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Row Spacing Alternatives in Corn

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Introduction

Row widths continue to decrease in the U.S. Corn Belt. Current row widths employed by producers typically vary from 15 to 38 inches, with most producers planting in 30-inch rows. Yet more and more acres are planted to narrower row widths. In general, narrow-row producers are using 15- or 20-inch row widths although in some parts of the Midwest, 30-inch rows are considered narrow. Some producers employ twin rows[†] in an effort to attain the benefits of narrow rows while being able to use 30-inch harvest equipment. Numerous advantages exist with narrower row widths including: using the same planting equipment for corn and soybean, reduced weed competition, increased shading of the soil, increased light interception per plant, less in-row crowding, and greater ease at harvest. Plant populations continue to increase about 400 plants per acre per year across the U.S. Using wide row widths force more plants into a concentrated area, whereas narrower rows allow better distribution. Agronomists have often thought that equidistant plant spacing maximizes crop yield, so it follows that narrow rows inherently allow for that to occur.

In general, we expect more of a yield response to narrow rows in northern Corn Belt production states, due to shorter growing seasons and limited light, compared to southern growing regions (Paszkiewicz, 1997). Dr. Peter Thomison thoroughly covered row spacing options at the 2003 Indiana CCA Conference. We intend here to present a brief update on recent row spacing data (in this written report we will focus on Iowa data). Then we will discuss the current agronomic thinking on when positive yield responses will likely occur.

Recent Iowa Results

What has Iowa State University research shown in terms of yield responses to narrow rows? Six years of research (1995-2000) conducted in Iowa showed no yield differences when comparing 15-inch row width to 30-inch (Table 1). This data is from the *Corn Planting Guide* (Farnham, 2001). Year to year response varied; yet in general, corn planted in a 15-inch row width yielded the same as 30-inch rows and yield in 38–inch rows yielded less. It is important to note that yields are seldom reduced when using narrow row widths.

Table 1. Relative yield differences of corn grown in 15- and 38-inch row spacings when compared with 30-inch row spacings. From: Farnham, 2001 (Table 6).

Year	15-inch	38-inch
1995	+2.2	-
1996	0	-
1997	-1.9	-
1998	+1.2	-7.5
1999	-1.2	-0.5
2000	+1.8	-2.7
Average	+0.3	-2.9

Ongoing research at ISU investigates the yield response of a twin row corn production system compared to 30-inch row widths. Previous research (2003-2005) conducted at the SW Research and Demonstration Farm (Lewis, IA) showed no yield difference between a twin row configuration and 30-inch row spacing during any of the three years. Twin row research data from the last two years are shown in Table 2.

Table 2. Corn grain yield in twin rows in comparison to 30-inch rows at two Iowa State University Research and Demonstration Farms.

	Grain Yield (bu/acre)		Statistical difference
Year/Farm	Twin-row	30-inch	
2006 / NE	199	198	Not significant
2006 / SW	205	210	Not significant
2007 / SW	182	179	Not significant

Twin rows yielded the same as 30-inch rows in all three site-years. Several seeding rates were included as factors in these trials. In 2006, the responses to seeding rate were the same in both row configurations and at both locations. However in 2007, yield in 30-inch rows decreased as seeding rates increased from 32,000 to 48,000 seeds per acre whereas yield in 15-inch rows was greatest at 40,000 seeds per acre and was less at lower as well as higher seeding rates. We must study this interaction more.

Row Spacing and Yield: Why don't yields always increase with narrow rows?

Narrow rows often increase corn yields in Northern Corn Belt environments. The interaction of light interception and row spacing at a central Michigan location is evident in Figure 1. This data is from an experiment where near-infrared radiation was measured and then used to estimate the normalized differential vegetation index (NDVI). Early and later in the growing season NDVI of both row spacings and leaf area indices (not shown in this figure) were similar. However, during the critical flowering stages (late June through early July) narrow rows had increased NDVI; this is correlated with light interception. Thus, in northern Corn Belt environments similar to that present in this experiment, positive yield responses to narrow rows are essentially due to the increased light interception which increased photosynthesis at flowering.

