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2024 RESEARCH SUMMARY

PTI PRECISION TECHNOLOGY INSTITUTE
NORTH DAKOTA

Introduction

In the spring of 2024, Precision Planting launched a strategy to expand the Precision Technology Institute footprint into other unique geographic regions to magnify our positive impact on farmers. **PTI | North Dakota**, formerly known as AGCO's Dakota Smart Farm, was the first of that expansion. Located just west of Casselton, ND off I-94 and a short 20-minute drive from Fargo, PTI | ND is near the heart of the Red River Valley.

PTI | ND focuses on delivering solutions and agronomic data to farmers in the Northern Plains so they may increase their farm's net income and navigate the return of investment decisions related to agronomic practices, technology, and equipment in crops grown throughout the Northern Plains.

The farm design complements the scale of production seen in this region of North America by using commercial-sized equipment and large plot sizes (minimum of 40 feet by 120 feet). This gives us an advantage by using the same or similar equipment as our regional farmers, ensuring our trial results translate to the same outcomes on your acres.

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Farm History

Since this was our first year operating the farm, it is important to give some history and context around the land:

For the last 10+ years, this farm was continuous soybeans after shallow late spring tillage. The soil is Fargo Silty Clay with an average CEC of 38.4 meq., making it a “very heavy” soil. The farm is “low lying” in the area and has not been tiled. In the fall of 2023 and 2024, we worked to control surface water with land leveling and grading projects. Moving surface and subsurface water is our biggest challenge on the farm. This publication contains trial data from our corn, spring wheat, and cover crop trials from our first season at PTI | ND. Due to the challenging season at the farm, barley and soybean trials did not provide quality data for us to share this year.

Trial Information

At the beginning of each crop section, you will see variety, equipment, herbicide, management factors, and economics used within the crop trial. You will notice our herbicide program is extensive and was formulated specifically for our farm's waterhemp issue to ensure weeds do not influence treatment outcomes. Each trial report has specific treatment information and return on investment (ROI) specifics such as commodity pricing.

We are excited to bring these results to you and look forward to the 2025 season where we will begin to replicate these trials and refine our focus to provide even more impactful data to this region of North America!

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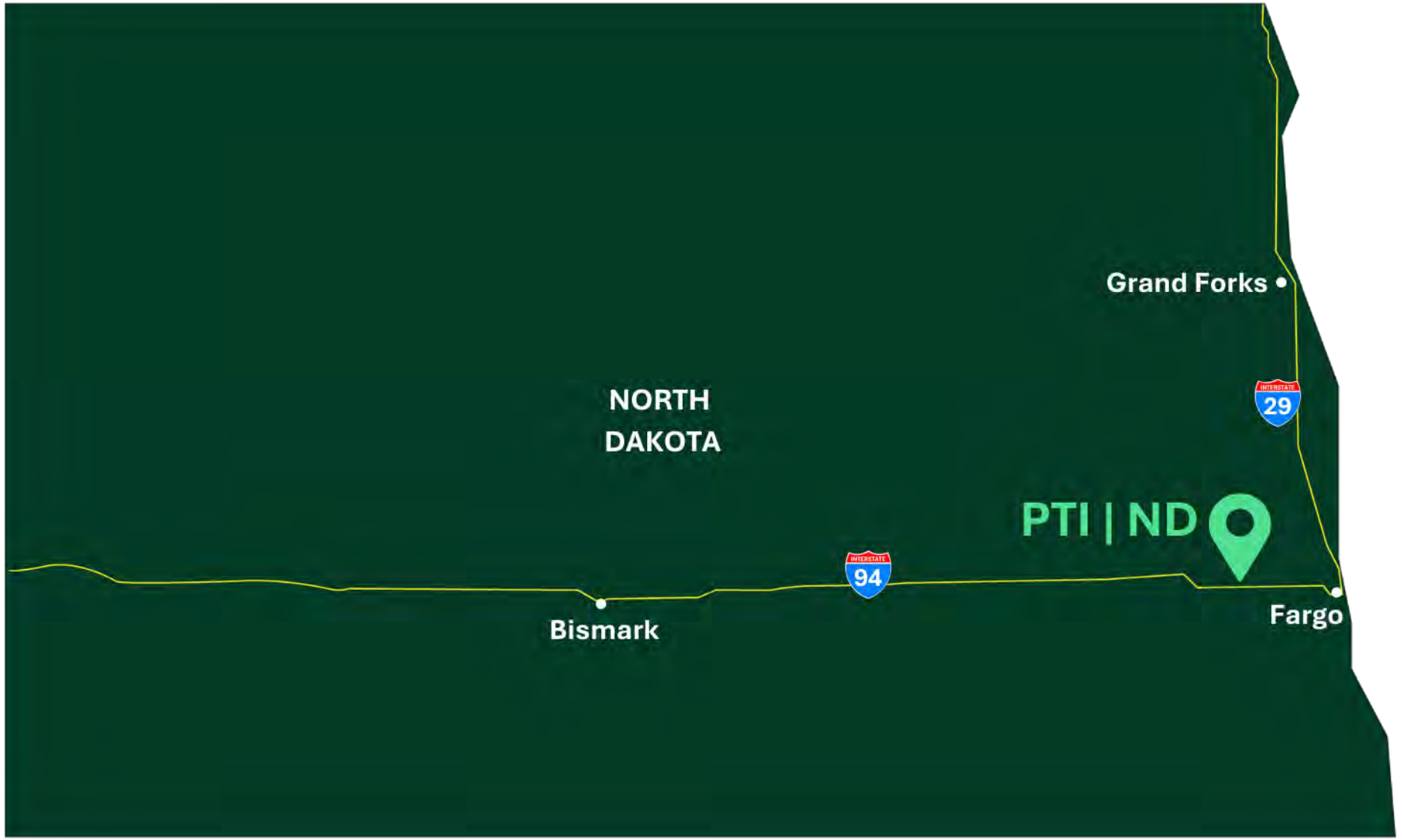

Directions ↓

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Wheat Trial Results

Cover Crop Weed Suppression

Corn Trial Results

Complete Corn Fertility Trial Results

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Wheat Trial Results

Trials Conducted

1. Managing Nitrogen, Population and Straw Strength
2. UAV Applied Fungicides for FHB Infection Management

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Supporting Information

Varieties

- Westbred 9590
- Croplan 3188
- LCS Buster

Planting

- Planting populations were determined using a seed/lb, 10% loss, variety germination percentage, and target stand.
- John Deere 1890 Air seeder equipped with SeederForce set to Active 50 lbs.
- Planting Date: 5/11/24
- Planting depth was approximately 1.5 inches.

Harvest

- Harvest Date: 11/12/24
- Test weight, moisture, and protein were sampled on a per plot basis from the grain tank using a GAC and NIR protein analyzer from UAS.

Crop Prices

- USDA/NASS 2024 price received:
  - Hard Red Spring Wheat - $6.10/Bu
  - National US Total
- Fixed cost of production (FCP) was calculated at $203.52/A based on 2020-2024 NDSU Custom Rate Guide.
- Seed, seed treatment, seeding, Nitrogen, N application, herbicide, herbicide application and harvesting costs.

Seed Treatment

- Raxil Pro

Herbicide Program

- Sharpen 2 oz/A day of planting.

Fertility

- Urea applied on 4/27/24 using John Deere 70’ variable rate air boom spreader.
- Incorporated on the same day at 2” using a cultivator.

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Managing Nitrogen, Population & Straw Strength

- **Objective:** Determine how yield and net revenue are impacted by the three-way relationship between nitrogen rate, planting population, and straw strength in hard red spring wheat.
- **Methods:** Trial included three hard red spring wheat varieties based on their yield and straw strength as described in NDSU's 2023 variety trials.
- Population was increased on each pass by 250,000 plants/A.
- Nitrogen rates were based on 2.5, 3, 3.5, and 4 lbs. N/Bu.
- Yield was determined by plot harvest using a Fendt Ideal 7T combine with 35ft drapier header and weigh wagon.

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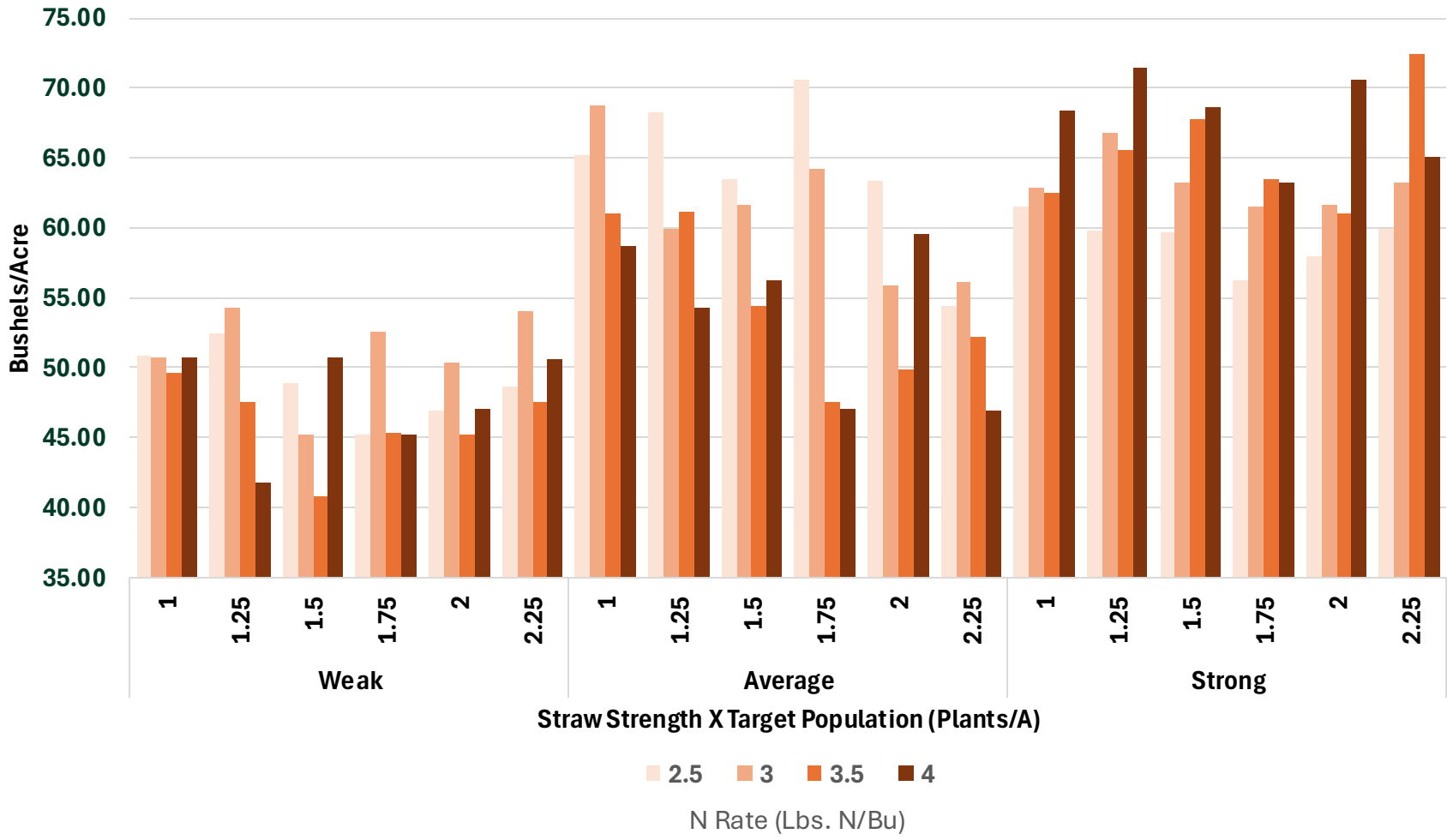
Managing Nitrogen, Population, and Straw Strength

- **Yield:** Response to N and straw strength was variable between all three varieties as expected.
- The lowest yields were in the **Weak** variety where lodging impacted harvestability.
- The **Average** variety demonstrated how increasing N & population can negatively impact yield whereas the **Strong** variety shows the opposite.
- The **Strong** variety exhibited the least lodging with increasing N and population.
- By managing N and population according to straw strength scores, similar yields can be achieved between **Average** and **Strong** varieties.



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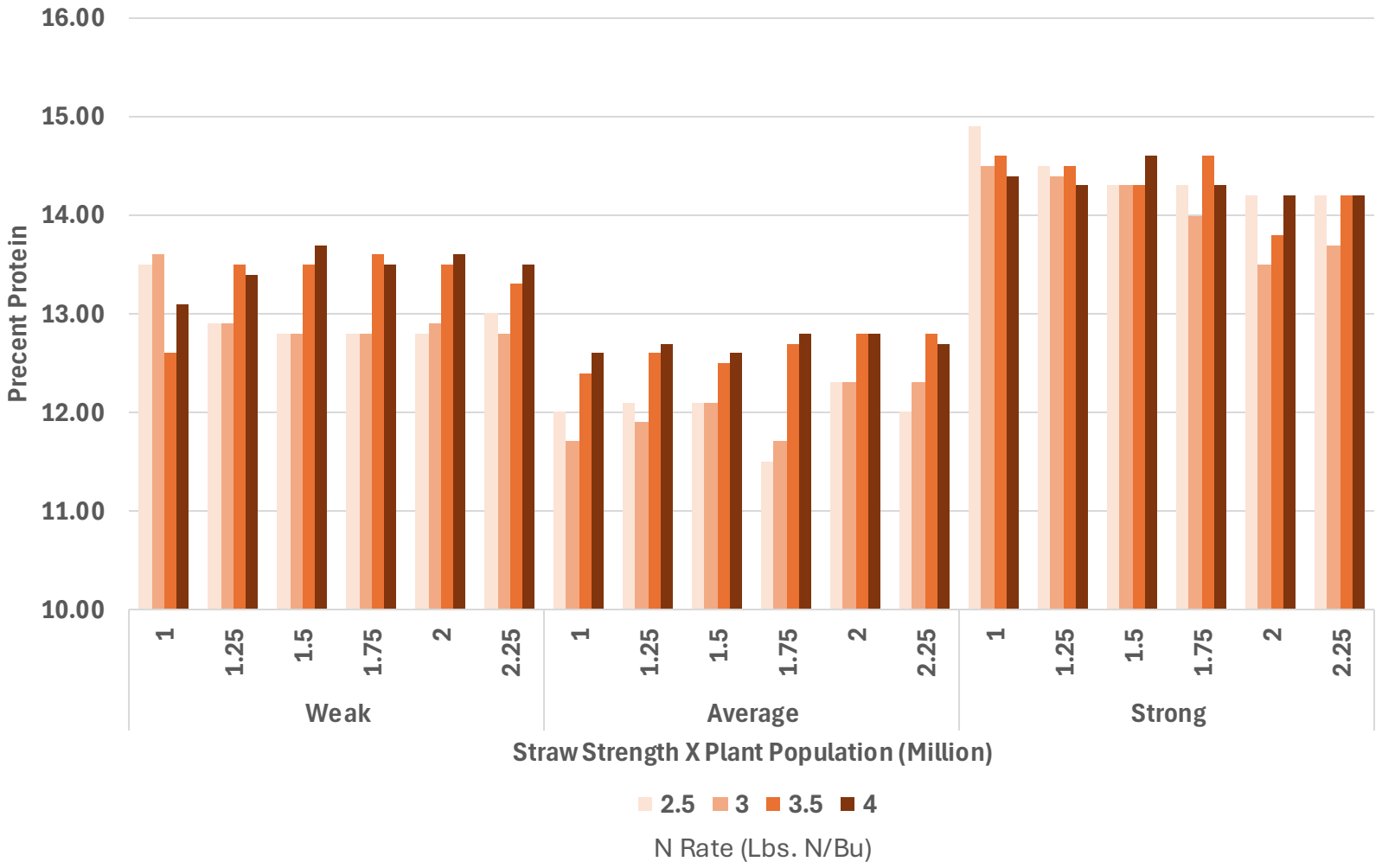
Managing Nitrogen, Population, and Straw Strength

- **Protein:** Seed protein content was largely influenced by variety, as expected.
- However, when we increase the N and population in both **Average** and **Weak** varieties saw an increase in protein content.



