FIELD FACTS

University/Pioneer Research Update[1]:

Corn Response to Row Width, Plant Population, and Hybrid Maturity in the Far-Northern Corn Belt

by Jeff Coulter[2] and John Shanahan[3]

Key Research Findings

- Results from this study indicate yield levels can be increased with a combination of narrow rows (22 vs. 30 inches) and populations above 33,000 plants/acre in the far-northern Corn Belt.
- Economic optimum seeding rates were higher for narrow rows in this study, averaging around 3,500 seeds/acre more for 22- vs. 30-inch rows.
- These optimum seeding rates were higher than what was expected at the onset of this study, and were higher than what most growers are using in the far-northern Corn Belt.
- The 89-day hybrid yielded 5% more than the 80- and 85-day hybrids. This was consistent for both row widths.
- The response to row width and final plant population was similar among hybrids.

Introduction

Use of best agronomic practices is crucial for maximizing economic returns in corn production, especially in the far-northern Corn Belt where short growing seasons necessitate use of lower-yielding, early maturity hybrids. Narrow rows and high plant populations are agronomic practices with potential to increase corn yields in the far north. However, prior to this research, little knowledge was available for implementing these practices with modern stress-tolerant hybrids adapted to this region.

Previous research (Butzen and Jeschke, 2008) has shown a 4% average yield increase with narrow (15- to 22-inch) rows across 16 trials in the Dakotas and Minnesota between 1991 and 2006, with a positive response to narrow rows in 15 of the 16 trials. Meanwhile, in the central and southern Corn Belt, yield responses have been inconsistent and sometimes negative for row widths less than 30 inches (Lee, 2006; Butzen and Jeschke, 2008). The inconsistency of yield response to narrow rows was attributed primarily to yield-limiting light or moisture effects (Lee, 2006, Butzen and Paszkiewicz, 2008). Northern locations are limited in the amount of solar radiation they receive during critical ear development stages. Hence, northern states may show greater responses to planting arrangements that are more efficient in collecting available sunlight, such as narrow rows. Past results of narrow-row research from throughout the U.S. substantiates this claim.

Pioneer Agronomy Sciences Northern Research

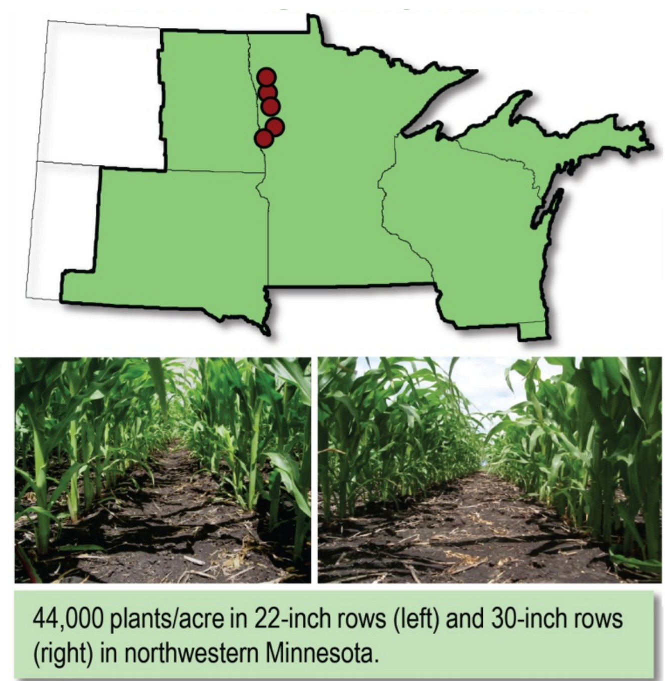

Figure 1. Location of row spacing by plant population by hybrid trials.

For example, research conducted in southern and central Minnesota in the early 1990s found a 7 to 9% increase in corn yield with narrow rows, and row width did not consistently affect corn response to plant population (Porter et al., 1997). However, the stress tolerance of corn hybrids has improved considerably since the early 1990s, and the hybrids grown in the far-northern Corn Belt are earlier than those evaluated in previously published row width by plant population studies. Therefore, research is needed in the far North to determine whether narrow-row corn requires higher plant populations, and whether this is consistent among adapted modern hybrids of varying maturity.

