Tall and Short Stature Corn Agronomic Response to Nitrogen Rates

Trial Objective

- The optimum nitrogen (N) rate for corn can be difficult to determine, as different products can require different amounts of N. Inadequate N can cause a noticeable reduction in yield, whereas excess N can cause weak stalks and water quality risks.
- Short stature corn (SSC) is a new corn breeding innovation that will be part of the Preceon™ Smart Corn System set to launch in the United States within the next few years. SSC is intended to provide high-yielding corn with a shortened internode (the area between leaves), resulting in shortened corn height. Short stature corn will typically have a maximum height of seven feet and corn ear placement of at least two feet above the soil level.
- The reduced height of SSC is expected to decrease green snap and stalk lodging issues.
- The objective of this trial was to evaluate the effects of N rate on three commercially available corn products and three short stature corn (SSC) products.

Experiment/Trial Design

Location	Soil Type	Previous Crop	Tillage Type	Planting Date	Harvest Date	Potential Yield (bu/acre)	Seeding Rate (seeds/acre)
Gothenburg, NE	Hord Silt Loam	Corn	Strip-till	05/3/2023	10/19/2023	250	36,000

- The trial design was a split-plot with N fertilizer as the whole plot and corn product as the subplot, with four replications.
- A total of six N rates and six corn products were selected for this trial.
  - » N rates: 0, 60, 120, 180, 240, and 300 lb/acre
- Three tall corn products of 113 relative maturity (Tall-A, Tall-B, and Tall-C), and three short stature corn products of 110 to 113 relative maturity (SSC-A, SSC-B, and SSC-C) were evaluated.
- The nitrogen fertilizer used was 32-0-0 and was applied using the 360 Y-DROP® fertilizer tube attachments on 06/14/2023.
- Weeds were uniformly controlled with herbicides and no other pesticides were applied.
- Plant heights were measured at the R4 to R5 growth stage.
- Ear height, plant lodging, nitrogen stress, intactness, drought, and stay green ratings were collected close to harvest time.
- Plots were combine-harvested and total plot weight, test weight, and moisture measurements were collected.
- The grain yield was corrected to a standard moisture content of 15%.

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Understanding the Results

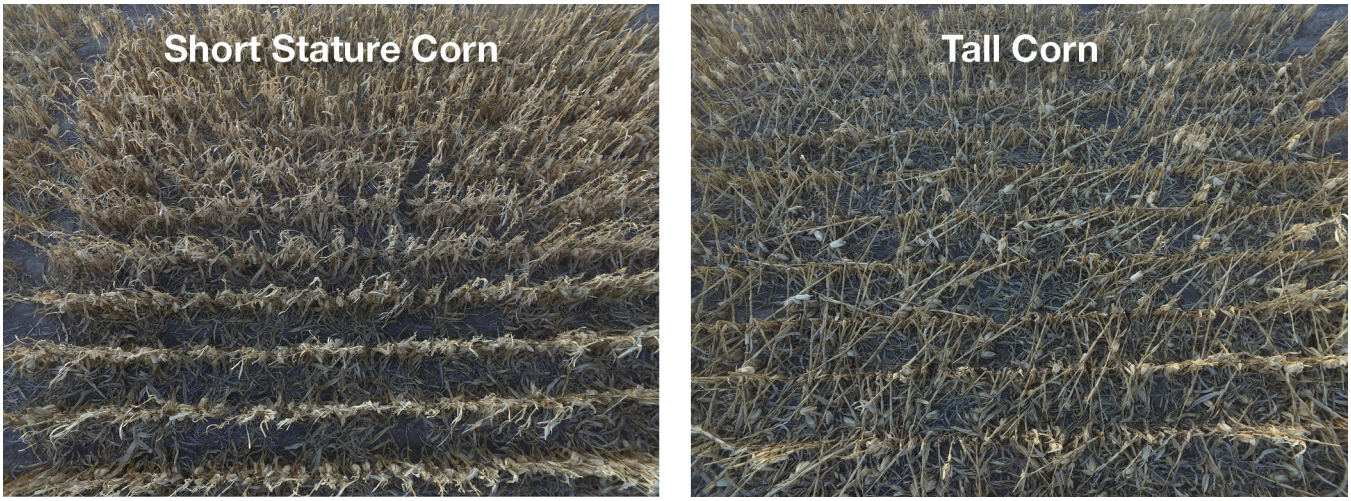

Figure 1. Plant lodging on short and tall stature corn. Pictures were taken on 11/15/2021 at the Water Utilization Learning Center in Gothenburg, Nebraska.