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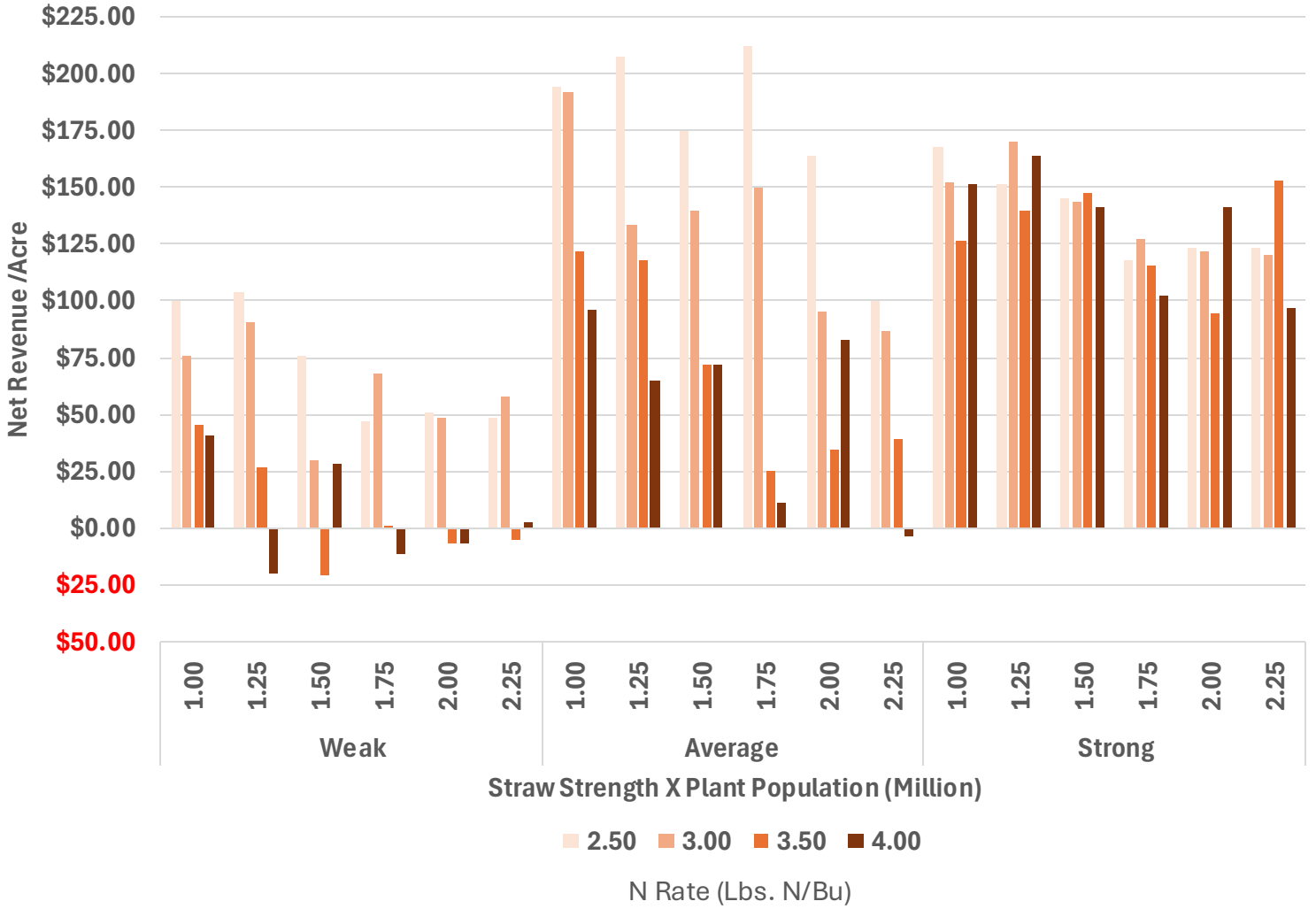
Managing Nitrogen, Population, and Straw Strength

- **Economics:** Wheat pricing is very dynamic in the growing region due to harvest timing compared to the rest of the US.
- Wheat pricing is strongly connected to seed quality, unlike other row crops.
- For that reason, net returns were calculated across 4 pricing levels: $6.10, $5.00, $4.00, and $3.00/Bu.



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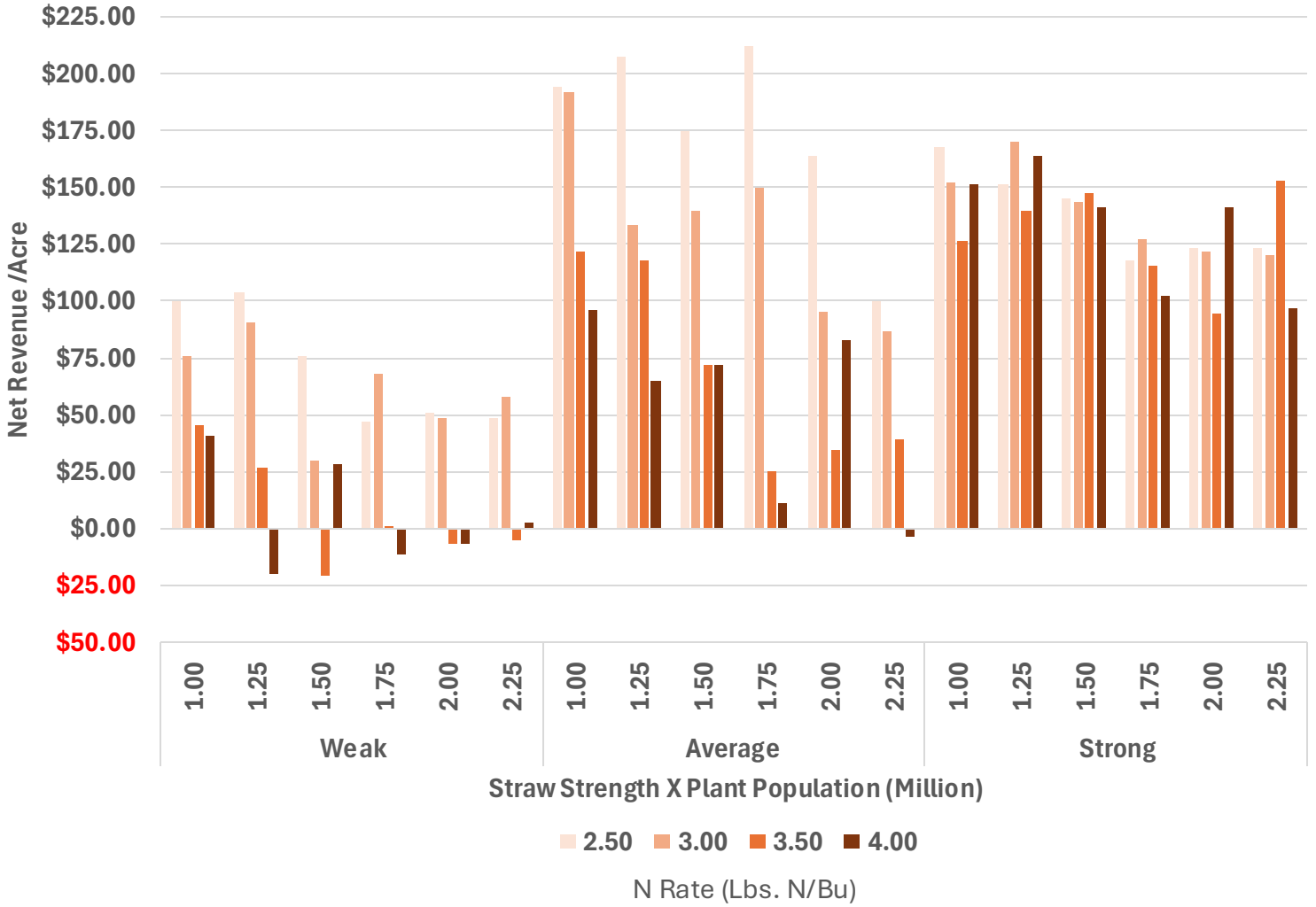
Managing Nitrogen, Population, and Straw Strength

- When using the National Average Cash Received per bushel at **$6.10** times yield, minus FCP, we see our greatest returns on the **Average** straw strength variety at the lowest N rate when the population range is 1-1.75 million plants/A.
- **Weak** variety had the lowest net returns regardless of N or population.
- **Strong** variety had less dynamic difference between net return but tended to decrease with increased inputs of N and seed.



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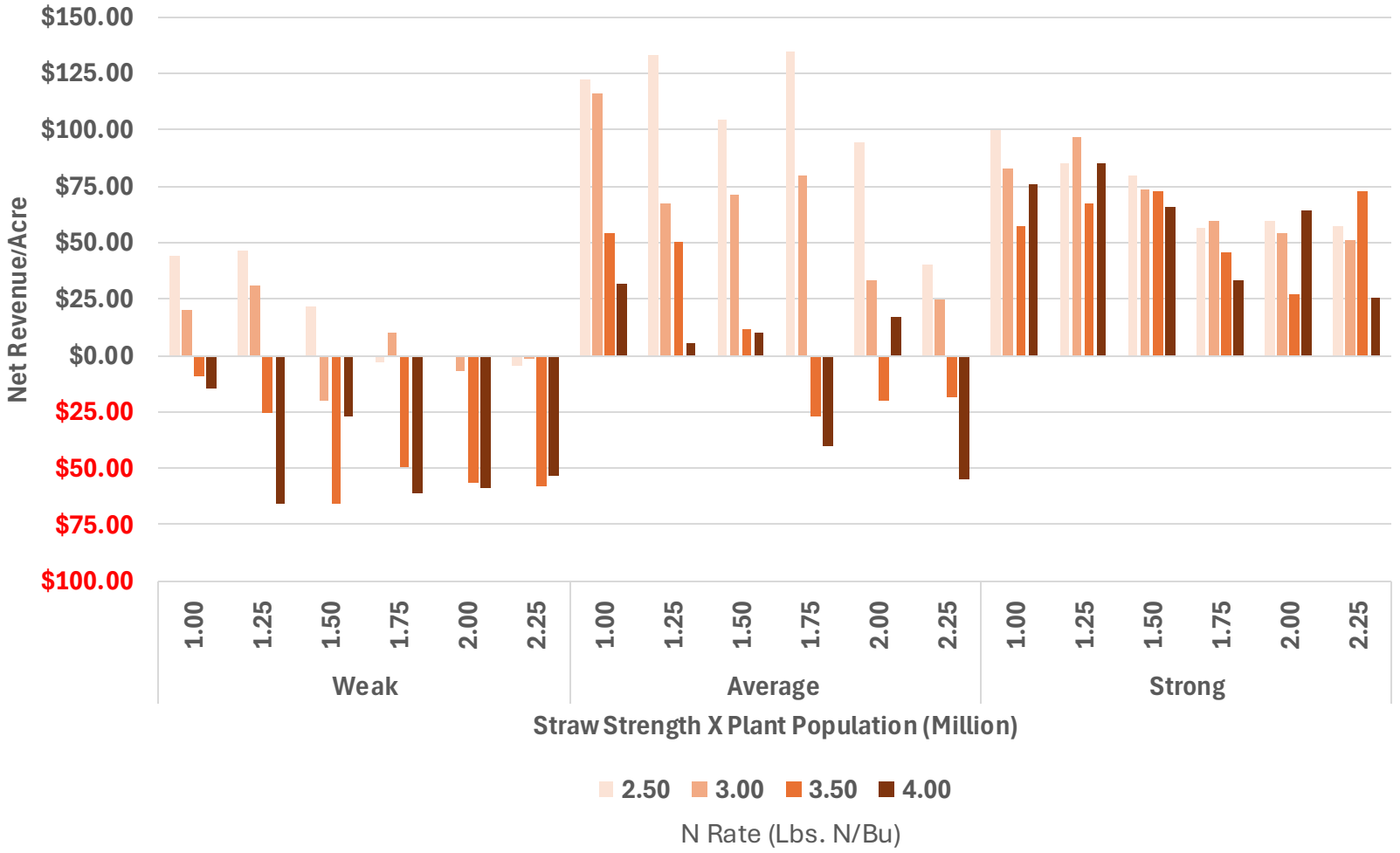
Managing Nitrogen, Population, and Straw Strength

- **<u>Economics Continued:</u>** When using $5.00/Bu, an uptick in negative return shows in the **Weak** variety, negative returns in the higher populations, and N rates in the **Average** variety.
- The greatest losses in revenue are seen in the **Weak** variety when N rates and populations exceed 3.5lbs/Bu at 1,000,000 plants/A.



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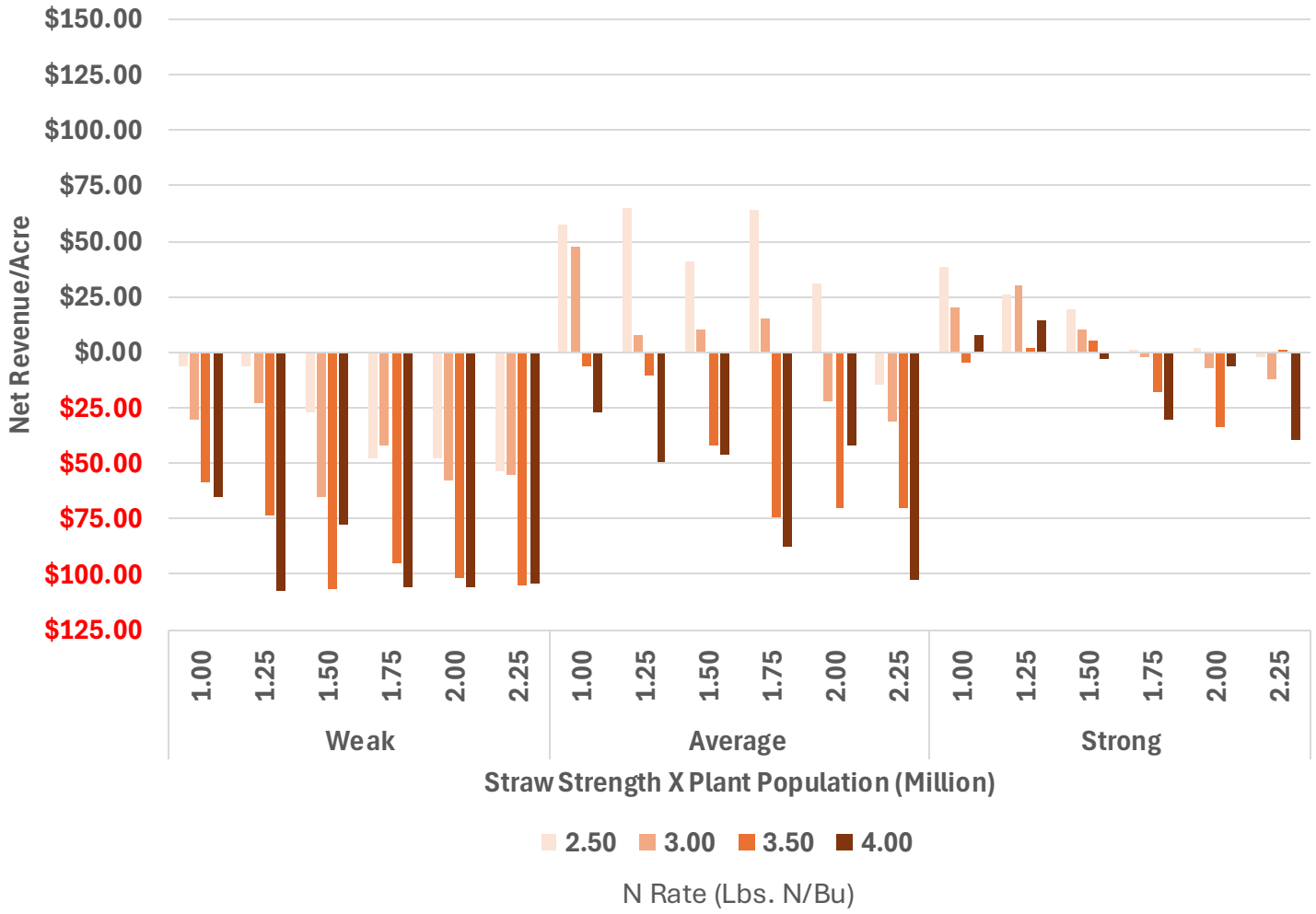
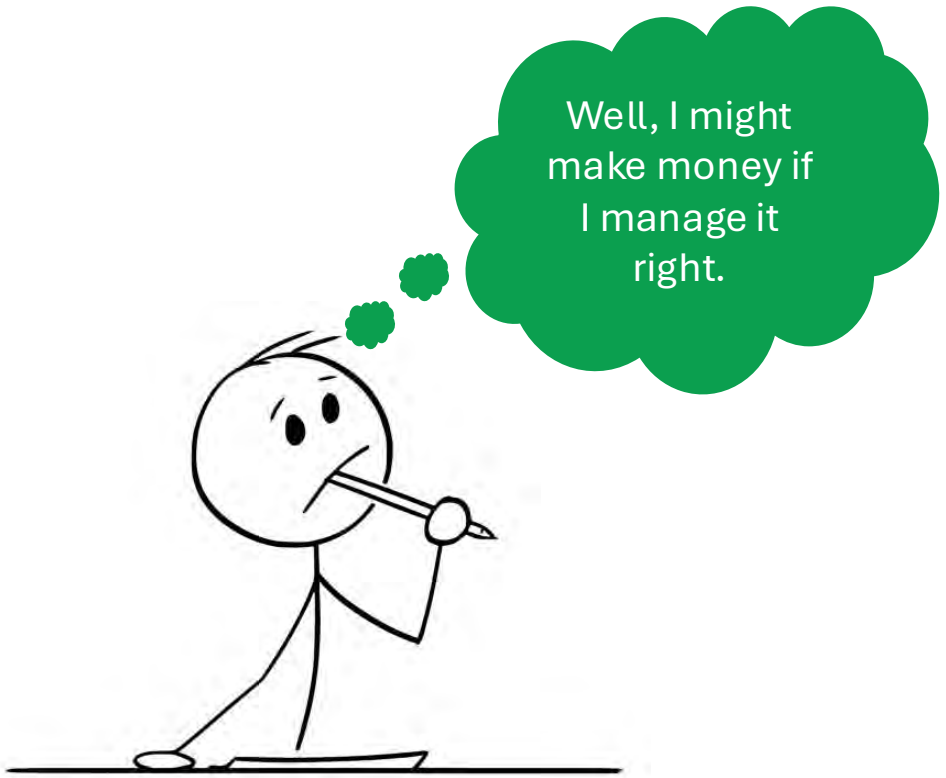
Managing Nitrogen, Population, and Straw Strength

