



PROVEN performance

Key Findings from Independent Evaluation of Pivot Bio Products

University
of Georgia

NC STATE
UNIVERSITY

BARKER
Research and Consulting LLC

I UNIVERSITY OF
ILLINOIS
URBANA-CHAMPAIGN

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Precision
Planting

Purdue
University

Summer 2023



About Pivot Bio

In a volatile world with a growing population, pressure on natural resources and unpredictable weather, growers need nitrogen that is reliable, predictable, safe and better for the environment without compromising on yield.

Our crop nutrition technology harnesses nature to solve agriculture's biggest challenge: delivering nitrogen to plants to feed a growing population without the negative impacts of a synthetic fertilizer. Pivot Bio's technology meets this demand for nitrogen consistency and dependability by enabling microbes to convert atmospheric nitrogen and deliver it to crops, providing a source of nitrogen throughout the growing season by adhering to the roots of the plant.

By making this possible at scale for the first time, we're transforming agriculture and changing how the industry evaluates nitrogen performance.

Redefining How the Industry Evaluates Nitrogen

For over 100 years, nitrogen evaluation centered on big yield improvements. Because Pivot Bio has taken nitrogen science to a

scale that has never been seen, it is changing how nitrogen should be evaluated. Our approach requires a more comprehensive approach.

The future of nitrogen is about measuring the consistency, dependability and productivity that microbial nitrogen delivers. Metrics we encourage include biomass, growth rate, nitrogen captured per acre in above- or below-ground tissue, canopy closure and sensor readings to measure plant greenness.

To embrace the innovation necessary for the industry and farmer economics, evaluation of nitrogen performance must be redefined.

“Our transformative technology is changing something that has been done the same way for over 100 years. We know we have work to do to build more understanding. That's why we invite collaboration and open dialogue with those that are interested in discovering better ways to support sustainable agriculture and help farmers increase the quality and productivity of their land.”

- Ernie Sanders
Senior Vice President Product Development
Pivot Bio

Our Product Promise

Synthetic fertilizer has, until now, been the primary way for farmers to grow the food the world needs. Yet, it is one of agriculture's leading contributors to global greenhouse gas emissions and a significant driver of poor water quality, biodiversity loss and air pollution. Synthetic fertilizer is also unpredictable, vulnerable to runoff and leaching, and leads to personal health and safety issues for people working on farms.

Pivot Bio makes the leading synthetic nitrogen replacement products on the market. Our nitrogen is manufactured in the U.S. Our nitrogen is weatherproof. Our nitrogen is safer to handle. Our nitrogen does not leach and does not contribute to nitrous oxide pollution. It's simple: The more synthetic nitrogen that is replaced with microbial nitrogen, the cleaner our water and air will be.

Independent research demonstrates how our breakthrough technology delivers on our product promise to reduce dependence on synthetic nitrogen fertilizer and increase profitability, predictability and sustainability without compromising on yield.

Independent Research that Follows Our Product Protocols Shows Our Product Promise in Action

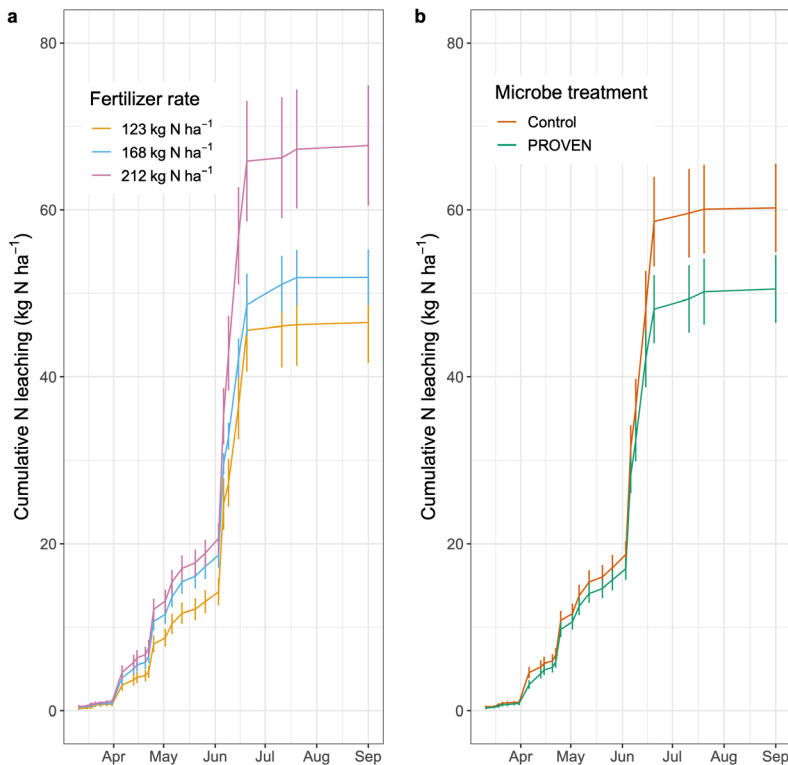
We've invested in extensive independent research, with a shared goal of discovering better ways to support sustainable agriculture and help farmers increase quality and productivity. This research is the result of these studies.

Our research agenda is expanding to 22 universities for the 2023 growing season. These researchers are conducting structured trials and following product protocols to evaluate our products based on our promise to growers. The outcome will be reliable data growers can trust.