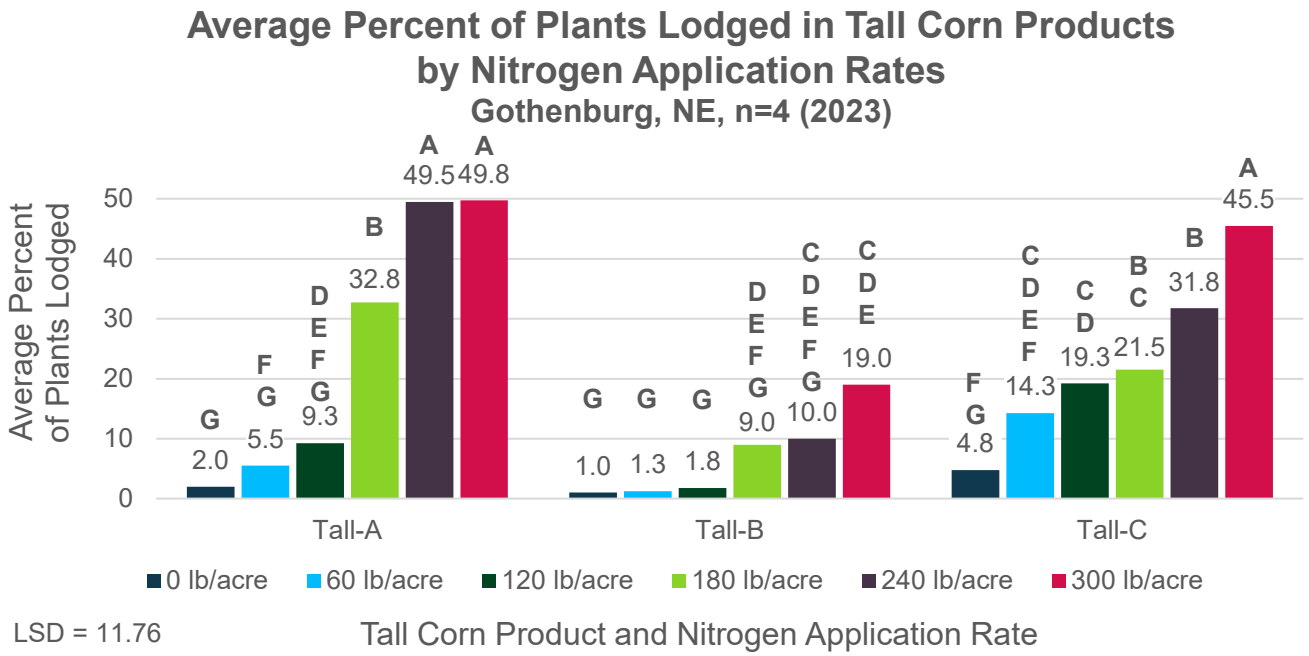

Figure 2A. Average rate of lodging by nitrogen treatment and corn product for tall products tested in Gothenburg, NE in 2023. Letters indicating statistical significance apply to Figures 2A and 2B.

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- Lower nitrogen rates (0 to 120 lb/acre) resulted in reduced lodging for products Tall-A and Tall-B (Figure 2A).
- Lodging increased with higher nitrogen rates (180 to 300 lb N/acre), though the 180 lb/acre N treatment was not statistically different from 60 or 120 lb/acre in product Tall-C (Figure 2A).
- Nitrogen treatments had less of an effect on lodging in product Tall-B than they did on the other tall products, though the 300 lb/acre nitrogen rate still produced a significantly higher percentage of lodged plants in Tall-B (19%) than the 0 lb/acre nitrogen rate (1%) (Figure 2A).

