



Conservation Tillage Systems for Corn on Corn: Midwest Perspectives

**Tony J. Vyn,
assisted by colleagues, graduate students,
technicians, and farmers**





What is a Conference?

- **A conference is a gathering of important people who individually can do nothing, but who together can decide to do nothing!**
Fred Allan

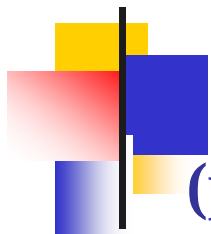


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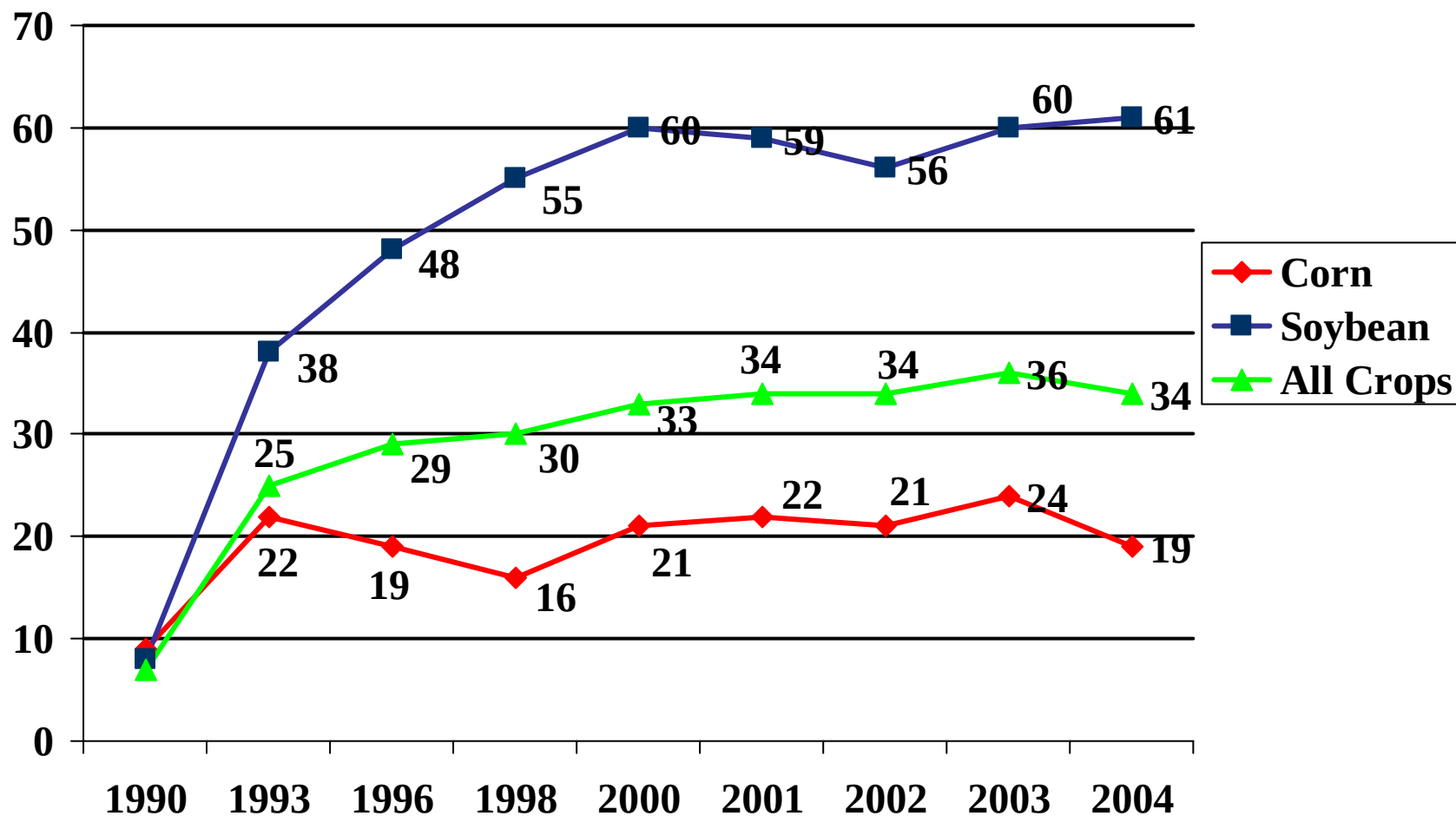
What is a No-Till Conference?

A no-till conference is a gathering of experienced farmers who individually no-till, but who together can decide how to do nothing better!



Indiana Tillage Data, 1990-2004

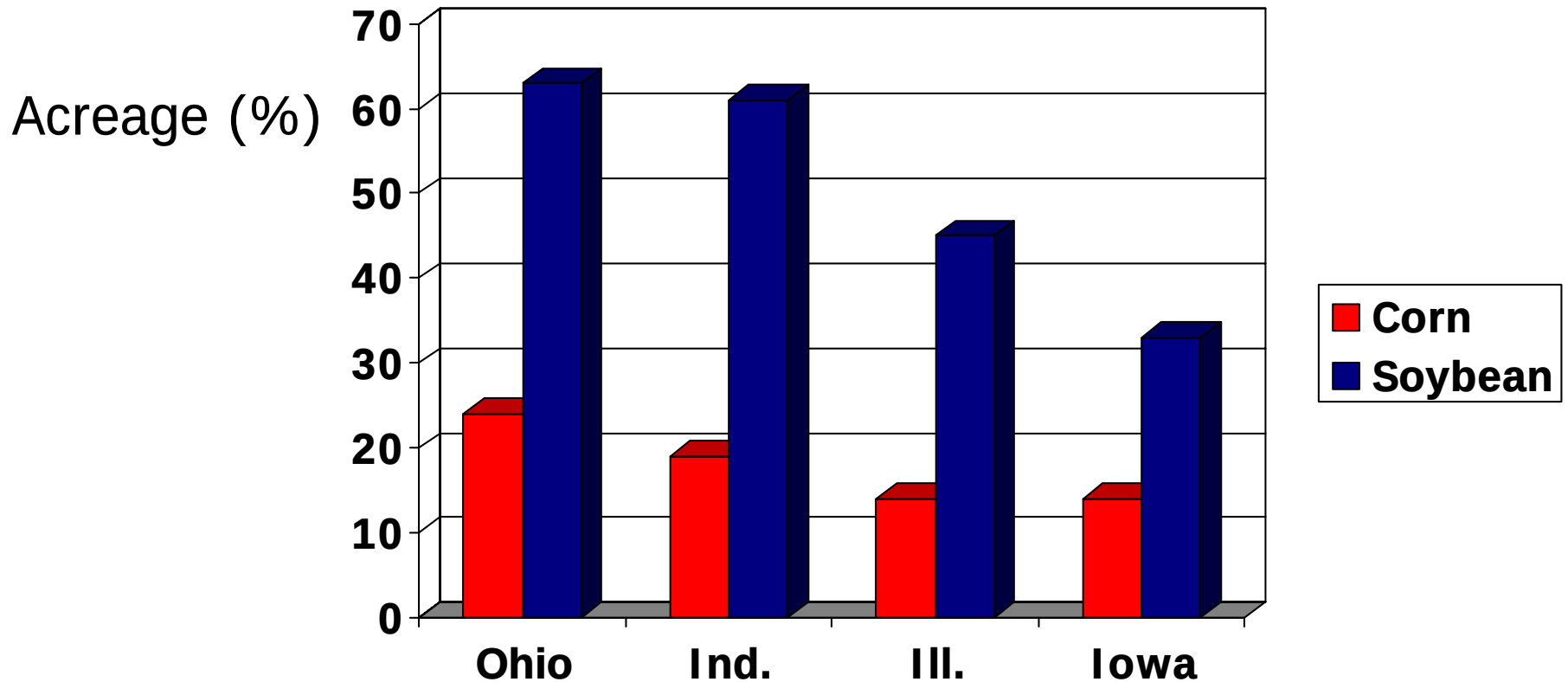
(percent of total cropland for specific crop in a no-till system)



Source: Purdue University-Transect Data



4-State No-till Adoption in 2004



Source: CTIC National Crop Residue Survey

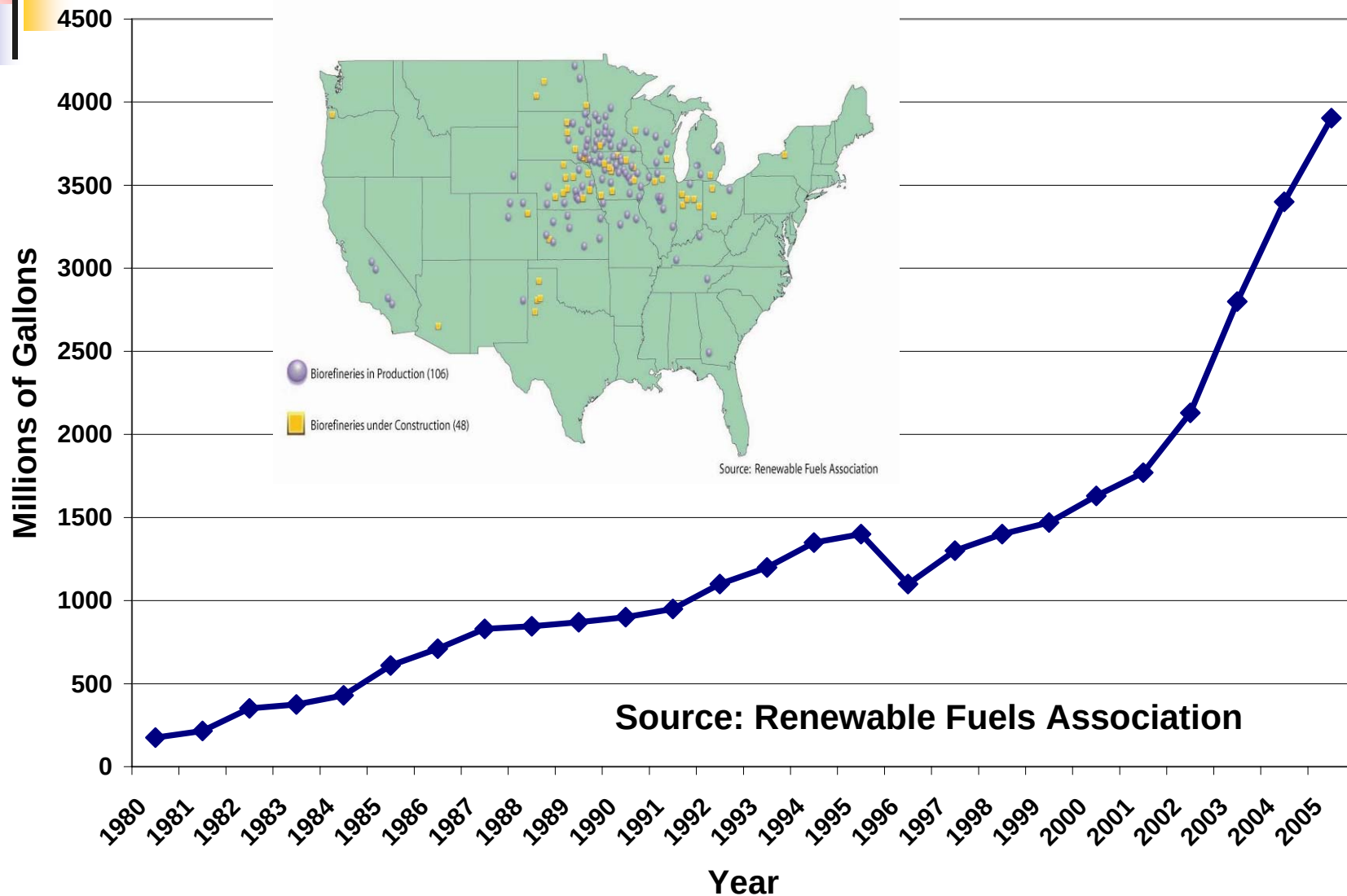
Corn after Soybean versus Corn after Corn?