Key findings include:

- The use of Pivot Bio PROVEN® 40 led to higher yields and additional revenue.
- When combined with a Pivot Bio proprietary carbon additive, corn treated with PROVEN 40 could increase its yield advantage by up to 11 bushels per acre.
- Nitrate leaching can be reduced by an average of 10 kilos of nitrogen per hectare (-9 pounds per acre) with the use of PROVEN 40.
- Pivot Bio's products are highly efficient in the field with little waste; whereas only 40-60% of synthetic fertilizer ever reaches the crop, and the rest can leach, volatilize, or runoff into the environment.

Decreased Nitrate Leaching on Corn



Protocol

A steel box mesocosm system was used for this agronomic study to enable precise measurement of nitrate leaching and nitrous oxide emissions. A mesocosm is a system that examines the natural environment under controlled conditions. Each box contains an undisturbed soil core from either Clarion or Webster soil types. All water that moves downward through each box is collected and tested for nitrates and other nutrients.

36 replicated mesocosms, or soil blocks, were used to test the following treatments:

- Non-treated check (control)
- PROVEN® 40

Across three N rates:

- 110, 150, 190 Lbs. N/A

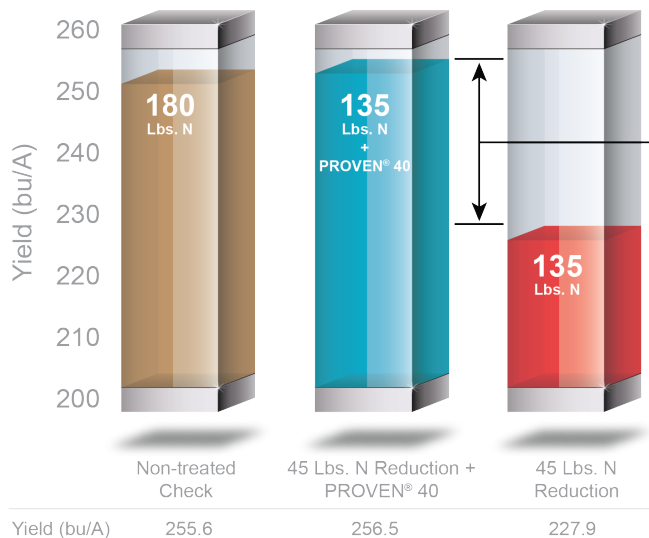
Nitrate Leaching Assessment

As expected, nitrate levels varied by nitrogen rate (*Figure a*). Detecting the N-rate driven nitrate differences also validated the effectiveness of the steel box mesocosm system.

Across all nitrogen rates, when treated with PROVEN® 40, mean nitrate leaching was **10 kg N ha(-1)** less than the non-treated check (control) (*Figure b*).

Increased Yields and ROI

with Reduced N and Use of Pivot Bio PROVEN® 40



PROVEN® 40 replaces 45 Lbs. of nitrogen with a **27.7** bu/A yield advantage over the reduction treatment alone

Yield Performance

Results indicate that when PROVEN® 40 was added to the reduced N rate of 135 Lbs., a **+27.7 bu/A** yield advantage was reported versus the 135 Lbs. alone.

When PROVEN® 40 was added to the nitrogen reduction treatment (135 Lbs.), the product not only replaced the 45 pounds of N but also yielded slightly higher, **+0.9 bu/A**, than the 100% nitrogen non-treated check (180 Lbs.).

Return on Investment

To calculate the return on investment, the following assumptions were used:

- Corn Price: \$6.00
- UAN32%: \$0.78/Lb.
- PROVEN® 40 Price: \$21/A

When the 100% nitrogen rate was reduced by 45 Lbs. of N and replaced with PROVEN® 40, revenue was increased by **+\$12.56/A**.



Protocol	Details
<p>For this agronomic study, nitrogen rates are evaluated at:</p> <ul style="list-style-type: none"> • 180 Lbs. N - 100% full N rate (non-treated check) • 135 Lbs. N - 25%/45 Lbs. N reduction • 135 Lbs. N - 25%/45 Lbs. N reduction + PROVEN® 40 	<ul style="list-style-type: none"> • Planting Date: April 28, 2022, April 28, 2021, May 27, 2020 • Hybrid: AgriGold 639-70 (2022), DKC 66-17 (2021), DKC 59-82 (2020) • Population: 36k • Row Width: 30" • Application: In-furrow at planting via Precision Planting FurrowJet® treatments

This report has been produced by an independent third-party consulting firm, 9 North Group, utilizing data collected and processed by Precision Planting.

Pivot Bio PROVEN® 40 used with a Carbon-rich Food Source Shows Great Promise

Applying a carbon additive in conjunction with Pivot Bio PROVEN® 40 supplies the Pivot Bio microbe with a carbon-rich food source while the crop is still young. This carbon additive likely enhances PROVEN® 40's capacity to fix nitrogen from the atmosphere early in the growing season and returns that nitrogen to the developing crop. As the crop matures, Pivot Bio PROVEN® 40 will utilize root exudates from the corn plant as a food source and continue to provide nitrogen to the crop. Pivot Bio's goal is to design microbe specific carbon sources.