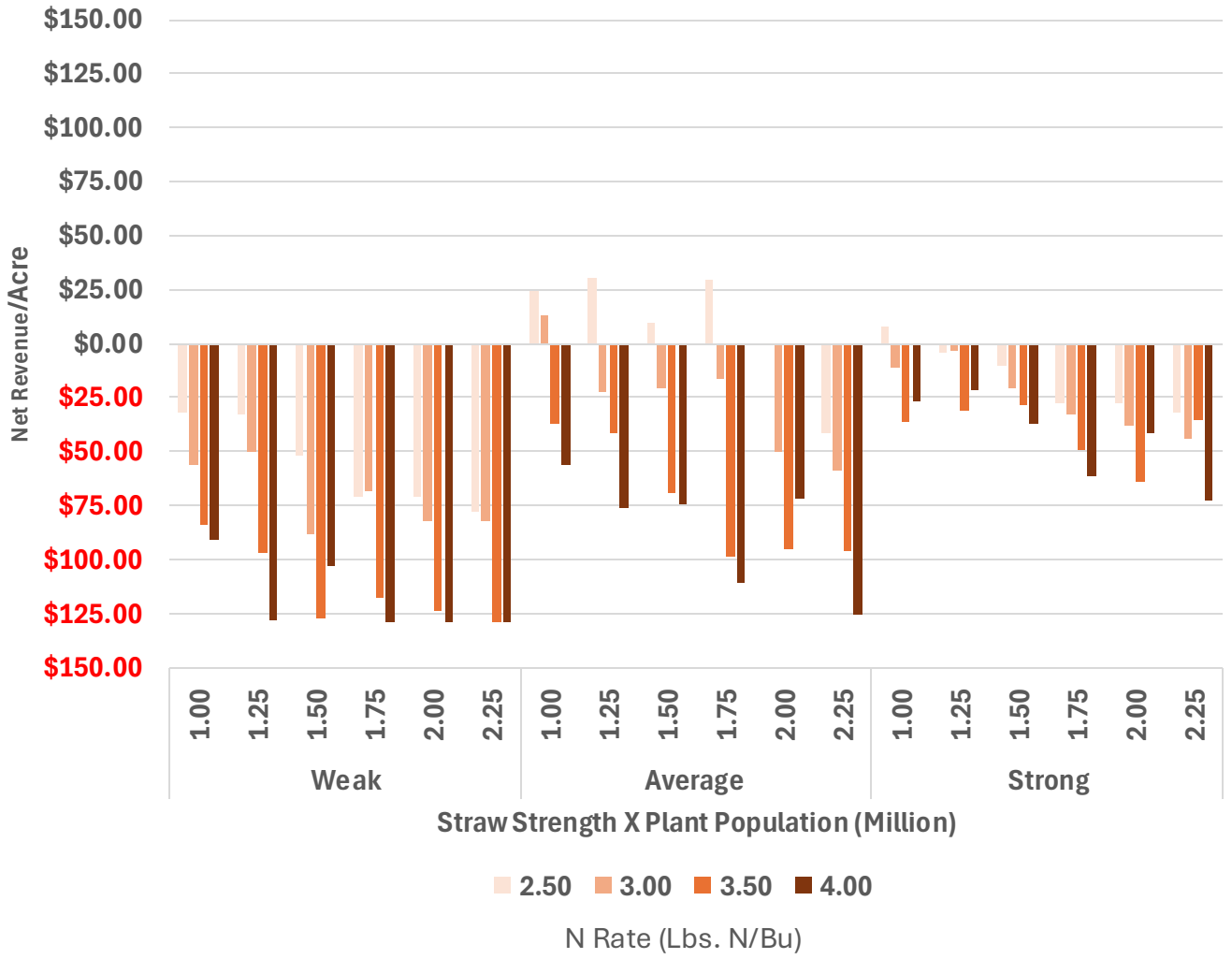
- **Economics:** At $4.00/Bu, money is lost on all but the lower N rates on the **Average** and **Strong** varieties.



Managing Nitrogen, Population, and Straw Strength

- **Economics:** $3.50/Bu pricing.





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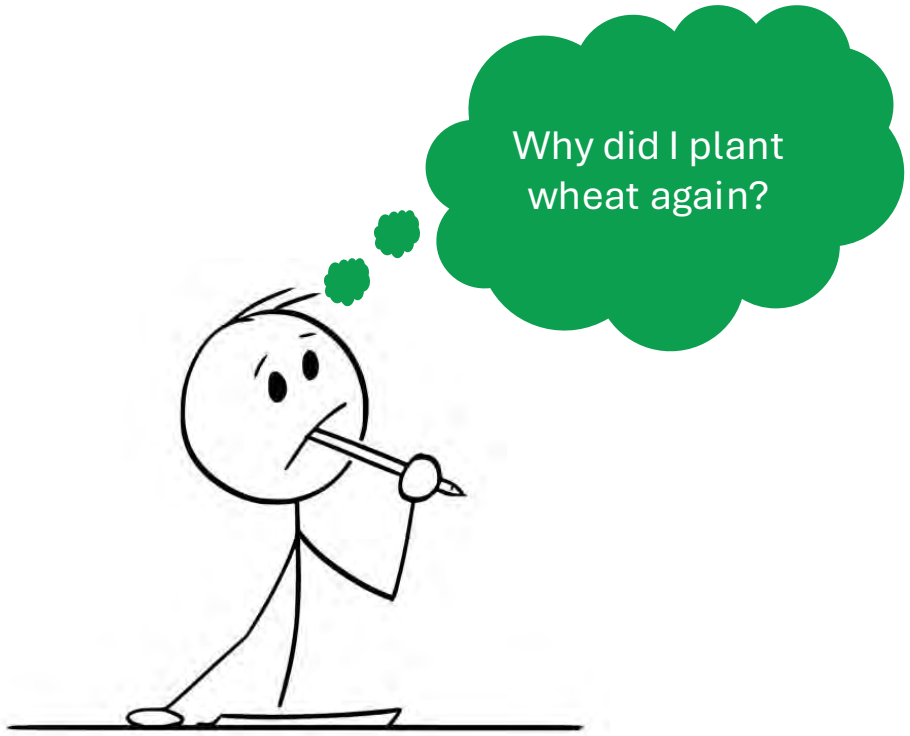
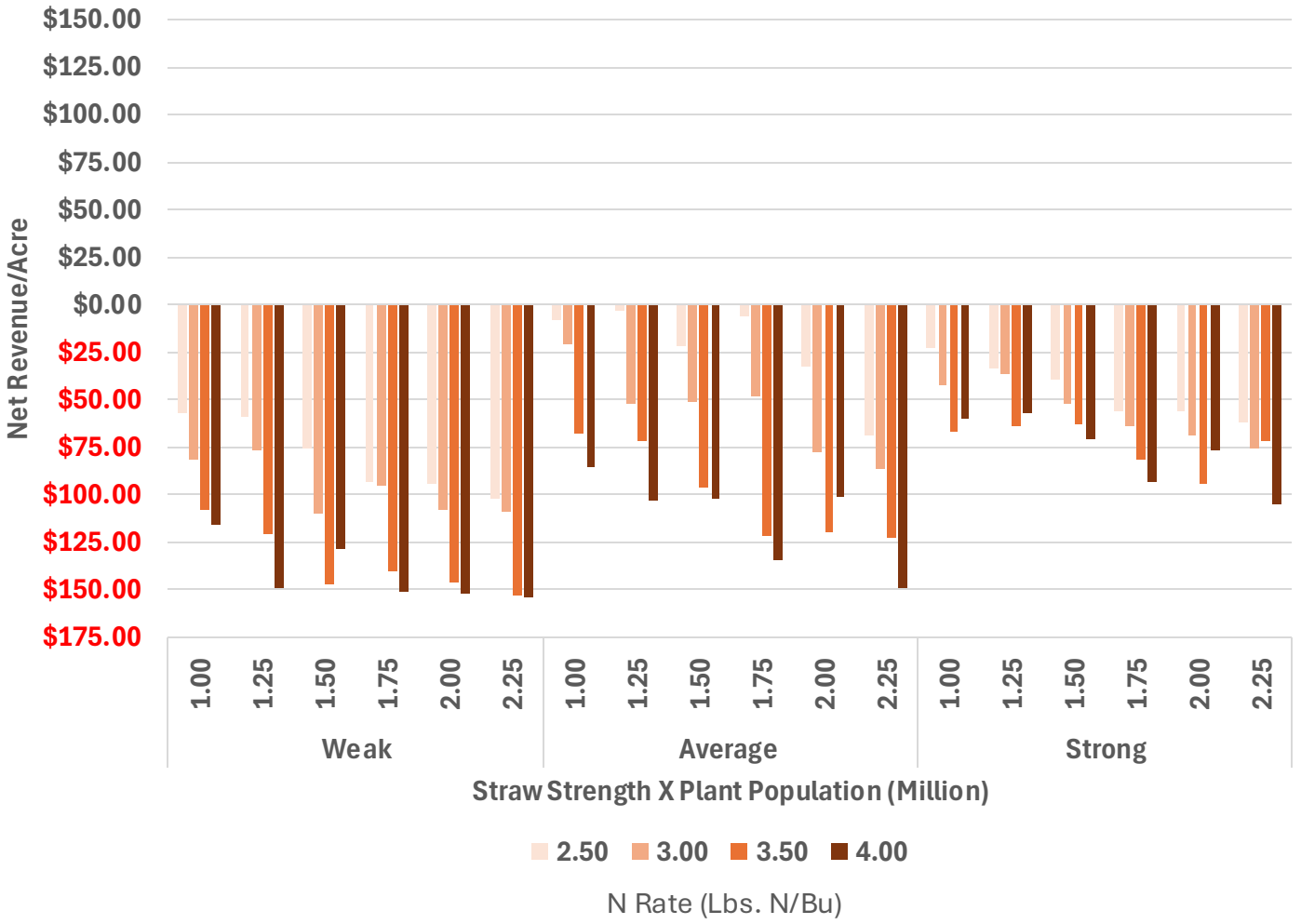
Managing Nitrogen, Population, and Straw Strength

- **Economics:** $3.00/Bu pricing





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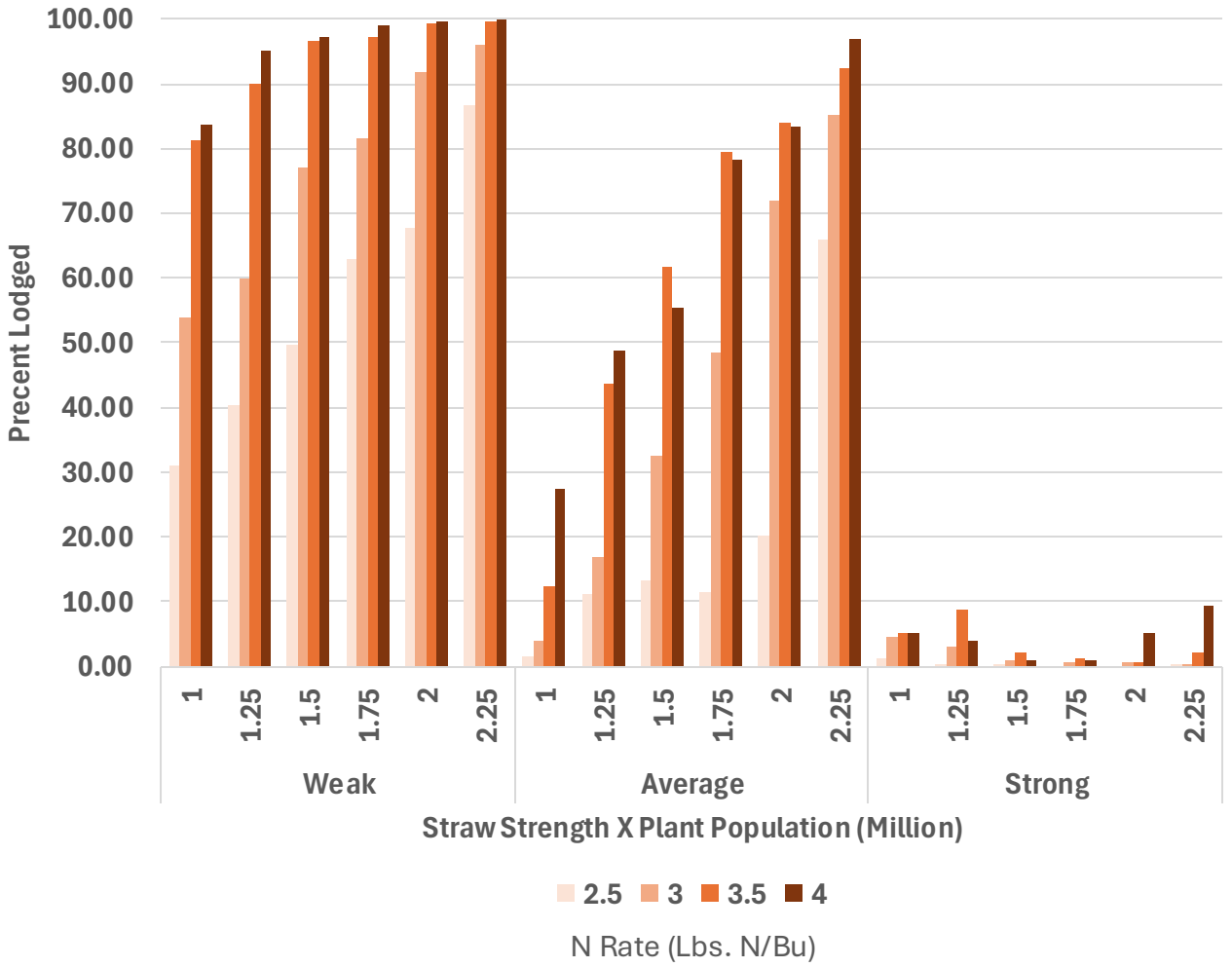
Managing Nitrogen, Population, and Straw Strength

- **Lodging:** Lodging was determined using UAV imagery and surface modeling to determine the percent plot lodging.
- Completed by taking an image of the soil surface after planting but before emergence.
- Take another at peak crop height and another after a lodging event.
- For **PTI | ND**, our lodging "*events*" started on July 15.



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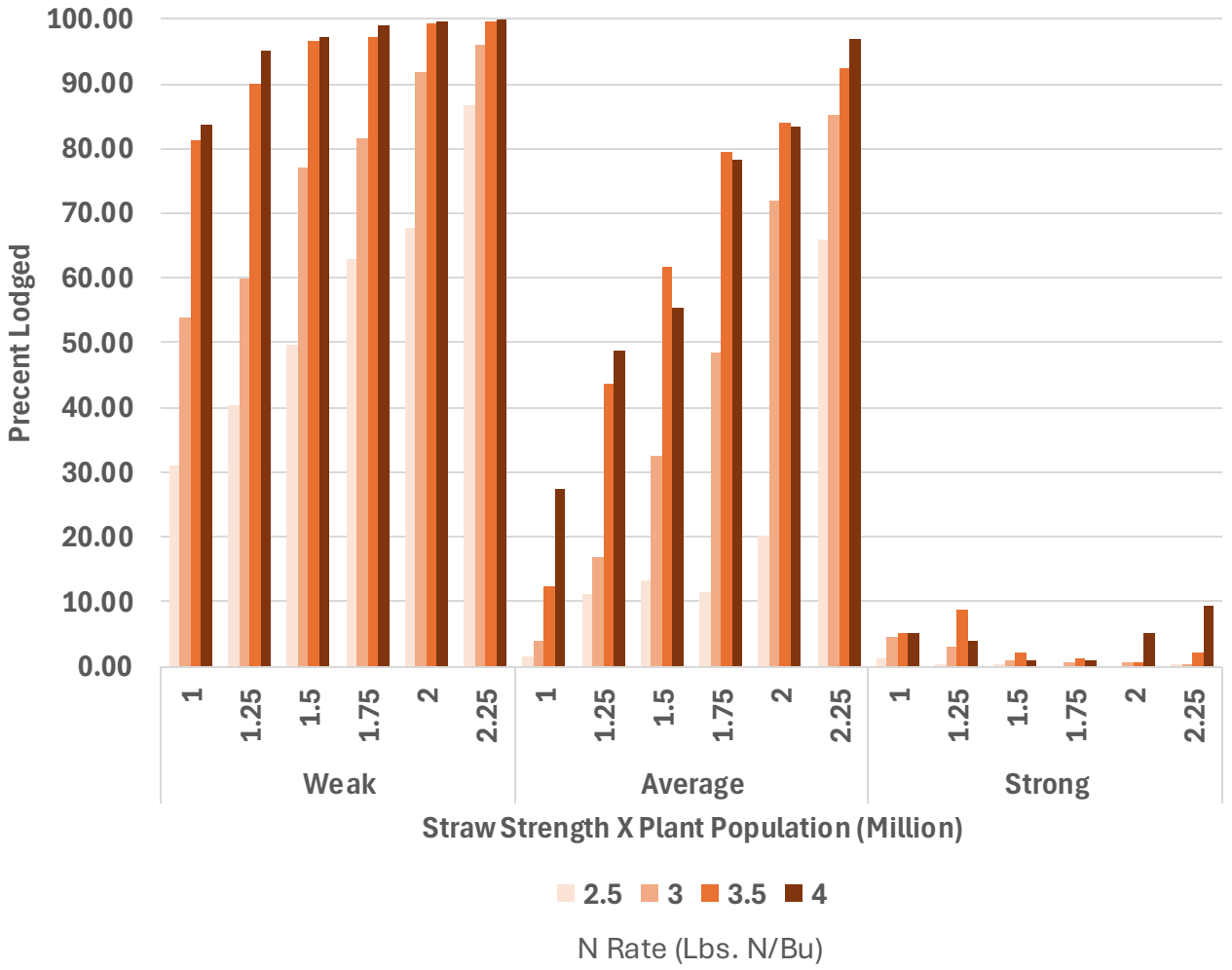
Managing Nitrogen, Population, and Straw Strength

- Overall, the straw strength ratings provided by NDSU align with expectations when N is increased and population, lodging will also increase.
- The least amount of lodging occurring in our **Strong** variety.
- However, **PTI | ND** was able to manage our **Average** variety's weakness by decreasing N rate and population which produced a greater return on investment than the **Strong** variety.