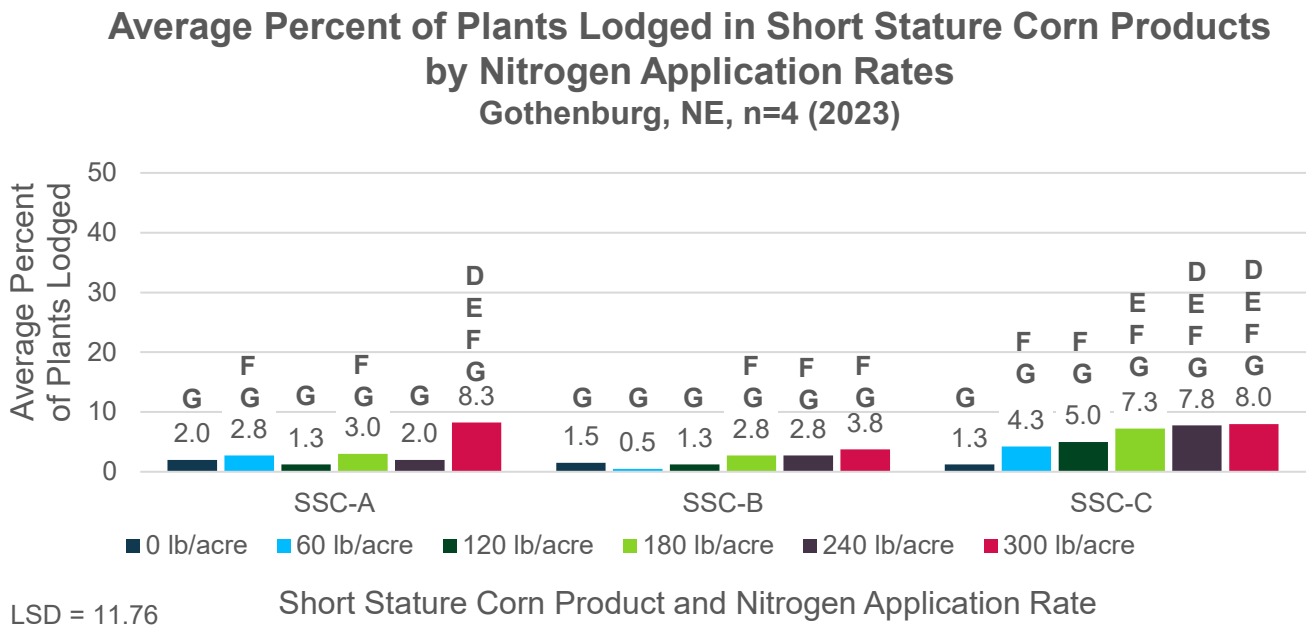

Figure 2B. Average rate of lodging by nitrogen treatment and corn product for short products tested in Gothenburg, NE in 2023. Letters indicating statistical significance apply to Figures 2A and 2B.

- In SSC products, no statistical difference was found between treatments regardless of nitrogen rate or product (Figure 2B).
- Lodging in all short corn products (Figure 2B) across all nitrogen rates (0 to 300 lb/acre) was not statistically different from all tall products (Figure 2A) within the 0 to 120 lb N/acre range.
- The 300 lb/acre nitrogen treatment did not produce significant differences in lodging between the Tall-B product (Figure 2A), the SSC-A product, and SSC-C product (Figure 2B).

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Table 1. Corn parameters of nitrogen stress, intactness, drought, and stay green ratings organized by corn product.

Corn Product	Nitrogen Stress (1–9)	Intactness (1–9)	Drought (1–9)	Stay Green (1–9)	Plant Height (in.)	Ear Height (in.)
Tall-A	6.0 a	5.2 b	4.0 bc	5.9 a	—	—
Tall-B	6.2 a	4.1 d	4.1 b	5.8 a	—	—
Tall-C	5.7 a	6.0 a	4.7 a	5.9 a	—	—
SSC-A	4.0 c	5.0 b	3.2 d	3.3 c	82 a	37.9 a
SSC-B	4.6 b	4.5 c	3.5 cd	3.5 c	62 c	23.9 c
SSC-C	5.0 b	5.3 b	3.6 bcd	4.3 b	74 b	31.2 b

The characteristic rating scale runs from 1-9; 1 to 2 is excellent, 3 to 4 is good, 5 to 6 is average, 7 to 8 is fair, and 9 is poor.
Numbers followed by letters indicate statistical difference at α = 0.1.

- Tall products showed greater nitrogen stress compared to short stature products (Table 1).
- In general, tall products showed greater drought stress compared to short stature products, except SSC-C which showed similar drought stress to Tall-A and Tall-B (Table 1).
- Short stature products had greater stay green than tall products (Table 1).
- There was a strong correlation between plant height and ear height (R2 = 0.99) for short stature corn products. SSC-A produced the largest average ear height (37.9 inches), followed by SSC-C (31.2 inches), and SSC-B produced the smallest average ear height (23.9 inches) (Table 1).

Table 2. Corn parameters of nitrogen stress, intactness, drought, and stay green ratings organized by nitrogen application rates.

Nitrogen Rates (lb/acre)	Nitrogen Stress (1–9)	Intactness (1–9)	Drought (1–9)	Stay Green (1–9)
0	4.2 d	4.2 d	3.4 de	3.8 c
60	4.8 bc	4.3 d	3.0 e	4.1 c
120	4.7 cd	4.8 c	3.6 cd	4.2 c
180	5.3 b	5.3 b	4.0 bc	5.0 b
240	6.0 a	5.7 a	4.5 ab	5.6 a
300	6.4 a	5.8 a	4.6 a	5.9 a

The characteristic rating scale runs from 1 to 9; 1 to 2 is excellent, 3 to 4 is good, 5 to 6 is average, 7 to 8 is fair, and 9 is poor.
Numbers followed by letters indicate statistical difference at α = 0.1.