Protocol

For this agronomic study, the following treatments were utilized:

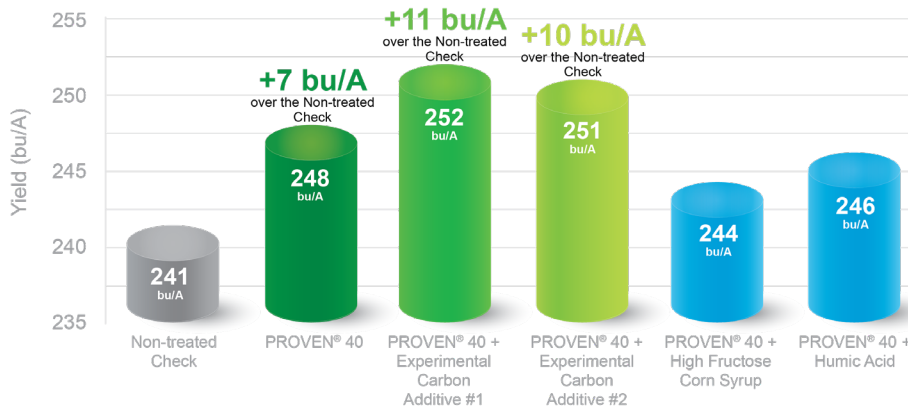
- 140 Lbs. N/A (Non-treated check)
- 140 Lbs. N/A + PROVEN® 40
- 140 Lbs. N/A + PROVEN® 40 + Pivot Bio Experimental Carbon Additive #1
- 140 Lbs. N/A + PROVEN® 40 + Pivot Bio Experimental Carbon Additive #2
- 140 Lbs. N/A + PROVEN® 40 + High Fructose Corn Syrup
- 140 Lbs. N/A + PROVEN® 40 + Humic Acid

Details

- Planting Date: May 16th Nashville, May 13th Champaign (On-seed and In-furrow), May 23rd Yorkville
- Tillage: Fall chisel pass and field cultivation in the spring
- Treatment Application: Pivot Bio PROVEN® 40 applied In-furrow at three locations and as an On-seed application at one location. Carbon sources were tank mixed with PROVEN® 40 for In-furrow applications. For On-seed PROVEN® 40, carbon additives were applied as an In-furrow application on top of the treated seed.
- Nitrogen Application: 140 Lbs./A 32% UAN applied pre-plant incorporated as a broadcast application.
- Hybrid: Pioneer P1082AM

Corn Thrives with Pivot Bio PROVEN® 40 and Carbon Sources

Influence of PROVEN® 40 and carbon additives on corn yield averaged across four Illinois locations in 2022

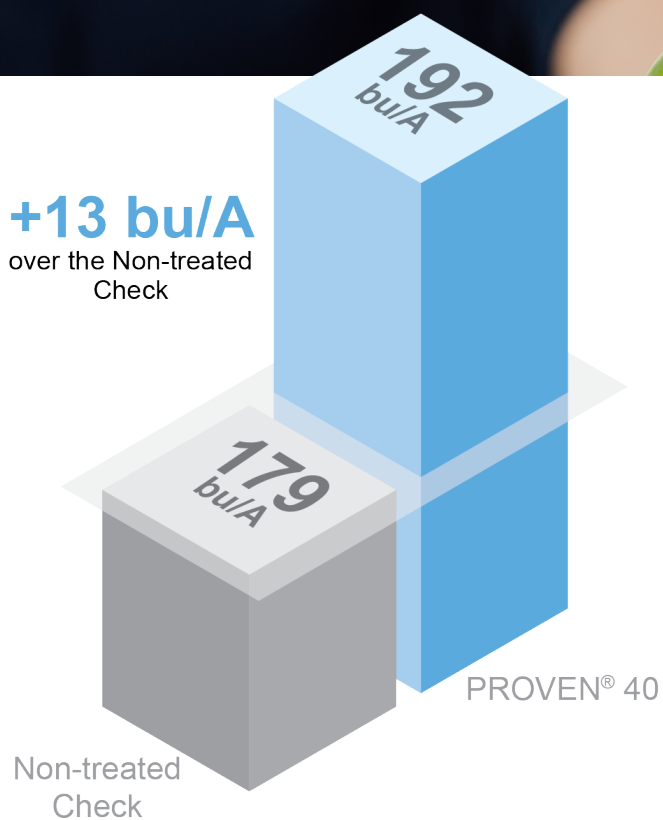


Yield Performance

Averaged across four trial locations, corn yields increased numerically with all PROVEN® 40 treatments. When PROVEN® 40 was applied alone, corn yield increased **+7 bu/A** compared to the non-treated check.

Corn yields increased by an additional **3 to 4 bu/A** when PROVEN® 40 was applied with a Pivot Bio experimental additive.





Corn Yield Increases

with Pivot Bio PROVEN® 40

Yield Response

Corn yield increased **+13 bu/A** when PROVEN® 40 was added to the base nitrogen rate (non-treated check) of 250 Lbs./A.

Location

Midville, Georgia

Protocol

This was a single location replicated strip trial conducted at the University of Georgia research station near Midville, Georgia, under irrigated conditions. The following two treatments were evaluated:

- 250 Lbs. Nitrogen/A (Standard Grower Rate and Non-treated check)
- 250 Lbs. Nitrogen/A + PROVEN® 40



Higher Test Weights and Greater Yields

Compared to Standard Grower Rate

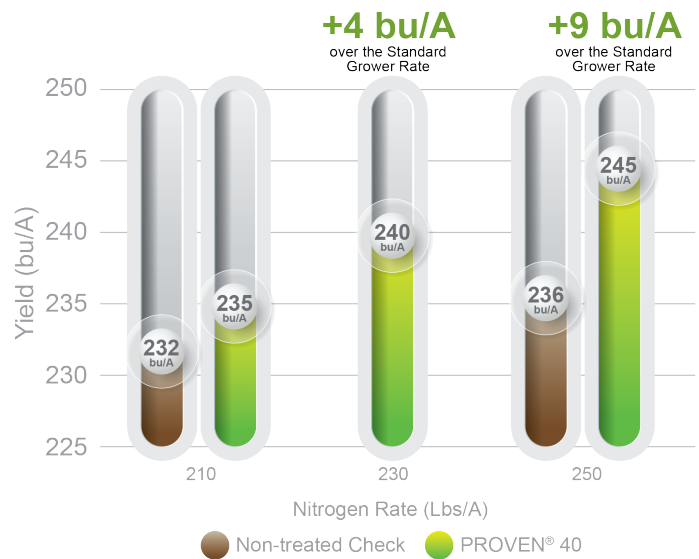
Yield Response

When the Standard Grower Rate of 250 Lbs./A of synthetic nitrogen was reduced by 20 Lbs./A, PROVEN® 40 replaced the synthetic nitrogen and increased corn yields by **+4 bu/A**.