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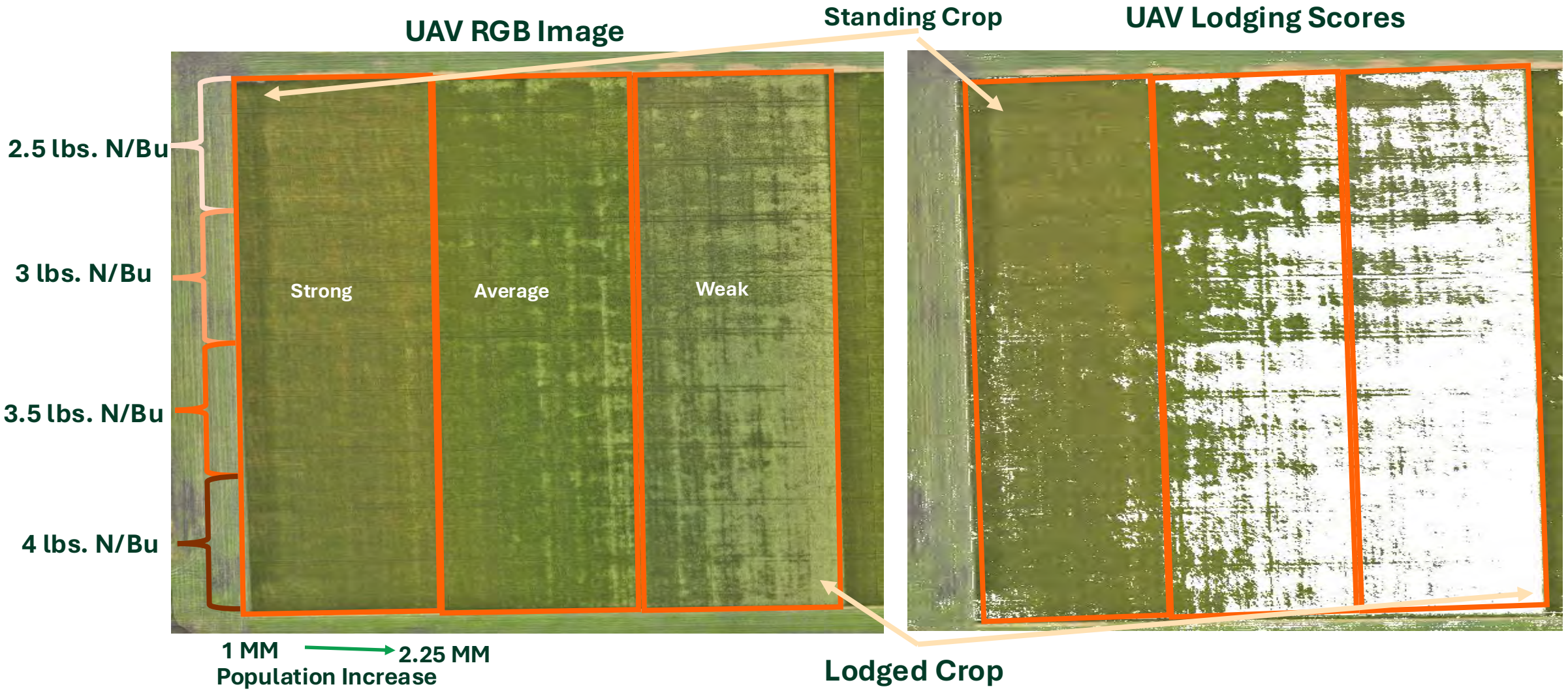
Managing Nitrogen, Population, and Straw Strength



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UAV Applied Fungicides for Fusarium Head Blight Infection Management in HRSW

- **Objective:** Evaluate the effectiveness and economics of UAV applied fungicides on Fusarium Head Blight control in hard red spring wheat.
- **Methods:** 3 hard red spring wheat varieties were based on Fusarium Head Blight (FHB) resistance scores of weak, average, and strong.
- Fungicides were sprayed on July 8 using an XAG 100 Pro operating at 30mph at 10ft above the canopy with a 27ft application width.
- Carrier volumes of 2-5 gallons per acre were used following label rates.
- All wheat varieties were within NDSU Extension's recommended fungicide application timing of up to 7 days after early flowering.
- Individual plot yield was accomplished using a Fendt Ideal 7T combine with a 35ft draper header and weigh wagon.
- Each plot was also subsampled and sent for quality testing at North Dakota Grain Inspection for DON concentrations.

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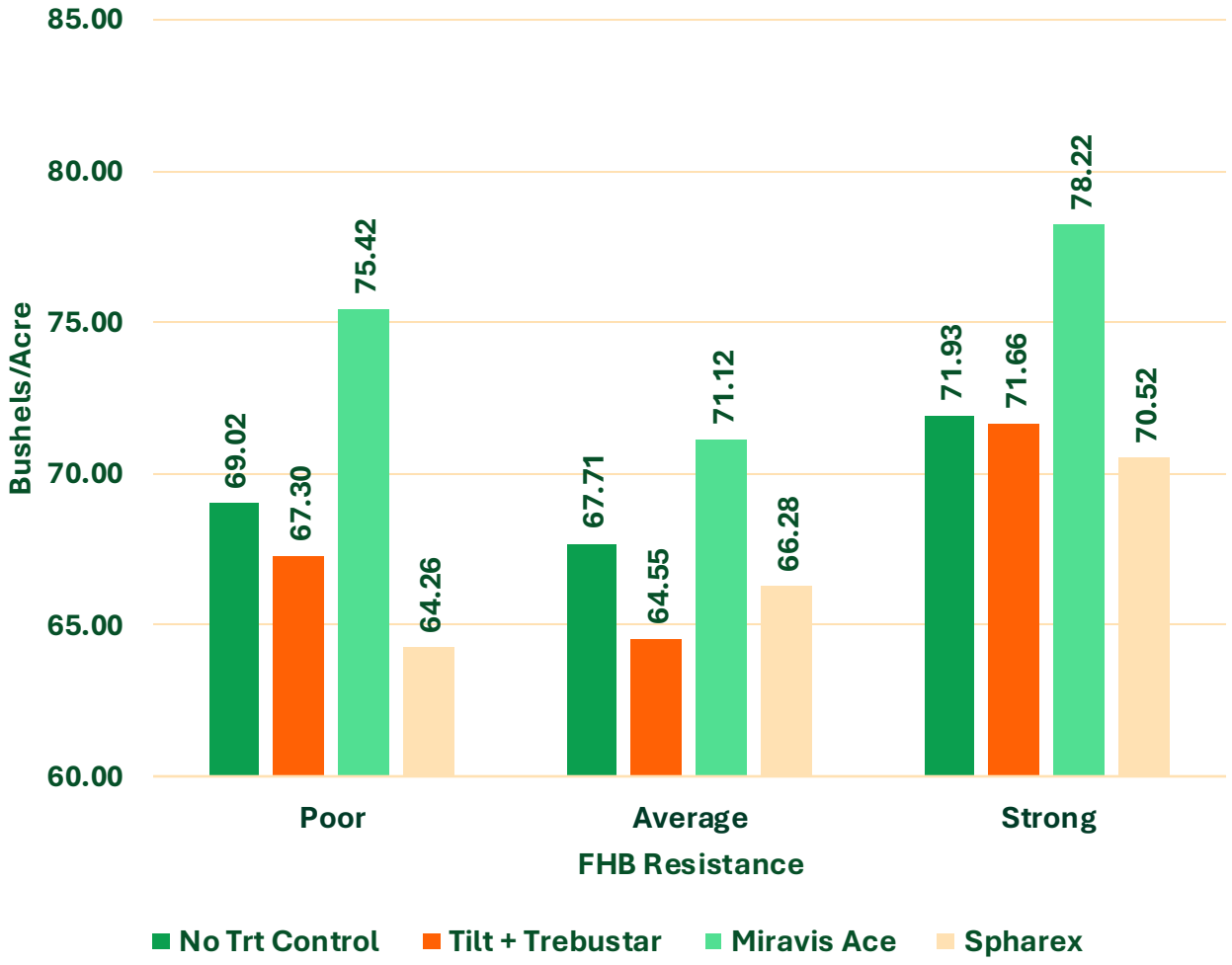
UAV Applied Fungicides for FHB Infection Management HRSW

- **Yield:** Results showed Miravis Ace had a significant yield advantage over other treatments regardless of varietal resistance to FHB.
- Both Spharex and the Tilt+Trebustar tank mixes were equal to or less than the untreated control.



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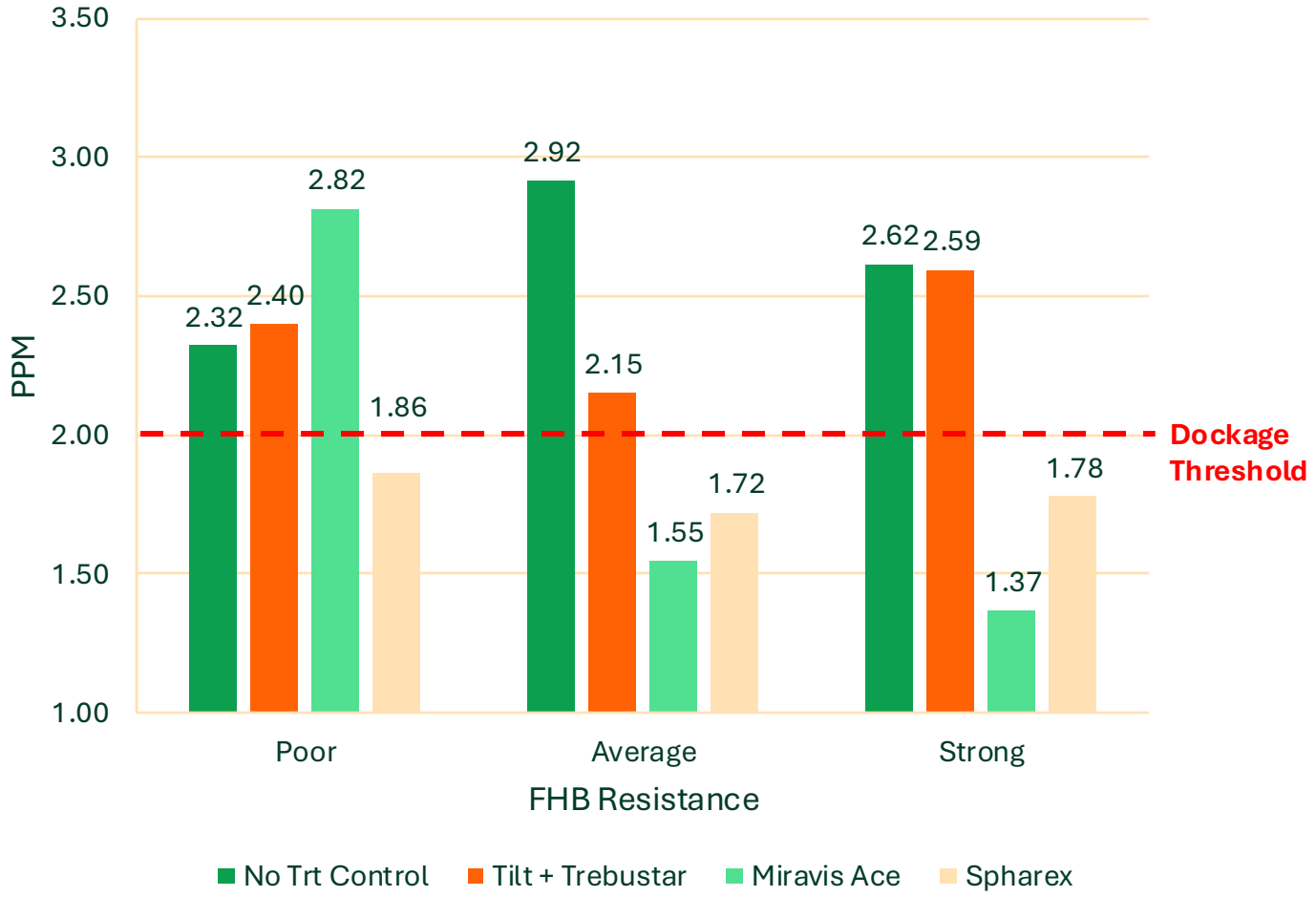
UAV Applied Fungicides for FHB Infection Management HRSW

- **<u>Deoxynivalenol (DON)/ Vomitoxin Test:</u>** Wheat quality plays a huge roll in marketability.
- One of the larger contributors of wheat quality is DON concentration measured parts per million (ppm).
- Elevator discount schedule begin DON discounts at 2.00 ppm at $0.10/Bu for ever 0.05 ppm greater than 2.00 ppm.
- At 4.0 ppm farms can begin to see load rejections at evaluators.
- This was an ideal year for FHB infections due to weather and disease presence.



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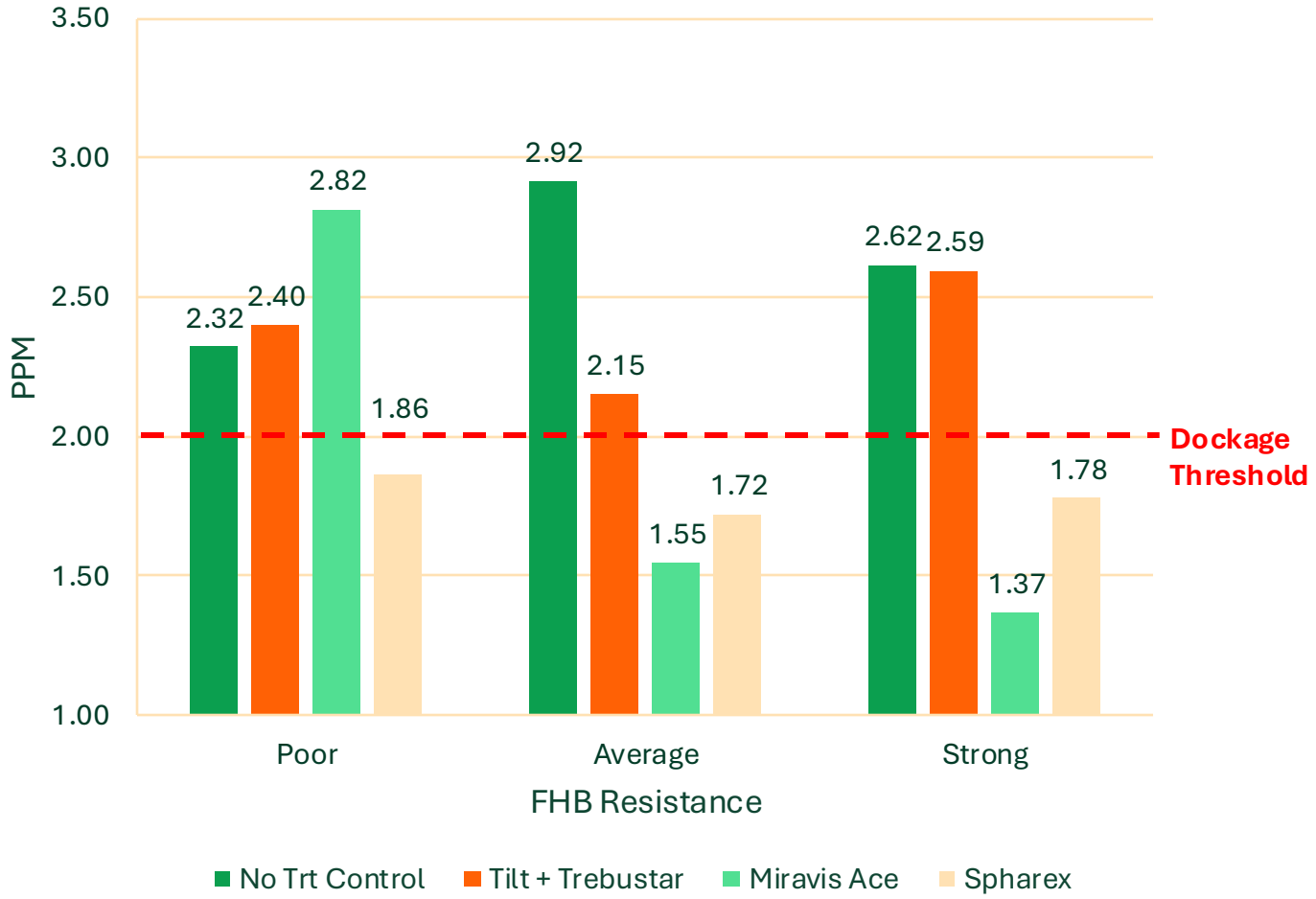
UAV Applied Fungicides for FHB Infection Management HRSW

- In addition, a mid-August rain in the Red River Valley caused DON scores to spike in wheat harvested afterward.
- Spharex was most effective at keeping DON scores below the discount threshold across all varieties.
- Marivace Ace was only effective in keeping DON scores lower in the Average and Strong varieties.
- Both the Untreated Control and Tilt+Trebustar treatments resulted in discounts from high DON scores.
- This graph suggests that pairing the right fungicide with varietal resistance level is effective at reducing harvest DON concentrations.



