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

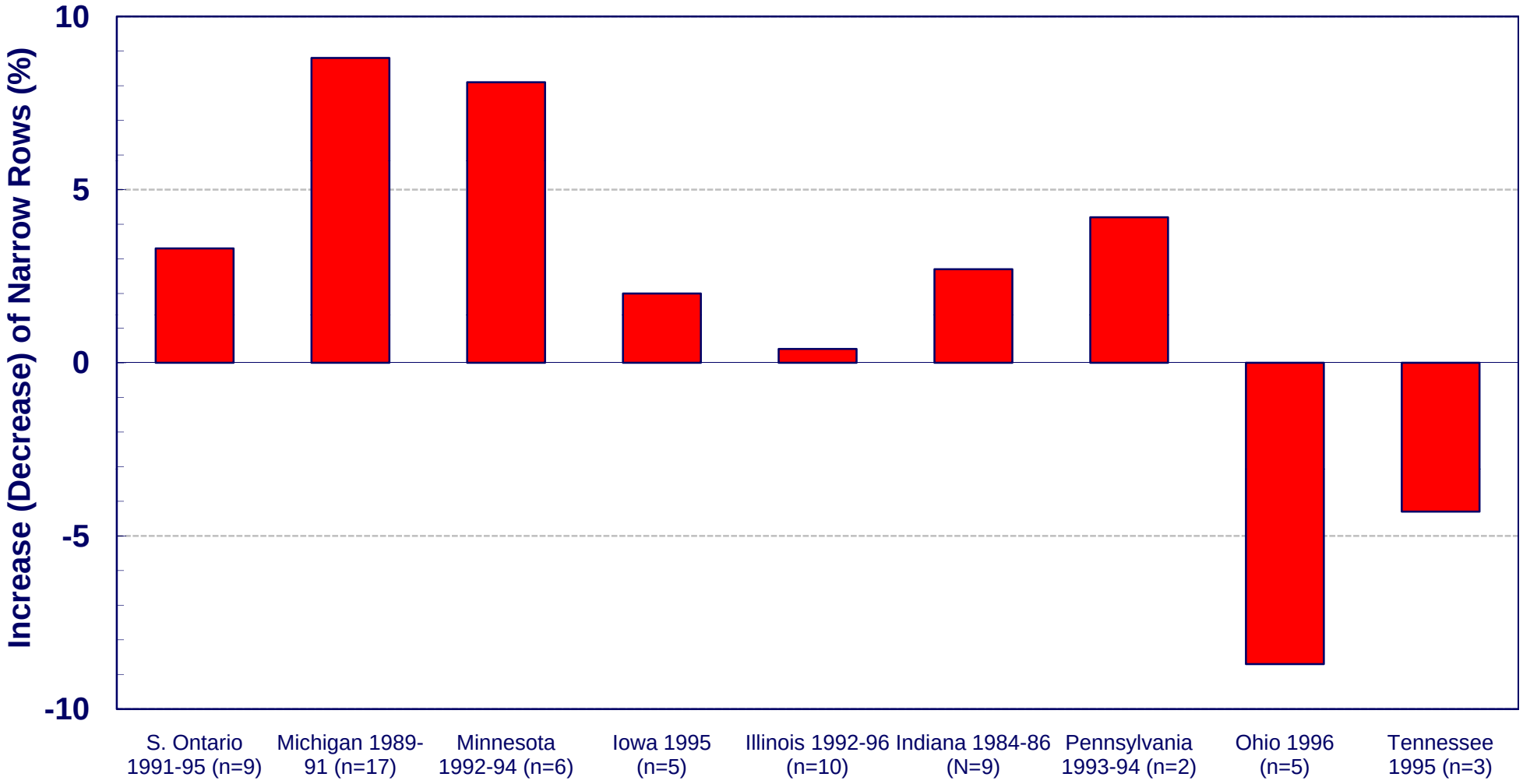
- Recent resurgence in grower interest to use one planter to establish corn, soybeans, and/or sugar beet.
- Grain yield increases with row spacing narrower than 30-inches in 7 of 11 AJ references.
  - ✓ Increases are larger and more consistent in the northern Corn Belt.
- Silage yield increases with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

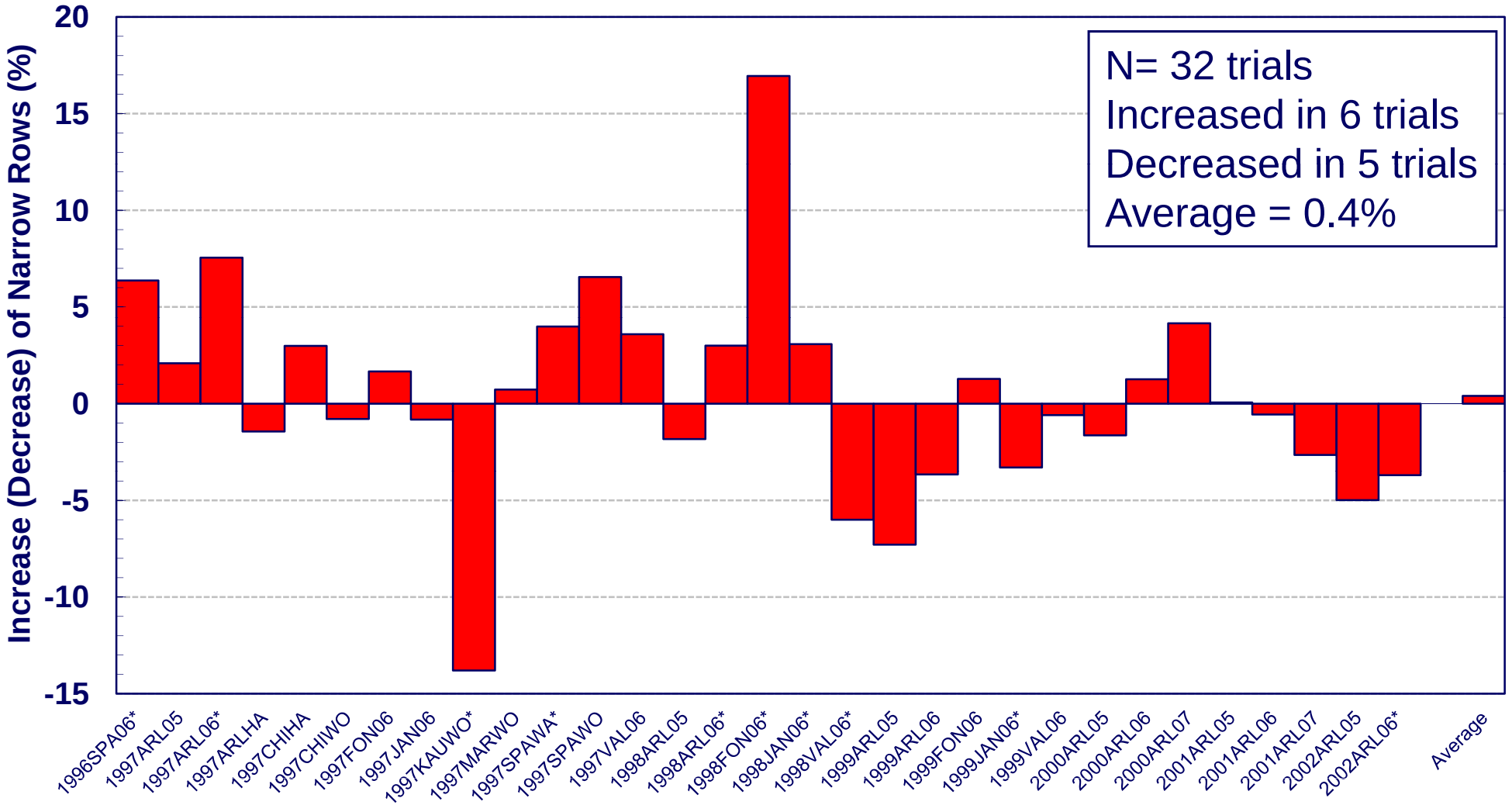
Management Interactions With Row Spacing Since 1960

