In-plant Nitrogen Study

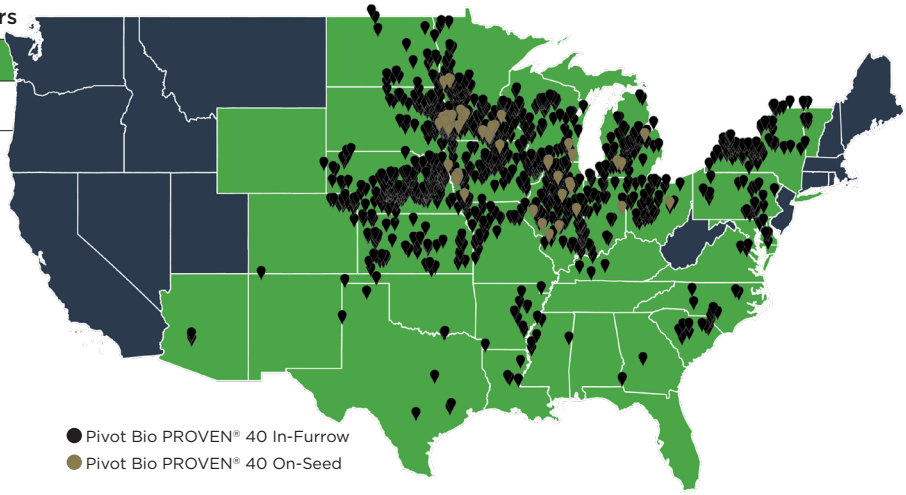
LARGEST SINGLE SEASON DATA COLLECTION

Pivot Bio has led the marketplace with focus and investments made to measure the performance of Pivot Bio PROVEN® 40. Starting in 2020, Pivot Bio diligently began collecting data from growers' farms. **More than 1.3 million data points** have been collected and analyzed this season alone, validating the nitrogen advantage PROVEN® 40 provides.

Figure 1 | Location of Participating Growers

Growers	Fields	States
>1,400	>2,400	34

Data available as of August 18, 2022.



Measuring the Pivot Bio PROVEN® 40 Nitrogen Advantage

During the 2022 growing season, Pivot Bio visited over 2,400 fields to take in-field measurements. In side-by-side on-farm tests comparing PROVEN® 40 In-Furrow and On-Seed to grower standard practice, agronomists used industry-standard chlorophyll meters and plant biomass readings to measure plant nitrogen status, immediately demonstrating to growers the nitrogen advantage delivered by PROVEN® 40.

Testing Protocol

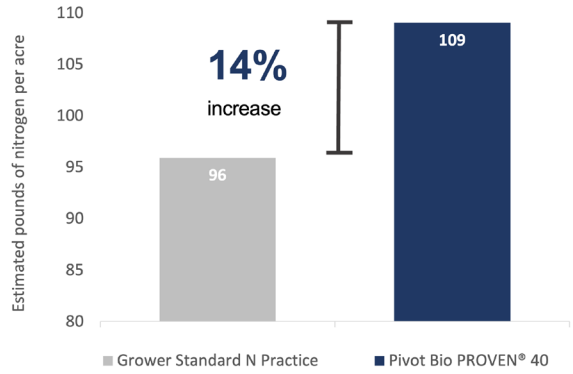
The testing protocol is intended to compare relative nitrogen status of plants in two sections of a field, for example, a section where PROVEN® 40 was applied and a section where it was not. Plants were sampled from each section of the field by cutting the corn stalks flush with the soil surface. Plants in each section were the same hybrid, had the same planting date, and were on similar soil types and elevations. Plant above ground biomass was measured using a standard, calibrated scale. The chlorophyll concentration of the uppermost collared leaf was measured if the plant had not tasseled. Chlorophyll was measured in the leaf below and opposite of the primary ear if the plant had a tassel.

Growing Conditions

It is important to note the general weather conditions experienced across the United States corn belt this growing season. Spring precipitation was near- to above-normal across the Midwest. Most areas received 75-125% of normal precipitation and the upper Midwest received over 150% of normal precipitation (NOAA, 2022). Temperatures throughout the 2022 growing season (March–June 2022) were slightly above the 100-year average in the primary corn and soybean belt (Climate at a Glance, 2022).