Photo Credit: Greg Stewart

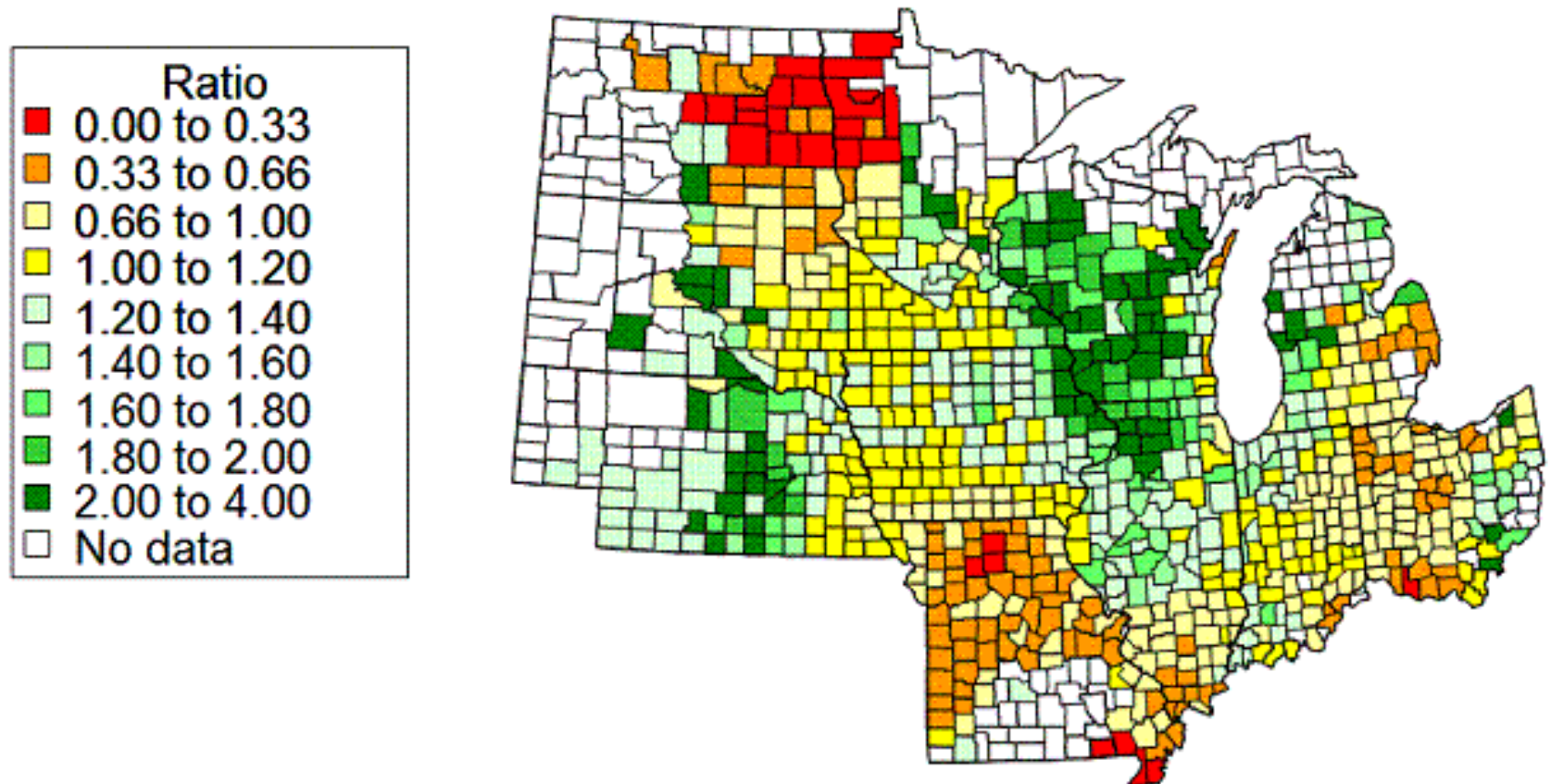
Grain-based U.S. Ethanol Production, 1980-2006

U.S. Ethanol Biorefinery Locations



Ratio of Corn to Soybean Acres (2005)

Appendix Figure 6. Corn Acres Divided by Soybean Acres, 2005



Source: G. Shnitkey, Univ. of Illinois, Farm Economics Facts and Figures (Sept. 15, 2006)



What Kind of Corn-Dominant Rotation?

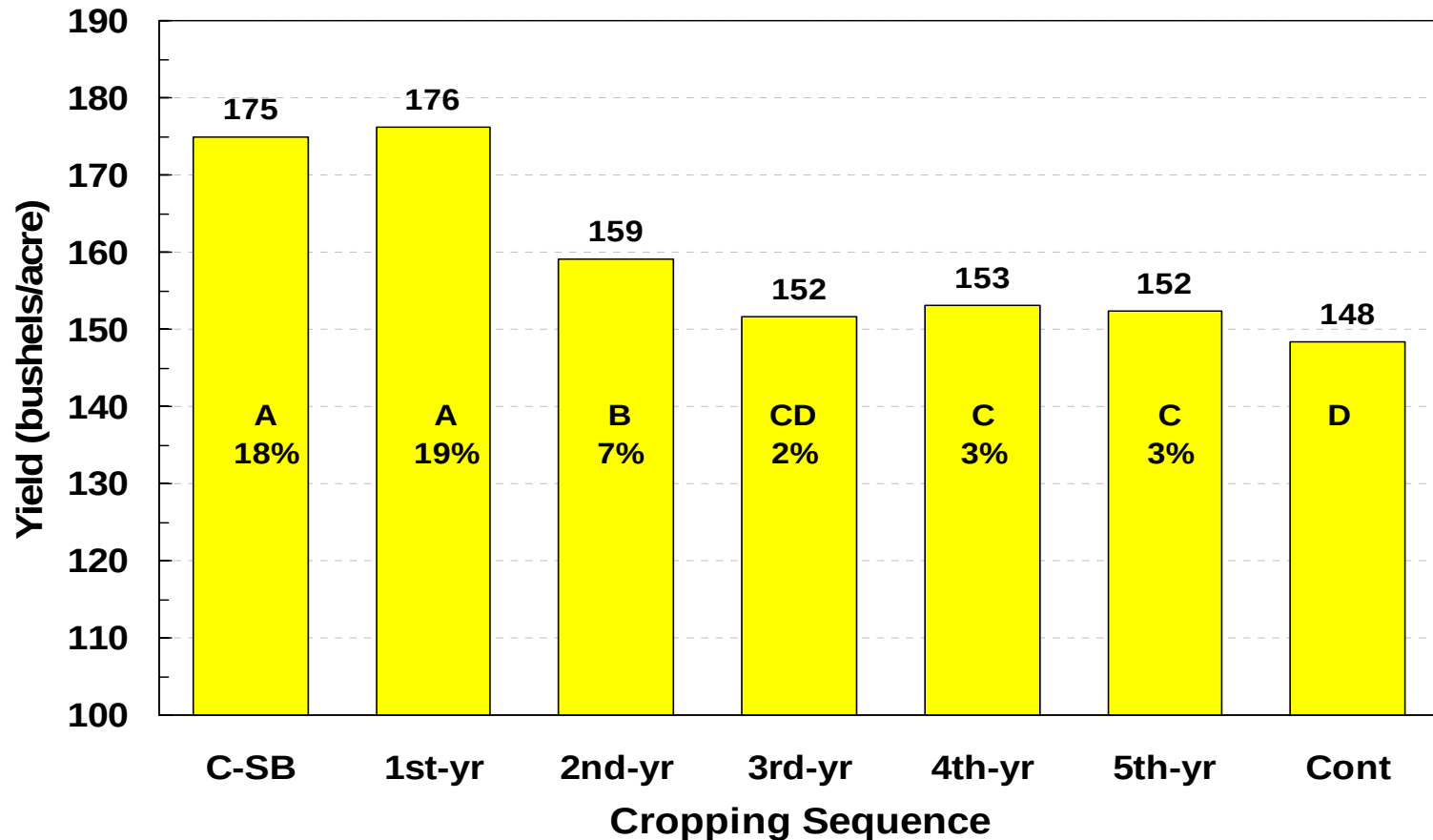
- **Continuous Corn**
- **Soybean-Corn-Corn**
- **Soybean-Corn-Corn-Corn**
- **Soybean-Corn-Corn-Soybean-Corn**
- **Soybean-Wheat-Corn-Corn-Corn**
- **Alfalfa-Alfalfa-Alfalfa-Corn-Corn-Corn**



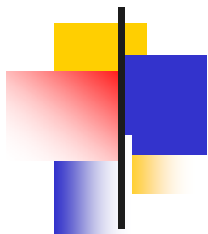


Corn Yield Means After 5 Years of Soybean

(Arlington, WI; 1987 to 2005; Control Treatments)