- Higher nitrogen rates (180 to 300 lb/acre) produced poorer intactness and stay green. In addition, high nitrogen rates (240 to 300 lb/acre) increased drought stress (Table 2).
- The findings on the effects of nitrogen application rates on nitrogen stress, drought, and stay green can be justified by the hot and dry conditions found especially from August 10 to September 3 in Gothenburg, NE in 2023. Less nitrogen likely produced smaller plants, which required less water than larger plants to stay green and so experienced less drought stress.

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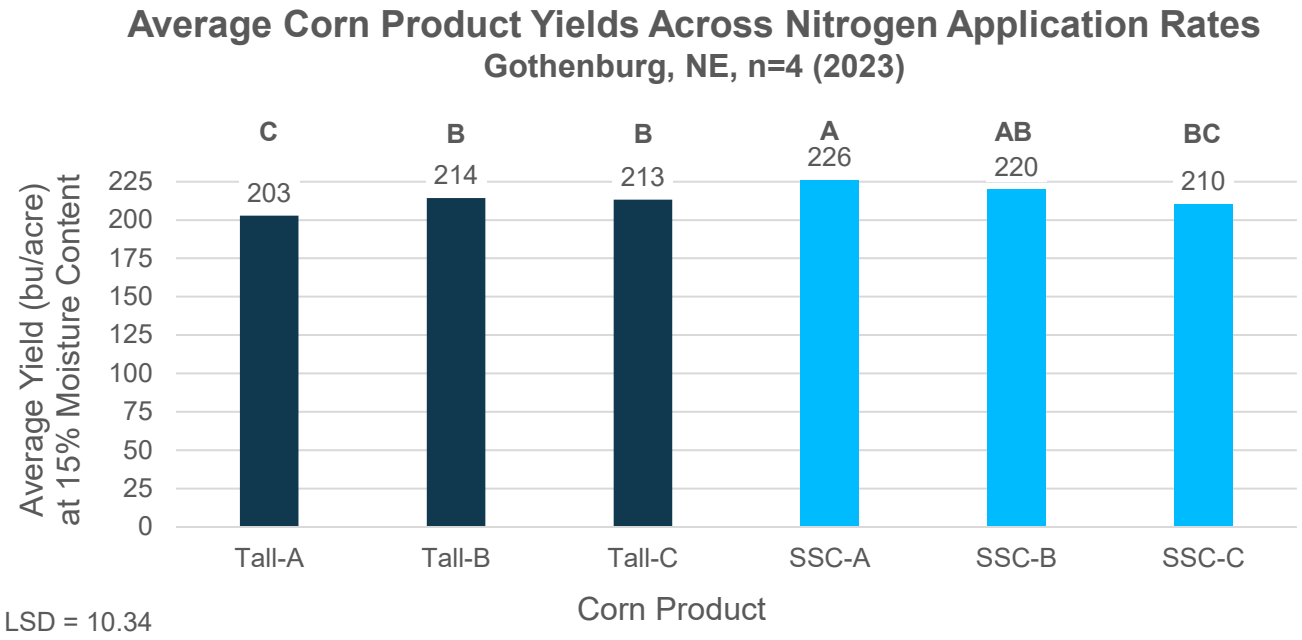

Figure 3. Yield produced by all corn products averaged across all nitrogen application rates tested in Gothenburg, NE in 2023.

- The average yield produced by short stature corn products (218.6 bu/acre) was numerically higher than that produced by tall corn products (210.1 bu/acre), but no statistical difference was found in this comparison (Figure 3).
- Short stature product SSC-A had the highest yield, though it was not statistically different from SSC-B (Figure 3).
- Two tall (Tall-B and Tall-C) and 2 short (SSC-B and SSC-C) products produced statistically similar average yields (Figure 3).
- The Tall-A product had the lowest overall average yield, though it was not statistically different from SSC-C (Figure 3).