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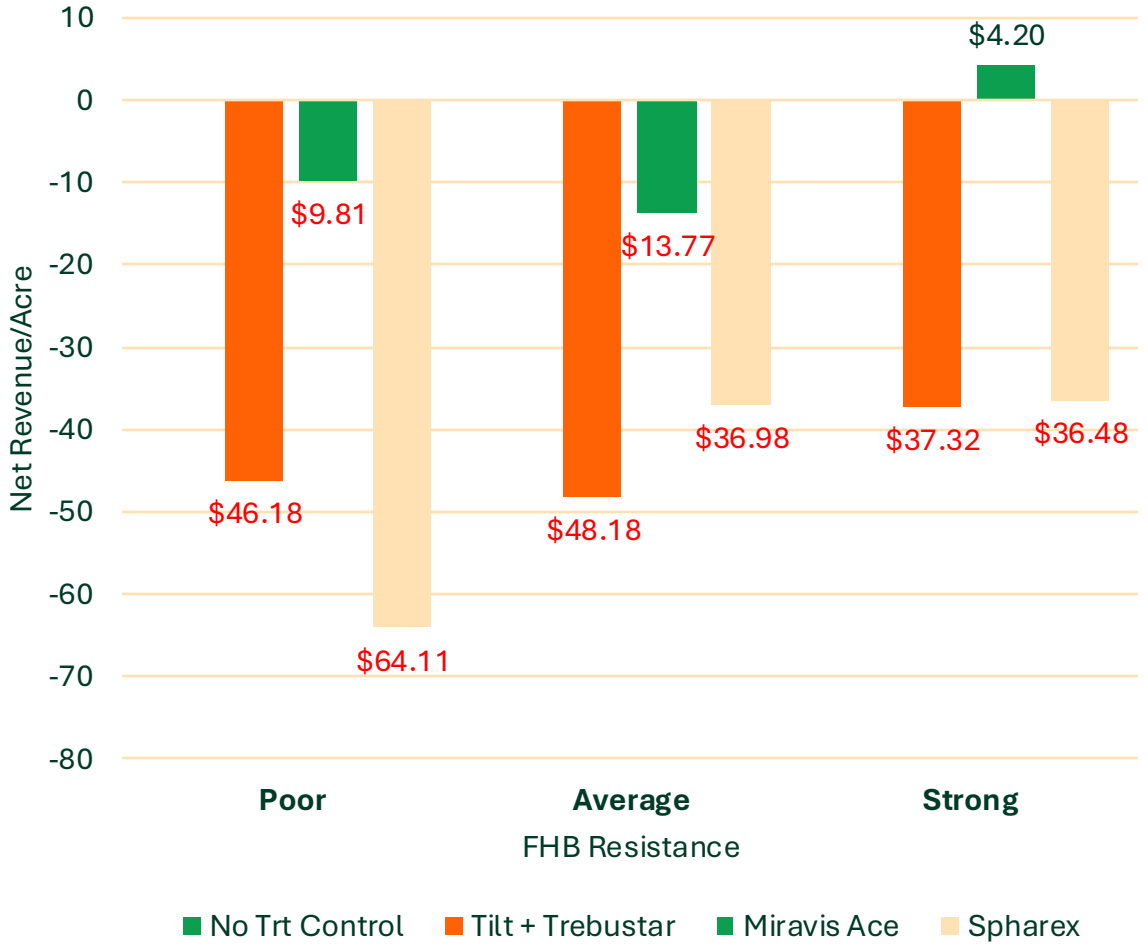
UAV Applied Fungicides for FHB Infection Management HRSW

- **<u>Economics:</u>** Return on investment (ROI) calculations used the National HRSW average received sale price of $6.10, seed cost, fungicide cost, application cost, and DON discount schedules cost.
- Miravis Ace fungicide was the only winner of ROI displaying a positive ROI of >$4.00/A for our Strong variety.
- This graph is suggesting using the right fungicide with resistance we can gain even more protection of ROI.



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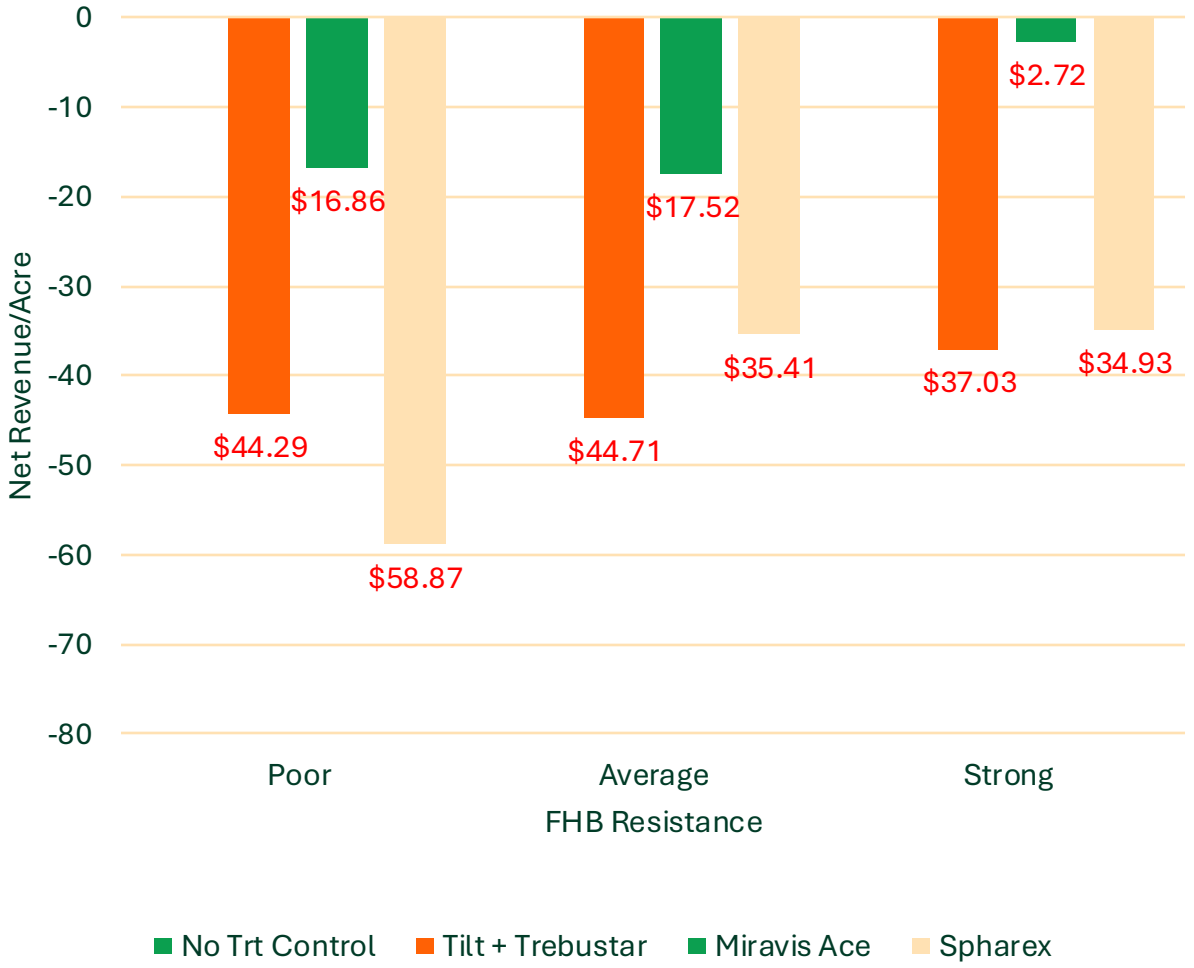
UAV Applied Fungicides for FHB Infection Management HRSW

- Economics at $5.00 sale price



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Cover Crop Weed Suppression

Objective: Determine how different cover crops and cover crop mixes reduce weed growth.

Supporting Information

Cover Crops

- German Millet @ 28.36 lbs./A
- BMR Hybrid Millet @ 28.36 lbs./A
- Berseem Clover @ 11.91 lbs./A
- 3 custom mixes

Planting

- Planted using a Land Pride no-till box drill.
- Planting Date: 7/12/24

Harvest

- Harvest Date: 8/28/24
- 1/10,000-acre hoop cut to 2.5” height
- 3 replications

Fertility

- Field was fertilized for corn but flooded out on 5/25/24.
- 160 lbs. N/A urea applied 4/27/24 using John Deere 70’ variable rate air boom spreader.
- Incorporated on the same day at 2” using a cultivator.

Mix	lbs./A	Species	% Blend
PP Grazer Mix	25	Oats	40.0%
		Peas	26.0%
		BMR Sorghum Sudangrass	12.0%
		German Millet	12.0%
		Radish	4.0%
		Turnip	4.0%
		Hybrid Brassica	2.0%
PP Soil Builder Mix	25.0	Peas	48.0%
		Lentil	20.0%
		German Millet	10.0%
		Radish	8.0%
		Flax	8.0%
		Common Vetch	4.0%
		Berseem Clover	2.0%
PP Cover Mix	12.0	Italian Ryegrass	58.5%
		Radish	25.0%
		Turnip	16.5%

Herbicide Program

- Gramozone 3.0L @ 1.5 pt/A and 20 GPA sprayed 2 days after planting

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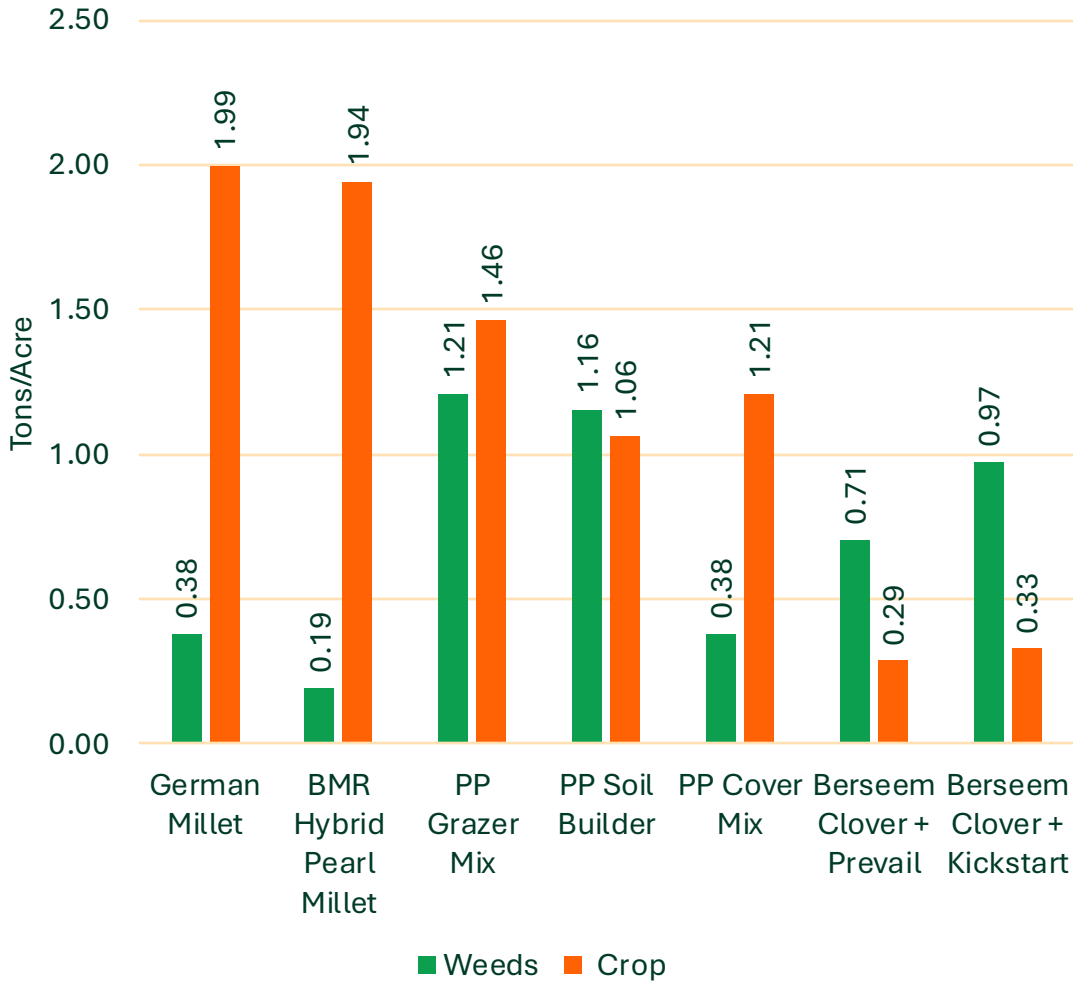
Cover Crop Weed Suppression



- **<u>Plant Growth Yield:</u>** Both Millets had the highest tonnage yield at almost 2 ton/A and were the most effective at suppressing weed growth.
  - Weed content of millet plots was above the acceptable level for feed quality.
- The cover crop mixes with the second highest yield were the addition of sorghum to PP Grazer, which increased tonnage by 0.3 ton/A.
- Both PP Grazer and PP Soil Builder struggled the most to suppress weeds compared to the rest of the treatments.
- Although PP Cover Mix yielded significantly less, it was just as effective at reducing weed yield as the German Millet.
- The graph suggests cover crop leaf density and architecture are effective tools in reducing weed growth.

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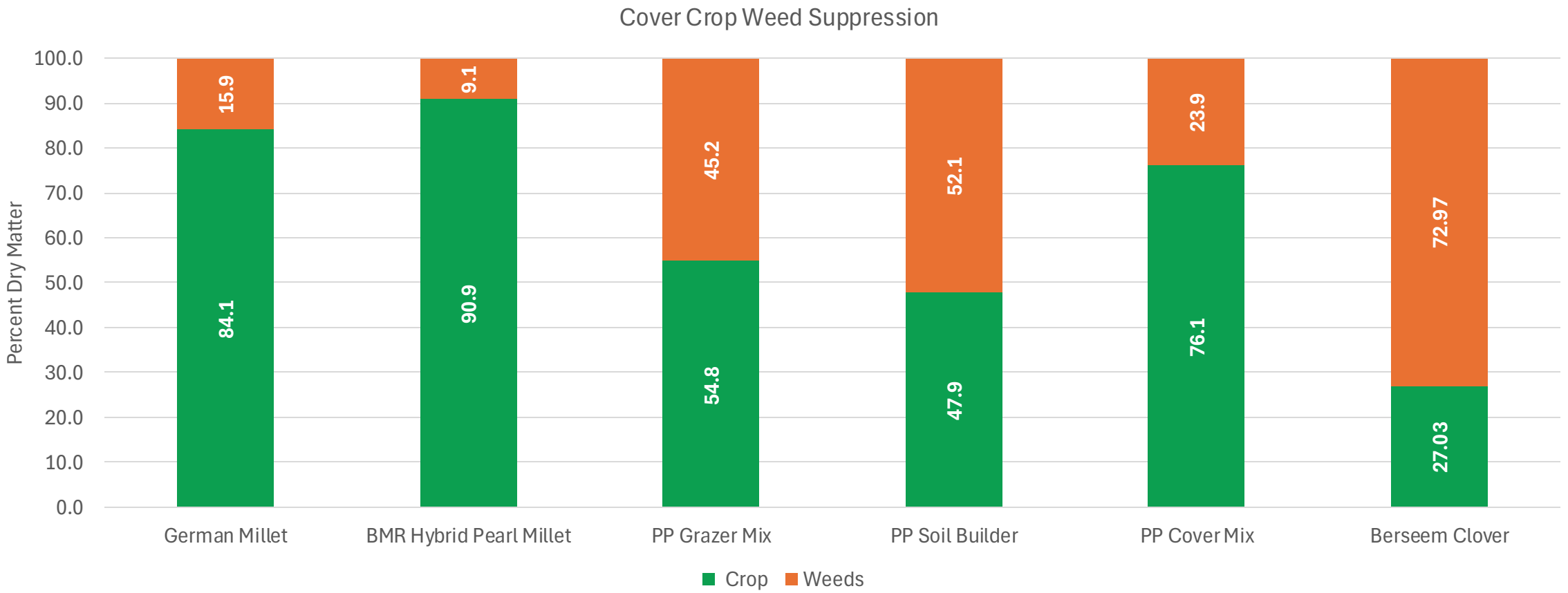
Cover Crop Weed Suppression



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Corn Trial Results

Corn Trials Conducted

1. Value of Starter Fertilizers
2. Impact of Adding Zn to Starter Fertilizers
3. Impact of Adding Pivot Bio Proven40*os* as a Seed Treatment with In-furrow Starter Fertilizer
4. Single Stage Closing Wheels Performance

Plant Date: 6/12/14 (later than average due to weather)
Harvest date: 11/12/24 at 24% seed moisture

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Supporting Information

Variety

- Thunder Seed T6294 VT2P
- 94 RM

Planting

- 32,000 seeds/A population target
- Planted on 6/12/24
- Plots were 16 rows x ~90ft with 3 replications

Harvest

- Harvested: 11/12/24
- 24% moisture
- 51.2 Average test weight

Fertility

- Urea applied on 4/27/24 using John Deere 70' variable rate air boom spreader.
- Incorporated on the same day to 2" using a cultivator.
- Full N rate was 160 lbs. N/A and Reduced N was 120 lbs. N/A.

Crop Prices

- USDA/NASS 2024 Price Received: Corn - $4.07/Bu

Starter Fertilizers

- Applied at 5 GPA through Keeton Seed Firmer

PivotBio ProveN40

- Applied as a seed treatment (ProveN40*os*).
- On-seed is compatible with in-furrow Zn.

Herbicide Program

- Atrazine 0.38 lbs. AI/A
- Storen 2.4qt/A
- Status 5 oz/A
- Buccaneer Plus 32oz/A
- 8.5 lbs. AMS/100gal

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Value of Starter Fertilizers

- **Objective:** Evaluate the value of Phosphorus starter fertilizers in reduced Nitrogen situations on corn yield.
- **Method:** Starter fertilizers were applied at 5 gpa through a Keeton seed firmer at planting using a Fendt Momentum 16-row planter equipped with the FurrowForce closing system.
- This trial had three replications of 16-row plots for each N rate (100% and -40lbs/A) and starter fertilizer combination.
- Twelve rows of each plot were harvested using an Ideal 7T combine with a 12-row corn head.