- 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)

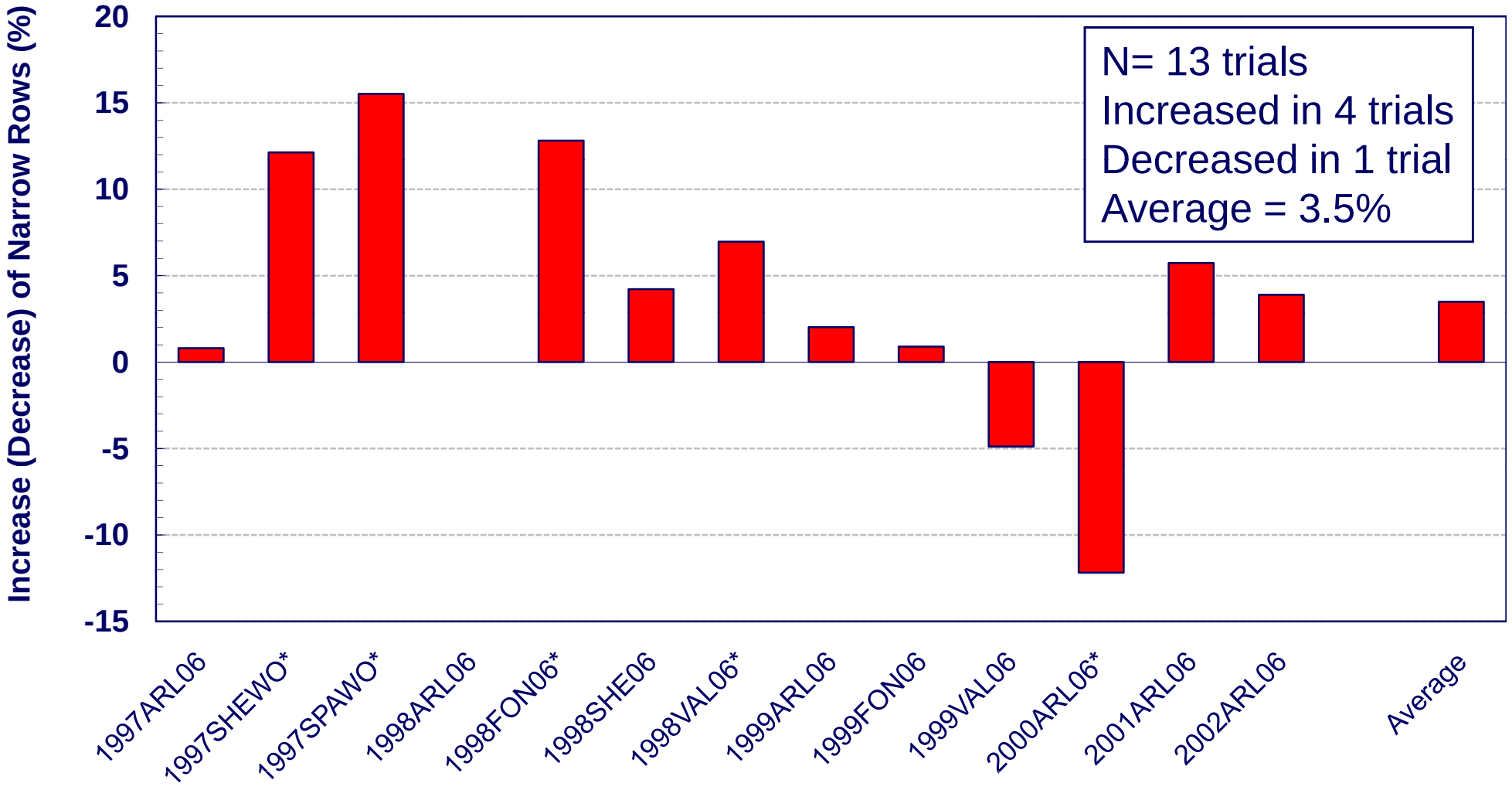
Corn Grain Yield Change For Narrower Compared to 30-inch Row Spacing (University research - Paszkiewicz, 1996)



Corn Grain Yield Change For Narrower Compared to 30-inch Row Spacing in Wisconsin



Corn Forage Yield Change For Narrower Compared to 30-inch Row Spacing in Wisconsin

