Corn Row Width and Plant Density—Then and Now
Overview

• History of row spacing response in corn production
• Recent research
  ✓ Wisconsin
  ✓ Michigan
  ✓ Iowa
• Paired rows
• Economics of the row spacing decision
• When will farmers likely see success with narrower rows
Previous Corn Research on Row Spacing > 30-inches

• Early 1900 to 1950 corn was “check” planted in 40- to 44-inch row spacing.
  ✓ Limited by width of a horse.
  ✓ Afforded weed control in lieu of herbicides

• Development of hybrid corn, herbicides, irrigation made it apparent that plant arrangement (row spacing and plant density) was limiting yield.

• Grain yield increases were consistent when narrowing rows from 36-, 38- or 40-inches to 30-inches in Wisconsin. The average increase was 5%, and ranged from -1 to +15%
Previous Corn Research on Row Spacing < 30-inches

- Recent resurgence in grower interest to use one planter to establish corn, soybeans, and/or sugar beet.
- Grain yield increases with row spacing narrower than 30-inches in 7 of 11 AJ references.
  ✓ Increases are larger and more consistent in the northern Corn Belt.
- Silage yield increases with row spacing narrower than 30-inches in 4 of 6 AJ references.

**WARNING**: There may be an inherent bias in trials reported due to publication process. NS data are not often published.
Management Interactions With Row Spacing Since 1960

• Plant population: Significant in 3 of 12 references
• Hybrid: Significant in 4 of 10 references
• Single references
  ✓ Plant growth
    • Greater corn growth rate in narrow rows (Bullock et al., 1988)
    • Reduced biomass of late emerging weeds in narrow rows (Murphy et al., 1996)
    • Narrow rows had no effect on Giant Foxtail and Common Ragweed growth (Johnson et al., 1998) and Velvetleaf (Teasdale, 1998)
  ✓ Greater grain yield with higher N-rate in narrower rows (Ulger et al., 1997)
Corn Grain Yield Change For Narrower Compared to 30-inch Row Spacing
(University research - Paszkiewicz, 1996)
Corn Grain Yield Change For Narrower Compared to 30-inch Row Spacing in Wisconsin

N= 32 trials
Increased in 6 trials
Decreased in 5 trials
Average = 0.4%
Corn Forage Yield Change For Narrower Compared to 30-inch Row Spacing in Wisconsin

N = 13 trials
Increased in 4 trials
Decreased in 1 trial
Average = 3.5%
Michigan

Widdicombe and Thelen, 2002 (AJ 94:1020)

**Methods**

- 15 total site-years (5 Sites x 3 Years)
- 4 hybrids per Site
- 5 populations per site (23000, 26400, 29800, 33200, 36500 plants/A)
- 3 row widths (15, 22, 30 in)
- 2640 total plots
Corn response to row width in Michigan 1998-1999. Each value is the mean of 880 plots.

<table>
<thead>
<tr>
<th>Row width (in)</th>
<th>Yield (bu/A)</th>
<th>Moisture (%)</th>
<th>Stalk Lodging (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>177 c</td>
<td>19.6 a</td>
<td>1.60 b</td>
</tr>
<tr>
<td>22</td>
<td>181 b</td>
<td>19.2 b</td>
<td>1.92 a</td>
</tr>
<tr>
<td>15</td>
<td>184 a</td>
<td>19.2 b</td>
<td>1.65 b</td>
</tr>
</tbody>
</table>
Corn Performance in Narrow Rows in Michigan 1997-99 Three Year Averages

Widdecombe and Thelen, 2002
Conclusions from Michigan

• Corn grain yield increased 2% and 4% when row width was narrowed from 30 inches to 22 inches and from 30 inches to 15 inches.
• Increasing plant density had a quadratic plateau effect on grain yield.
• Grain moisture was negatively correlated and test weight was positively correlated with plant density.
• As plant density increased corn forage yield increased and DMD, ADF, NDF, and CP were adversely affected.
Narrow Row Comparisons in Iowa 1997-1999 (Farnham, 2001 AJ 93:1049)

- Lewis
- Crawfordsville
- Sutherland
- Nashua
- Kanawha
- Ames

Grain yield (bu/A)

LSD(0.05) = 2
Karlen and Kasperbauer (1989) reported a 9% decrease in corn yield in the SE USA from twin rows compared to 30 in single rows.

Ottman and Welch (1989) reported no differences between single 30 in rows and twin rows on 30 in centers (-2% difference).
Kansas
(Staggenborg et al.)

• Six Location-Years:
  ✓ Manhattan (dryland) 2001
  ✓ Manhattan (dryland) 2002
  ✓ Powhattan (dryland) 2002
  ✓ Belleville (dryland) 2002
  ✓ Rossville (irrigated) 2001
  ✓ Topeka (irrigated) 2002

• Three planting patterns:
  ✓ 30 in, 20 in, and paired row

• Two plant populations:
  ✓ Dryland: 24,000 and 28,000 plants/a
  ✓ Irrigated: 26,000 and 30,000 plants/a

• Previous Crop
  ✓ Soybeans at all location-years, except Manhattan 2001 was corn
Row Configuration Comparisons in Kansas (Staggenborg et al.)