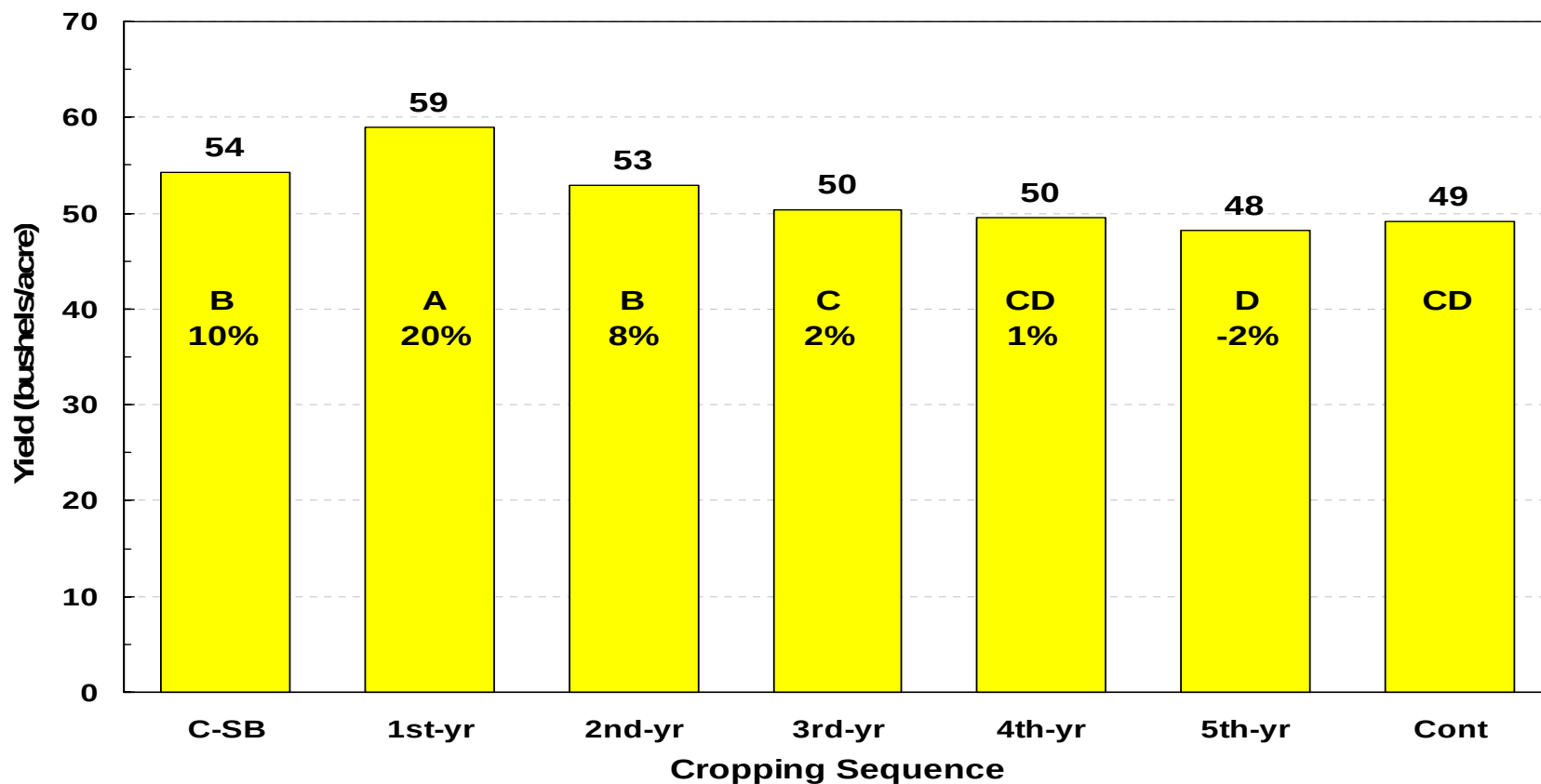


Source: J. Lauer and T. Stanger, Univ. of Wisconsin



Soybean Yield Means after 5 Years of Corn

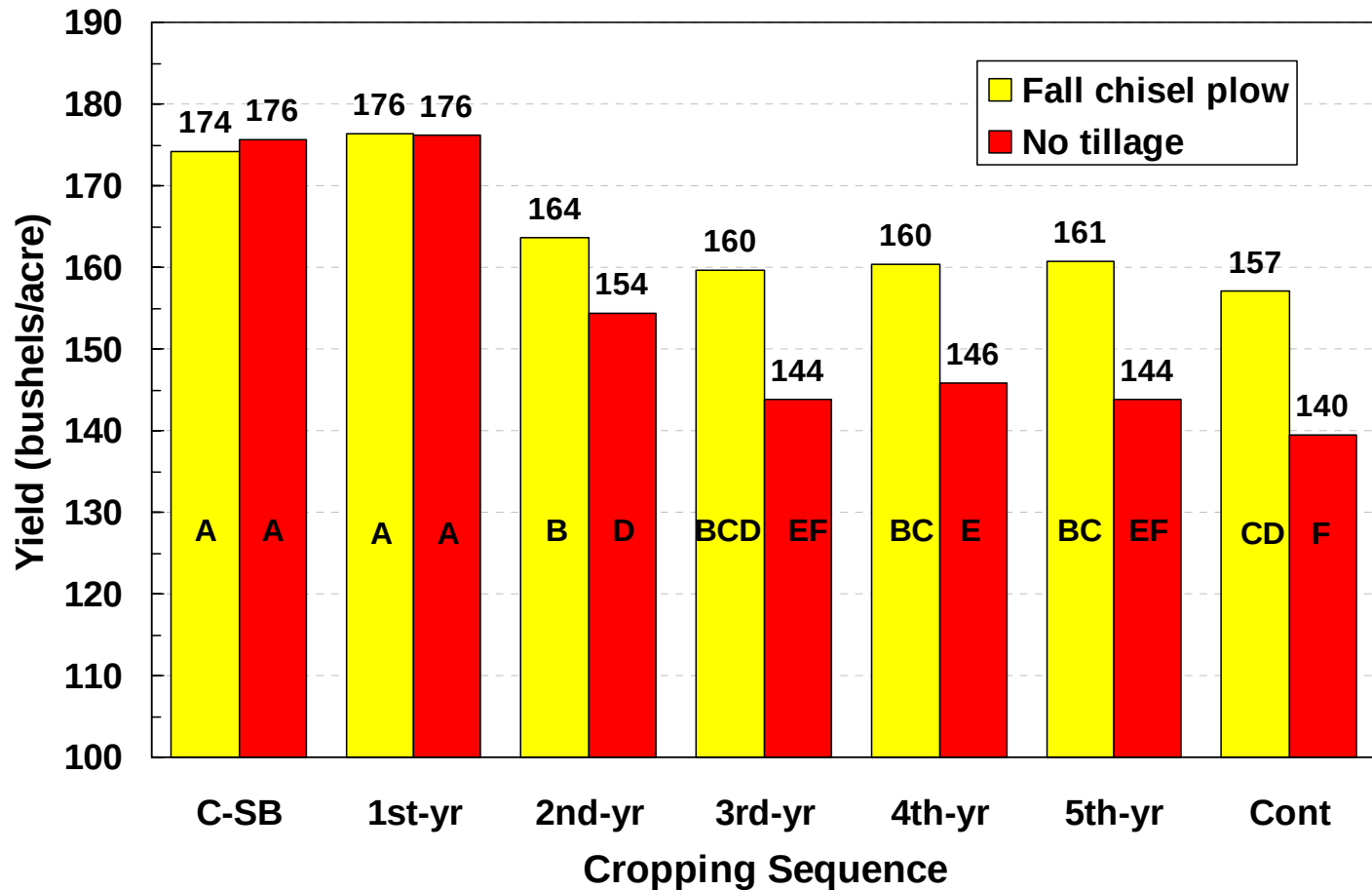
(Arlington, WI; 1987 to 2005; Control Treatments)



Source: J. Lauer and T. Stanger, Univ. of Wisconsin



Corn Yield Response to Tillage After 5 Years of Soybean (Arlington, WI; 1987 to 2005; Control Treatments)



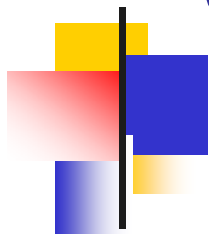
Source: J. Lauer and T. Stanger, Univ. of Wisconsin



Corn Response to Tillage & Rotation on Kenyon Loam Soil, Nashua, IA (1978-1997)

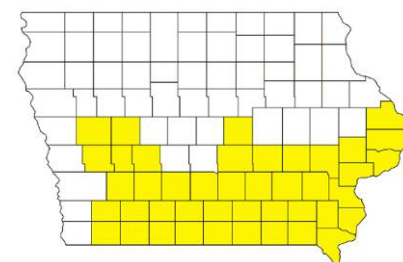
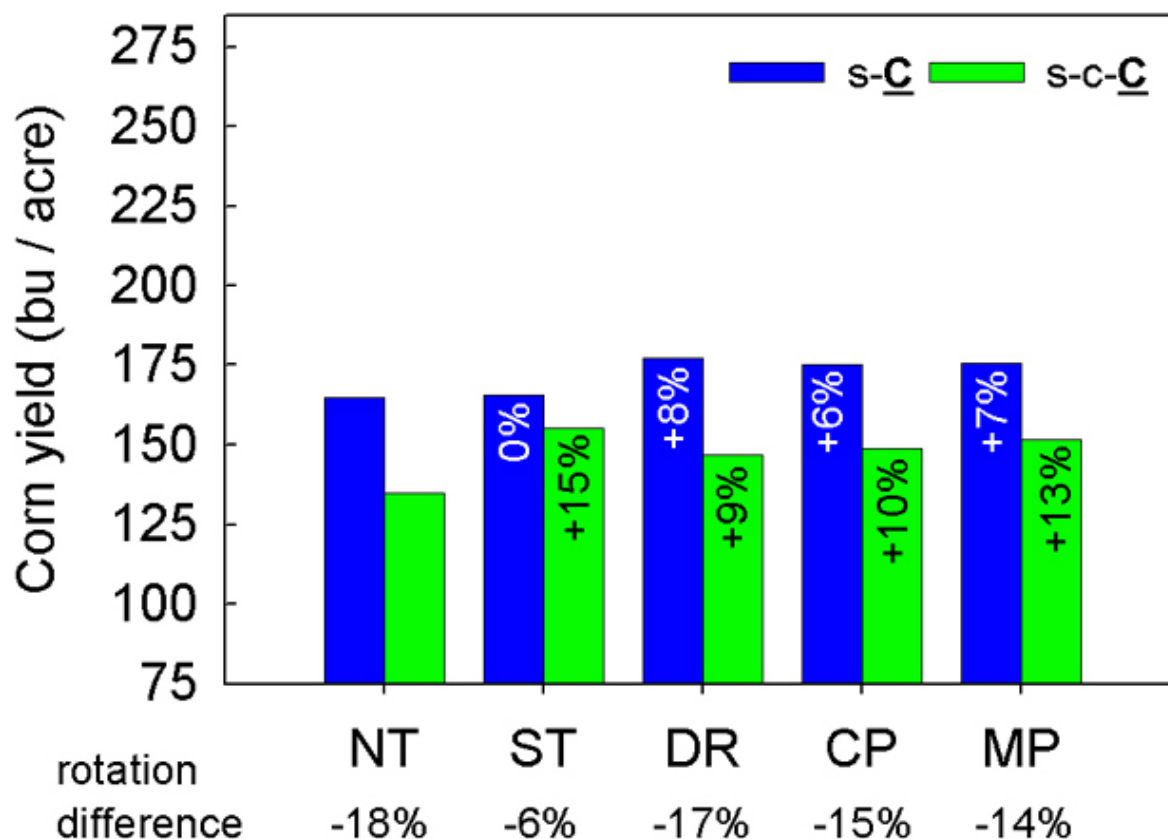
Tillage	Corn/Soybean		Con't. Corn		Yield Gain for Rotation
	bu/acre	Relative yield	bu/acre	Relative yield	
Plow	146ab	100%	137a	100%	6%
Chisel	147a	101%	132b	96%	11%
Ridge	142c	97%	129c	94%	10%
No-till	144bc	99%	123d	90%	17%

Source: Al Kaisu and Yin, 2004



Corn Yield Response to Rotation & Tillage: Southern Iowa Region (2002-2005)

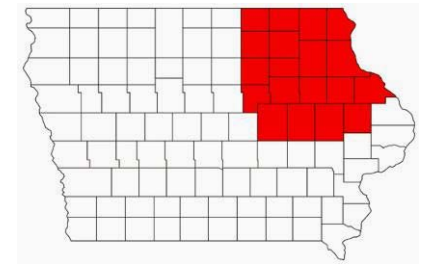
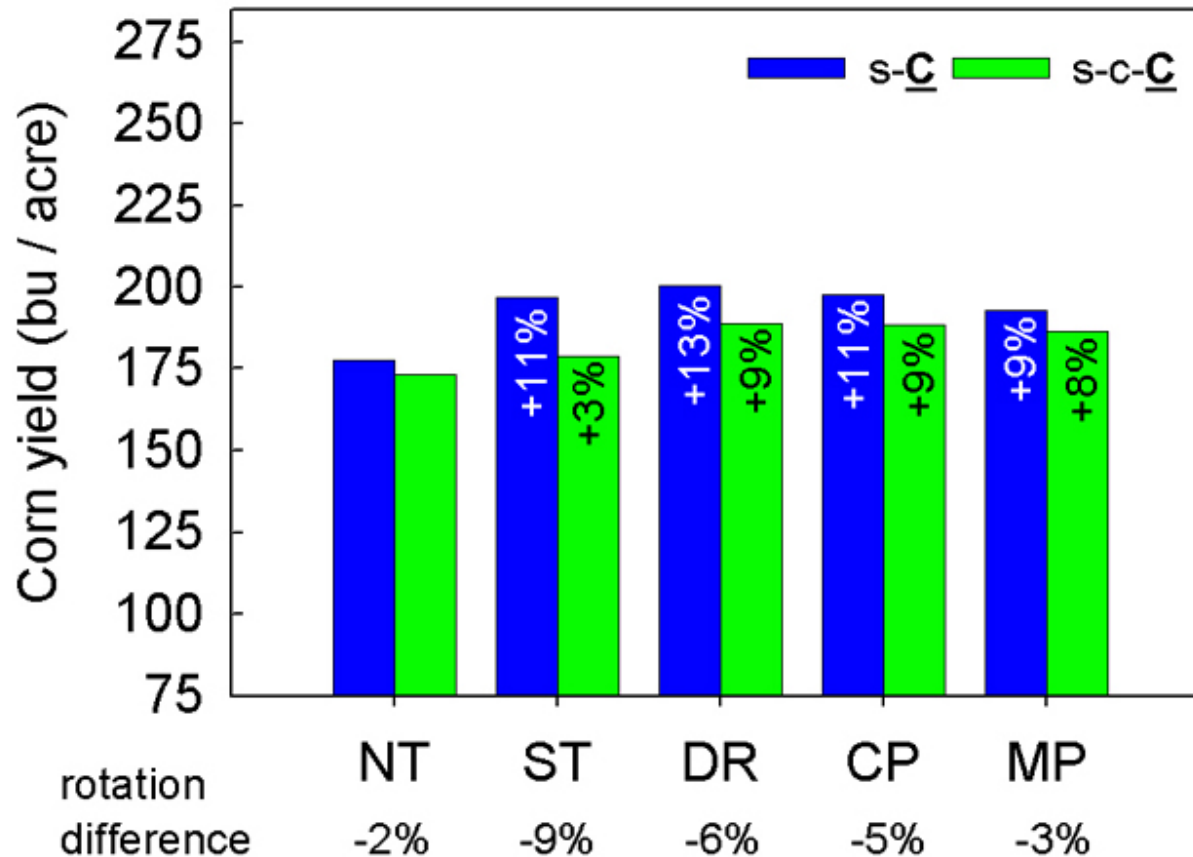
Crawfordsville & Chariton, IA