When PROVEN® 40 was applied to the Standard Grower Rate of 250 Lbs./A, yields improved by **+9 bu/A**. PROVEN® 40 outperformed the Non-treated check at the 210 Lbs./A nitrogen application rate, and was only 1 bu/A less than the yield achieved with the Standard Grower Rate of 250 Lbs./A.

Similar results were observed in 2021 at this location with Pivot Bio PROVEN® (data not presented).

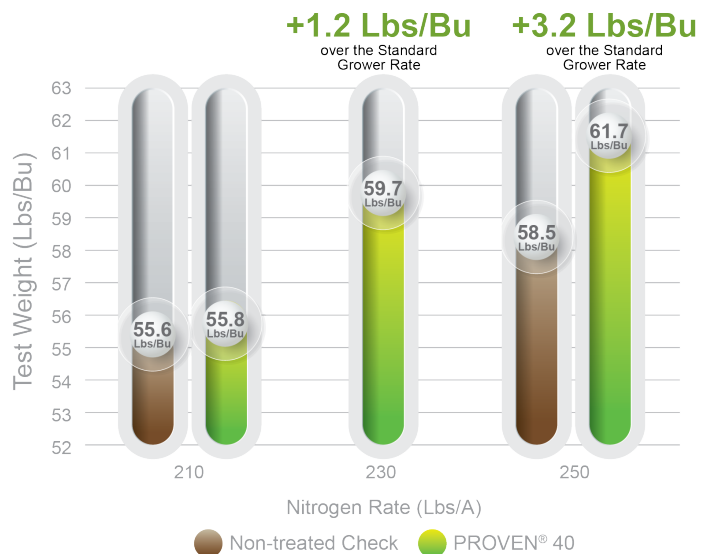
Corn Yield Response to Nitrogen and PROVEN® 40



Test Weight

When replacing 20 Lbs./A of synthetic nitrogen with PROVEN® 40, the test weight was **+1.2 Lbs./bu higher** than with the 250 Lbs./A Standard Grower nitrogen rate. When PROVEN® 40 was applied with the Grower Standard Rate, test weight was **+3.2 Lbs./bu higher**.

Corn Test Weight Response to Nitrogen and PROVEN® 40



Location

Tifton, Georgia

Protocol

This was a replicated small plot study conducted under irrigation at the University of Georgia research station near Tifton, Georgia. Five treatments were evaluated:

- 210 Lbs. Nitrogen/A (Non-treated check)
- 210 Lbs. Nitrogen/A + PROVEN® 40
- 230 Lbs. Nitrogen/A + PROVEN® 40
- 250 Lbs. Nitrogen/A + PROVEN® 40
- 250 Lbs. Nitrogen/A (Standard Grower Rate)

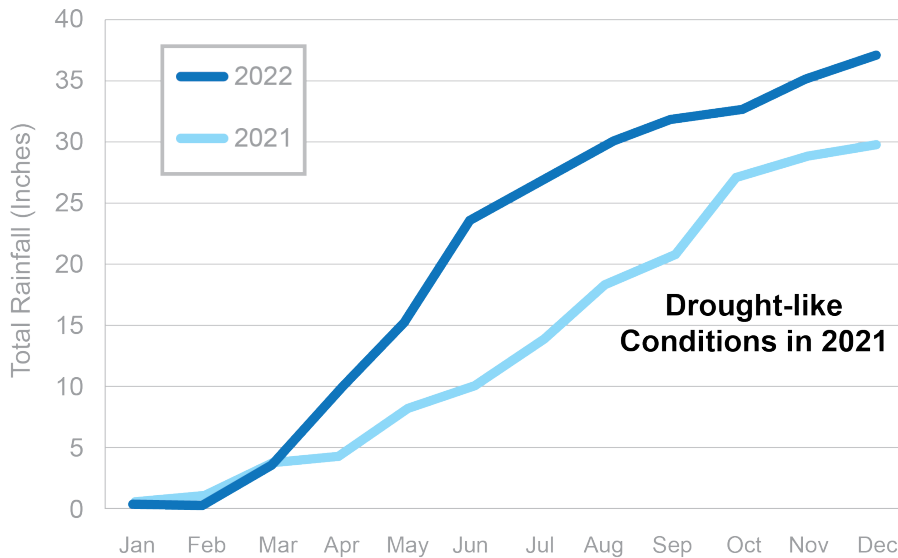


Strikingly Different Growing Conditions

for Pivot Bio PROVEN® 40 Evaluations in 2021 and 2022

Cumulative Rainfall 2021 and 2022

Ames, IA



Rain Conditions

The 2021 season experienced drought-like conditions, as illustrated in the chart. Drought conditions were severe enough in 2021 that abandonment of the research site was considered for several weeks.

The lack of precipitation in 2021 likely limited the ability of corn plants to fully benefit from the biomass and nutrient uptake advantages established with PROVEN® 40 OS.

