CAN PROVEN REDUCE CORN NITROGEN REQUIREMENT IN MINNESOTA?

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ABSTRACT

ProveN is a microbial product applied in-furrow with the goal of reducing the total amount of nitrogen fertilizer needed for corn (*Zea mays* L.). Four field trials were established over two growing seasons in Minnesota to evaluate corn response to nitrogen with and without ProveN applied at planting on the seed. Nitrogen was applied as urea prior to planting at three locations and split applied with 1/3 of the total rates of nitrogen applied at -planting, at V4, and V8 growth stages at one irrigated location. ProveN was applied at suggested rates with the planter directly on the seed at planting. Corn plant mass at V5 and R1, corn nitrogen uptake, and corn grain yield was always affected by nitrogen rate. V5 and R1 corn plant mass was not affected by ProveN or it's interaction with nitrogen rate. Only one of the four field trials showed a yield response to ProveN. In 2020, the Waseca plots with ProveN yielded more than their counter parts without the microbe. Maximum yield was also achieved with 30 lbs. N ac^{-1} less with ProveN. ProveN can have an impact on corn growth but may not reduce the rate of N required by corn across all locations, and benefits may be specific to soil types and specific environmental conditions.

MATERIALS AND METHODS

Four field trials were established at four different University of Minnesota research and outreach centers over three years. Lamberton (2019), Rosemount (2019), Becker (2020), and Waseca (2020). Sixteen treatments were arranged in a strip plot design, consisted of two factors (nitrogen and ProveN), and were replicated six times. Nitrogen applications weren't the same for all sites. Application methods and amounts were altered depending on University of Minnesota nitrogen guidelines for that region. In 2019, nitrogen was applied before planting as urea at eight different rates (0, 50, 100, 150, 175, 200, 225, and 275 lbs. nitrogen per acre). ProveN was applied directly to the seed at planting at a rate of 5 gallons per acre (GPA). The liquid solution contained either 0 or 67 (2019) or 12.8 (2020) oz of ProveN mixed in deionized water and applied at a total rate of 5 GPA of water/ProveN mixture. In 2020, nitrogen was split applied at planting, V4, and V8 for Becker and nitrogen at Waseca was applied before planting. The nitrogen rates changed to 0, 100, 175, 200, 212.5, 225, 250, and 300 lbs. N per acre for Becker and 0, 50, 100, 125. 137.5, 150, 200, and 250 lbs. N per acre for

Waseca. Triple superphosphate and potassium sulfate were applied at none limiting rates to supply all phosphorus, potassium, and sulfur needs.

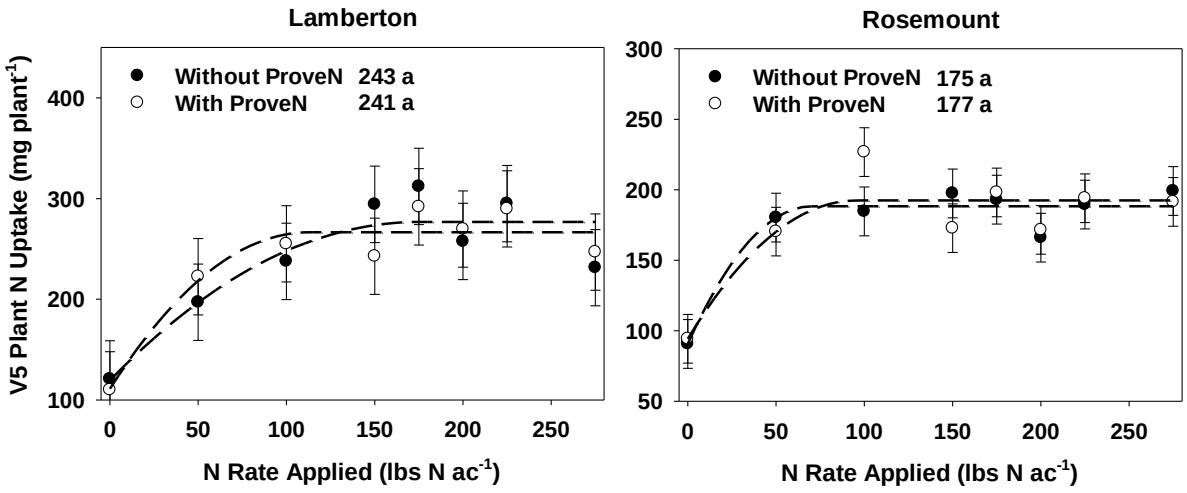
Whole plant samples were collected by sampling six plants at the ground level from non-harvest rows at the V5-V6 and R1 growth stages. Plant samples were dried at 95ºF, weighed, ground, and analyzed for total N concentration by dry combustions analysis with a Leco. Corn grain yield was determined by harvesting the middle two rows using a research grade plot combine. Corn grain yield is reported adjusted to 15.5% grain moisture.

