SHORT-STATURE AND FULL-STATURE CORN HYBRID RESPONSE TO NITROGEN RATE AND PLANT POPULATION

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ABSTRACT

The recent introduction of short-stature corn (*Zea mays* L.) hybrids (5-7 ft height) suggests agronomic management recommendations need to be reassessed and updated in comparison to modern full-stature hybrids. Short-stature hybrids target to increase overall Midwest corn production and agronomic efficiency by reducing lodging potential under higher plant populations through improved wind tolerance, stalk strength, and plant standability. However, the optimal combination of nitrogen rate and plant population for short-stature corn has yet to be determined. The objective of this research trial is to compare short-stature and full-stature corn performance across diverse nitrogen rates and plant populations to determine optimal nitrogen rates and plant population recommendations for future use. This research study utilizes a factorial, randomized complete block design with four replications to assess grain yield, yield components, leaf area index (LAI), plant standability, ear height, and plant height responses of two short-stature corn hybrids (PR111-20SSC, PR112-20SSC), and two full-stature corn hybrids (DKC61-41RIB, DKC62-70RIB; Bayer Crop Science, St Louis MO.) across four nitrogen rates (160, 200, 240, 280 lbs. N/ac), and three plant populations (32,000; 38,000 and 44,000 plants/ac). Small-plot (15 ft wide x 40 ft long) studies were conducted at The Agronomy Center for Research and Education (ACRE) in West Lafayette, IN. Preliminary data observed interactions between hybrid type and optimum seeding rate, but not nitrogen rate. Across all examined treatments, full-stature hybrids yielded higher than short-stature hybrids by 10-20 bu/ac. On average, short-stature corn requires a higher optimum seeding rate as compared to full-stature hybrids.

MATERIALS AND METHODS

A field trial was established at the Purdue Agronomy Center for Research and Education (ACRE) in Tippecanoe County, Indiana. The research trial examined corn yield response to different short and full-size corn hybrids, nitrogen, and seeding rates. This research study utilizes a factorial, randomized complete block design with forty-eight treatments and four replications. Individual plots measured 15 feet wide (6, 30-inch corn rows) by 40 feet long, and the center 2 rows were harvested with a small-plot combine and adjusted to 15.5% moisture for yield analysis. The trial factors included both short-stature hybrids (PR111-20SSC and PR112-20SSC) and full-stature hybrids (DKC61-41RIB and DKC62-70RIB). Three corn seeding rates at 32,000, 38,000, and 44,000 seeds per acre. Four nitrogen fertilizer rates (160, 200, 240, and 280 lbs N/acre) were applied using UAN (28-0-0) at the V5 growth stage, with all plots receiving an initial 2x2 starter nitrogen application totaling 40 lbs N/acre.

The trial was established on Drummer Fine-Silty soil with a 0-2% slope. Corn was planted on May 11, 2023, and harvested on October 22, 2023. Soybean served as the previous crop, and conventional tillage practices were employed. The trial data collection

included soil samples at a depth of 0-8 inches before trial initiation, followed by plant stand counts at the V4 growth stage. Leaf area index (LAI) was measured at the R2 growth stage, while ear height and plant height were recorded at the R3 growth stage. Grain yield was measured (adjusted to 15.5% moisture), kernel number and kernel weight also analyzed. Data analysis was subject to ANOVA using lme4 package in R. Treatment means were estimated and separated using the emmeans package in R and considered statistically different at $P<0.1$.

RESULTS

Table 1. Analysis of variance (ANOVA) for corn grain yield in response to the main effects of nitrogen (N) fertilizer rate, corn seeding rate, hybrid type, and their interactions. West Lafayette, IN 2023.

Source of Variation	*Pr>F*
Corn Hybrid	**<0.001**
Nitrogen Fertilizer Rate	**0.09**
Corn Seeding Rate	**<0.001**
Hybrid * N Rate	0.112
Hybrid * Seed Rate	**0.013**
N Rate * Seed Rate	0.298
Hybrid* N Rate* Seed Rate	0.784

Figure 1. Mean corn grain yield (bu/ac) interaction differences between corn hybrid type and corn seeding rate. Black diamonds indicate mean values. *Individual box plots that contain letters different from each other indicate a significant difference at P<0.1. West Lafayette, IN 2023.