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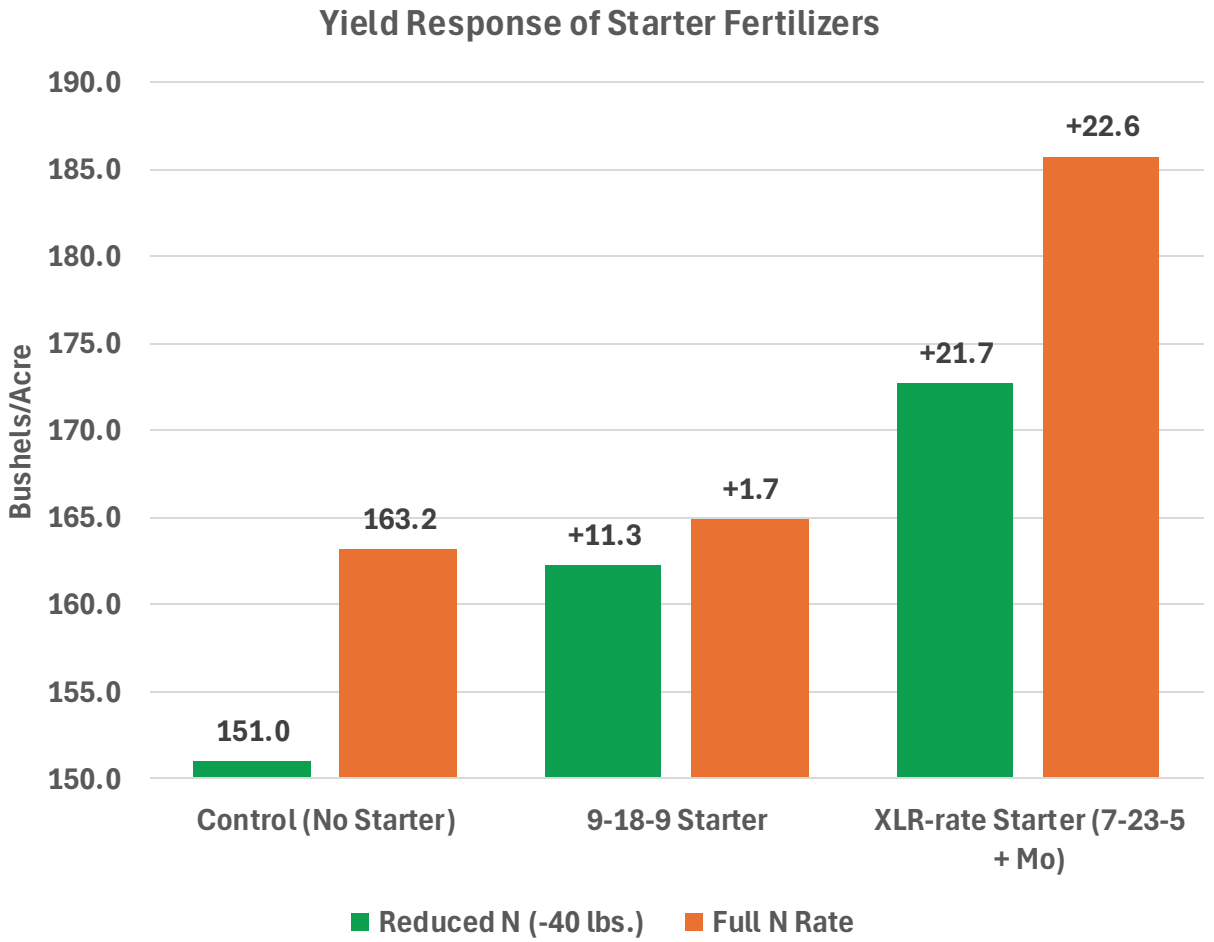
Value of Starter Fertilizers

- **Yield:** Adding in-furrow phosphorous fertilizers significantly increased yield in all treatments except when we used 9-19-9 with a full N rate.
- CHS's XLR-rate (7-23-5) product was the most effective at increasing yield when applied in-furrow with the seed compared to all other treatments regardless of N rate.



Plant Date: 6/12/14 (later than average due to weather)
Harvest date: 11/12/24 at 24% seed moisture

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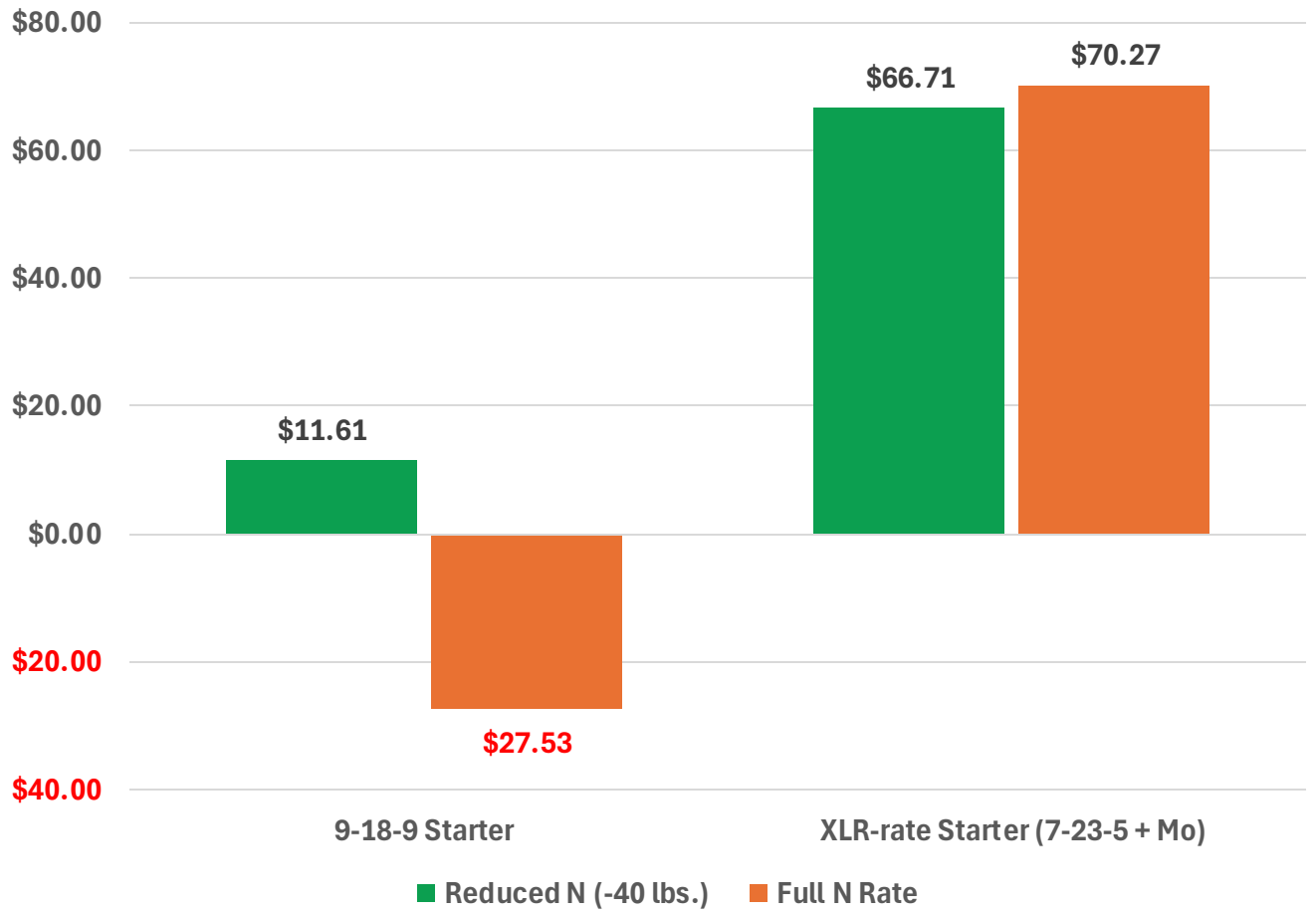
Value of Starter Fertilizers

- **Economics:** Return on investment per acre was calculated by subtracting fertility inputs (spring N and starter fertilizer).
- 9-18-9 saw mixed revenue between the lower and full rate N treatments. Higher N rates saw a negative $27.53/A return.
- Compared to both the control and 9-18-9 treatments XLR-rate produces the greatest return on investment.
- Reducing our N input reduced our overall cost but also reduced our ROI.



Plant Date: 6/12/14 (later than average due to weather)
Harvest date: 11/12/24 at 24% seed moisture

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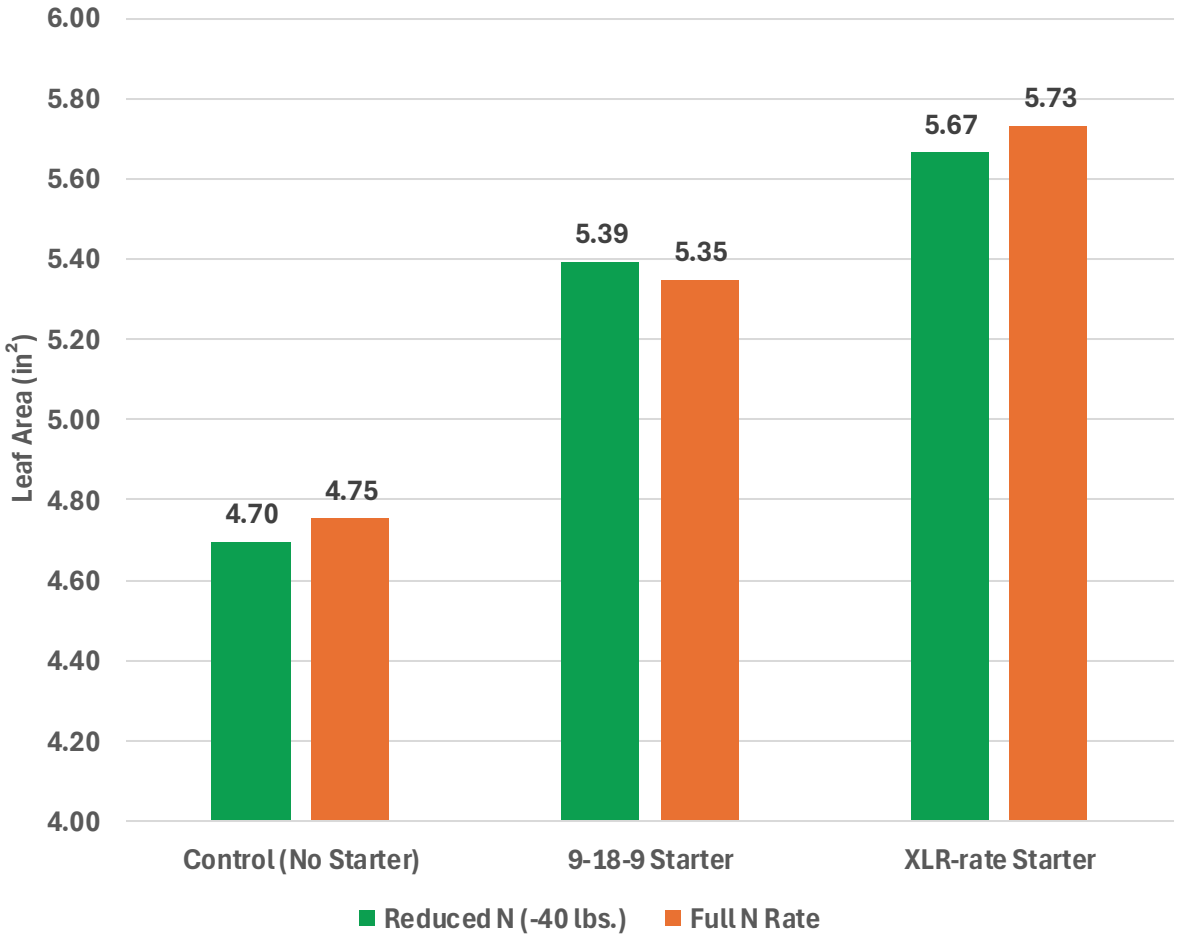
Value of Starter Fertilizers

- **<u>Plant Response:</u>** using a UAV to collect RGB data and imagery algorithms from Sentera we were able to see the impact of starter P fertilizers on early plant growth.
- This graph illustrates average plant surface area (in^2) for V3 corn plants per treatment.
- As we expected when adding starter fertilizers, we saw an increase in early plant growth compared to the control.
- This trend is similar to yield where the XLR-rate has the largest plant surface area regardless of N treatment.



Plant Date: 6/12/14 (later than average due to weather)
Harvest date: 11/12/24 at 24% seed moisture

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Impact of Adding Zn to Starter Fertilizers

- **Objective:** Evaluate the value of adding Zn to Phosphorus starter fertilizers in reduced Nitrogen situations on corn yield.
- **Methods:** Starter fertilizer 9-18-9 at 5 gpa and CHS's Zinc 9 at 1 qt/A product were used to create our treatments.
- This trial had three replications of 16-row plots for each N rate (100% and -40lbs/A) and starter fertilizer combination.
- Twelve rows of each plot were harvested using an Ideal 7T combine with a 12-row corn head.

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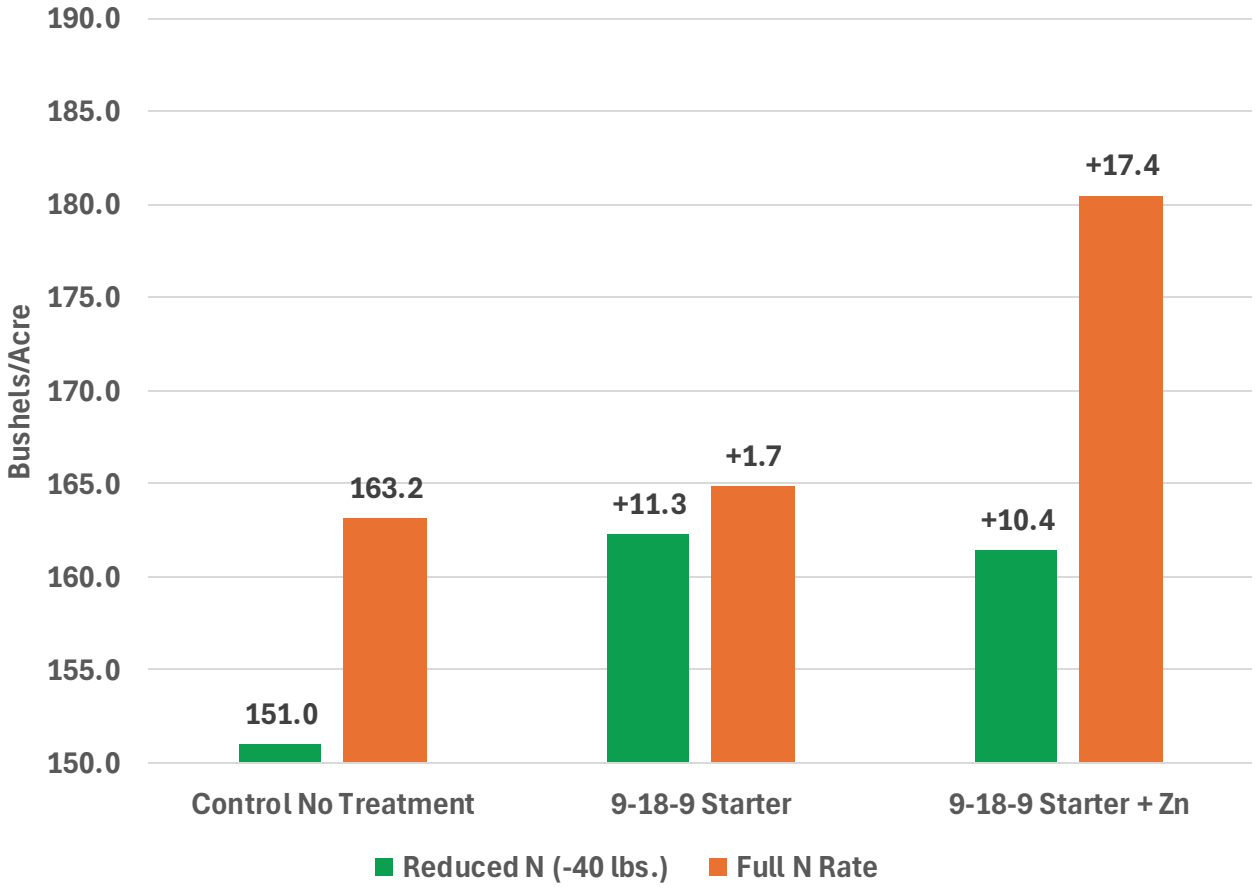
Impact of Adding Zn to Starter Fertilizers

- **Yield:** Using in-furrow 9-18-9 with or without Zn increased yield overall compared to the control (no treatment).
- The greatest yield response (+17.5 bushels) came from adding Zn to 9-18-9 while maintaining our full N rate.
- Adding Zn to 9-18-9 while reducing the N rate had a similar effect as 9-18-9 without Zn.



Plant Date: 6/12/14 (later than average due to weather)
Harvest date: 11/12/24 at 24% seed moisture

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Impact of Adding Zn to Starter Fertilizers

- **Economics:** The return on investment (ROI) was positive for all treatments except 9-18-9 without Zn.
- Even after paying for a full N rate, Zn, and 9-18-9 the trio produced the greatest ROI in the trial of +$36.42/acre.
- When we reduced N we saw a positive ROI but doing so prevented us from achieving our full return potential when using 9-19-9 + Zn.

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Pivot Bio Proven40 as a Seed Treatment

With In-furrow Starter Fertilizer

- **Object:** Evaluate the impact and return on investment (ROI) of using ProveN40*os* microbial seed treatment with starter fertilizers under reduced and full N rates.
- **Method:** Starter fertilizers were applied at 5 gpa through a Keeton seed firmer at planting using a Fendt Momentum 16-row Planter equipped with the FurrowForce closing system.
- N was applied using a John Deere 70’ airboom on 4/27/24 and incorporated on the same day using a field cultivator.
- Trials were planted over a month later due to wet spring planting conditions.
- *Proven40os* was applied to the seed prior to planting using a small batch treater. This trial had three replications of 16-row plots for each N rate (100% and -40lbs/A) and starter fertilizer combination.
- Twelve rows of each plot were harvested using an Ideal 7T combine with a 12-row corn head.