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Research Objectives

The objectives of this study were to determine: 1) if row width affects corn grain yield and its response to plant population in the far-northern Corn Belt, and 2) whether this is consistent for hybrids of differing maturity. Dr. Jeff Coulter of the University of Minnesota led this study.

Study Description

Location and Treatments

Small-plot field experiments were conducted on six farms in or near the Red River Valley in northwestern Minnesota from 2009 to 2011 (Figure 1). The trial at Moorhead was lost to flooding in 2009. Each trial had 36 treatments, consisting of a factorial combination of two row widths (22-inch vs. 30-inch), three corn hybrids of differing maturity, and six final plant populations (16,500, 22,000, 27,500, 33,000, 38,500, and 44,000 plants/acre). The experimental design at each farm was a split-plot arrangement in a randomized complete block with four replications. Main plots were all combinations of row width and hybrid maturity. Subplots were six final plant populations established by over-planting followed by hand thinning at V5. Subplots were four rows wide by 25 feet long.

Hybrid Selection

Three Pioneer® hybrids, 39V07 (HX1, LL, RR2), P8581R (RR2), and 39N99 (HX1, LL, RR2), were selected for evaluation in the study. The hybrids are similar for many traits, but vary in comparative relative maturity (CRM) ratings, ranging from 80 to 89.

Crop Management

Corn was planted with a modified small-plot planter capable of planting corn in both 22- and 30-inch rows. The previous crop at each site was soybean or spring wheat. Soil fertility was maintained according to university guidelines for high yields, and a conventional tillage system was used. Planting dates ranged from April 20 to May 21. Weeds were controlled with pre- and post-emergence herbicides.

Field Measurements

Grain yield and harvest moisture were determined by hand-harvesting from the center two rows of each plot. Harvested ears were shelled and yield was adjusted to 15% moisture.

Results

1. How did row width affect corn grain yield and its response to plant population?

When averaged across hybrids, plant populations and years, narrow rows resulted in a yield increase of 5 bu/acre or 3% compared to conventional row widths of 30 inches. However, it should be noted that a significant interaction between row width and plant population was observed in this study. The interaction was most pronounced at the 2010 Crookston trial. At this site differences between row spacing treatments were only observed at populations exceeding 33,000 plants/acre (data not shown). For example, at the two populations of 38,500 and 44,000 plants/acre, yields were 8 and 12% higher for 22 vs. 30 inch-rows, respectively (data not shown), and this was consistent across hybrids. Averaged over all site-years and hybrids, yields were 4 to 5% higher for 22- vs. 30-inch rows at the two highest plant populations (Figure 1). These results indicate that in the far-northern Corn Belt, yield levels can be increased with a combination of narrow rows and populations above 33,000 plants/acre.

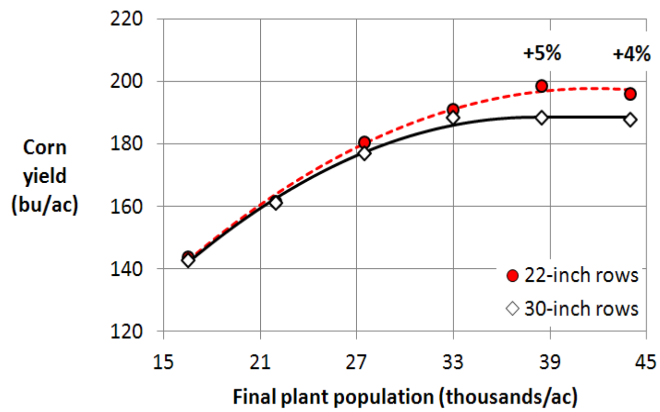

Figure 2. Corn response to plant population and row width, averaged across 3 hybrids and 5 site-years in northwestern MN.

Economic optimum seeding rates were calculated for response curves of both row spacing's as shown in Figure 2 for various seed costs and grain price scenarios (Table 3). In general, these calculations show economic optimum seeding rates are higher for narrow rows, averaging around 3,500 seeds/acre more for 22- vs. 30-inch rows. These optimum seeding rates are higher than what we expected at the onset of this study, and are higher than what most growers are using in the far-northern Corn Belt.