Comparatively, growing conditions at this site in 2022 were much more ideal.

Protocol

This study was conducted near Ames, Iowa, in 2021 and 2022 using a replicated strip plot layout. Corn yields with and without PROVEN® 40 OS were compared at various nitrogen rates using two different hybrids each year.

- Non-treated check
- PROVEN® 40 OS

These treatments were tested across the following nitrogen rates:

- 2021
 - 0, 20, 40, 80, 120, 160 Lbs./A
- 2022
 - 0, 40, 80, 120, 160, 200 Lbs./A

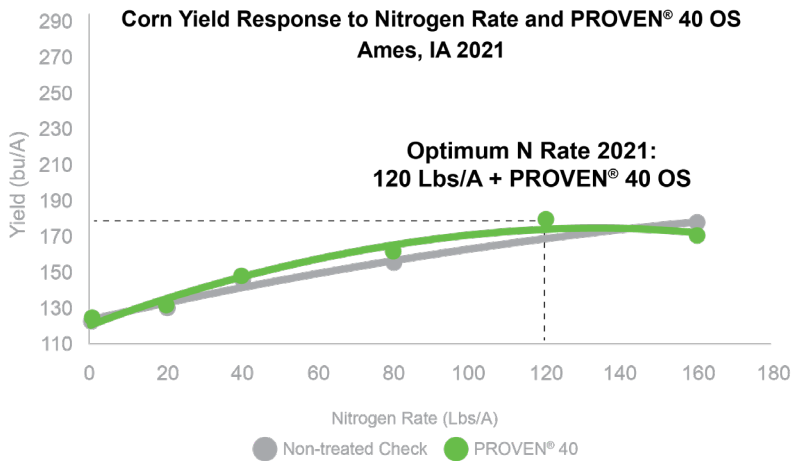
Details

- Soil Type: Clarion Loam
- Hybrid: 2021 - P1089AM, DKC59-82RIB, 2022 - P1082AM, DKC61-41RIB
- Fertilizer:
 - Surface BDC 150 Lbs./A
 - 0-0-60 + 100 Lbs./A Gypsum
 - 28% UAN banded 6-8 inches deep to establish treatments



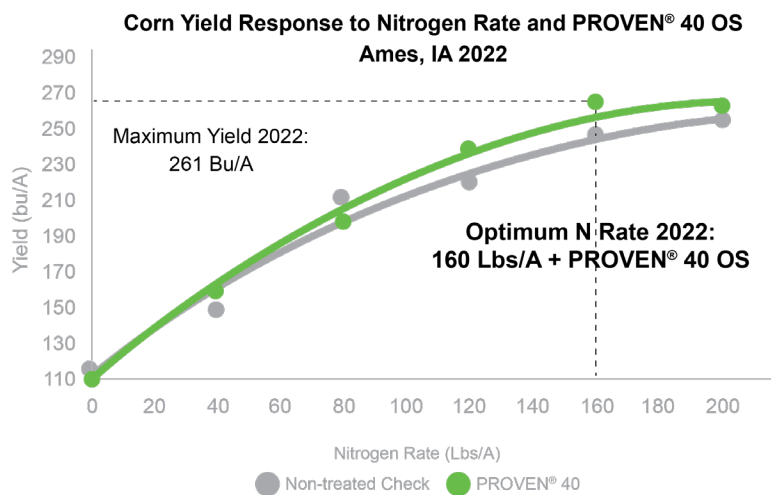
More Corn Produced With Less Nitrogen

Under Drought and Ideal Growing Conditions Using PROVEN 40® OS



Yield Response Across N Rates

In 2021, when drought conditions occurred, maximum corn yield of **180 bu/A** was achieved using **120 Lbs./A of nitrogen with Pivot Bio PROVEN® 40 OS**. This was similar to the corn yield achieved with 160 Lbs./A of synthetic nitrogen alone.



In 2022, when growing conditions were more ideal, the **160 Lbs./A nitrogen rate + PROVEN® 40 OS maximized yields** at 264 Bu/A, which was 9 Bu/A higher than with the 200 Lbs./A nitrogen rate commonly used by farmers in this region.

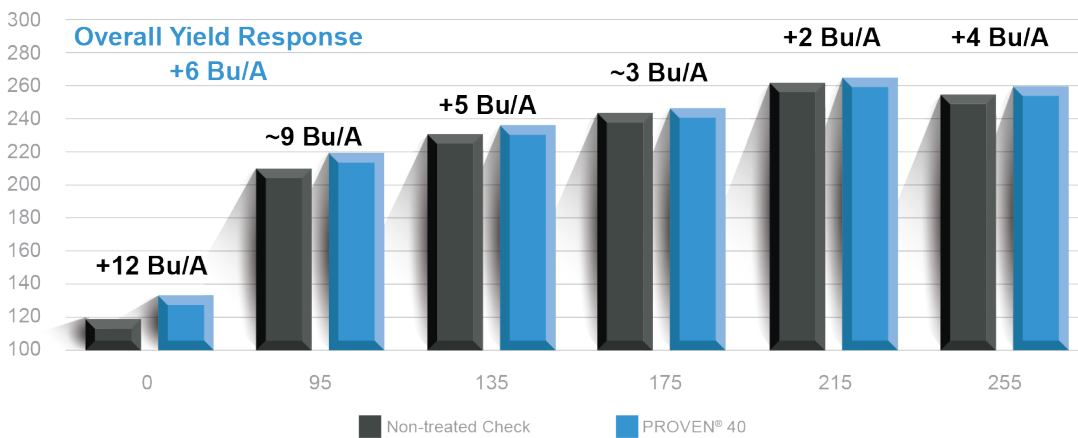
July 30, 2021 - VT/R1 Growth Stage



Corn Yields Reach New Heights

With PROVEN® 40 when Compared to Non-Treated Check

Pivot Bio PROVEN® 40 and Nitrogen Rate Effect on Corn Yield
2021 – 2022



Yield Performance Across Nitrogen Rates

Averaged over two years, corn treated with Pivot Bio PROVEN® 40 had numerically **higher yields across all nitrogen rates** compared to the non-treated check.