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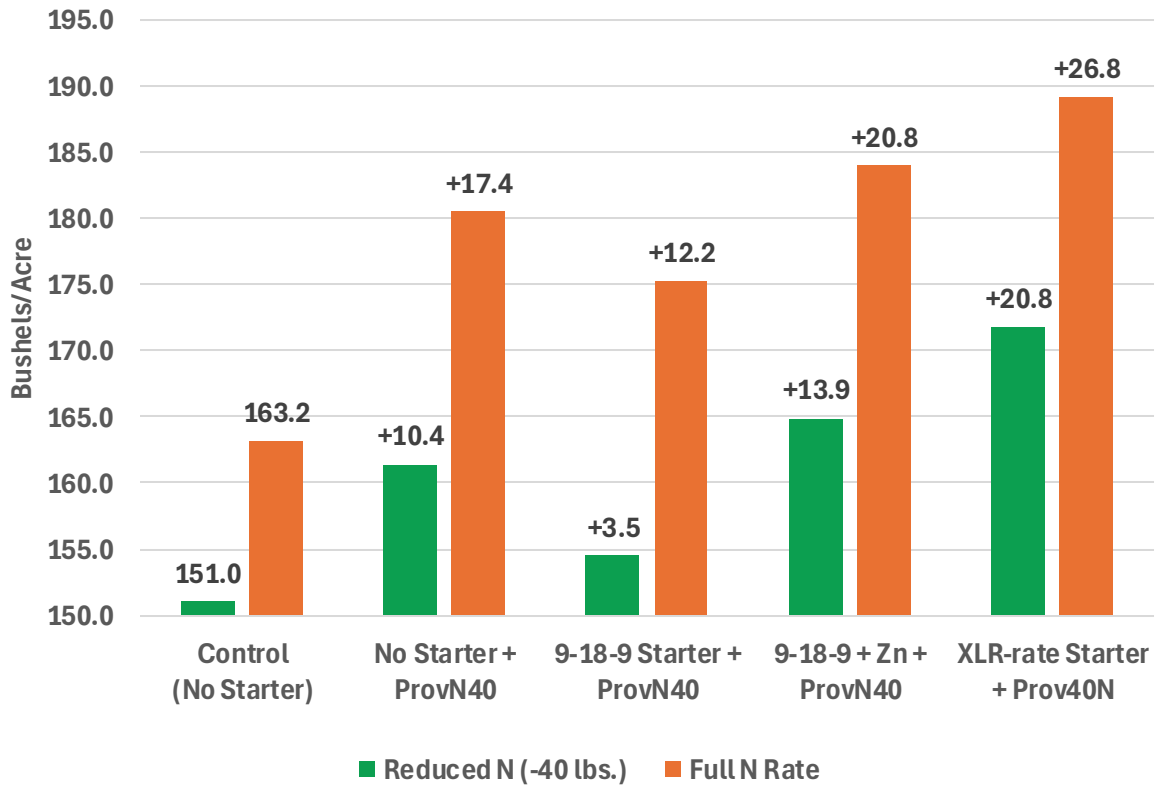
Pivot Bio Proven40

Seed Treatment with In-furrow Starter Fertilizer

- **Yield:** When Proven40*os* was applied to seed, a minimum yield bump of +3.5 bu/A occurred over the control and a maximum of +26.8 bu/A increase.
- When a starter rate was applied and we cut back the N rate, using Proven40os gave a +10.4 bu/A increase.
- As starter fertilizer was applied, it gained even more yield under reduced N conditions except for 9-18-9 alone.
- The biggest gains came from using the full N rate and Proven40os together.
- Pairing XLR-rate and Proven40os together showed a +26.8 bu/A yield gain.



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Harvest date: 11/12/24 at 24% seed moisture

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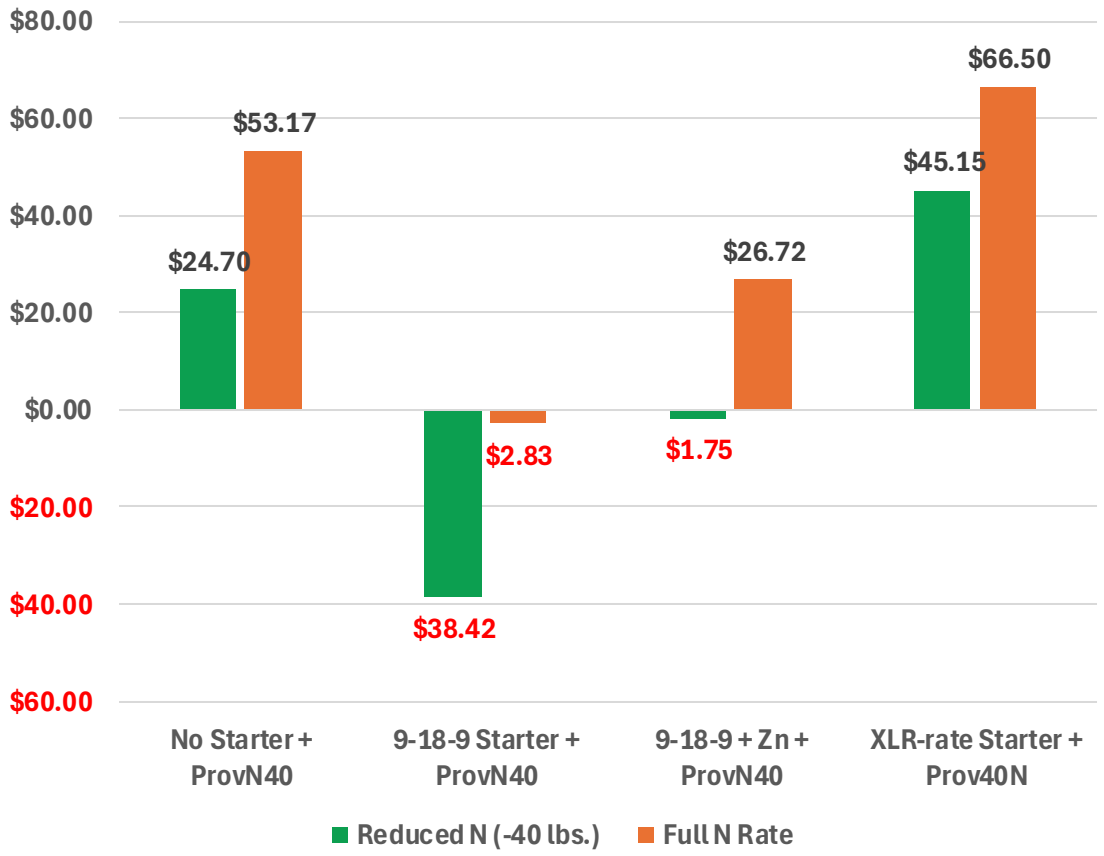
Pivot Bio Proven40

Seed Treatment with In-furrow Starter Fertilizer

- **<u>Economics:</u>** Using ProveN40os produced a positive ROI across most of our treatments.
- When we added Zn to 9-18-9 under reduced N conditions, we did see a negative ROI (≤-$38.42/A).
- The largest ROI gain was Proven40os paired with XLR-rate +$65.50/A.
- Reducing N showed a positive ROI but doing so prevented the crop from achieving full return potential when adding starters and ProveN40os.



Plant Date: 6/12/14 (later than average due to weather)
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Single Stage Closing Wheels Performance

Objective:

The impact on emergence rate, yield, and ROI of single stage closing wheels.

Method:

- Trials were planted using a Momentum 16-row planter.
- Twelve rows of each plot were harvested using an Ideal 7T combine with a 12-row corn head.
- Each closing wheel was set to the spacing specified in the installation guides.
- The closing wheel system had 80ft to adjust down pressure setting by observing closing conditions, air pocket presence in the closed trench, and seed-soil contact.
- Once each was set at its optimal closing down pressure the full trail was planted without any further adjustments.
- PTI | North Dakota is situated on Fargo Clay and is considered a tight low-lying soil.
- Emergence rates were calculated by counting plant emergence in the same 17.5 ft row every 24 hours.

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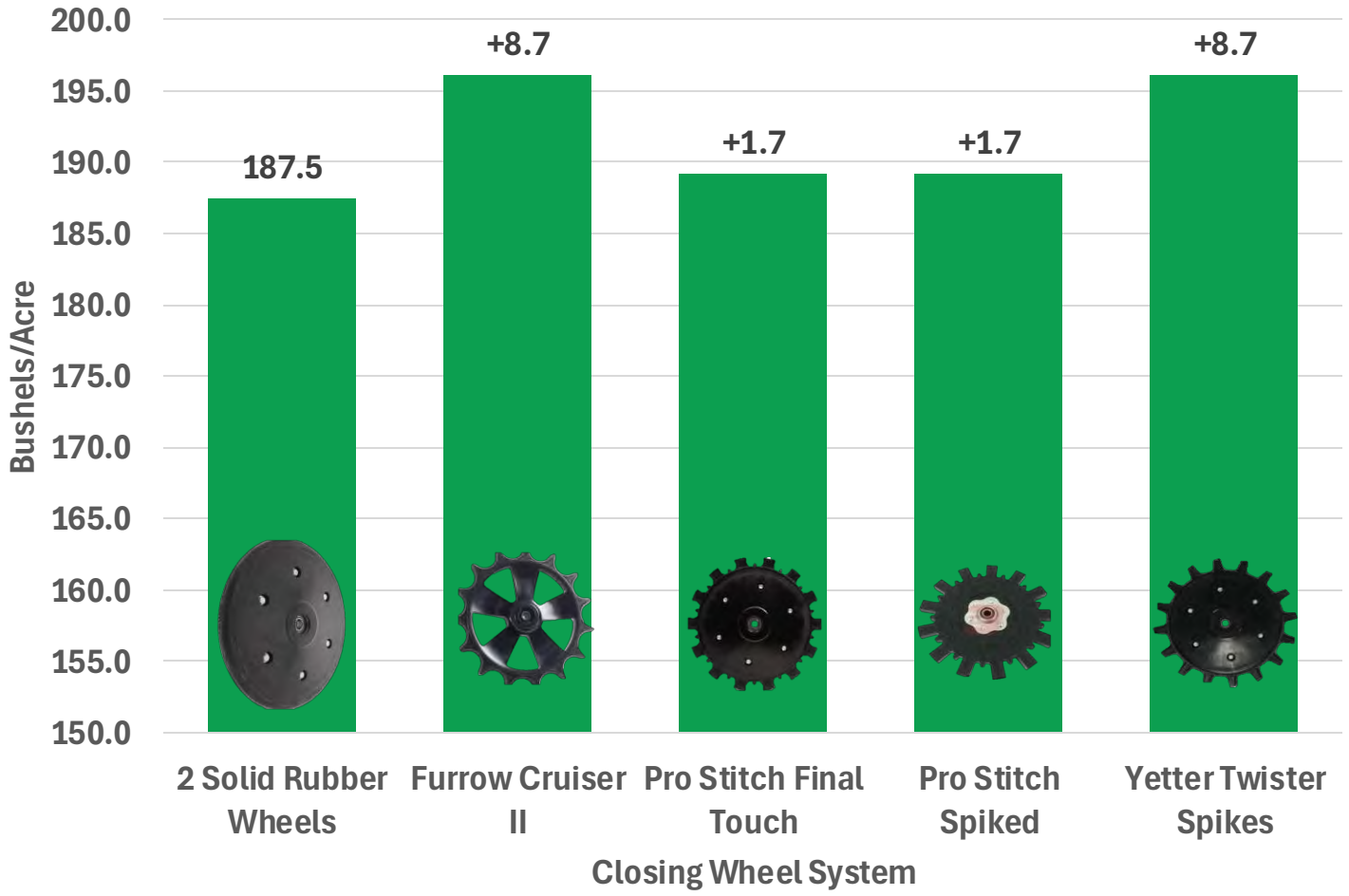
Single Stage Closing Wheels Performance

- **Yield:** All closing wheels performed better than the control of 2 Solid Rubber Wheels.
- Both Furrow Cruiser II and Yetter Twisters provided the highest yield bump of +8.7 bu/A.
- The second highest yield increase was a tie between Pro Stich Final Touch and Spiked wheels at +1.7 bu/A.



Plant Date: 6/12/14 (later than average due to weather)
Harvest date: 11/12/24 at 24% seed moisture

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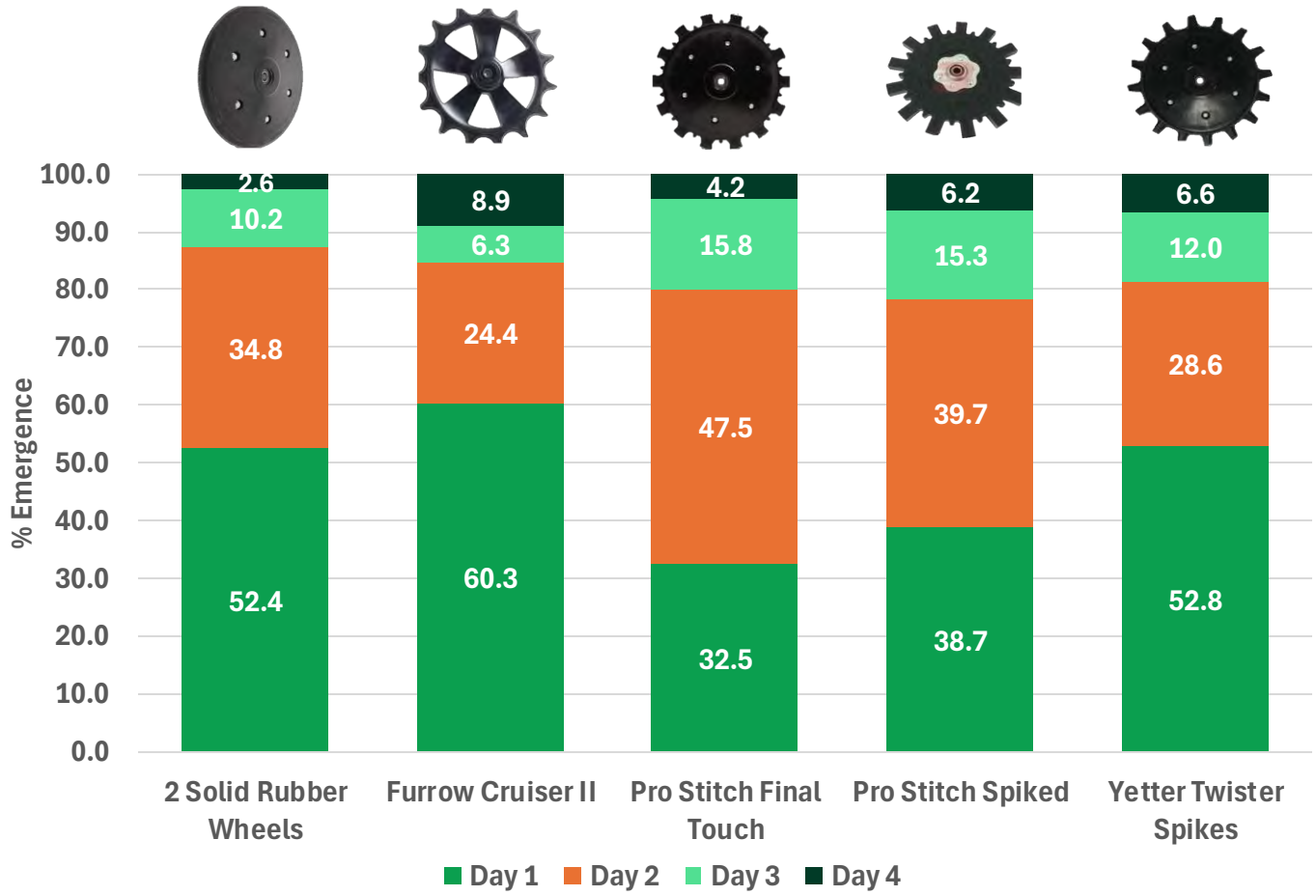
Single Stage Closing Wheels Performance

- **Emergence Rate:** Using Precision Plantings emergence flagging method showed mixed results of percentage emergence every 24hrs.
- Furrow Cruiser had the most delayed emergence over the 4 days but had the highest percentage of Day 4 emergence.
- Yetter Twister Spikes performed similarly to the Rubber Closing wheels, while both Pro Stitch closing wheels hand the most delayed emergence.



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Precision Planting®

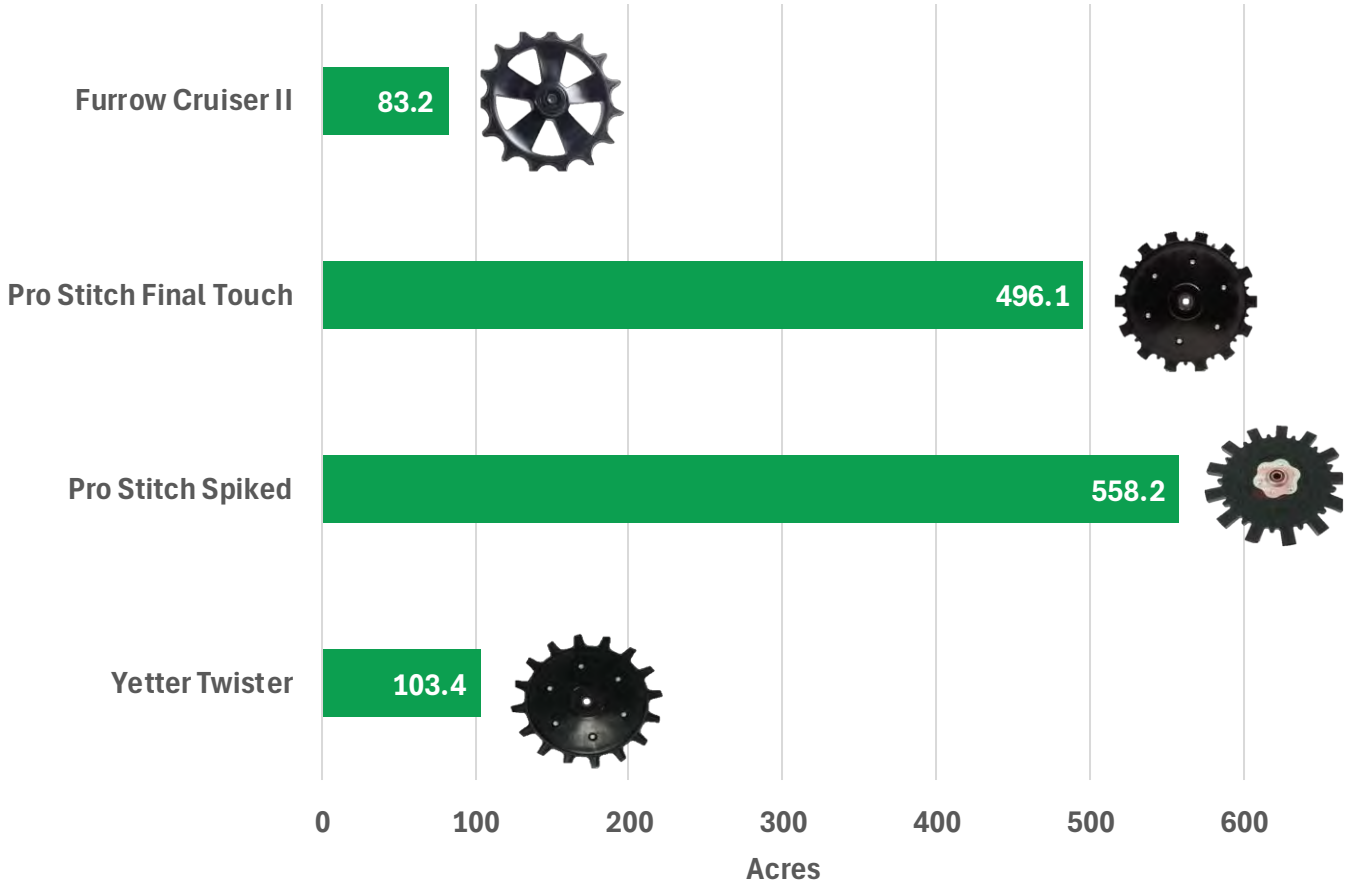
Single Stage Closing Wheels Performance

- **Economics:** Breakeven formula ↓

  Cost of Wheels for 16-Row Planter /
  (Difference in ROI/A Compared to Rubber Wheels)
  = Additional Acres to Breakeven

  (This does not factor in effective use lifespan or replacement timelines)

- Breakeven figures show Furrow Cruiser II is the most economical closing system in the trial followed by the Yetter Twisters.
- Both Pro Stich wheels although better than the Rubber Wheels in yield had the highest additional acres breakeven.