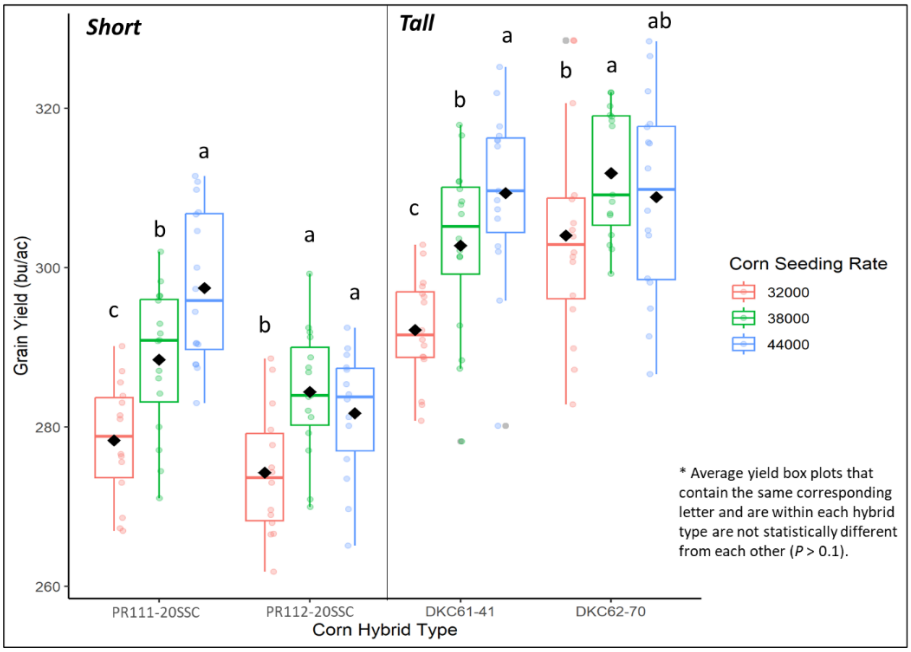

Figure 2. Mean corn grain yield (bu/ac) interaction differences between corn hybrid type and corn nitrogen rate (lbs/ac). Black diamonds indicate mean values. *Individual box plots that contain letters different from each other indicate a significant difference at P<0.1. West Lafayette, IN 2023.

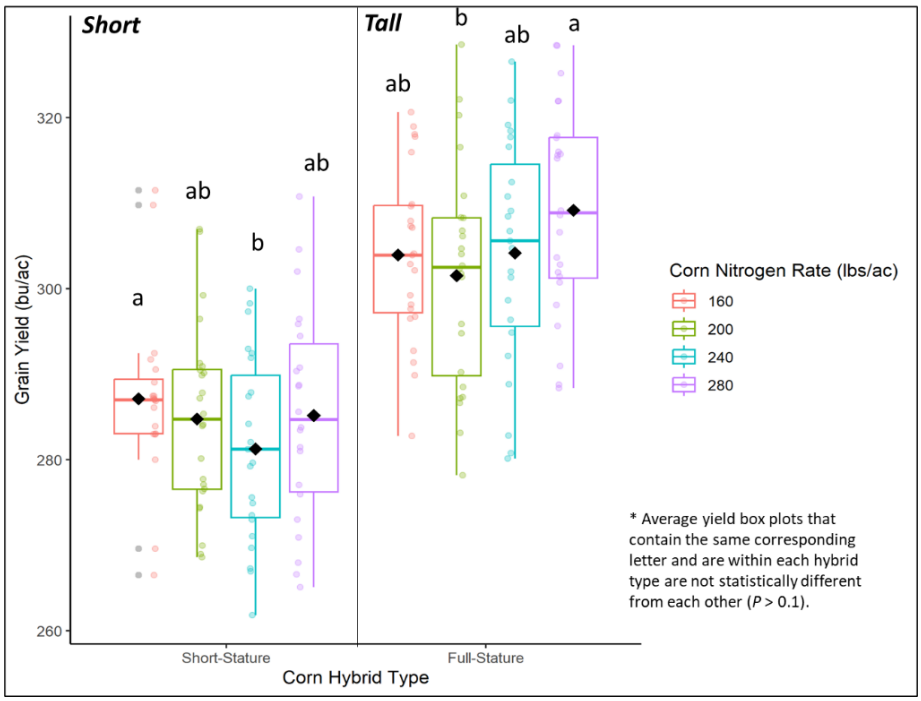

Table 2. Short and tall-stature corn yield, stalk nitrate, harvest index, kernel number, kernel weight, stover biomass, and total N uptake. Mean values which contain different letters and are within the same column are significantly different at P<0.1. West Lafayette, IN 2023.

Hybrid (Type)	Grain Yield	Stalk Nitrate	Harvest Index	Kernel #	Kernel Wt	Stover Biomass (R6)	Total N Uptake (R6)
	-- bu/ac --	--- ppm ---		kernels/ear	1000 kernels	-- lbs/ac --	-- lbs/ac --
PR111-20SSC (Short) †	299 ab	0.11 ab	0.67 b	471 b	349 a	7953 a	60 a
PR112-20SSC (Short)	288 b	0.05 b	0.71 a	590 a	284 c	6751 b	45 b
DKC61-41RIB (Tall)	311 a	0.14 a	0.71 a	566 a	299 bc	7039 b	48 b
DKC62-70RIB (Tall)	304 a	0.12 ab	0.68 b	570 a	312 b	7404 ab	45 b

CONCLUSIONS

- A significant hybrid x seeding rate interaction was observed in this research trial (Table 1) which suggests that the different hybrids examined required different optimum seeding rates within this year and environment (Figure 2).
- Across all hybrids examined, the hybrids did not differ in their response to applied total N fertilizer rates (Table 1 and Figure 2). Results suggest optimum N fertilizer rates do not differ between short and full-stature corn hybrids. Lower N application rates added in 2024.
- Significant differences between grain yield, stalk nitrate, harvest index, kernel numbers, kernel weights, stover biomass, and total plant uptake were observed between the four hybrids examined (Table 2).
- Preliminary results suggest optimum seeding rates, yield levels, and various physiological characteristics differ between different short and tall-stature hybrids. However, optimum N rate does not.