Table 1. Economic optimum corn seeding rates by row width, averaged across 3 hybrids and 5 site-years in northwestern MN.

Seed cost ($/80,000)	Corn price ($/bu)	Seeding rates within $1/acre maximum net return*	
		30-inch rows	22-inch rows
225	5.00	36,100 - 39,000	39,500 - 42,500
225	6.00	36,600 - 39,300	40,100 - 42,800
225	7.00	37,100 - 39,400	40,500 - 43,200
Economic optimum rates all scenarios		37,100 - 39,000	40,500 - 42,500

*Assumes 5% over-seeding to account for stand loss.

2. How did hybrids respond to row width and plant population?

There was no interaction between row spacing by plant population by hybrid treatments (data not shown), so all three hybrids responded similarly to row spacing and plant population variables. The 89-day hybrid (39N99) was among the highest-yielding hybrids in all site-years (data not shown). However, at Crookston in 2010 there were no differences among hybrids. At Crookston in 2011, the 80-day hybrid (39V07) and the 89-day hybrid yielded the same. At Moorhead in 2010 and at Hitterdal in 2011, the 80-day hybrid and the 85-day hybrid (P8581R) had lower yields than the 89-day hybrid.

Across all site-years, row widths, and plant populations, yield with the 89-day hybrid averaged 5% higher than that with the 80- and 85-day hybrids (Figure 3). However, the 89-day hybrid is of late maturity for Beltrami and Crookston, while the 80-day hybrid is of early maturity for Hitterdal and Moorhead.

Harvest moisture increased with hybrid relative maturity (data not shown). Typically, grain moisture was more similar between the 85- and 89-day hybrids than between the 80- and 85-day hybrids. Across all site-years, row widths, and plant populations, grain moisture with the 85- and 89-day hybrids averaged 2.8 percentage points higher than that for the 80-day hybrid.

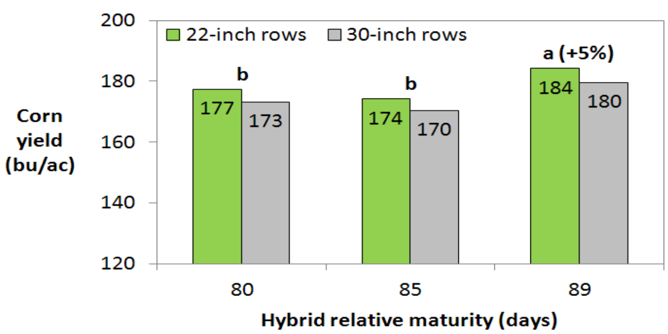

Figure 3. Yield response to row spacing for three corn hybrids varying in relative maturity averaged across five locations.

3. Based on this research, what are the promising agronomic practices for helping growers in the far-northern Corn Belt increase yield and economic return?

The combination of high plant populations, narrow rows, and full-season hybrids appears to be the best strategy for high yield and economic return in this region, with the most important factor being plant population.

Conclusions

The results from this study and other Pioneer work show the most consistent positive responses to narrow row corn are found in the northwest Corn Belt states of Minnesota, North Dakota and South Dakota, where yield can be increased by up to 5% with narrow rows and populations exceeding 33,000 plants/acre. Additionally, hybrid by row width interactions are rare, which means that selection of specific hybrids for narrow-row culture is unnecessary.

[1]The Pioneer Crop Management Research Awards (CMRA) Program provides funds for agronomic and precision farming studies by university and USDA cooperators throughout North America. The awards extend for up to four years and address crop management information needs of Pioneer agronomists, sales professionals and customers. This *Field Facts* research update was adapted from the final report submitted by Dr. Jeff Coulter, University of Minnesota, Department of Agronomy and Plant Genetics, for his CMRA project entitled, "Corn Response to Row Width, Plant Population, and Hybrid Maturity in the Far-Northern Corn Belt". This project was sponsored by Pioneer's Northern Business Unit and coordinated by Pioneer Agronomy Research Manager, Barry Anderson. Portions of this study are also shown in other reports by Coulter and Severson (2011).

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