Plant Date: 6/12/14 (later than average due to weather)
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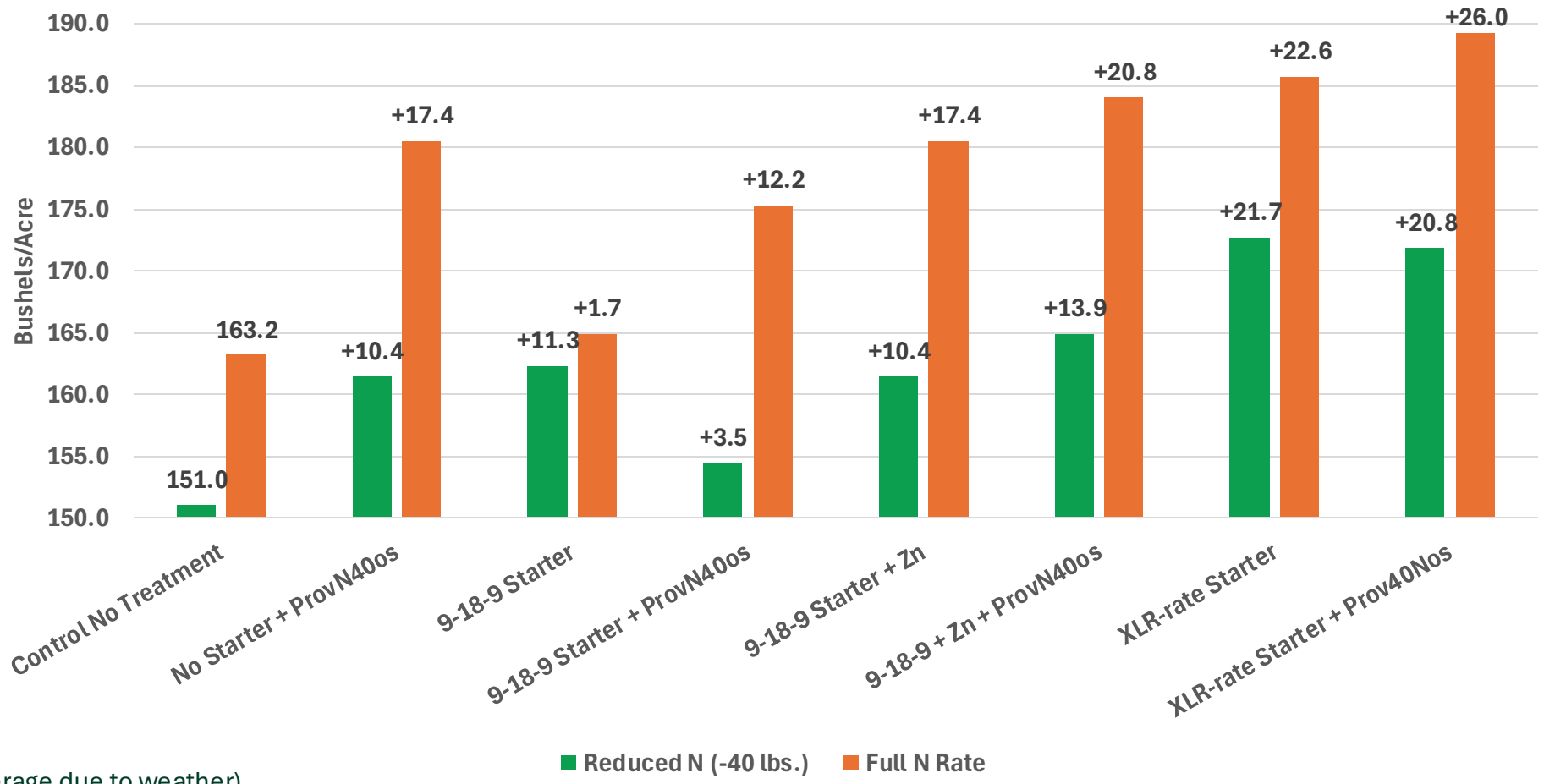
Complete Corn Fertility Data Set

Objective: Compare impact and ROI across all 2024 corn fertility treatments on the PTI | North Dakota Farm.

Complete Corn Fertility Trials

- **Yield:** XLR-rate and ProveN40os using a full N rate was the winner in overall corn fertility trials.
- All treatments produced a positive yield response compared to the control.



Plant Date: 6/12/14 (later than average due to weather)
Harvest date: 11/12/24 at 24% seed moisture

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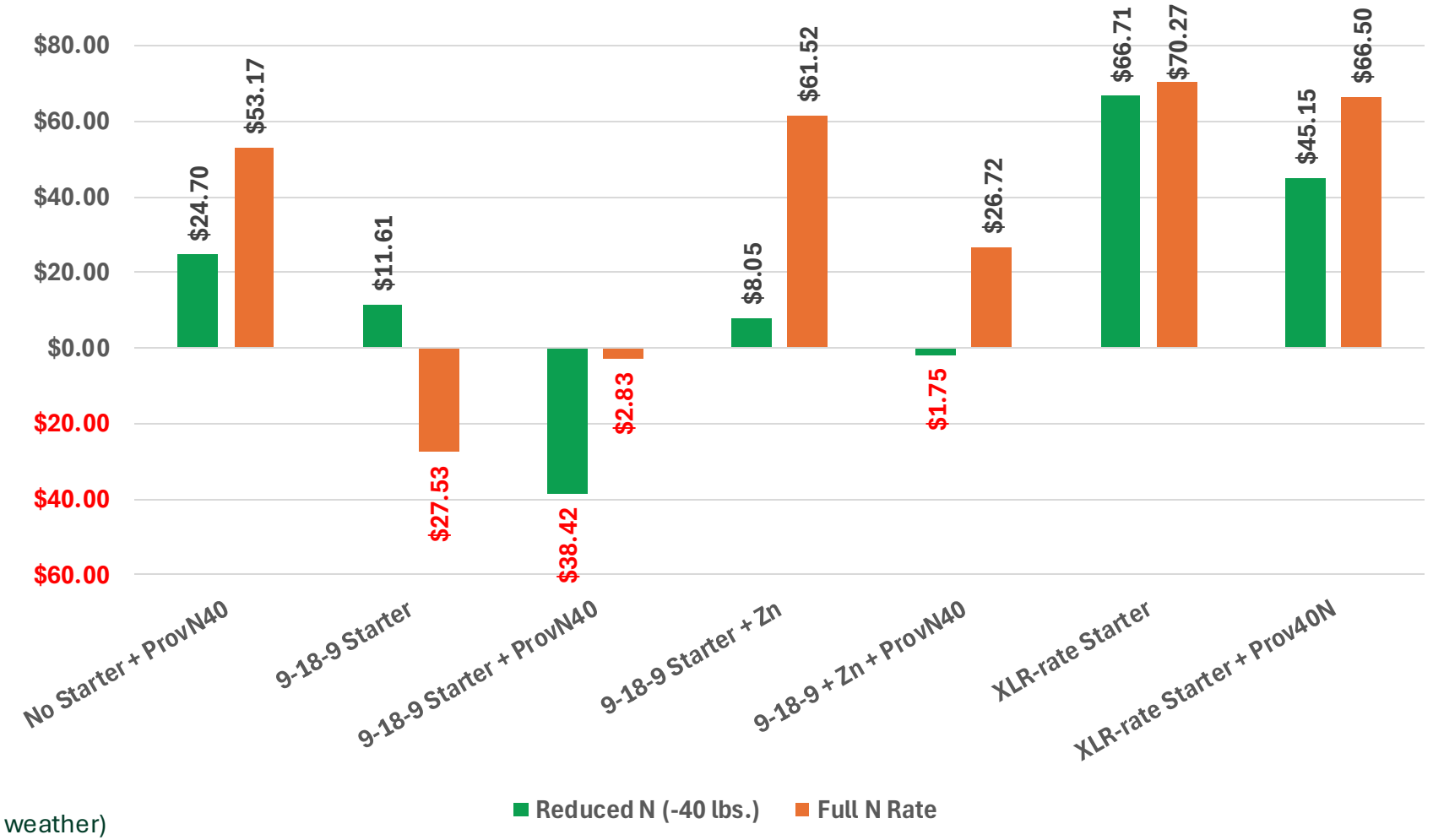
Complete Corn Fertility Trials

- **Economics:** The highest ROI occurred when using XLR-rate alone even under reduced N conditions.
- 9-18-9 showed mixed results on ROI including the largest loss in revenue at -$38.42/A.
- Not applying starters at all and using ProveN40os reduced complexity of planting and did provide a positive ROI. However, it was less than when used with starter fertilizers.
- When N is reduced, a positive ROI occurs but it prevented the crop from achieving the full return potential.



Plant Date: 6/12/14 (later than average due to weather)
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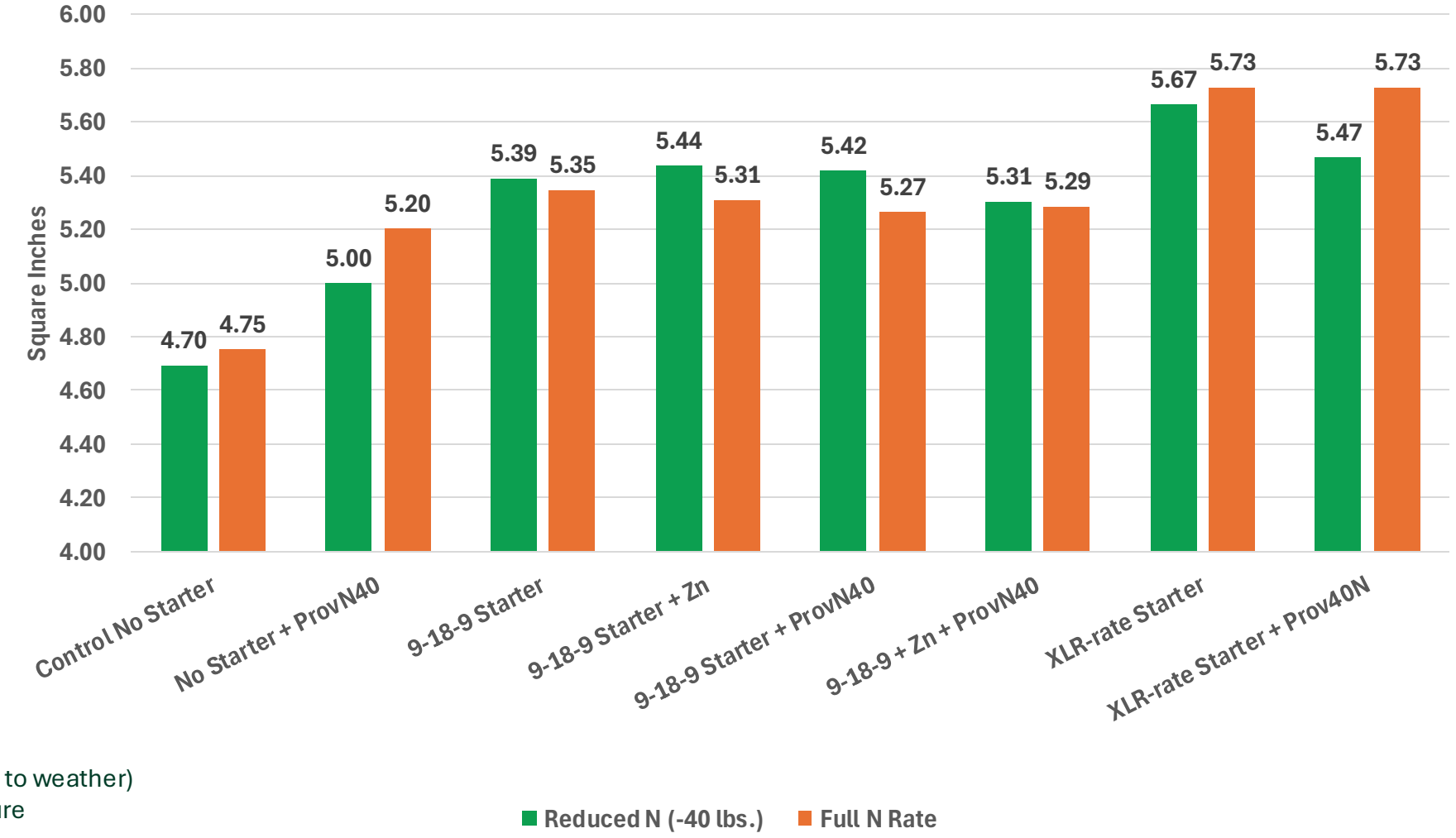
Complete Corn Fertility Trials

- **Plant Response:** Plant surface area at V3 increased with either ProveN40 or starter fertilizers.
- The greatest gains came from using XLR-rate seeing >1 in^2 compared to the control.
- Note: the increase in plant size when using ProveN40.
- This product is not marketed to influence plant growth prior to V5.
- A less than <0.5 in^2 increase in plant size at V3 occurred compared to the Control.



Plant Date: 6/12/14 (later than average due to weather)
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HOW DO I GET MORE DATA?

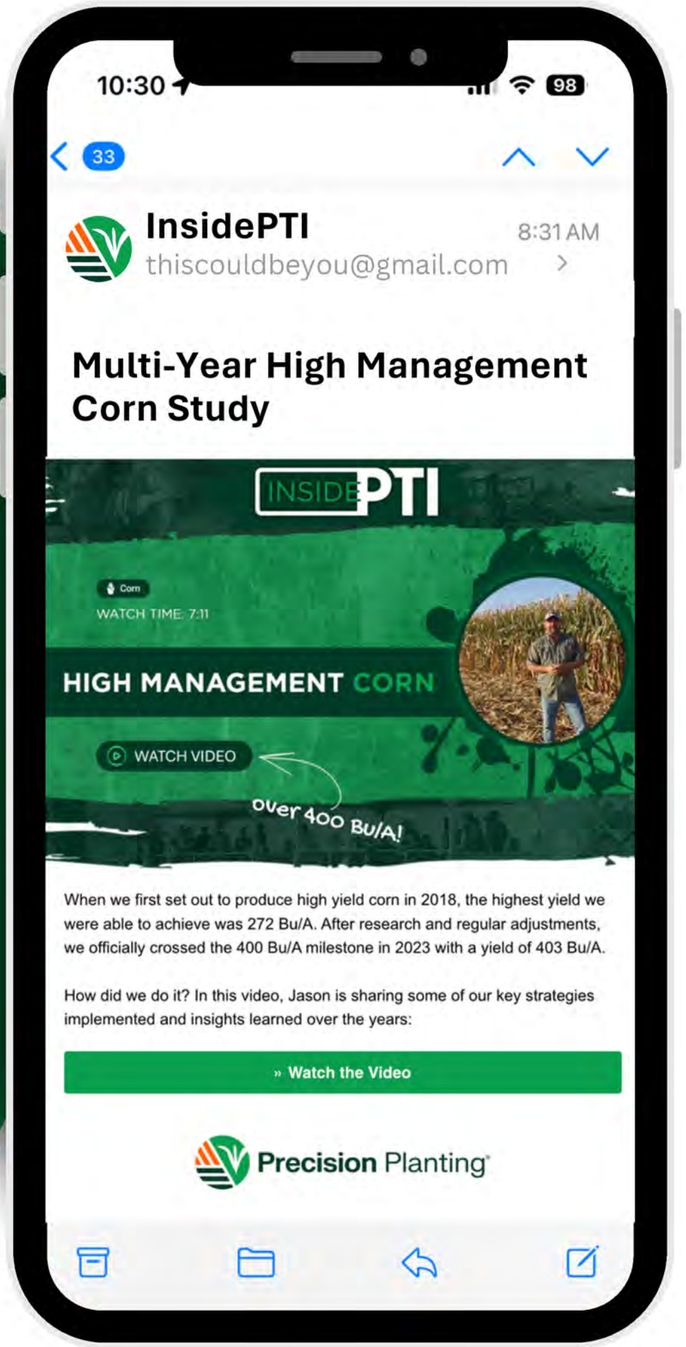
VISIT THE FARM

PTI PRECISION TECHNOLOGY INSTITUTE

HOW DO I GET MORE DATA?

JOIN INSIDEPTI

PTI PRECISION TECHNOLOGY INSTITUTE



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