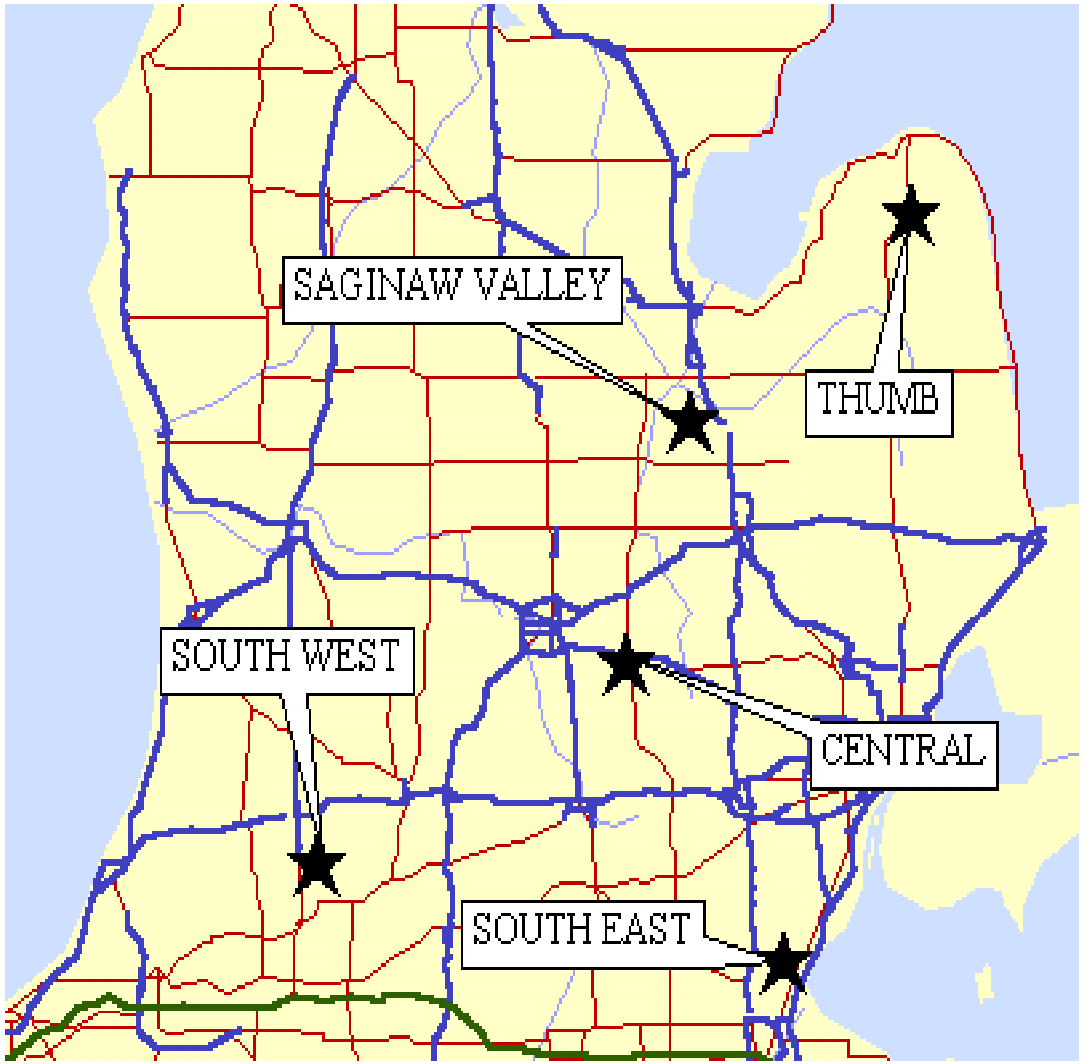


Michigan

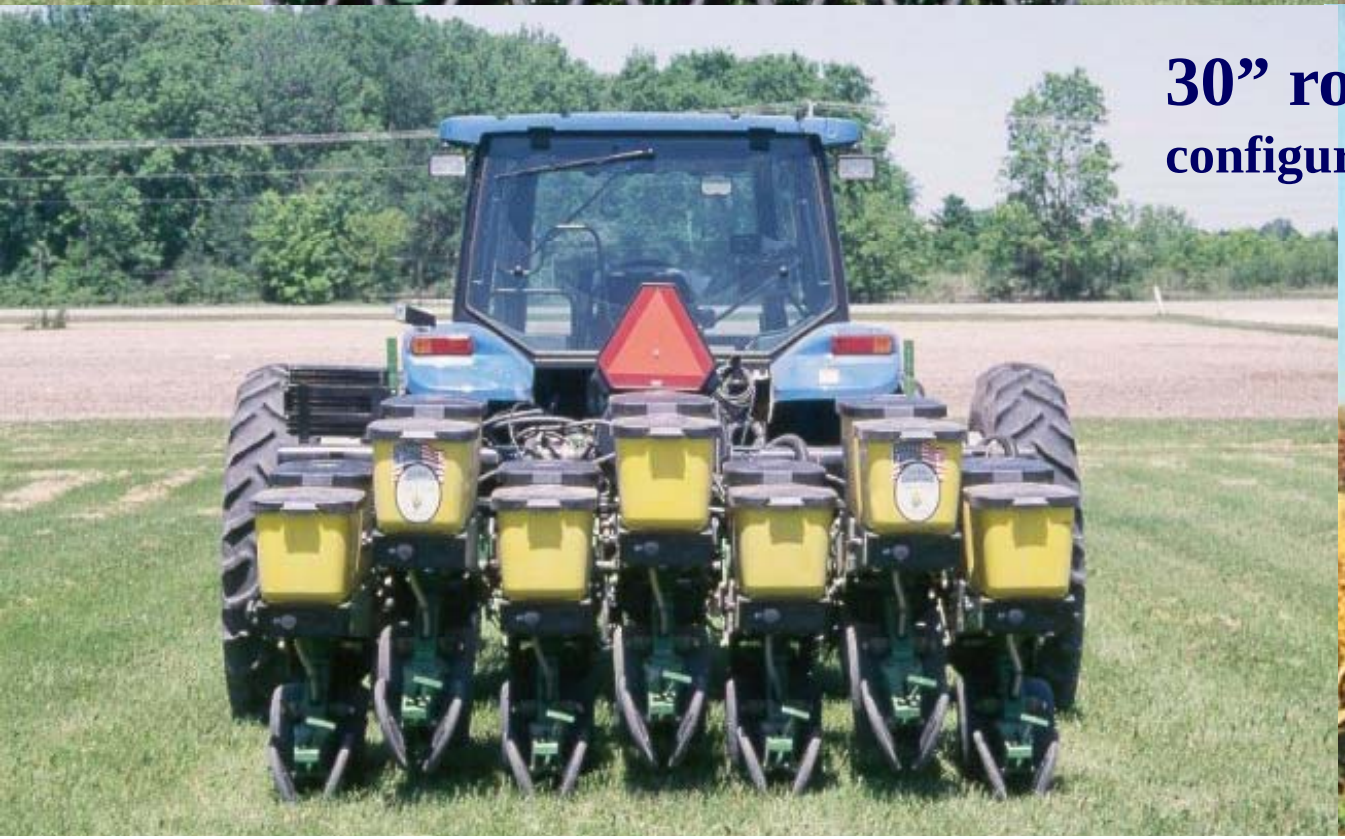
Widdicombe and Thelen, 2002 (AJ 94:1020)