Statistical analysis was conducted in SAS using the GLIMMIX procedure. Analysis was conducted considering the fixed effects of N fertilizer rate and ProveN application, and random blocking effects for each location. Data presented in subsequent tables may include LS means values which are adjusted for missing values and covariance structure within the dataset. The model selected was determined using AIC values from the statistical output. When possible, the simpler model was favored when analyzing and presenting data.

RESULTS AND DISCUSSION

The main effect of N rate was always significant. The main effect of ProveN was only significant for grain yield at Waseca. Nitrogen rate by ProveN interaction was never significant which indicates that nitrogen effects did not vary whether ProveN was or was not used.

Both N uptake in individual plants along with total N uptake, calculated in lbs. N per acre considering plant population, were assessed but did not differ in how both main effects affected either N uptake. Therefore, only individual N uptake by the plants is summarized. Plant N uptake was highly related to plant mass and was not impacted using ProveN. Since N requirement is generally low through V5 small differences in uptake of N when ProveN was applied may not be detectable. The uptake of N was affected by a slightly higher N application rate which demonstrates luxury uptake of N by the corn crop at V5.



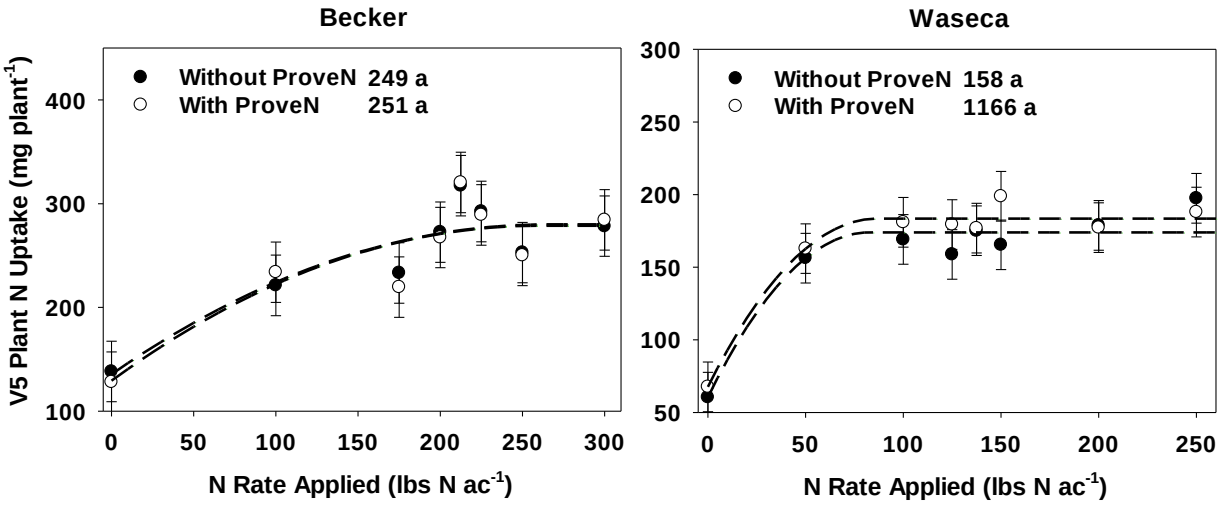
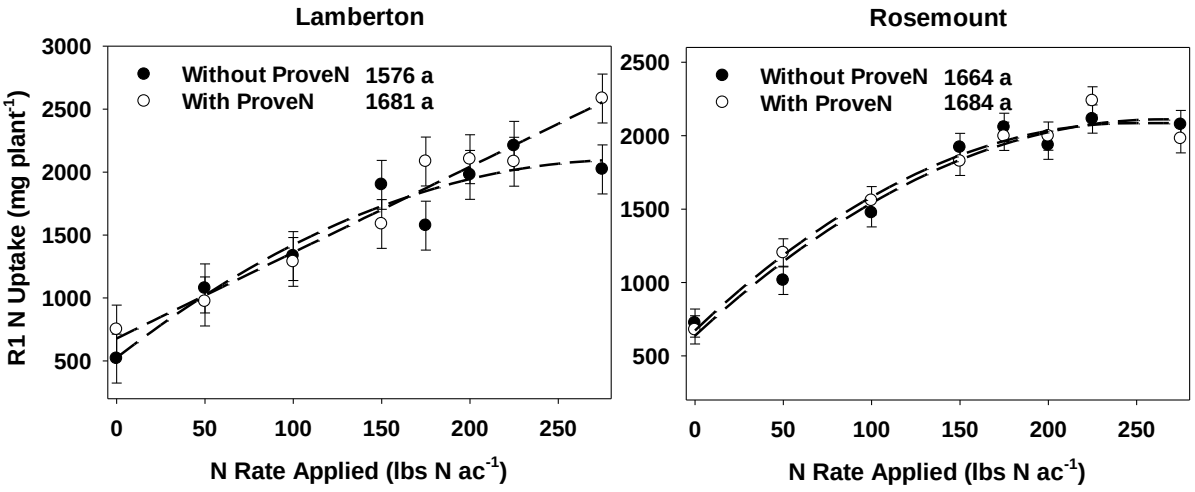