The study highlights the predictability of PROVEN® 40. The rainy conditions experienced this spring magnify the benefits of microbes that adhere to the roots of plants versus the unpredictability of synthetic nitrogen.

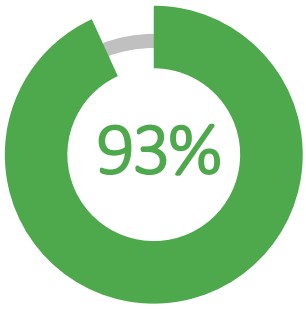
Figure 2 | In-Plant Nitrogen Levels



The Pivot Bio PROVEN® 40 Nitrogen Advantage

PROVEN® 40 treated corn plants had an estimated 14% more nitrogen than plants with grower standard nitrogen management practices.

Figure 3 | Pivot Bio PROVEN® 40 Win Rate



A win is defined as a field visit where the nitrogen levels of plants treated with Pivot Bio PROVEN® 40 are within 3%, or greater, of plants managed with grower standard practice.

The Pivot Bio PROVEN® 40 Nitrogen Win Rate

In side-by-side comparisons, 93% of field visits showed an increase in plant nitrogen levels when PROVEN® 40 was applied compared to the grower standard nitrogen management practice. Plants treated with PROVEN® 40 On-Seed had the same in-plant nitrogen advantage as plants treated with PROVEN® 40 In-Furrow.

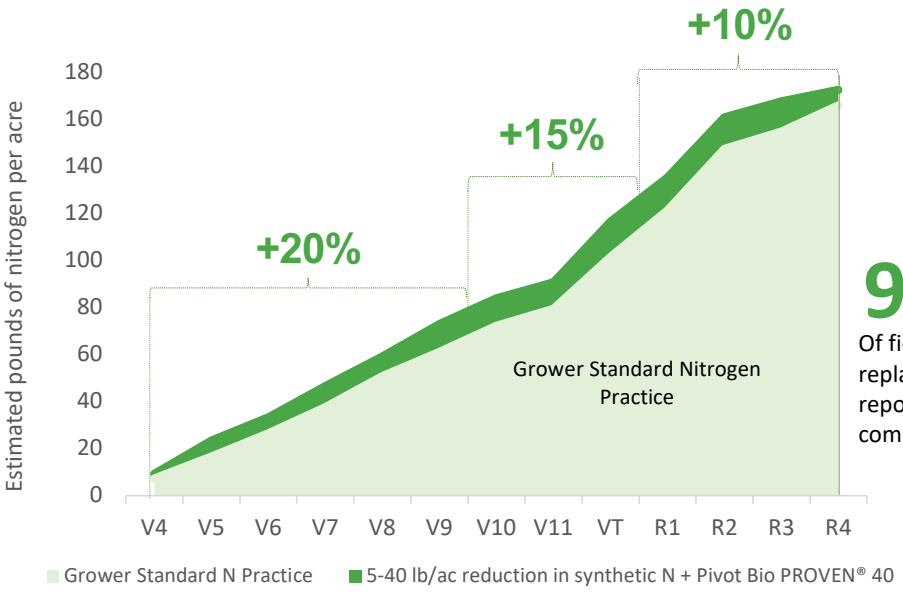
A Better Form of Nitrogen All Season Long

Fields where synthetic nitrogen was replaced (5-40 lbs./ac) with PROVEN® 40 had 13% more in-plant nitrogen. **This performance provides growers with confidence they can replace synthetic nitrogen. PROVEN® 40 will not only cover the synthetic nitrogen replaced, it will also provide an additional cushion of (on average) 13% more nitrogen.**

The PROVEN® 40 nitrogen advantage begins in the early stages of growth (V4-V10) when the linear phase of corn nitrogen uptake begins. PROVEN® 40 plants had 20% more nitrogen during this growth phase compared to plants with the grower standard practices.

Once the reproductive growth stages are reached (R1-R4), plants with PROVEN® 40 have an estimated 10% increase in pounds of nitrogen per acre. This 10% increase in nitrogen is above and beyond the 5-40 lbs. of synthetic already replaced by the microbes.