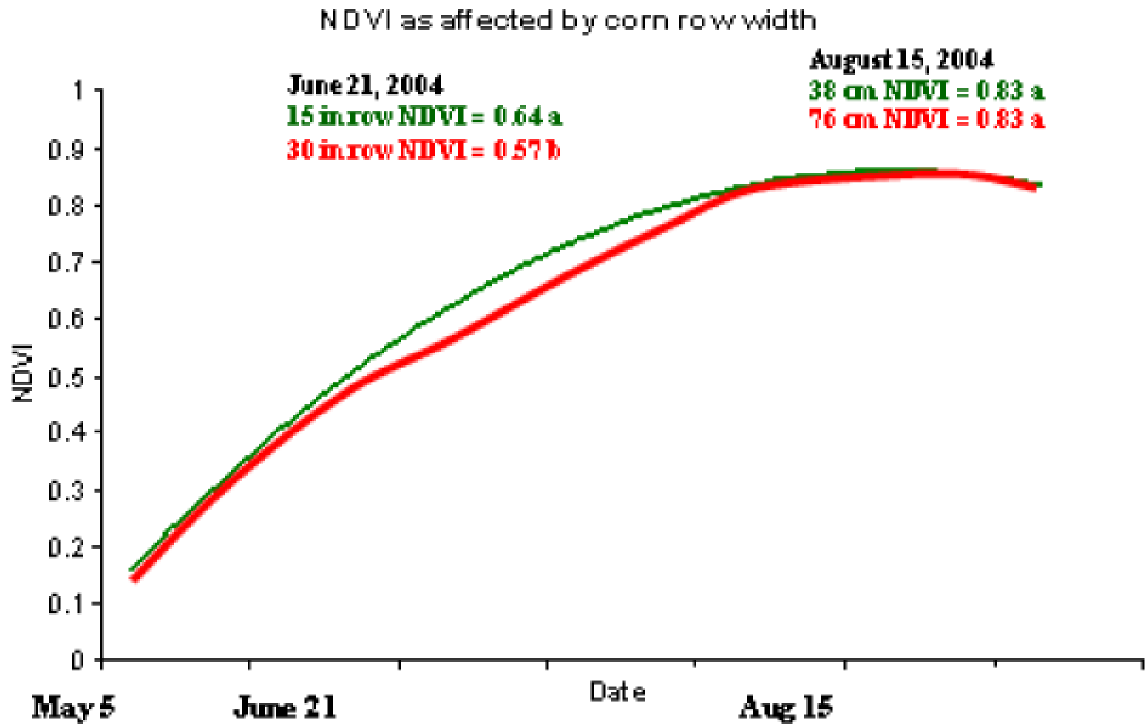

Figure 1. The northern latitude disparity (between wide and narrow rows) in normalized differential vegetation index (NDVI) is present during the critical yield determination period in late June/early July but disappears when both row widths reach full canopy closure later in the growing season. Caption and figure from Thelen (2006).

Typically, we have thought that narrow row spacing, higher planting rates, longer growing seasons, increased radiation use efficiency, wider stomata openings, and greater light inception in the canopy would maximize photosynthesis and thus yield (Mark Westgate, personal communication, 2007). Although these criteria are important and can limit yield under certain instances, our understanding of the importance of them have changed. It is clear from recent research that to have maximum yields, 95% light interception at flowering is necessary *regardless* of row spacing. If 95% radiation interception is not achieved with wide-row spacings, then narrow rows may increase yields. Figure 2 shows this relationship.

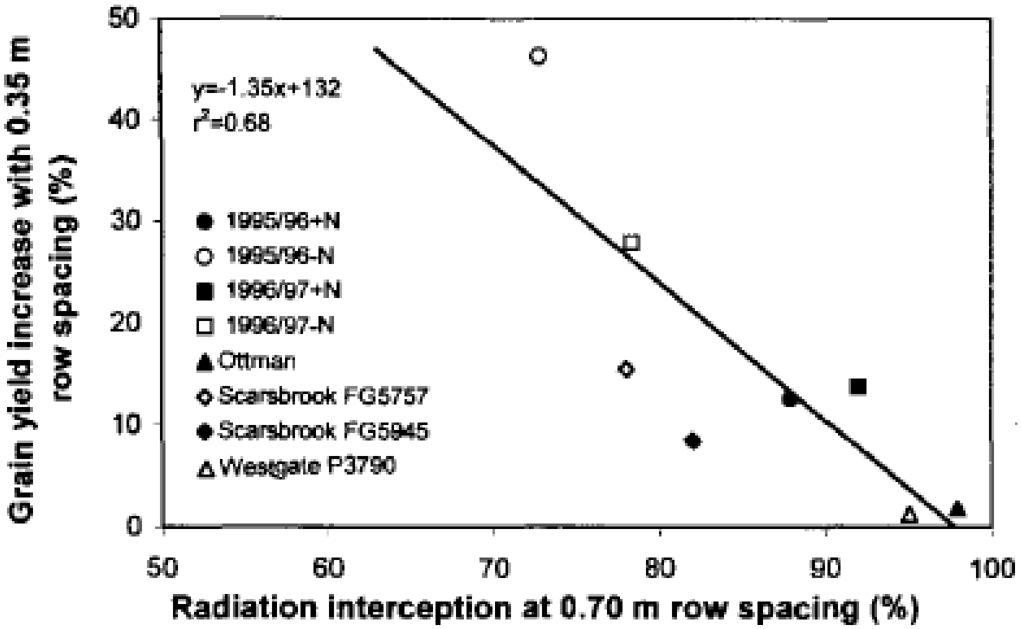

Figure 2. Relationship between percent increase of grain yield in response to narrow rows relative to conventional row spacings and percent radiation interception (at flowering) with conventional row spacing. Solid triangles refer to Ottman and Welch (1989), diamonds refer to Scarsbrook and Doss (1973), and open triangles refer to Westgate et al. (1997). Caption and figure are from Barbieri et al. (2000).