Source: M. Al Kaisi, Iowa State

Corn Yield Response to Rotation & Tillage: North-East Iowa Region (2002-2005)

Nashua, IA

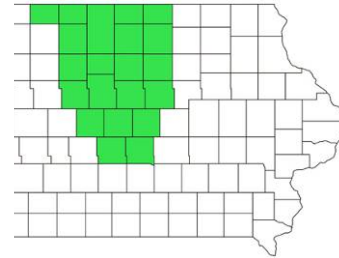
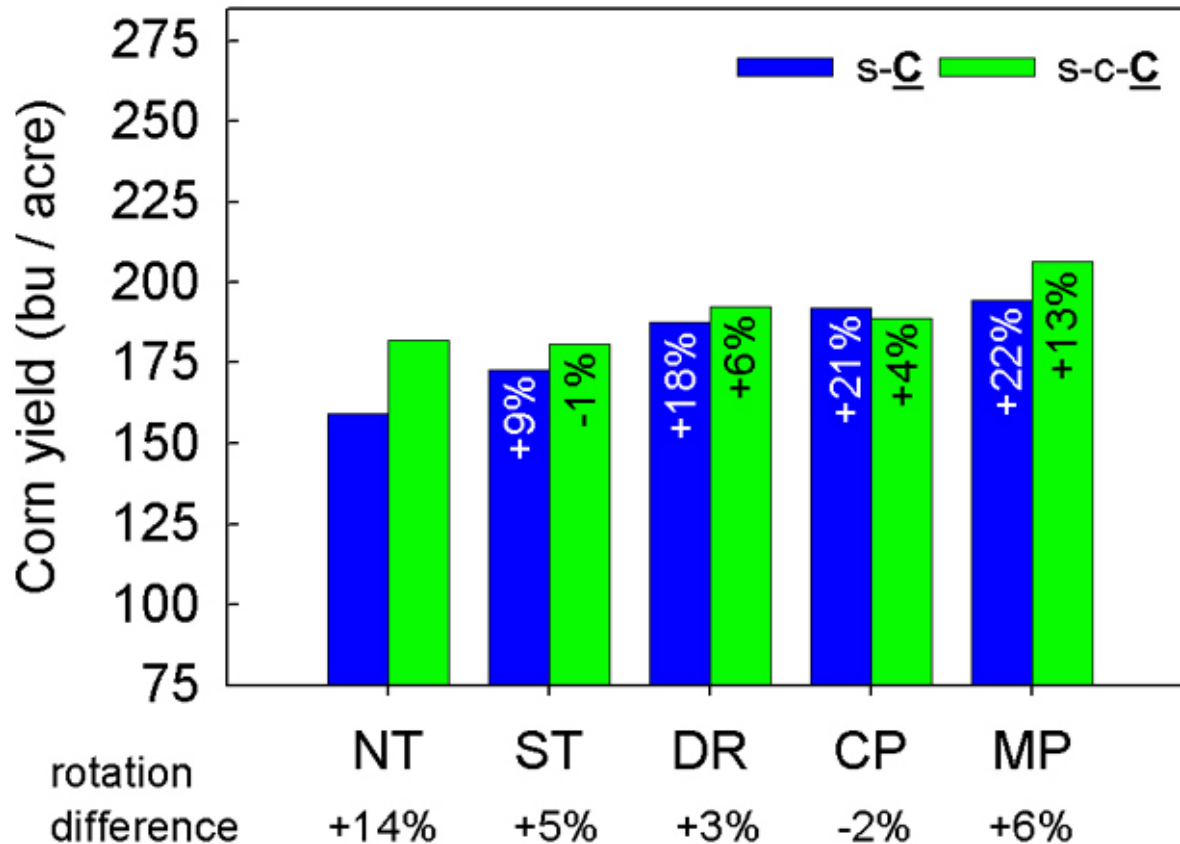


Source: M. Al Kaisi, Iowa State

Corn Yield Response to Rotation and Tillage: North-Central Iowa Region (2002-2005)

Ames & Kanawha, IA

M. Al-Kaisi, 2006, Iowa State Univ.





Going Deeper??



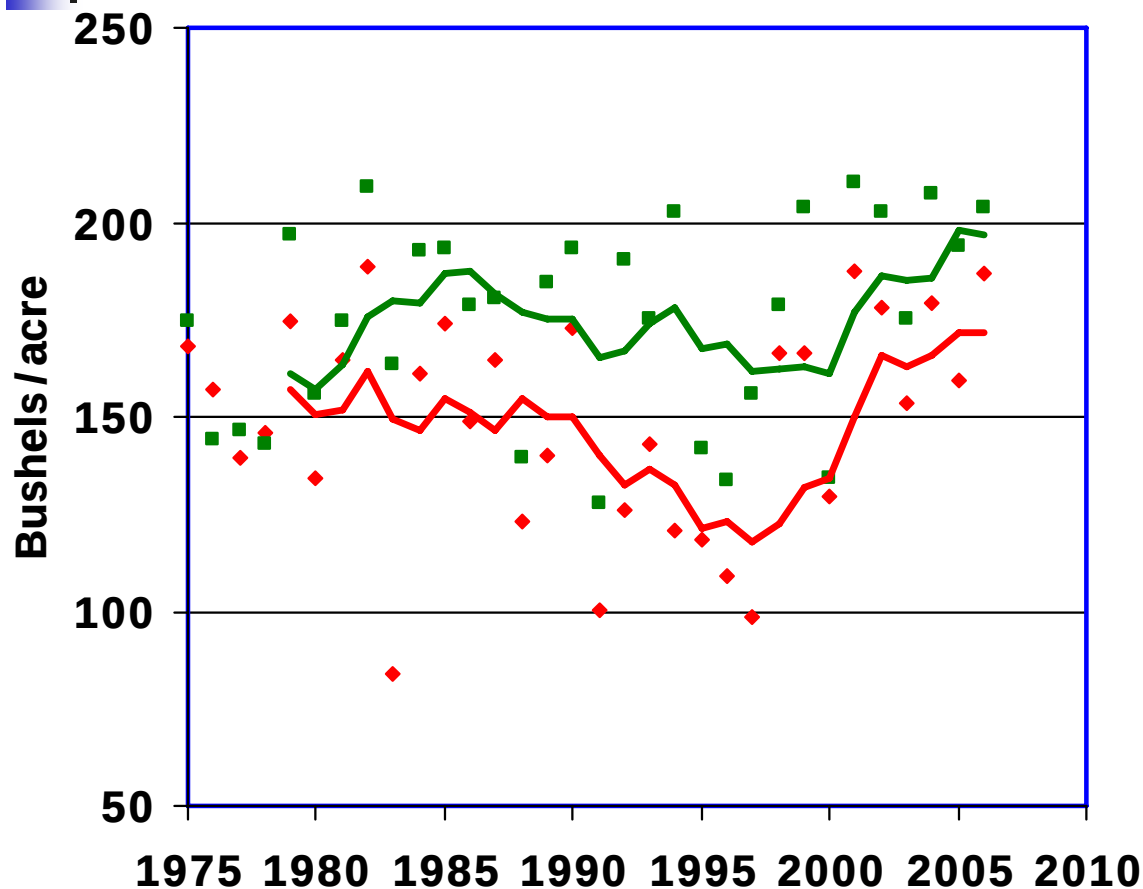
Corn Yield Response to Tillage & Rotation, Silty Clay Loam, Lafayette, IN, 1975-2006.



Tillage	Corn/Soybean		Con't. Corn		Yield Gain for Rotation
	bu/ac	% of plow yield	bu/ac	% of plow yield	
Plow	179.8	- - -	172.4	- - -	4%
Chisel	180.1	100%	167.7	97%	7%
No-till	175.2	97%	148.8	86%	18%



No-till Corn Yield in Rotation vs. Continuous Corn, West Lafayette, IN, 1975-2006.