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



15” row configuration

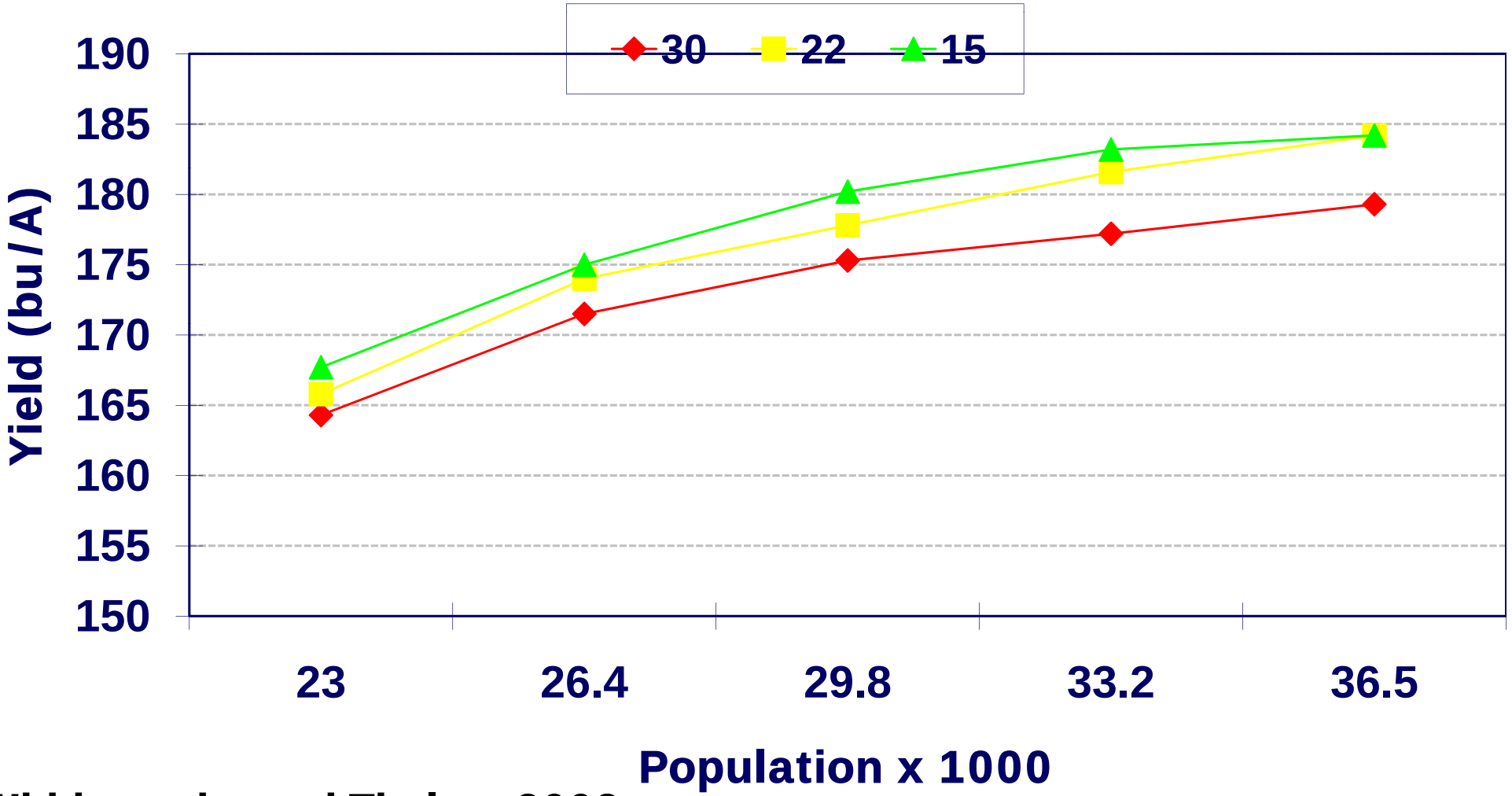


30” row configuration

Corn response to row width in Michigan 1998-1999. Each value is the mean of 880 plots

Row width	Yield	Moisture	Stalk Lodging
(in)	(bu/A)	(%)	(%)
30	177 c	19.6 a	1.60 b
22	181 b	19.2 b	1.92 a
15	184 a	19.2 b	1.65 b