Figure 1. Summary of the impacts of N rate and ProveN on individual corn plant nitrogen uptake at the V5 growth stage.

Uptake of N was maximized by the highest rate of N applied but typically increased up to that point. ProveN did not impact R1 N uptake nor was there an interaction between N rate and ProveN even though the curves did appear to separate around the highest rates of N applied at Waseca.



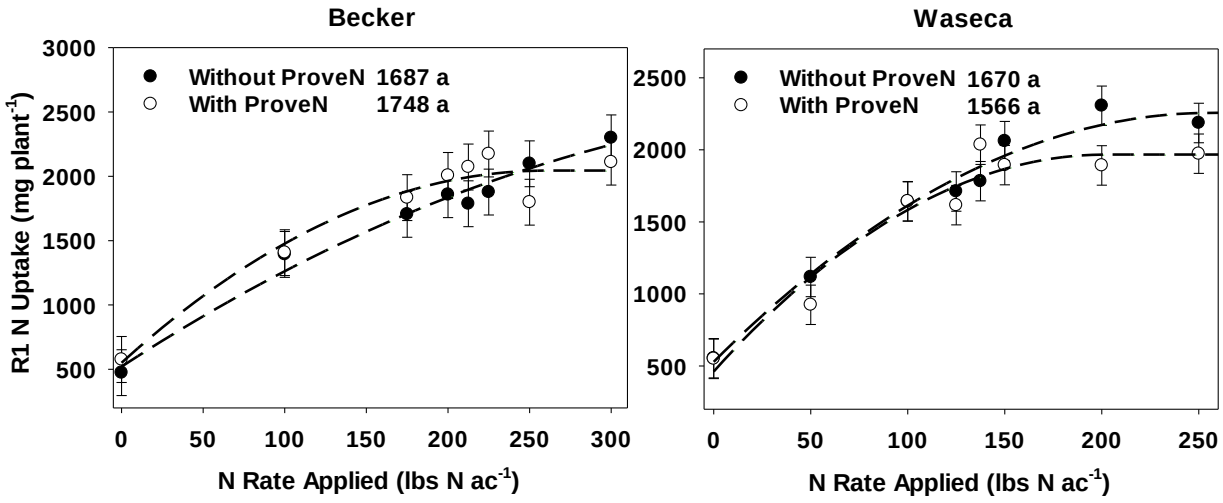
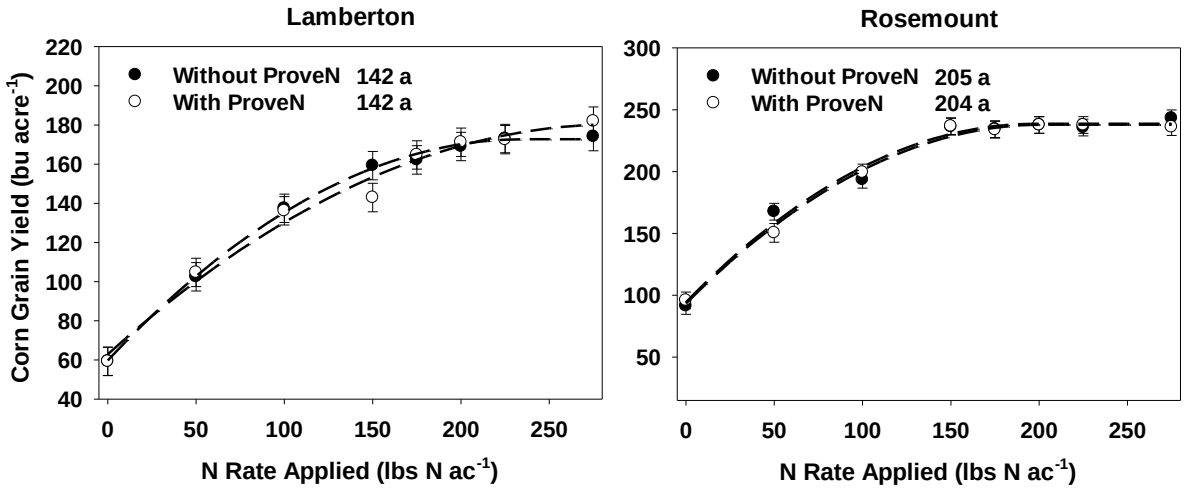