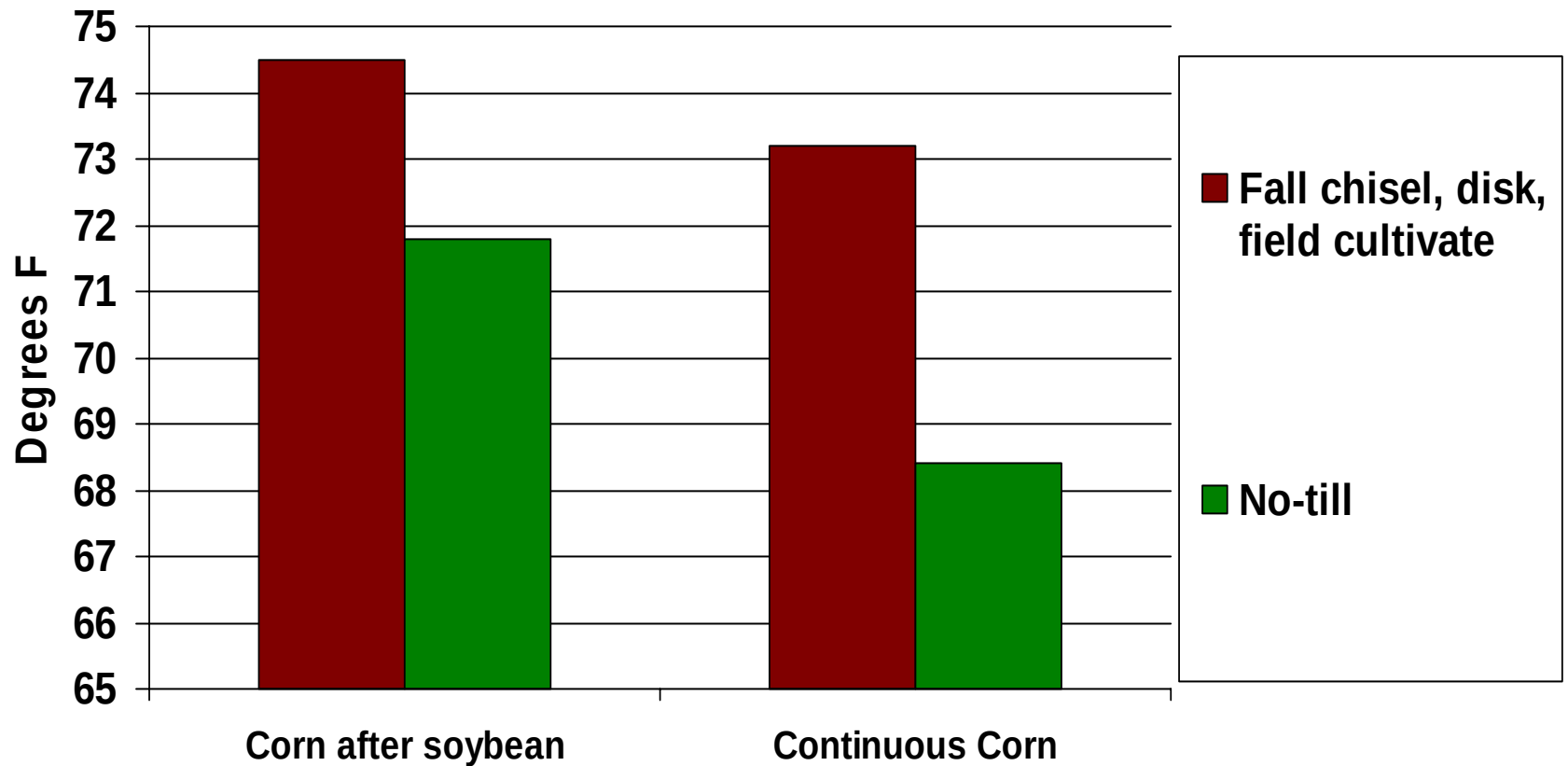


- ◆ Continuous corn
- Rotation corn/soybeans
- 5 per. Mov. Avg. (Continuous corn)
- 5 per. Mov. Avg. (Rotation corn/soybeans)

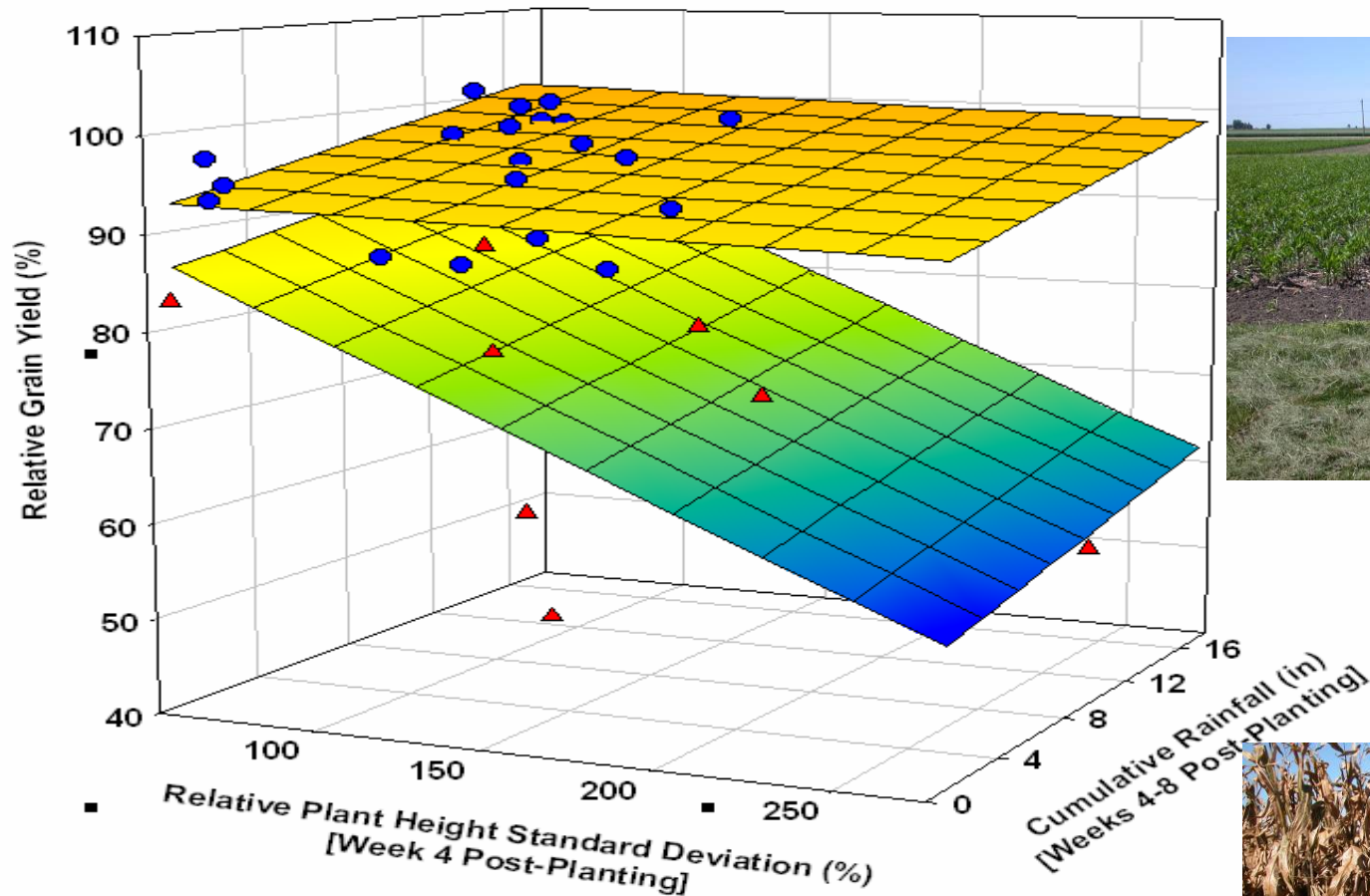




Average Maximum Soil Temperatures in First 4 Weeks after Planting (1997-2002)

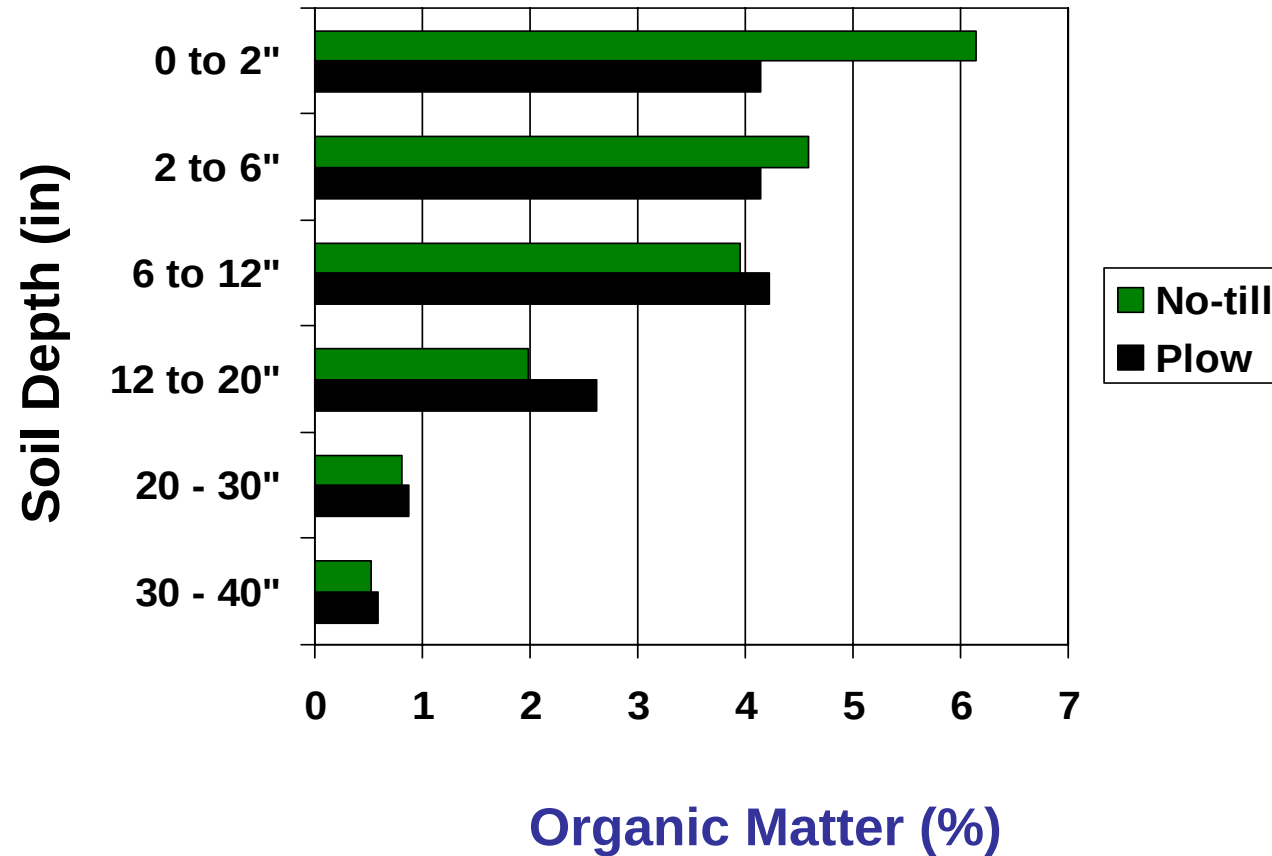


Grain Yield Response of No-till Continuous Corn vs. Plow + No-till Rotation Corn (1980-1994)





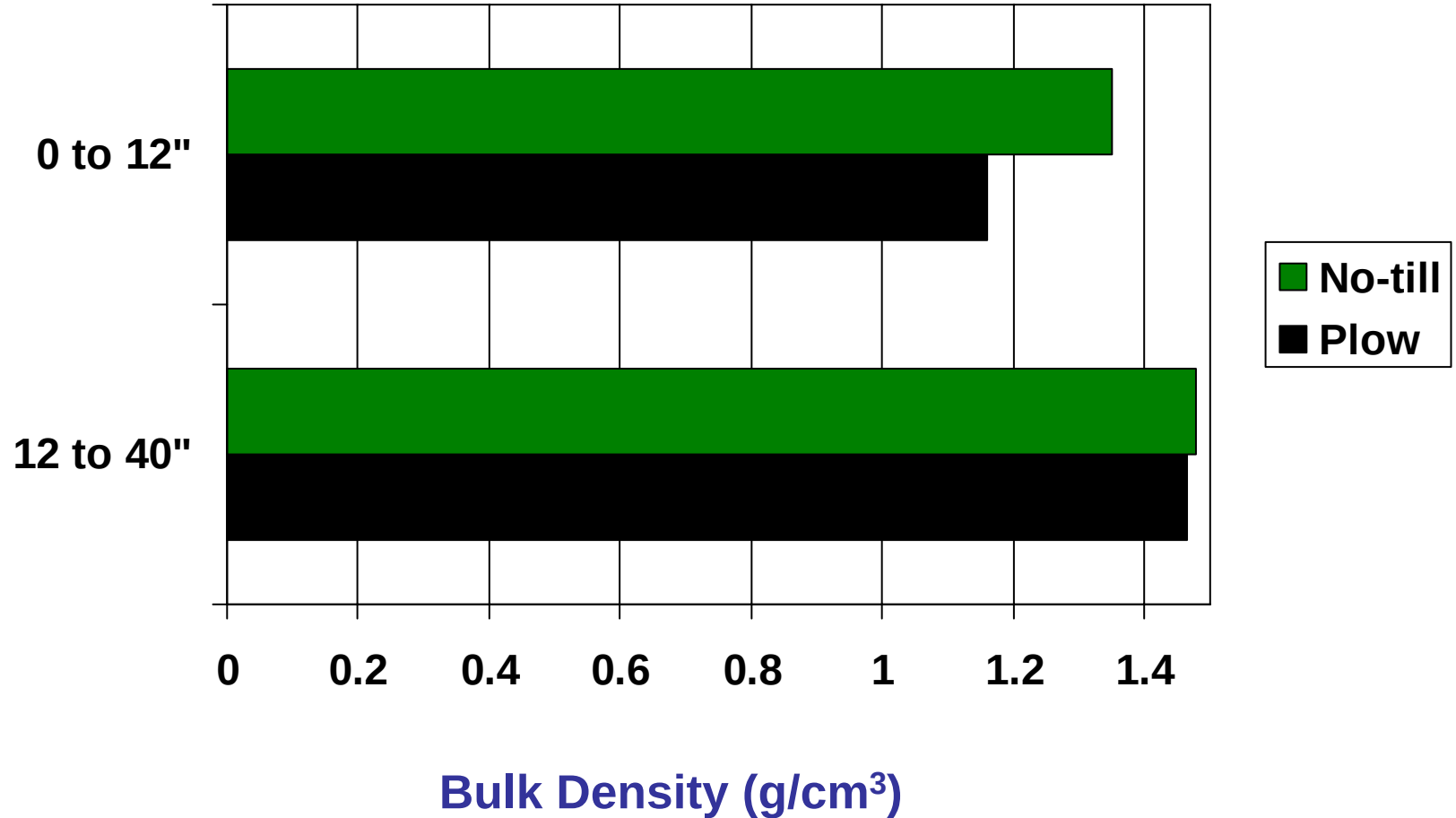
Long-term Tillage Effects on Soil Organic Matter (1975-2003, West Lafayette, IN)