Corn Performance in Narrow Rows in Michigan 1997-99 Three Year Averages

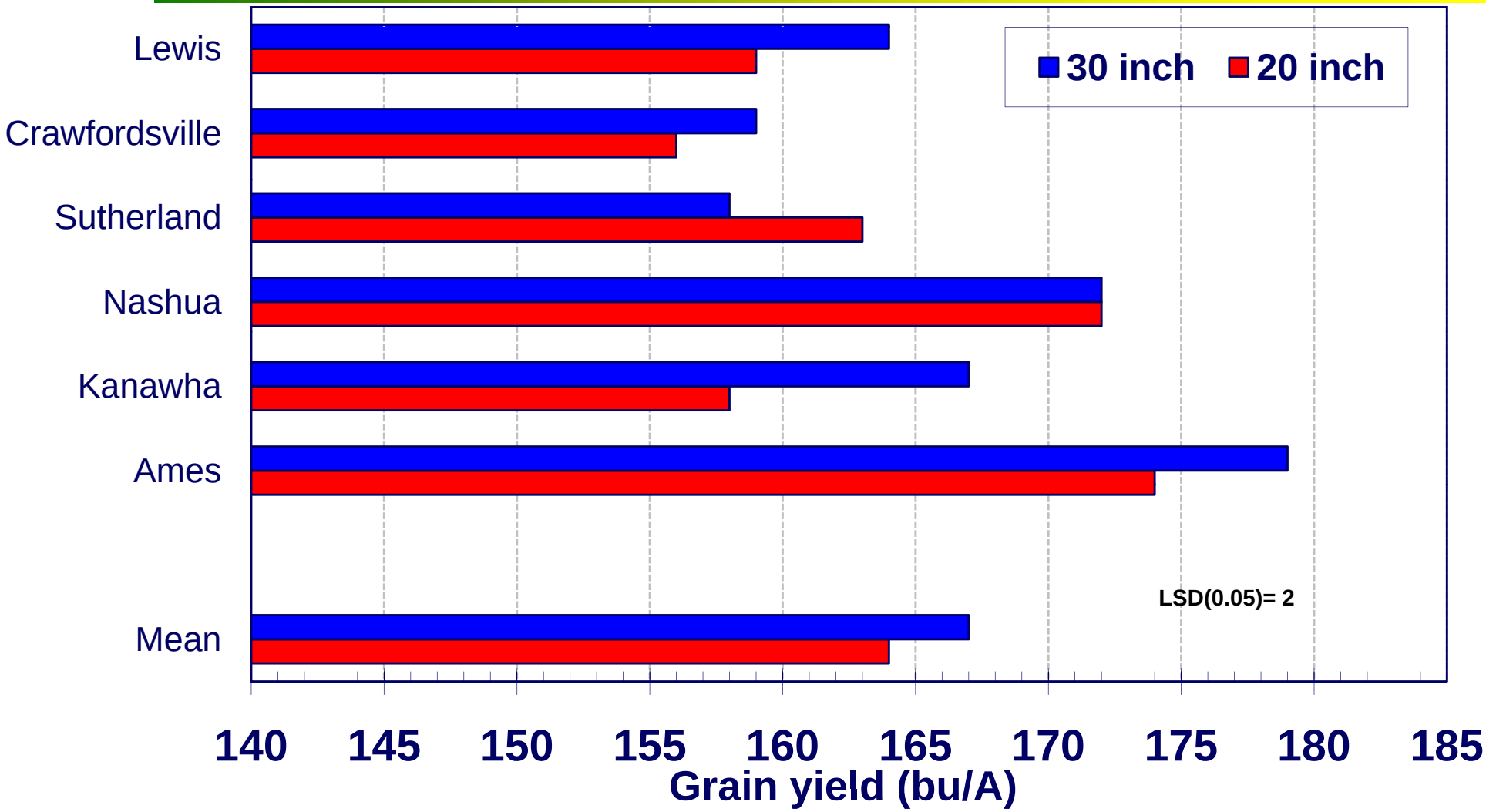


Widdecombe and Thelen, 2002

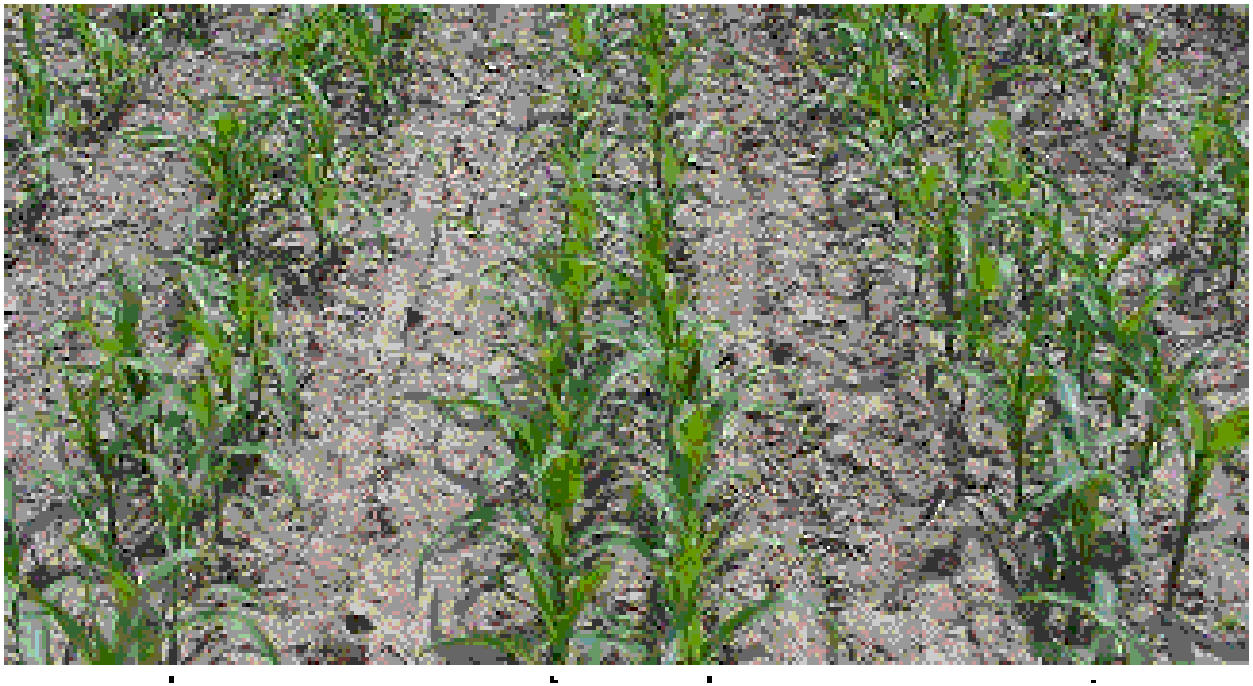
Conclusions from Michigan

- 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)



Paired (“Twin”) Row Corn

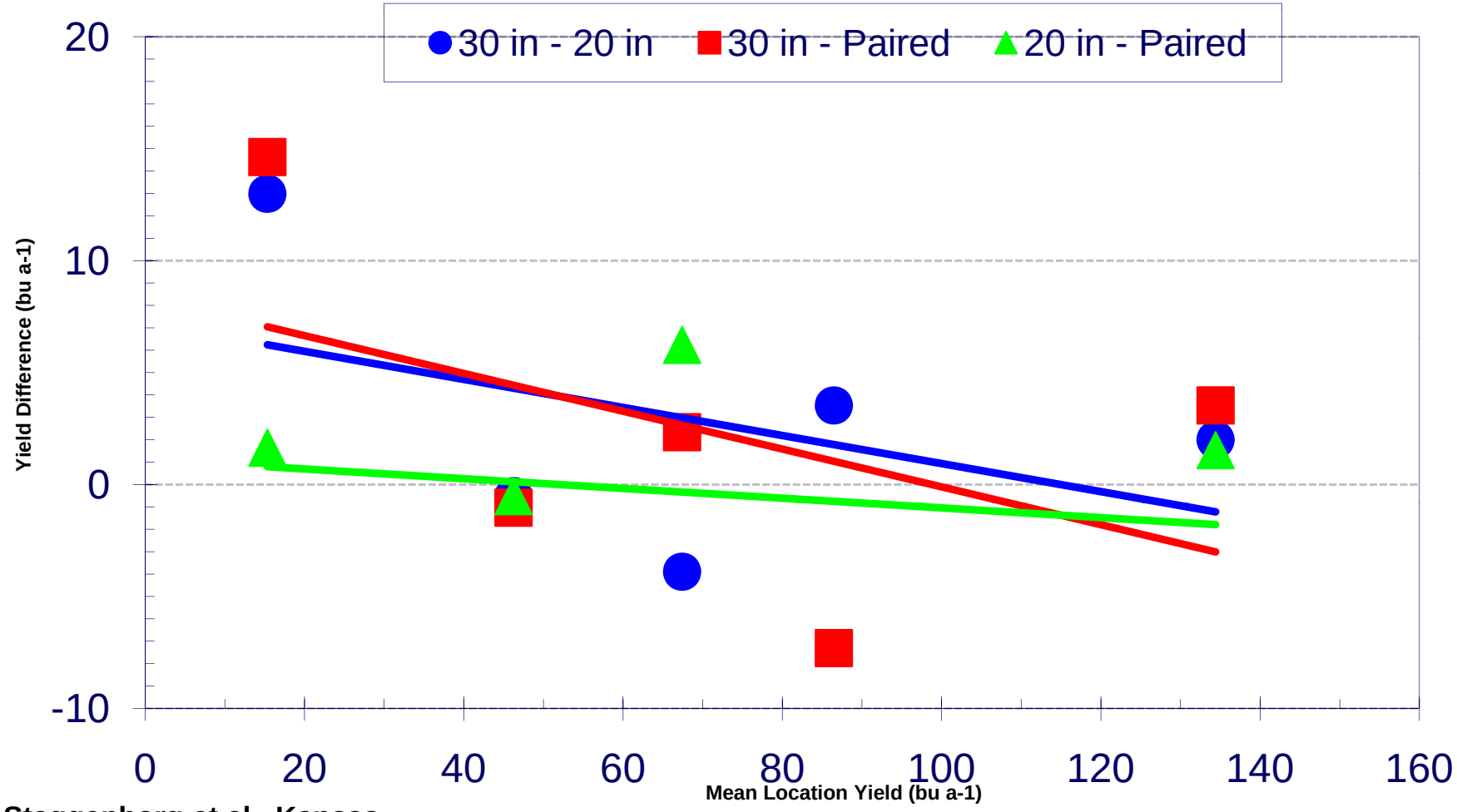


- Karlen and Kasperbauer (1989) reported a 9% decrease in corn yield in the SE USA from twin rows compared to 30 in single rows.
- Ottman and Welch (1989) reported no differences between single 30 in rows and twin rows on 30 in centers (- 2% difference).

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

Row Configuration Comparisons in Kansas (Staggenborg et al.)