Figure 4 | Pounds of Nitrogen Per Acre by Growth Stage



94.6%

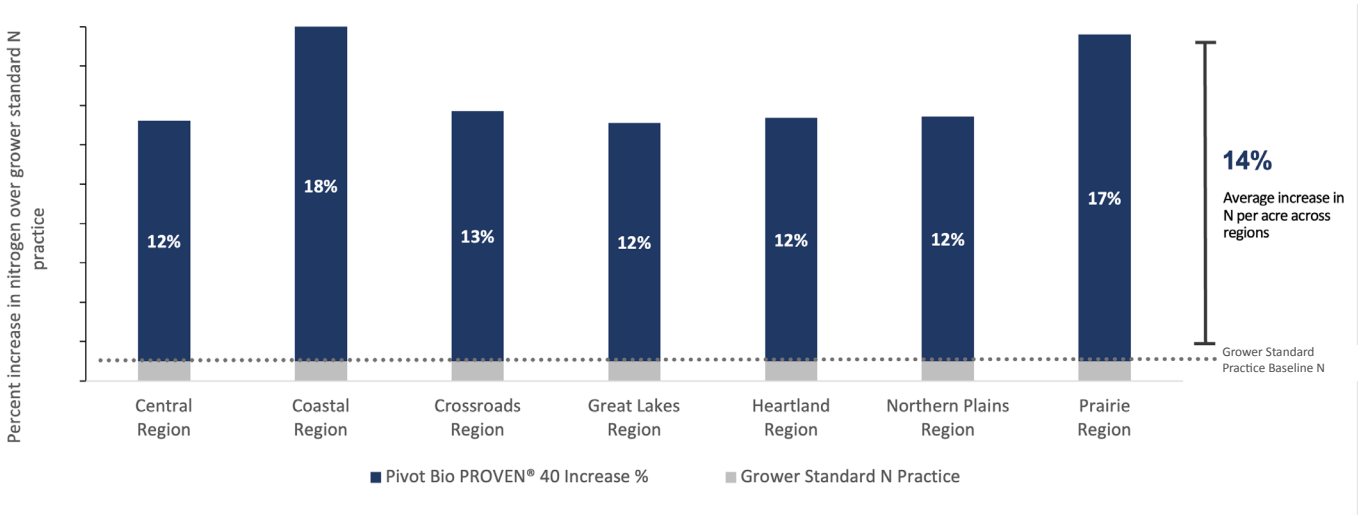
Of field visits where synthetic nitrogen was replaced (5-40 lbs./ac) with PROVEN® 40, reported an increase in plant nitrogen levels compared to grower standard N practice.

Figure 4 data represents 1,260 field visits where 5-40 lbs./ac of synthetic nitrogen was replaced with Pivot Bio PROVEN® 40.

Pivot Bio PROVEN® 40 Is a More Predictable, More Productive Form of Nitrogen

Growing conditions are diverse across all corn growing regions. Pivot Bio PROVEN® 40 has consistently increased the level of nitrogen in the plant, on average, by 14% across all regions where data was collected in 2022.

