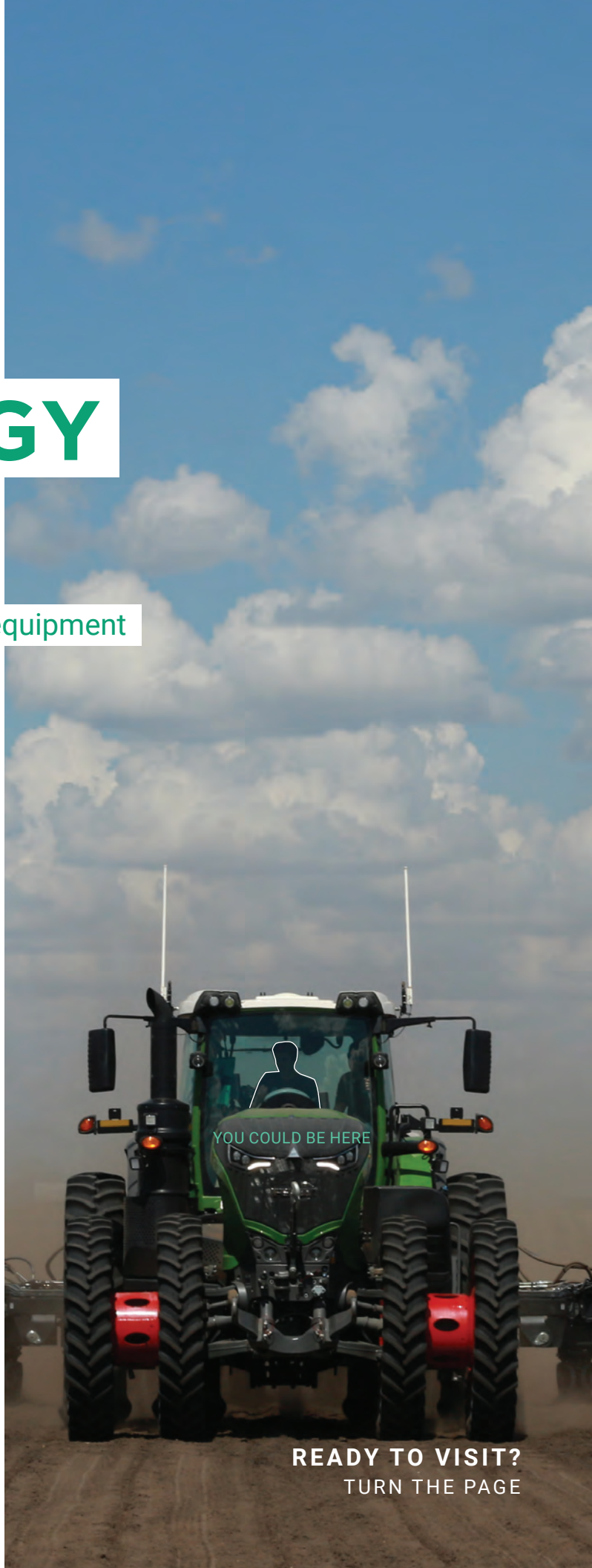
The Precision Technology Institute is Precision Planting's 200 acre agronomic research farm in Pontiac, IL.

It's Tough

We understand how challenging it can be to do on-farm research when weather, logistics, and time are working against you and it's go time. But you always need to continue learning and improving.

We're Here to Help

That's why the PTI farm is focused on doing in-field trials that help growers get the most out of technology, agronomy, and equipment. We know that a product is only as good as how it's used. We're constantly looking at products and practices that challenge the status quo. We want to provide you with information and insight to improve your bottom line in a practical way.



READY TO VISIT?
TURN THE PAGE

Events at the PTI farm are different than any plot day you've ever been to. There's over 50 agronomic plots to see at the farm, from planter settings to irrigation to fertility. And plots covering all aspects of production.

Test Drive it All

Plots and agronomic teaching is just one part. You also get to run equipment that is still in beta testing. We hand you the keys to literally the latest tractors and planting technology and let you run them in our 27 acre sandbox.

Nowhere Else in the World

Lastly, you will witness a unique water recycling system on the farm – drainage tile that feeds a pond in which water is then recycled through drip tape. Nowhere else in the world will you get an experience like this. You'll receive hands on teaching in small groups from our technical team and talented agronomy team, led by Jason Webster.

4 Different Planters

What can you expect in the sandbox? You'll have the opportunity to drive four tractors and planters in this session. When have you ever done that in one day?

Precision Planting support technicians will be in the buddy seat making sure you get the most out of your drive time.

Plus, you'll get an up close look at the latest technology on individual row units.

20 of the Over 50 Plots

1. Planter downforce
2. Planting depth based on moisture
3. Furrow residue management
4. Keeton® Seed Firmer study
5. Singulation study
6. Planting speed study
7. Furrow fracture study
8. Curve adjust study
9. Starter response by planting date
10. Hybrid response by zone
11. Liquid vs dry fertility
12. Nitrogen placement and timing
13. Relay Nutrition
14. Insecticides
15. Biologicals
16. Leaf orientation
17. Nitrogen sealers
18. Tillage type trials
19. Closing systems by tillage type
20. Combine residue management

precisionplanting.com/agronomy/pti

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