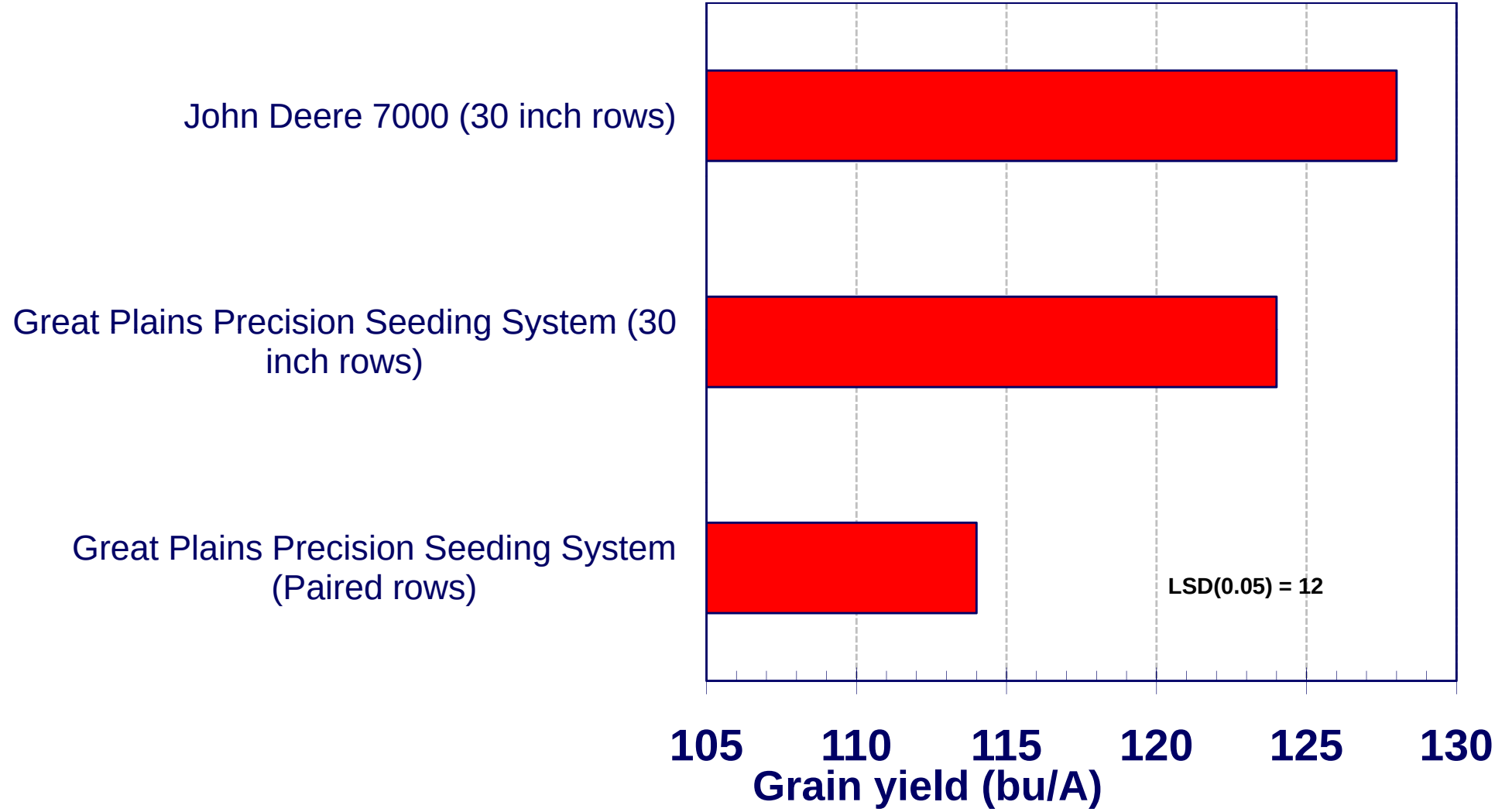


Staggenborg et al., Kansas

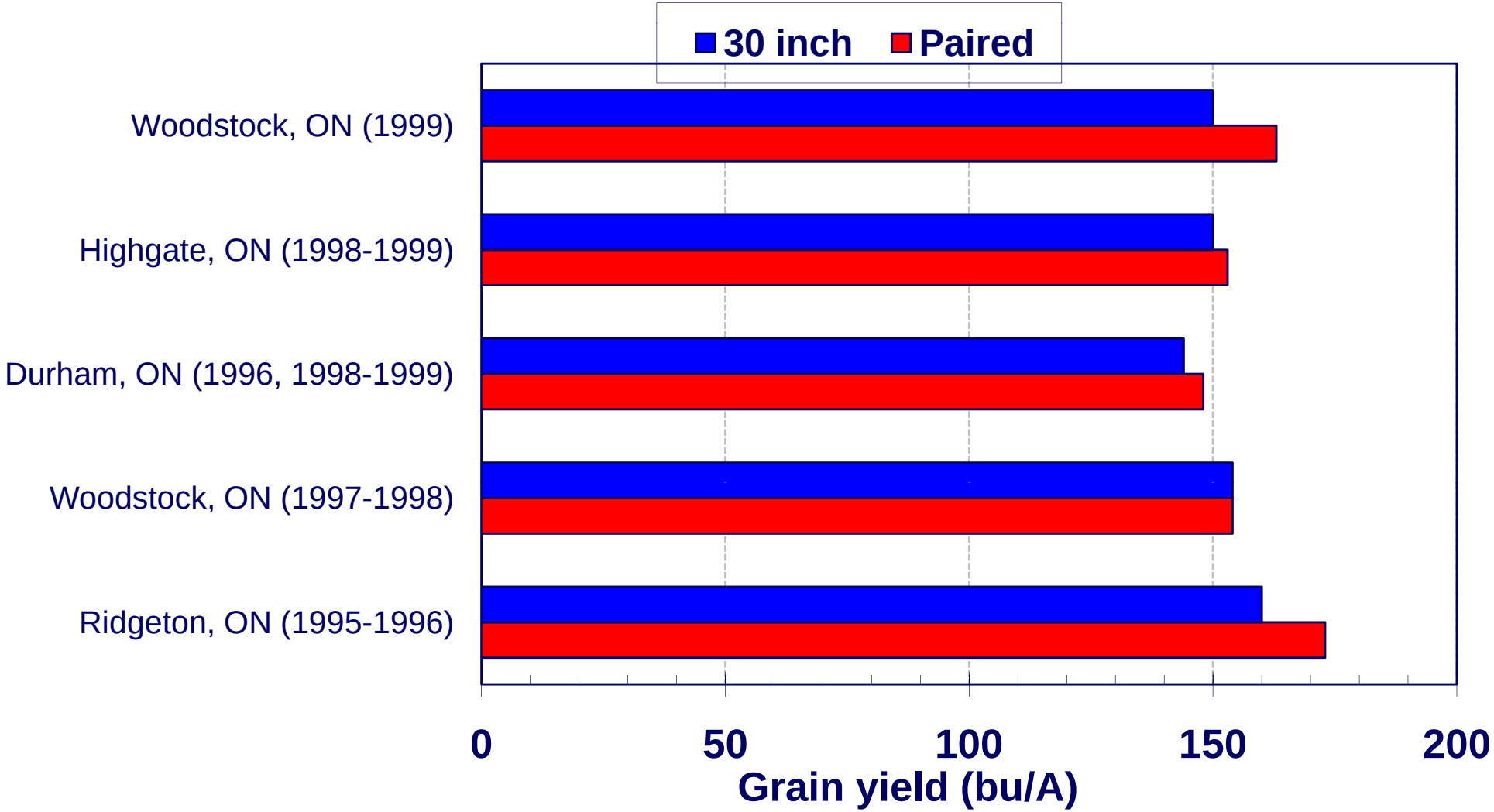
Conclusions from Kansas

- 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

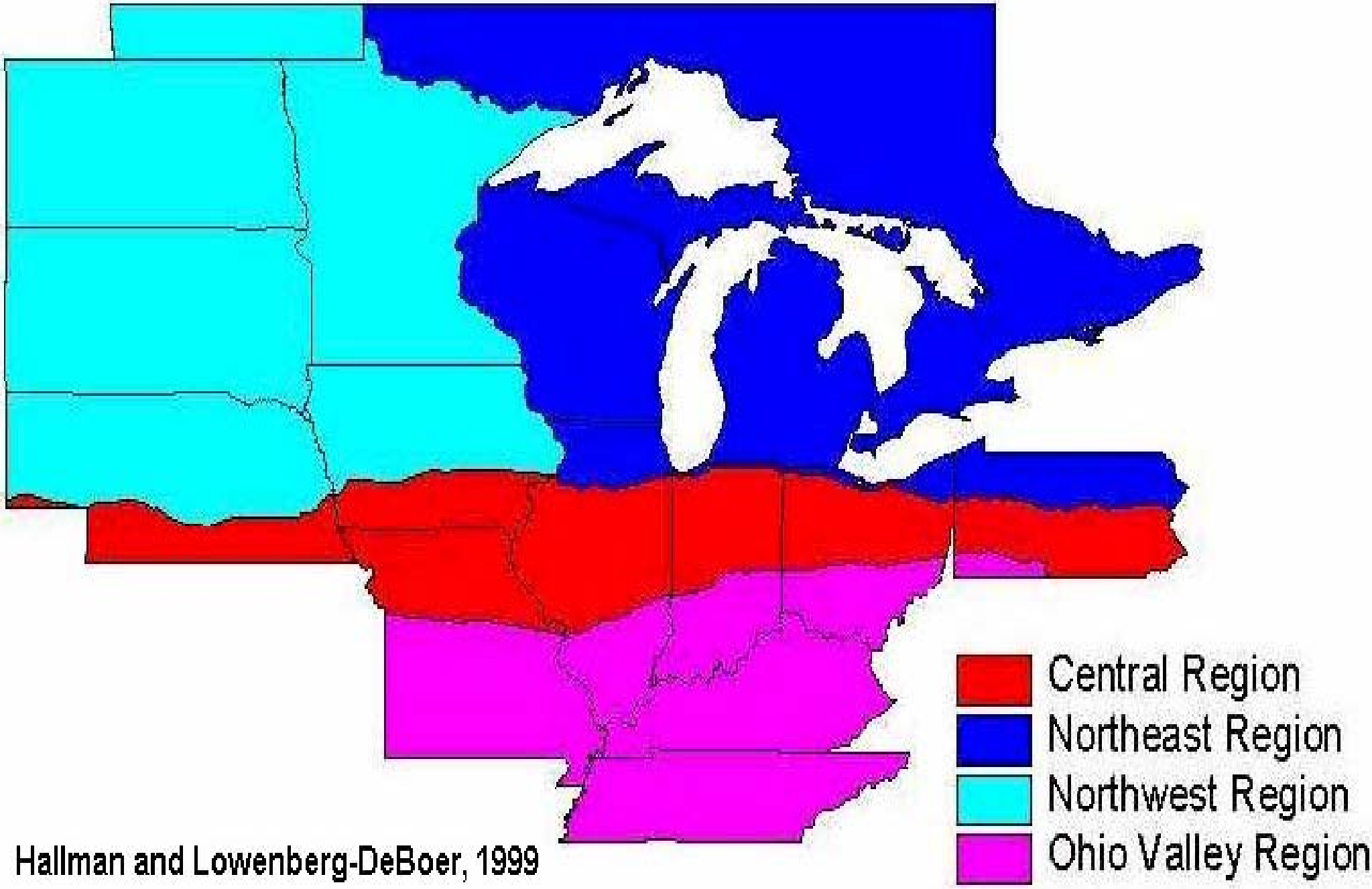
Paired Row Comparisons in Missouri (Nelson and Smoot)



Paired Row Comparisons in Ontario (Stewart)