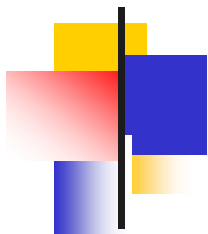
Source: Gál and Vyn, 2006

Long-term Tillage Effects on Soil Density for Soil Equivalent Mass C Calculations (W. Lafayette, 2003)

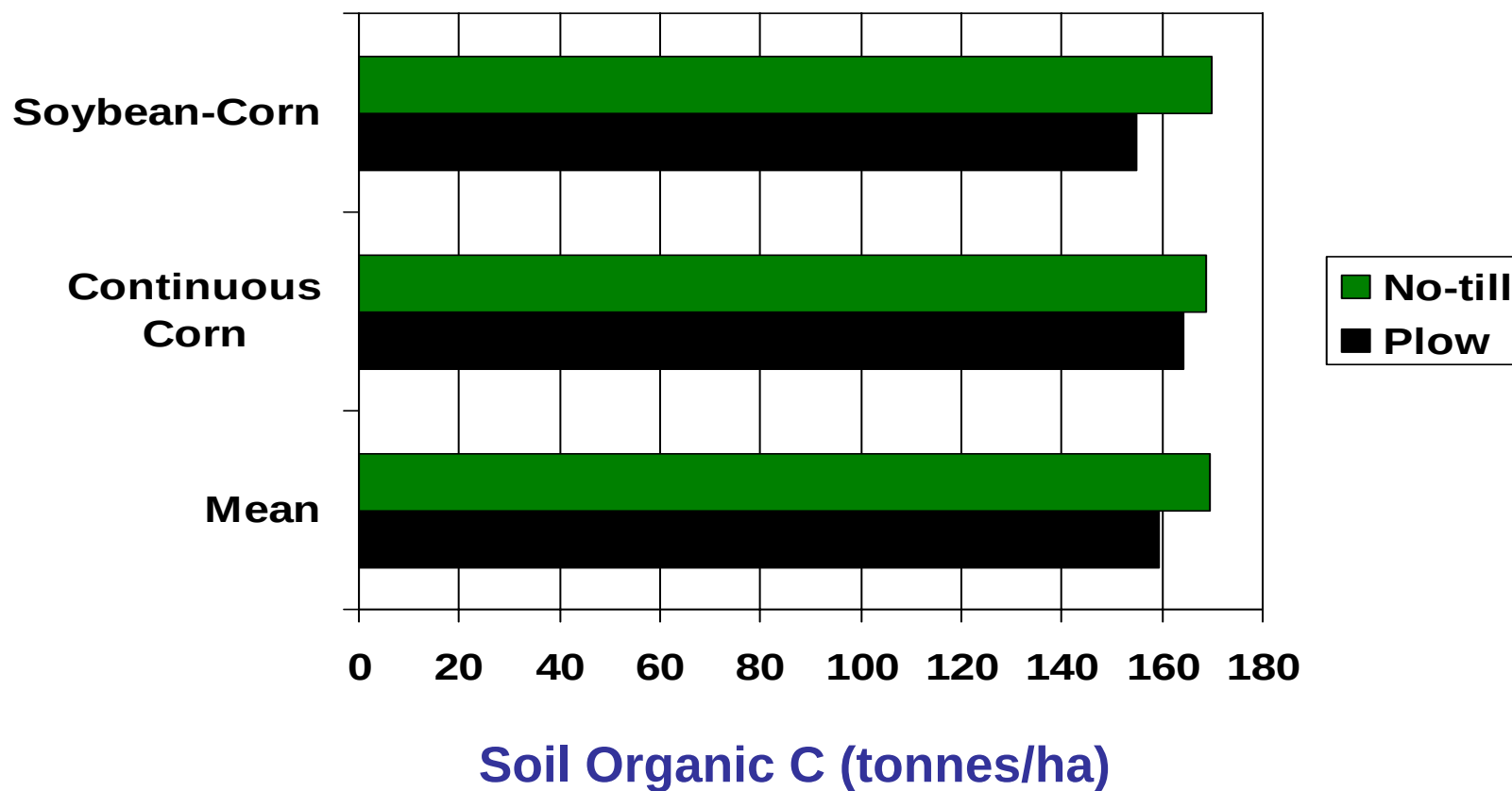
Soil Depth (inches)



Source: Gál and Vyn, 2005



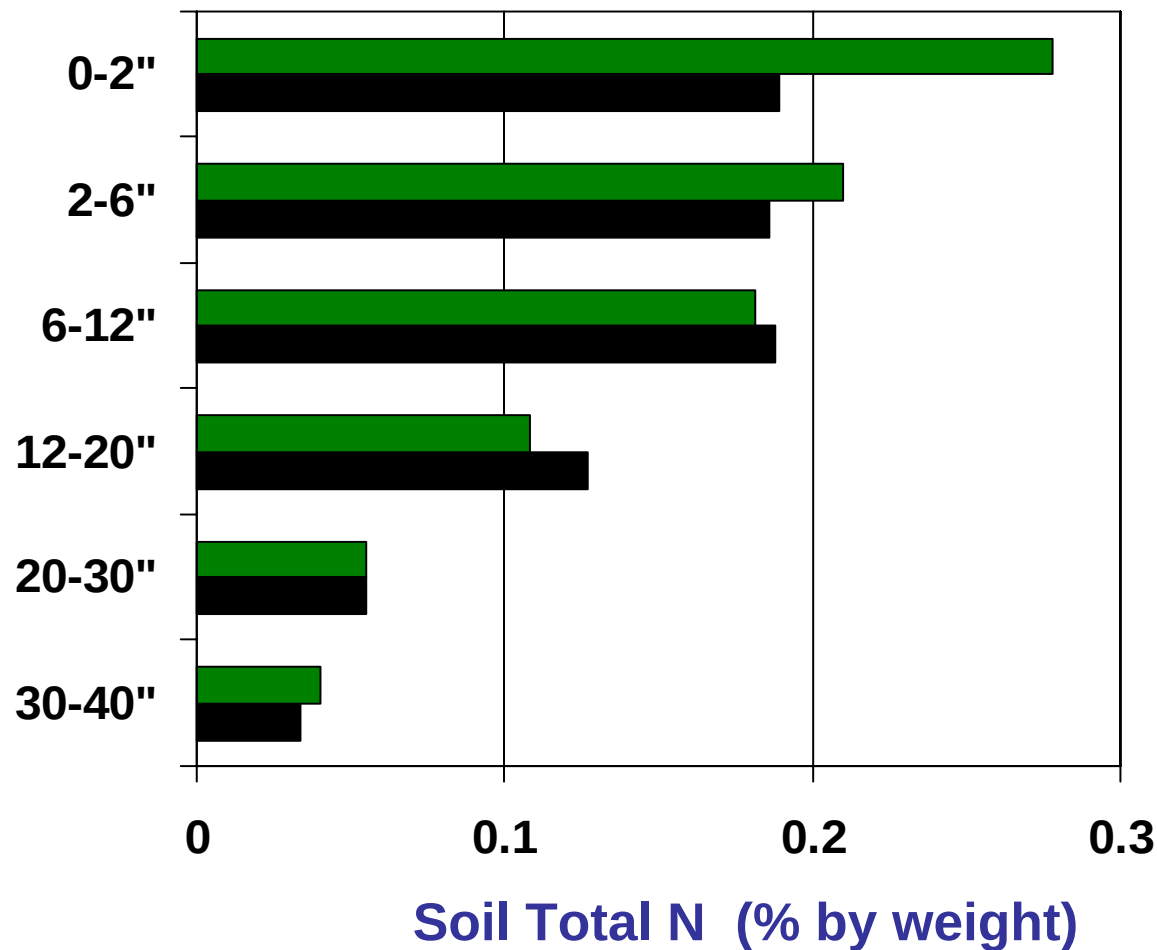
Long-term Tillage and Rotation Effects on Total Soil Carbon to a 39.3" depth (1975-2003)



Source: Gál & Vyn, 2006

Long-term Tillage Effects on Soil N (1975-2003), West Lafayette, IN

Soil Depth (INCHES)



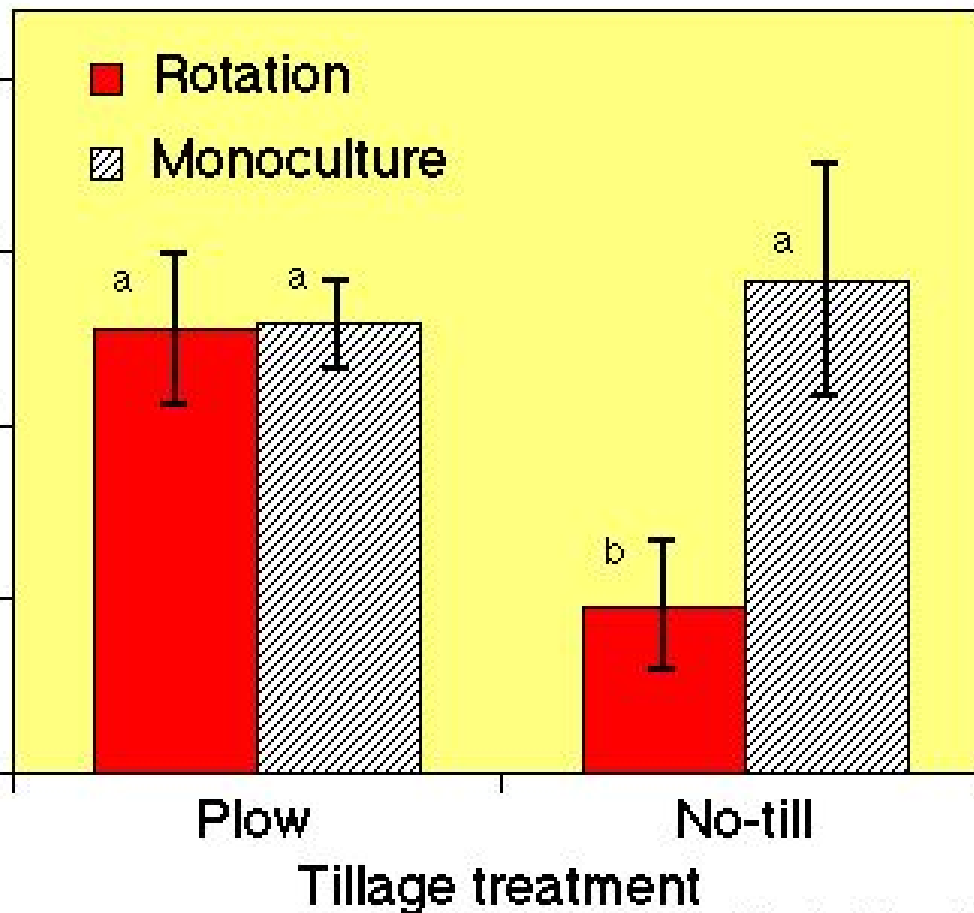
■ No-till
■ Plow



Source: Gál & Vyn, 2006

Population Density of Soybean Cyst Nematode in Response to Long-term Tillage and Rotation