Figure 2 shows percent grain yield increases with narrow rows (0.35 m ≈ 14 inches) in comparison to wide rows (y axis) at different levels of light interception in wide rows (x axis) (0.70m ≈ 28 inches). Thus, when 75% if the light is intercepted in wide rows at flowering, yield increases of narrow rows yields would be about 30% greater than those of wide rows. For every 10% increase in wide-row light interception, the yield advantage to narrow rows over wide rows was reduced by 13.5%.

In addition, Barbieri et al. (2000) investigated the relationship of row spacing and limited nitrogen. They found that reduced row spacing offset part of the negative effect of N deficiency. With limited N, radiation interception was less in wide rows than in narrow rows. Not surprisingly, they found a 27% to 46% increase in yield with narrow rows in N-deficient corn. When N was not limiting, light interception in both row spacings was similar.

Figure 3, which is based on University of Michigan research, shows the interaction between environment and responsiveness to row width. As the environmental yield increases 10 bushels per acre, the yield advantage for using narrow rows decreases by about 2.5 bushels per acre. Yield response to narrow rows is again better in lower yielding, more stressful environments (similar to results of Barbieri et al. (2000)).

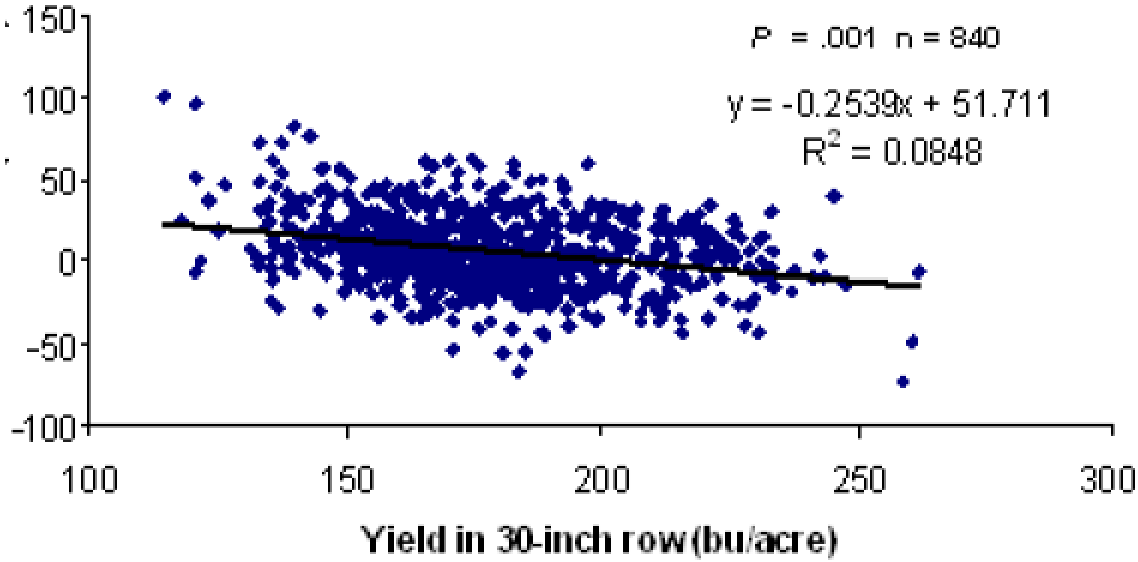

Figure 3. Effect of wide-row (30-inch) corn grain yield on the yield response to narrow rows. The y-axis on this figure shows the change in yield of 15-inch rows relative to 30-inch rows. A yield advantage of 15-inch rows compared to 30-inch rows is shown as positive numbers and a disadvantage as negative numbers. Thus, when yield in 30-inch rows is 125 bu/acre, yields in 15-inch rows are estimated at 20 bu/acre higher, or 145 bu/acre. (Thelen, 2006)

Summary

New research is clear on this point: a positive response to narrow rows in the Corn Belt is most likely to occur in the presence of yield-limiting factors, especially those that would directly reduce plant competitiveness or light interception.

So, when could we expect to see narrower rows increase yield potential in high yielding environments? As we mentioned earlier, plant populations generally increase every year. Much of the yield increase we are seeing today with our modern corn hybrids comes from their ability to withstand higher stress. One of the most important stresses modern hybrids are better able to withstand is higher plant-to-plant competition (more plants per area of land). With that in mind, as plant populations significantly increase from where they are today, we expect the yield differential to shift more towards narrow row systems than 30-inch rows. Yet for today, optimum row spacing in the central part of the Corn Belt varies from 15- to 30-inch row widths. These spacings allow for maximum light interception and maximum yields. However, we fully recognize that other row spacing configurations may maximize yields in specific environments as found in above noted research.

References

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†Image at:

http://www.agronext.iastate.edu/corn/gallery/display.php?photoid=66&catid=13