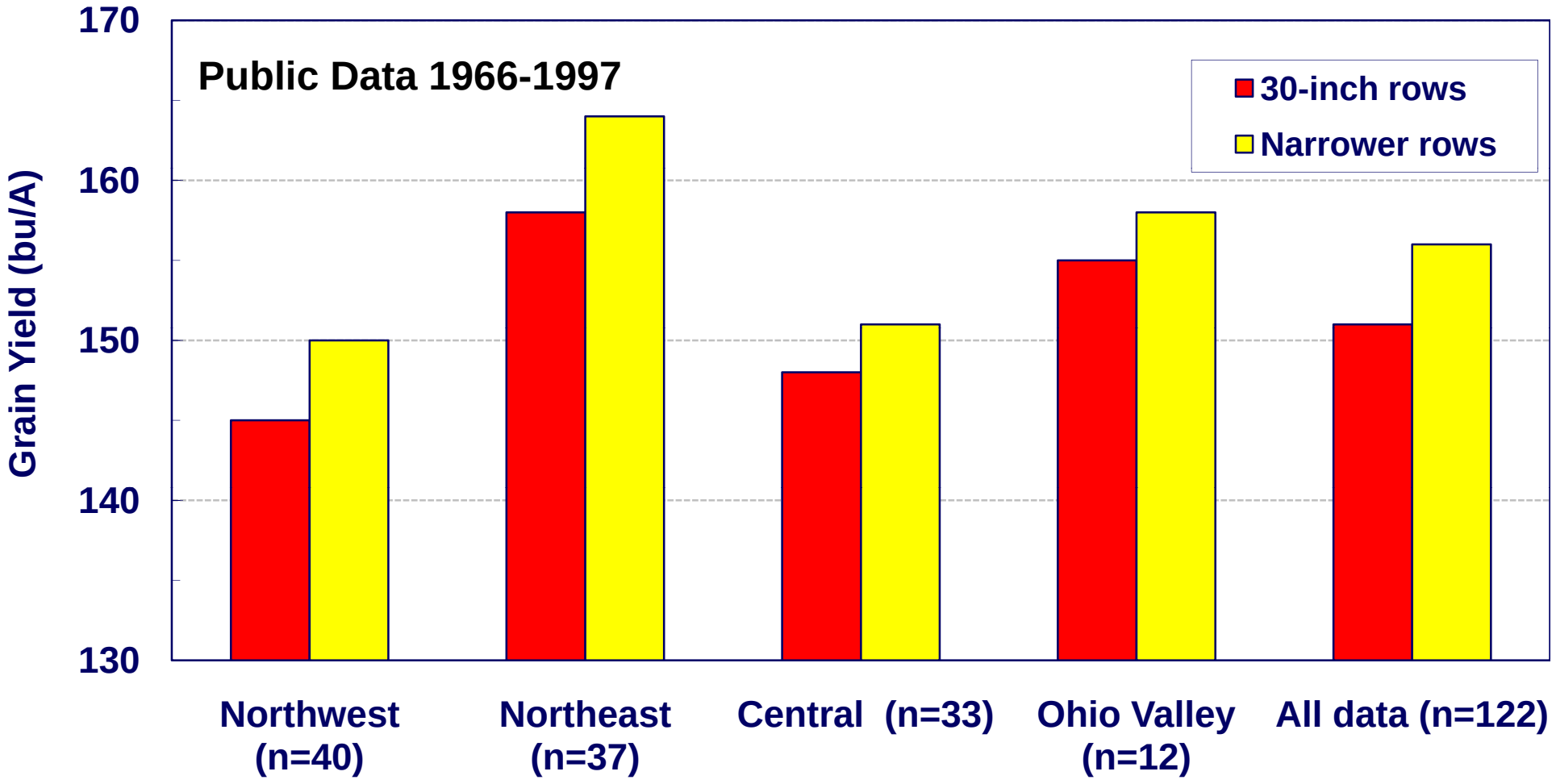


Regions used to group narrow row corn yield data



Hallman and Lowenberg-DeBoer, 1999

Corn Yield Comparison of 30-inch and Narrower Row Spacing



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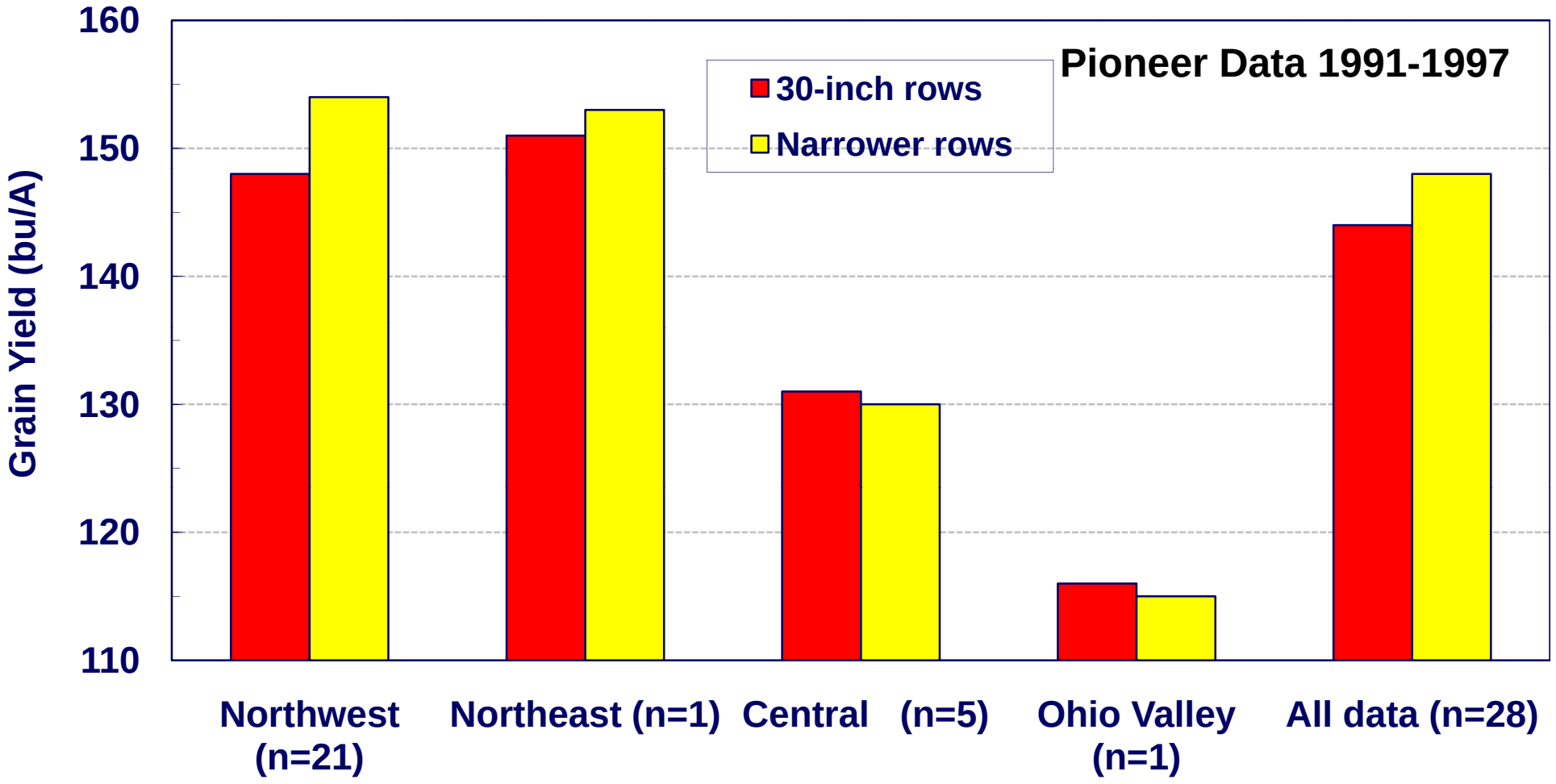


Hallman and Lowenberg-DeBoer, 1999