Figure 2. Summary of the impacts of N rate and ProveN on individual plant nitrogen uptake at the R1 growth stage.

Corn grain yield was impacted by N rate at all four locations (Figure 3). Corn grain yield response was similar when ProveN was and was not applied at Becker, Lamberton, and Rosemount. Although means separation indicated little difference in N rates greater than 200 lbs. At Waseca, corn grain yield was maximized with roughly 210 lbs. of N without ProveN while grain yield was maximized with 180 lbs. of N with ProveN which is a 30 lbs. reduction in the N required for maximum grain yield. The amount of N needed to reach maximum yield was more than suggested by current guidelines. Higher N requirement has been more common with soils at Waseca which are very poorly drained and tend to denitrify. Corn grain yield was 9 bu/ac greater with ProveN at Waseca but given enough N is applied, yield could be maximized with fertilizer alone.



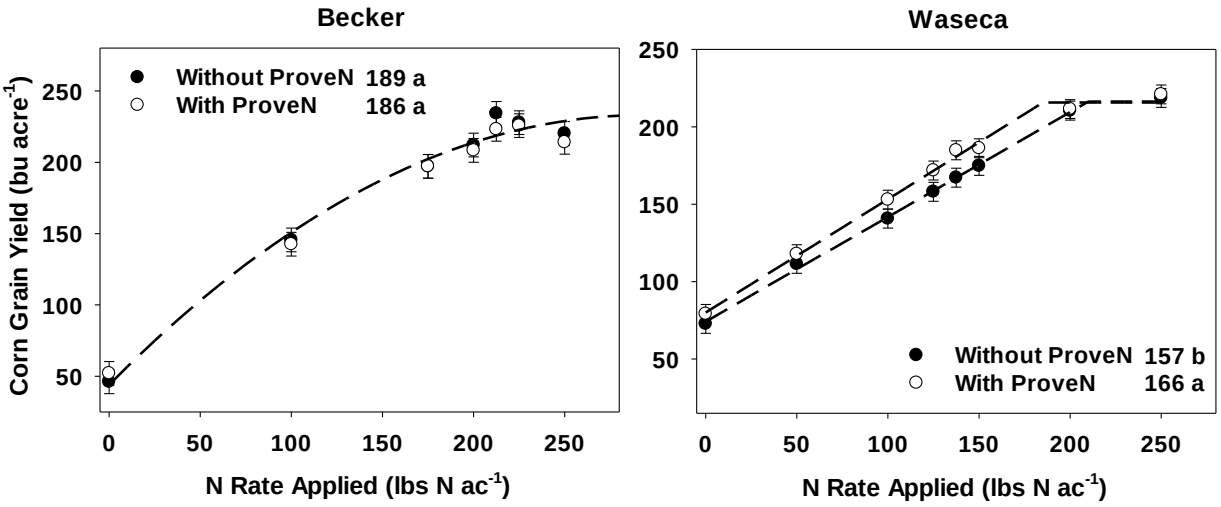


Figure 4. Summary of the impacts of N rate and ProveN on corn grain yield reported at 15.5% moisture.

Overall, ProveN did not increase corn N uptake at early vegetative and reproductive growth stages and only reduced the amount of N needed to maximize grain yield at one location. The plan for 2021 is to follow up with an additional site at Waseca and a site at Morris on a very poorly drained soil. This is to determine whether ProveN may work better for tougher soils which seem to need more N and more consistently respond to side-dress N because of poor drainage. Nitrogen fertilizer rates were adjusted for the 2021 locations to better match optimum N rates determined by research plots at the Waseca and Morris locations instead of using rates suggested by the current U of M guidelines.