Figure 5 | In-Plant Nitrogen Advantage by Pivot Bio Regions

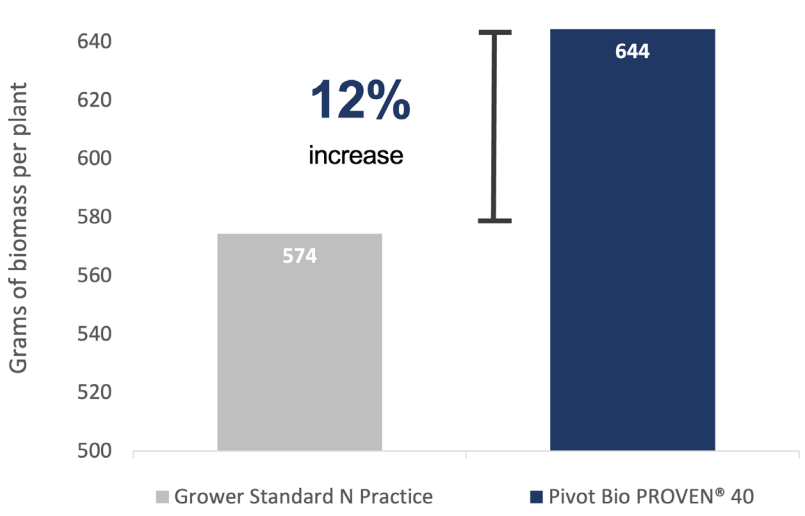


Why Biomass Matters

It is well documented and understood that nitrogen is critical to producing a healthy, productive crop. Nitrogen application generally increases biomass, grain yield, and kernel protein content in corn (Zhang et al. 1993; McCullough et al. 1994; Ma and Dwyer 2001). Biomass is considered a good measure of plant health because it reflects the amount of sunlight, water, and minerals a plant can capture and turn into plant mass. By measuring plant biomass in-season, growers can be confident that nitrogen availability is not a limiting factor for plant growth well before harvest begins.

Biomass test results from the 2022 season have consistently shown that PROVEN® 40 treated plants have more biomass compared to grower standard practices. This demonstrates that the microbes are supplying nitrogen to the crop, resulting in healthier, greener plants that accumulate carbohydrates. PROVEN® 40 consistently increases the average plant biomass compared to the untreated acres, giving the plant greater potential when it comes to grain production.

Figure 6 | In-Plant Biomass Levels



Why Chlorophyll Matters

Nitrogen is closely associated with leaf chlorophyll; thus, the chlorophyll concentration of leaves provides important information about the nitrogen status of the corn plant. Chlorophyll is what gives plants their green color. The primary function of chlorophyll is radiation absorption, which provides energy essential for photosynthesis. Because the majority of leaf nitrogen is contained in chlorophyll molecules, there is a close link between leaf chlorophyll content and leaf nitrogen content (Yoder and Pettigrew-Crosby, 1995).

Chlorophyll concentration in plant leaves is typically expressed in units of quantity per area of leaf surface, micromoles per square meter (umol m^2). In this study, Pivot Bio PROVEN® 40 treated plants have 7% higher levels of chlorophyll compared to grower standard practices, enabling plants to create oxygen and simple sugars through photosynthesis and support the plant through critical stages of development.

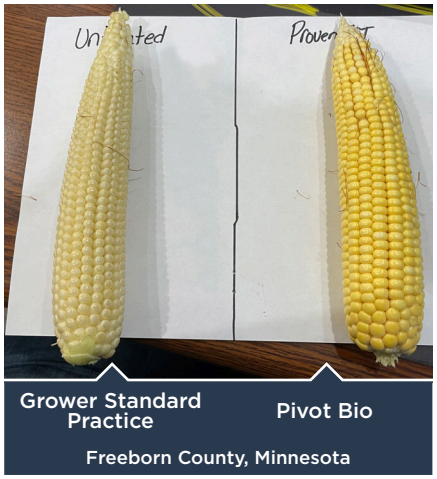
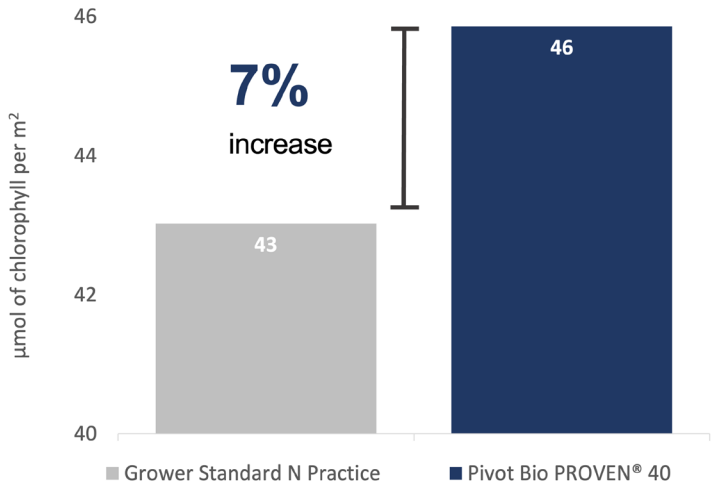


Figure 7 | Leaf Chlorophyll Levels



Scan the QR code to watch a short testing demonstration video.