Averaged across nitrogen rates and years, Pivot Bio PROVEN® 40 increased corn yield **+6 Bu/A**. Yield response to Pivot Bio PROVEN® 40 was greater in 2021 than in 2022 (data not presented).

Protocol

This was a replicated large plot trial conducted near West Lafayette, Indiana, at Purdue University ACRE research farm. Pivot Bio PROVEN® 40 was compared to a non-treated check using six different nitrogen rates.

Treatments:

- Non-treated check
- Pivot Bio PROVEN® 40

Nitrogen Rates:

- 0 Lbs./A
- 95 Lbs./A
- 135 Lbs./A
- 175 Lbs./A
- 215 Lbs./A
- 255 Lbs./A

Details

- Soil Type: Silt Loam
- Hybrid: P1395AM
- Planting Date: April 28 (2021)
May 2 (2022)
- Plots: 30 x 100 feet. Split plot design with 8 replications.
- Seeding Rate: 31,000 seed/A (2021)
34,000 seed/A (2022)
- Nitrogen Application: 0–255 Lbs./A UAN coulters applied at V5 Growth stage.



Corn Yield Response

To PROVEN® 40 was Greatly Influenced by Soil Test Potassium Levels

Effect of Potassium Levels on Yield Response

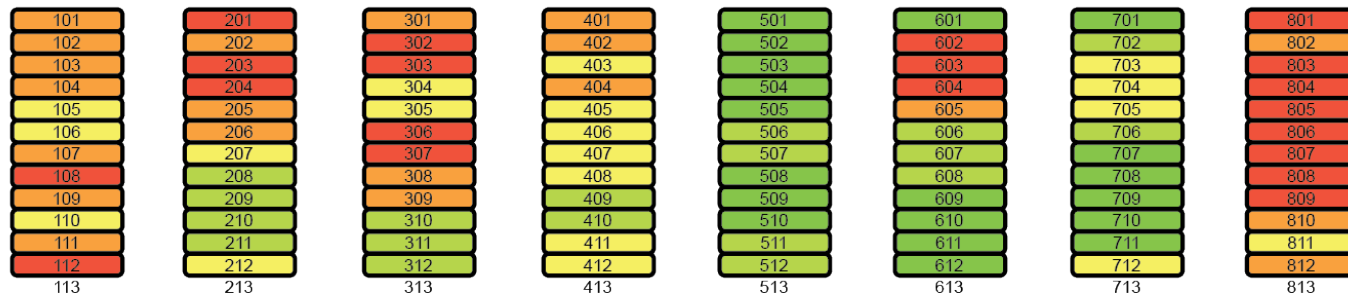
In 2021, corn yield response to PROVEN® 40 was greatly influenced by soil test potassium levels. In plots that ranged from 83 to 134 ppm soil test potassium, the yield response to PROVEN® 40 was +4.2 Bu/A

compared to +13.0 Bu/A in plots with potassium levels that ranged from 134 to 408 ppm.

Corn yield response to synthetic nitrogen is often limited by lack

of other critical nutrients. These results suggest that response to PROVEN® 40 can also be reduced when nutrients like potassium are not available in adequate quantities.

Potassium Level Variance Within Plots 2021



Values ranged from 83 to 408 ppm soil test potassium.

Effect of Soil Test Potassium Levels on Response to PROVEN® 40 in 2021		
	Soil Test Potassium Range (ppm)	
	83-134 (Low)	134-408 (high)
Number of Observations (n)	23	25
Soil Test Potassium Mean (ppm)	109	199
Yield Response to PROVEN® 40 (Bu/A)	+4.2	+13.0

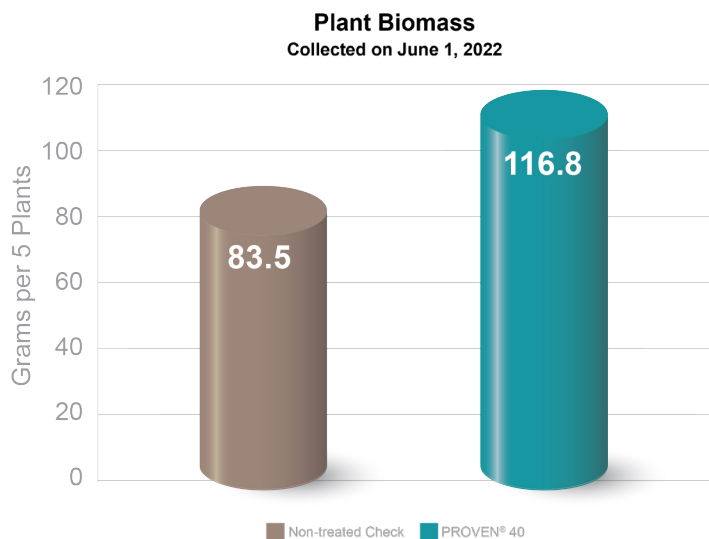
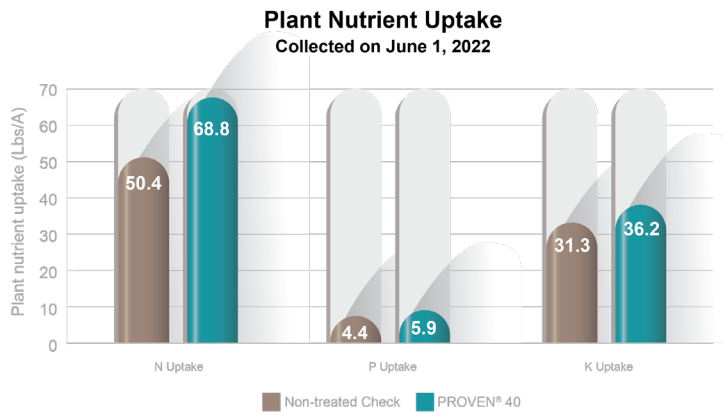