![Graph showing yield differences between row configurations in Kansas.](chart.png)
Conclusions from Kansas

- Hot and dry weather during 2001 and 2002 reduced dryland yields well below 5 year average.
- No significant differences occurred between row spacing treatments at 5 of the 6 location-years.
- Paired rows and narrow rows (20 in) reduced yields in very low yielding environments. Consistent with results of narrow row study conducted at that site in 1997.
- Trends suggest that wide rows have yield advantages over narrow and paired rows when yields are below 100 bu/a.
Paired Row Comparisons in Missouri (Nelson and Smoot)

- John Deere 7000 (30 inch rows)
- Great Plains Precision Seeding System (30 inch rows)
- Great Plains Precision Seeding System (Paired rows)

Grain yield (bu/A) vs. LSD(0.05) = 12

105 110 115 120 125 130

Lauer, © 1994-2003
University of Wisconsin – Agronomy
Paired Row Comparisons in Ontario (Stewart)

- Woodstock, ON (1999)
- Highgate, ON (1998-1999)
- Woodstock, ON (1997-1998)
- Ridgeton, ON (1995-1996)

Grain yield (bu/A)

Lauer, © 1994-2003
University of Wisconsin – Agronomy
Regions used to group narrow row corn yield data

Hallman and Lowenberg-DeBoer, 1999
Corn Yield Comparison of 30-inch and Narrower Row Spacing

Public Data 1966-1997

- 30-inch rows
- Narrower rows

Grain Yield (bu/A)

Northwest (n=40)  Northeast (n=37)  Central (n=33)  Ohio Valley (n=12)  All data (n=122)

Hallman and Lowenberg-DeBoer, 1999
Corn Yield Comparison of 30-inch and Narrower Row Spacing

Pioneer Data 1991-1997

Grain Yield (bu/A)

<table>
<thead>
<tr>
<th>Region</th>
<th>30-inch rows</th>
<th>Narrower rows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwest (n=21)</td>
<td>150</td>
<td>155</td>
</tr>
<tr>
<td>Northeast (n=1)</td>
<td>160</td>
<td>165</td>
</tr>
<tr>
<td>Central (n=5)</td>
<td>130</td>
<td>125</td>
</tr>
<tr>
<td>Ohio Valley (n=1)</td>
<td>110</td>
<td>115</td>
</tr>
<tr>
<td>All data (n=28)</td>
<td>132</td>
<td>137</td>
</tr>
</tbody>
</table>

Hallman and Lowenberg-DeBoer, 1999
Assumption Used in Economic Analysis

- Used Public university and Pioneer data sets
- 1800 A cash grain operation 50:50 corn:soybean rotation
  - Assume for smaller farms that returns would be smaller
- Corn prices varied by region and were derived from USDA
- Complete planting of corn and soybeans within 10 working days
- Resale value of narrow row equipment (planter and corn heads) is not well established. Not used here, but included in paper.

Hallman and Lowenberg-DeBoer, 1999
## Cost Assumptions Used in Economic Analysis

- **Insecticide**
  - 30-inch = $15.94 / A
  - 15-inch = $23.91 / A
  - Applied by linear foot causes 50% increase in insecticide

- **Fertilizer prices and removal rates**
  - N - $0.15/lb, 1.36 lb/bu
  - P2O5 - $0.22/lb, 0.37 lb/bu
  - K2O - $0.12, 0.27 lb/bu
  - Lime $12/ton, 5.11 lb/bu

- **Hauling charges of $0.20/bu**

- **Drydown** = 10% for total of $0.25/bu

- **Equipment cost used commercial rates**
  - 30-inch system used a 16-row planter and 8-row head
  - 15-inch system used a 24-row planter and 12-row head
  - 10-year depreciation rate

- **Prices for planters, corn heads, tires, and tire and combine modifications solicited from local dealers.**

Hallman and Lowenberg-DeBoer, 1999
Average Net Return Change For Narrower Row Spacing

Hallman and Lowenberg-DeBoer, 1999
Economic Analysis Conclusions

• Narrow row corn has potential in the northern Corn Belt.
  ✓ Range of $2.00 to $8.75 / A with no corn rootworm insecticide
  ✓ No net benefit, if corn rootworm insecticide is needed ($2.17 to -$17.09 / A)

• GMO rootworm resistant corn hybrids will influence decision

• Planting date risk will influence decision

• Currently, narrow rows have greater business risk due to reduced flexibility.
  ✓ Fewer options for custom spraying and harvesting
  ✓ Sharing equipment with neighbors
Summary

• In general, the amount of grain yield increase is often too small to measure with precision in field experiments.

• These small increases may be of economic importance, especially with no insecticide in the northern corn belt.

• In Wisconsin, corn grain yield response to narrower rows was variable. Silage response was more consistent.
  ✓ In 32 trials, grain yield was greater in 6 trials with narrow rows, but was less in 5 trials.
  ✓ In 13 trials, silage yield was greater in 4 trials with narrow rows, but was less in 1 trial.
Relative Impact of Management Decisions on Grain Yield in Wisconsin

- **Row Spacing**: 30-inches to 15-inches = 0 to 5% change
- **Hybrid**: Top to bottom ranking = 0 to 30% change
  - Presence or absence of genetic traits = 0 to 100% change
- **Date of Planting**: May 1 to June 1 = 0 to 30% change
  - Also need to add moisture penalty
- **Plant Density**: 32,000 to 15,000 plants/A = 0 to 22% change
- **Rotation**: Continuous v. Rotation = 5 to 30% change
- **Soil Fertility**: 160 v. 0 lb N/A = 20 to 50% change
- **Pest Control**: Good v. Bad = 0 to 100% change
  - Cultivation: Yes v. No = 0 to 10% change
- **Harvest Timing**: Oct. 15 to Dec. 1 = 0 to 20% change
Farmers Will Likely See Success With Narrow Rows When:

• Total acreage of corn and soybeans is large
• Yields in recent years have surpassed 160 bu/A
• Plant population exceeds 32,000 plants/A
• Have the agronomic “package” to optimize the narrow row environment for high yields (i.e. early planting date, high fertility, good weed control, early and timely harvests)
• Present corn planting and harvest equipment is worn and needs replacement

Pendleton, 1966 modified by Lauer, 2000