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.

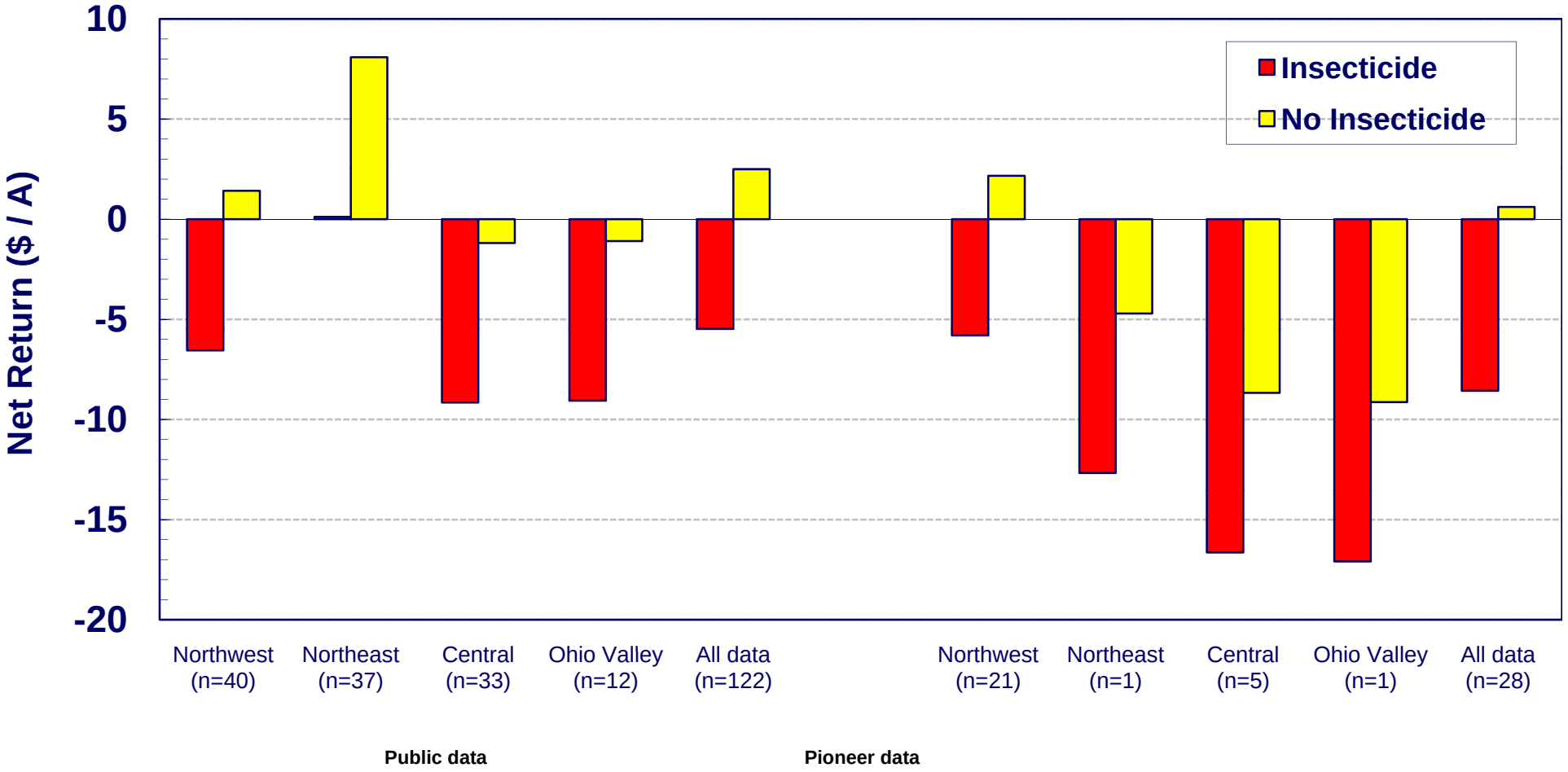
Hallman and Lowenberg-DeBoer, 1999

Cost Assumptions Used in Economic Analysis

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

Hallman and Lowenberg-DeBoer 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