Increased Macronutrient Uptake

and Greater Plant Biomass with Pivot Bio **PROVEN® 40**

Impact of Treatments on Nutrient Content, Biomass and Uptake

Although not statistically significant, compared to the non-treated check, the use of **PROVEN® 40 produced greater N, P, and K uptake and greater plant biomass.** Plant tissue was collected on June 1, 2022.



Location

Mike Harris Farm
(near Roper, NC)

Protocol

This agronomic study was a split-plot design with four replications. The main plots consisted of the following treatments:

- Non-treated check
- PROVEN® 40

Within each main plot were five subplots of varying nitrogen rates. The five nitrogen rates were: 70, 110, 140, 180, and 200 pounds per acre.

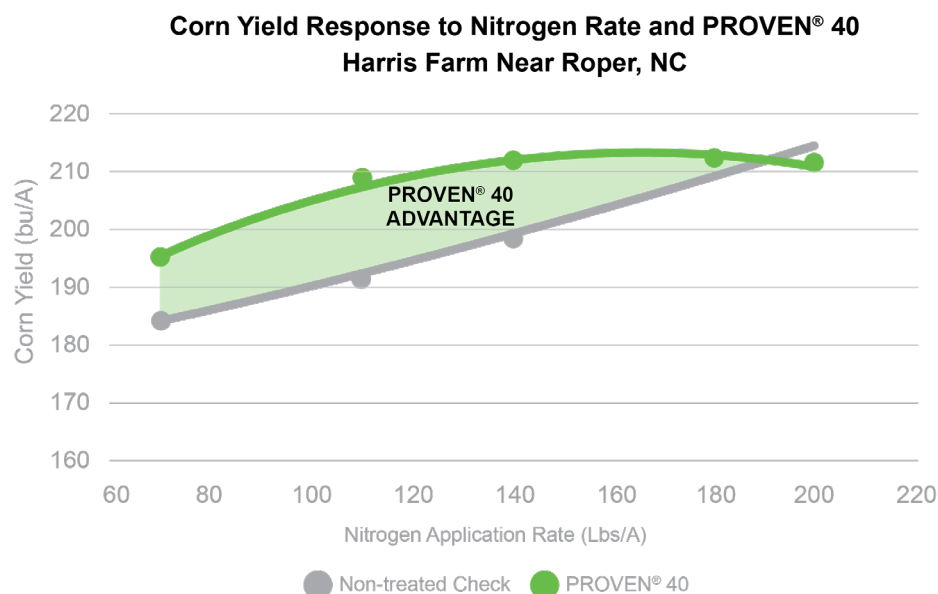
Details

- Soil Type: Roper Muck
- Hybrid: Pioneer 1847 YHR
- Planting Date: April 26, 2022
- Planting Method: Conventional tillage
- Plots: 30" rows, 40 ft long x 10 ft wide
- Seeding Rate: 33,000 seeds per acre
- Application: In-furrow at planting via Precision Planting FurrowJet® treatments
- Nitrogen Application:
 - 10-27-0 at 20 gal/ac at planting, 30% UAN broadcast at 15.6 gal/ac post plant, layby
 - 30% UAN applied at various rates for each nitrogen rate treatment.
- Harvest Date: September 14, 2022



Increased Corn Yields

Across a Large Range of Nitrogen Rates



Averaged over four replications, PROVEN® 40 replaced nitrogen and provided a yield advantage, specifically in treatments where the synthetic nitrogen rate applied was not meeting the demands of the crop.

The yield was greatly limited by drought at this location. PROVEN® 40 allowed corn plants to establish an early biomass and nutrient uptake advantage. Even under these water-limited conditions, **maximum corn yield was achieved with PROVEN® 40 using less nitrogen** than commonly used by growers.

*Drought was a key problem across the region in 2022. The dry period occurred over critical growth stages from V10 to R1 and would have had more impact on grain yield, except that irrigation was initiated with 1.5 inches of water applied.