Cyst population density (cysts/500 g of soil)



(Westphal and Vyn)





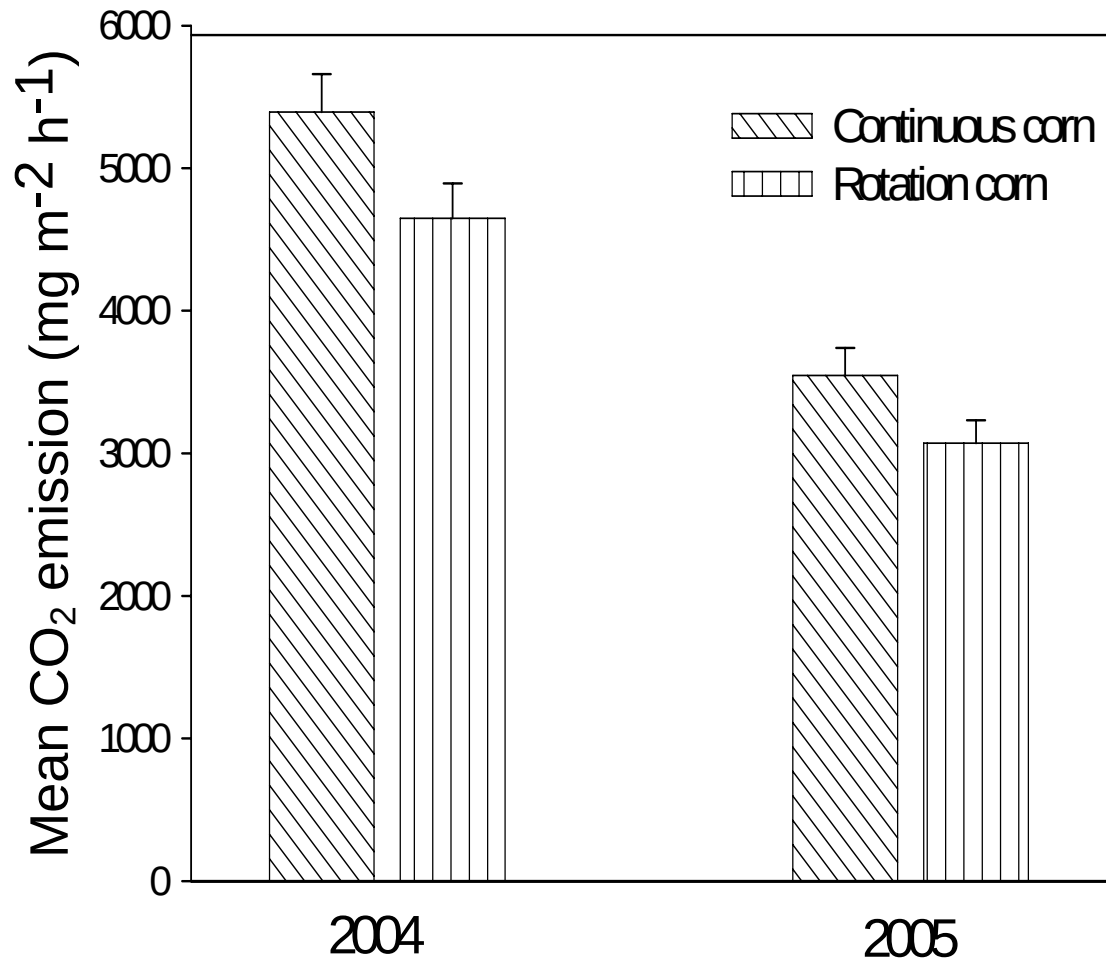
Gas Flux Monitoring of CO₂, CH₄, and N₂O Emissions (2004-2006)



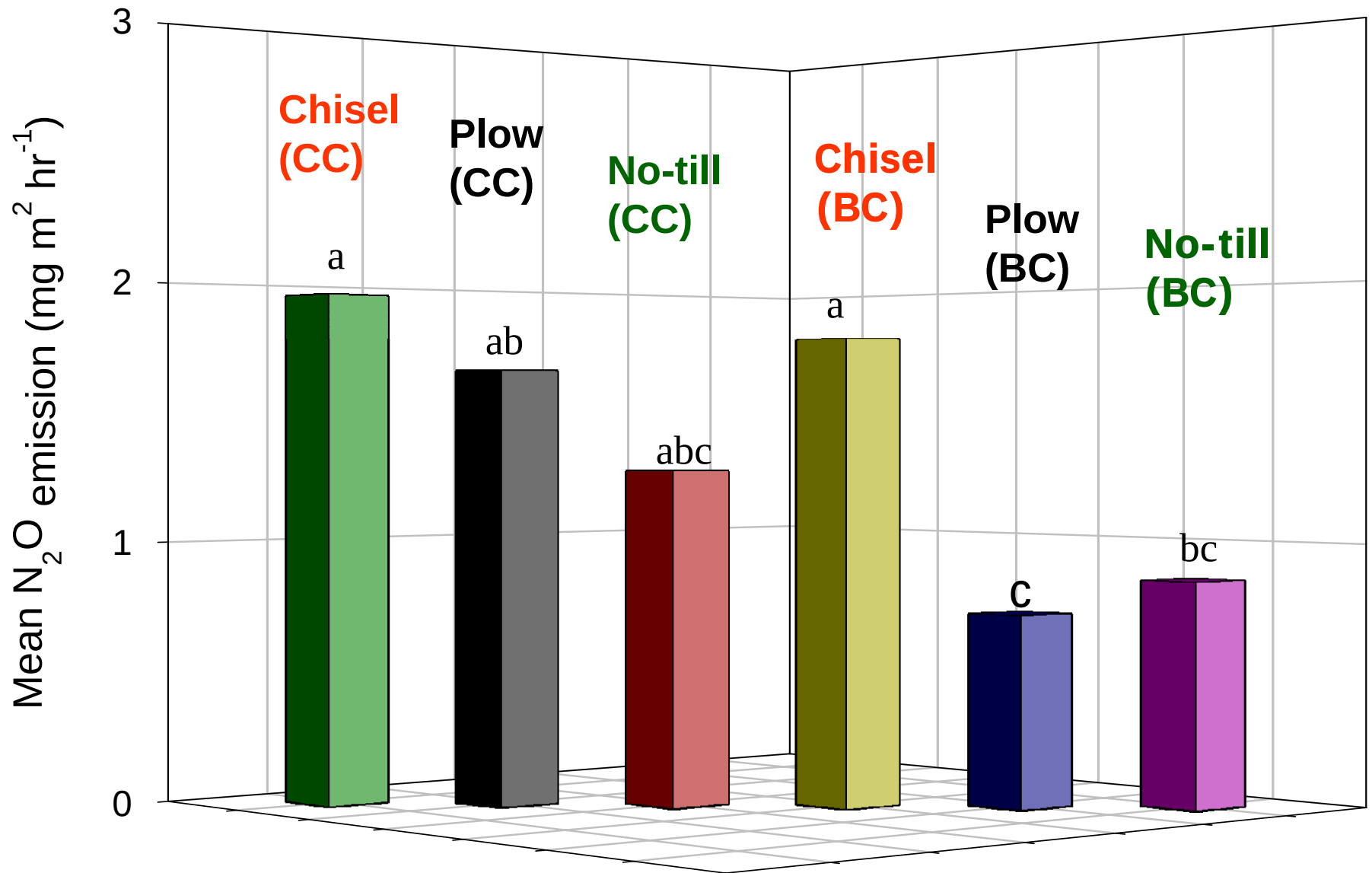




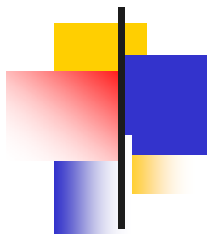
Rotation Effects on Mean CO₂ Emissions



Mean seasonal N₂O emission due to tillage in 2005



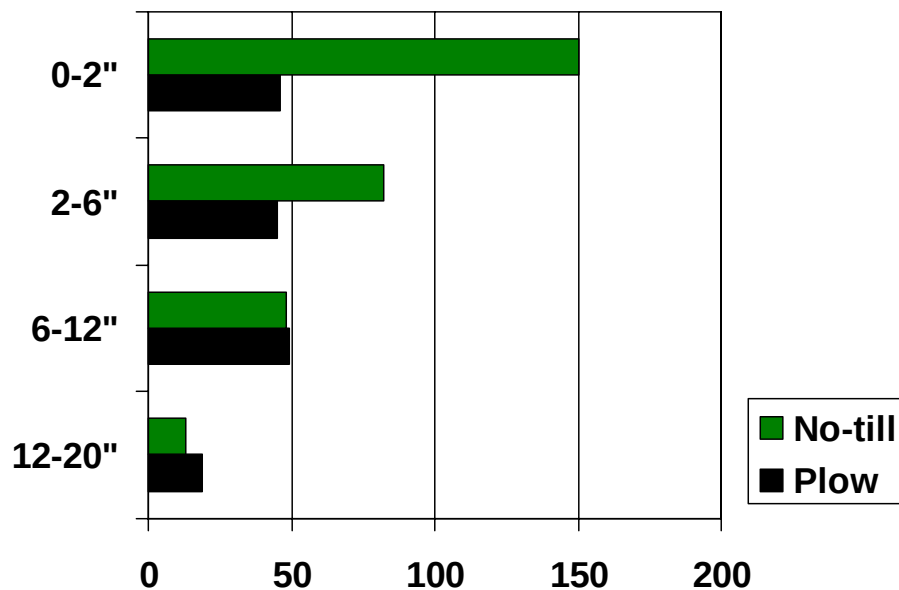
(Source: Omonode & Vyn, 2006)



Long-term Tillage Effects on Soil Available P & Exchangeable K with Broadcast Application

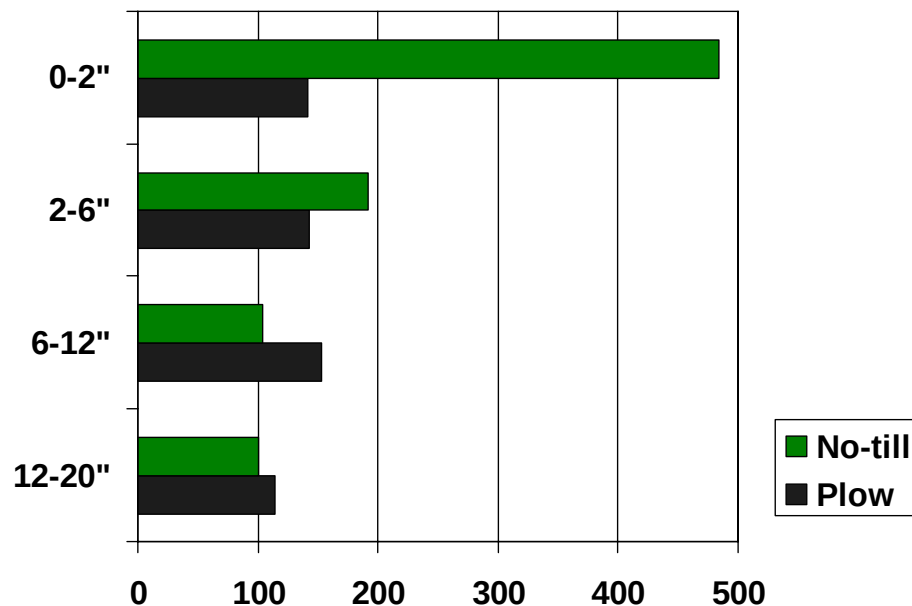
(Soybean-Corn Rotation, 1975-2003, West Lafayette, IN)