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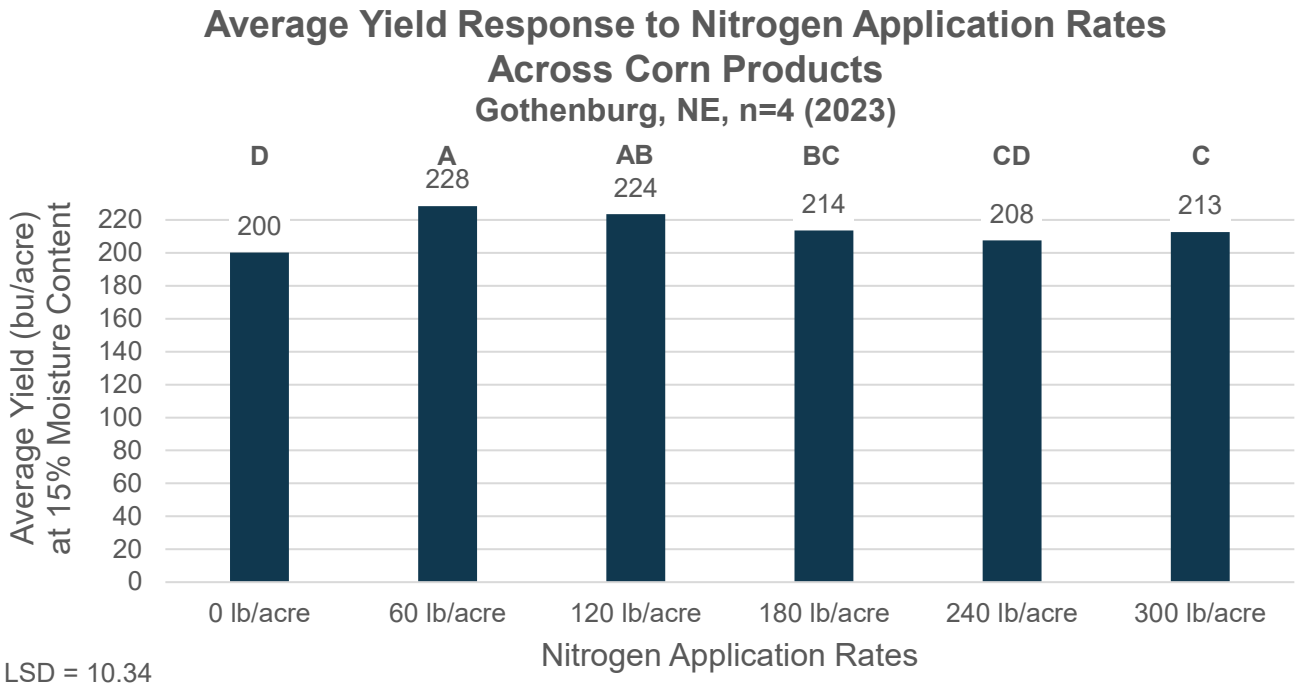

Figure 4. Yield produced by all nitrogen rates averaged across all corn products tested in Gothenburg, NE in 2023.

- The 60 lb N/acre rate had the numerically highest yield but it was not statistically different from the 120 lb N/acre rate (Figure 4).
- Higher N rates (180, 240, and 300 lb/acre) had an intermediate effect on yield and were not statistically different from one another (Figure 4).
- The 0 lb N/acre rate had the lowest yield. It produced an average of 28.4 bu/acre less than the highest-yielding nitrogen rate (60 lb/acre) and 7.7 bu/acre less than the second lowest-yielding nitrogen rate 240 lb/acre), but it was not statistically different from the 240 lb N/acre rate (Figure 4).

Key Learnings

- Short stature corn was less prone to lodging when compared to tall corn regardless of the nitrogen rate used. In addition, short stature corn showed less N stress, had greater stay-green scores, and had the potential to show less drought stress than some tall corn products.
- Short stature corn could be a great alternative for farmers located in regions with a high risk of plant lodging and environments that may respond to increments in N application.
- Higher nitrogen rates do not always show a corresponding yield increase and certain parameters such as corn product characteristics, population, precipitation, soil type, crop rotation, and management practices should be considered when applying fertilizer.
- Carefully matching nitrogen rate with corn product, yield potential, soil moisture conditions, and residual soil nitrogen is key to maximizing the potential benefit of N fertilizer while minimizing potential drawbacks.

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Legal Statements

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The Preceon™ Smart Corn System, including short stature corn developed through traditional breeding, is expected to be available, subject to final commercialization decisions, for planting in the 2024 growing season. Short stature corn developed through biotechnology is not currently available for commercial sale or commercial planting. Commercialization is dependent on multiple factors, including successful conclusion of the regulatory process. The information presented herein is provided for educational purposes only, and is not and shall not be construed as an offer to sell.

Performance may vary, from location to location and from year to year, as local growing, soil and environmental conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on their growing environment.

The recommendations in this material are based upon trial observations and feedback received from a limited number of growers and growing environments. These recommendations should be considered as one reference point and should not be substituted for the professional opinion of agronomists, entomologists or other relevant experts evaluating specific conditions.

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