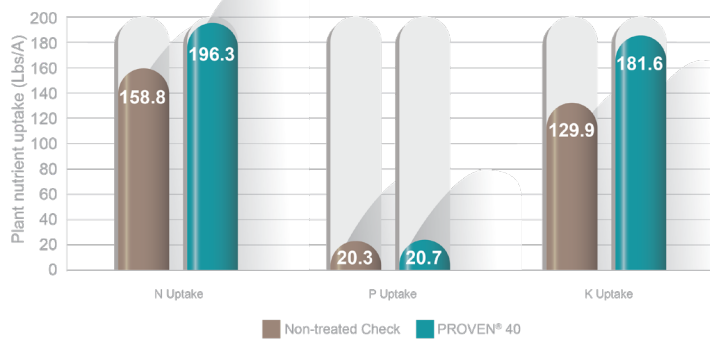
Greater N and K Uptake

Creates Greater Biomass

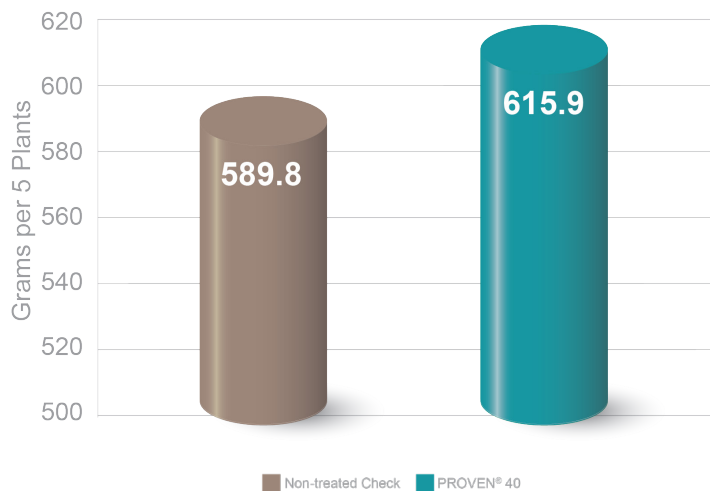
Impact of Treatments on Nutrient Content, Biomass and Uptake

Compared to the non-treated control, the use of PROVEN® 40 produced **greater N and K uptake**, primarily the result of **greater biomass**. The plant could not fully realize the value of this added growth and nutrient uptake due to drought conditions. Plant tissue was collected on July 5, 2022.

Plant Nutrient Uptake
Collected on July 5, 2022



Plant Biomass
Collected on July 5, 2022



Location

Peanut Belt Research Station
(outside Lewiston-Woodville, NC)

Protocol

This agronomic study was a split-plot design with four replications. The main plots consisted of the following treatments:

- Non-treated check
- PROVEN® 40

Within each main plot were five subplots of varying nitrogen rates. The five nitrogen rates were: 70, 110, 140, 180, and 200 pounds per acre.

Details

- Soil Type: Lynchburg sandy loam
- Hybrid: Pioneer 1847 YHR
- Planting Date: April 20, 2022
- Planting Method: Conventional tillage
- Plots: 30" rows, 40 ft long x 10 ft wide
- Seeding Rate: 33,000 seeds per acre
- Application: In-furrow at planting via Precision Planting FurrowJet® treatments
- Nitrogen Application:
 - 10-27-0 at 20 gal/ac at planting, 30% UAN broadcast at 15.6 gal/ac post plant, layby
 - 30% UAN applied at various rates for each nitrogen rate treatment.
- Harvest Date: September 16, 2022

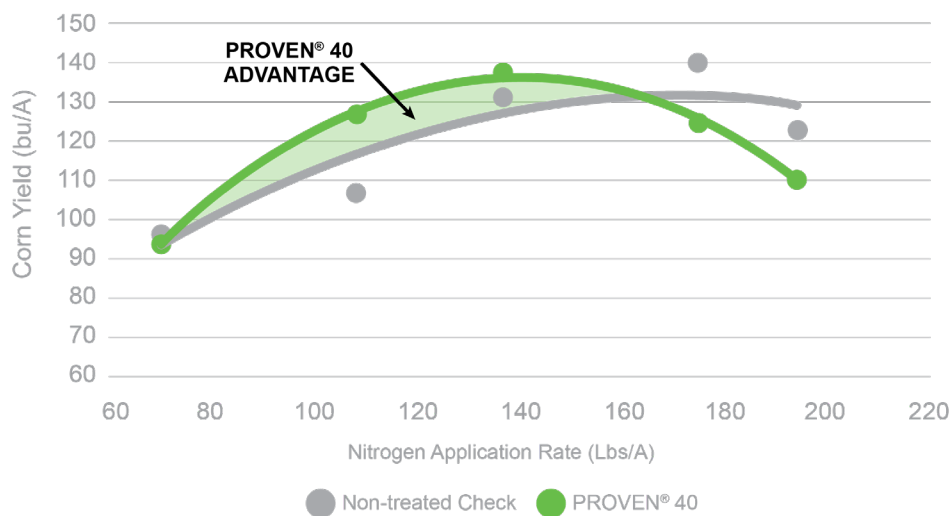




Maximum Yields Achieved

with Pivot Bio PROVEN® 40 Using Less Nitrogen

Corn Yield Response to Nitrogen Rate and PROVEN® 40
Peanut Belt Research Station



Averaged over four replications, PROVEN® 40 replaced nitrogen and provided a yield advantage, specifically in treatments where the synthetic nitrogen rate applied was not meeting the demands of the crop.

The yield was greatly limited by drought at this location. PROVEN® 40 allowed corn plants to establish an early biomass and nutrient uptake advantage. Even under these water-limited conditions, **maximum corn yield was achieved with PROVEN® 40 using less nitrogen** than commonly used by growers.

*Drought was a key problem across the region in 2022. The dry period occurred over critical growth stages from V10 to R1 and would have had more impact on grain yield, except that irrigation was initiated with 1.5 inches of water applied.



The information in this booklet was gathered by independent, third-party organizations conducting research on Pivot Bio PROVEN® 40.

For questions, please call:

877-451-1977



This report and the data provided herein is for information purposes only and DOES NOT constitute an endorsement or recommendation by any university or third party identified herein for the use of Pivot Bio products.

Product performance will vary and depend on weather, soil, and other farming conditions. We encourage all growers to discuss optimal use with sales representatives and agronomists.