Soil Depth



Soil P (ppm)

Soil Depth

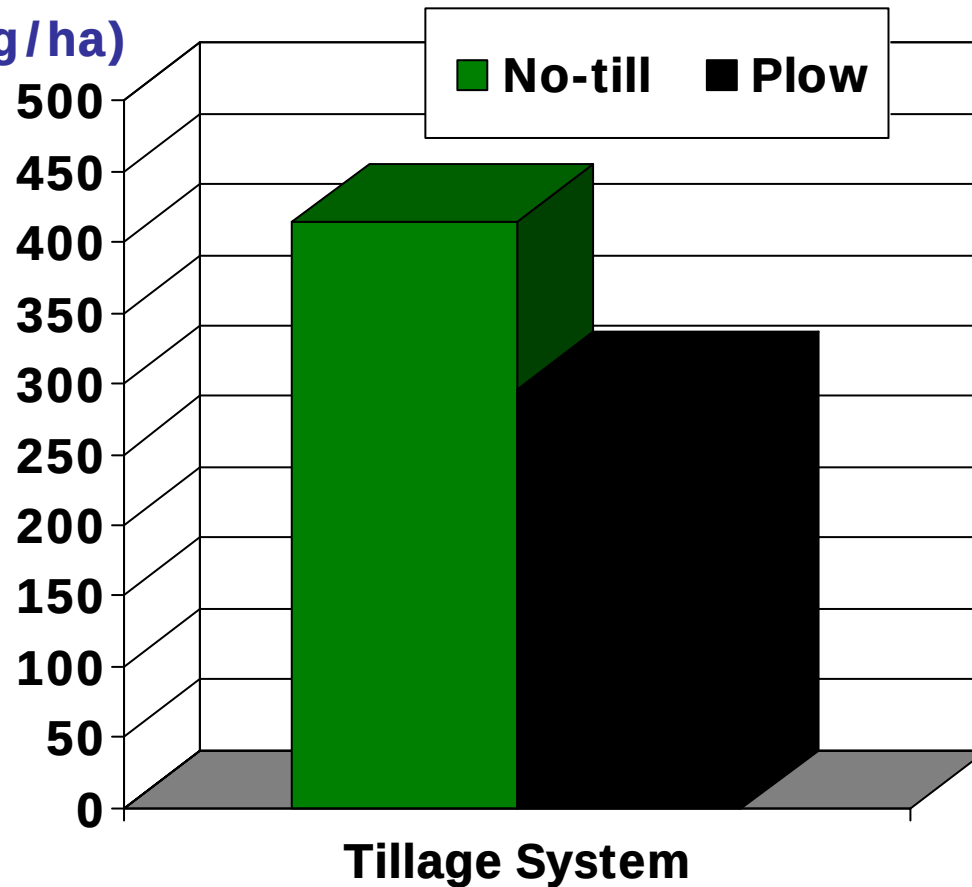


Soil K (ppm)



Tillage Influence on Cumulative Soil P

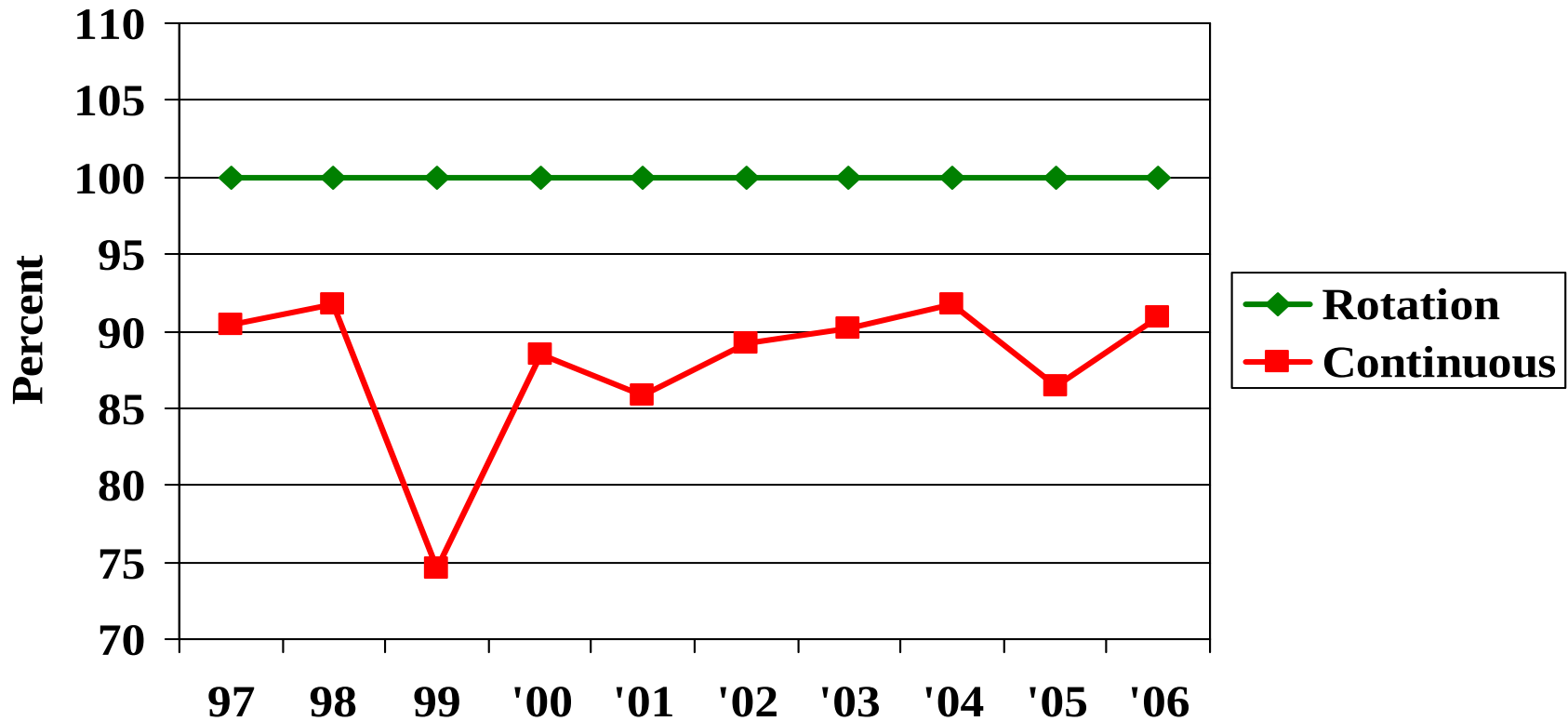
Available P (kg/ha)



Source: Gal and Vyn, 2005



No-till Corn Yields – Continuous as % Of Rotation – Loam Soil, Wanatah, IN (1997-2006)





Fertilizer Management Issues for Corn after Corn with Conservation Tillage

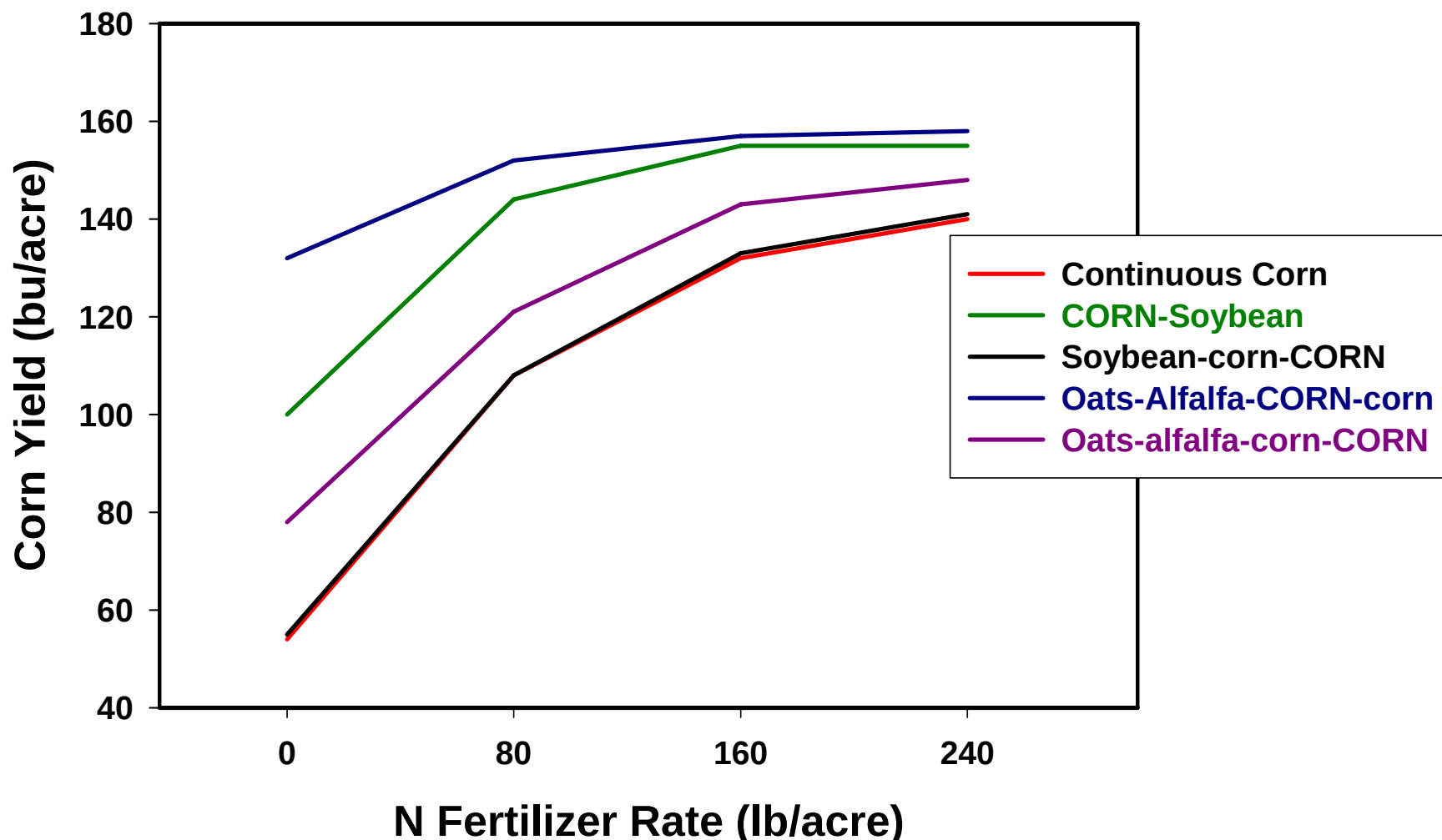
- Starter more important (Residues? Date?)
- More N needed for any version of corn after corn than typical corn-soybean rotation



Rotation Effects on Corn Response to Nitrogen

Nashua, IA, Mean of 1979 to 2004

Source: Mallarino and Ortiz-Torres, Iowa State Univ.



RTK + Pre-plant UAN Application 2006





RTK and Pre-plant UAN at Wanatah, IN



50 N at 0" versus 200 N at 0"



100 N at 0" versus 100 N at 10"



RTK and Pre-plant UAN at Wanatah, IN, 2006



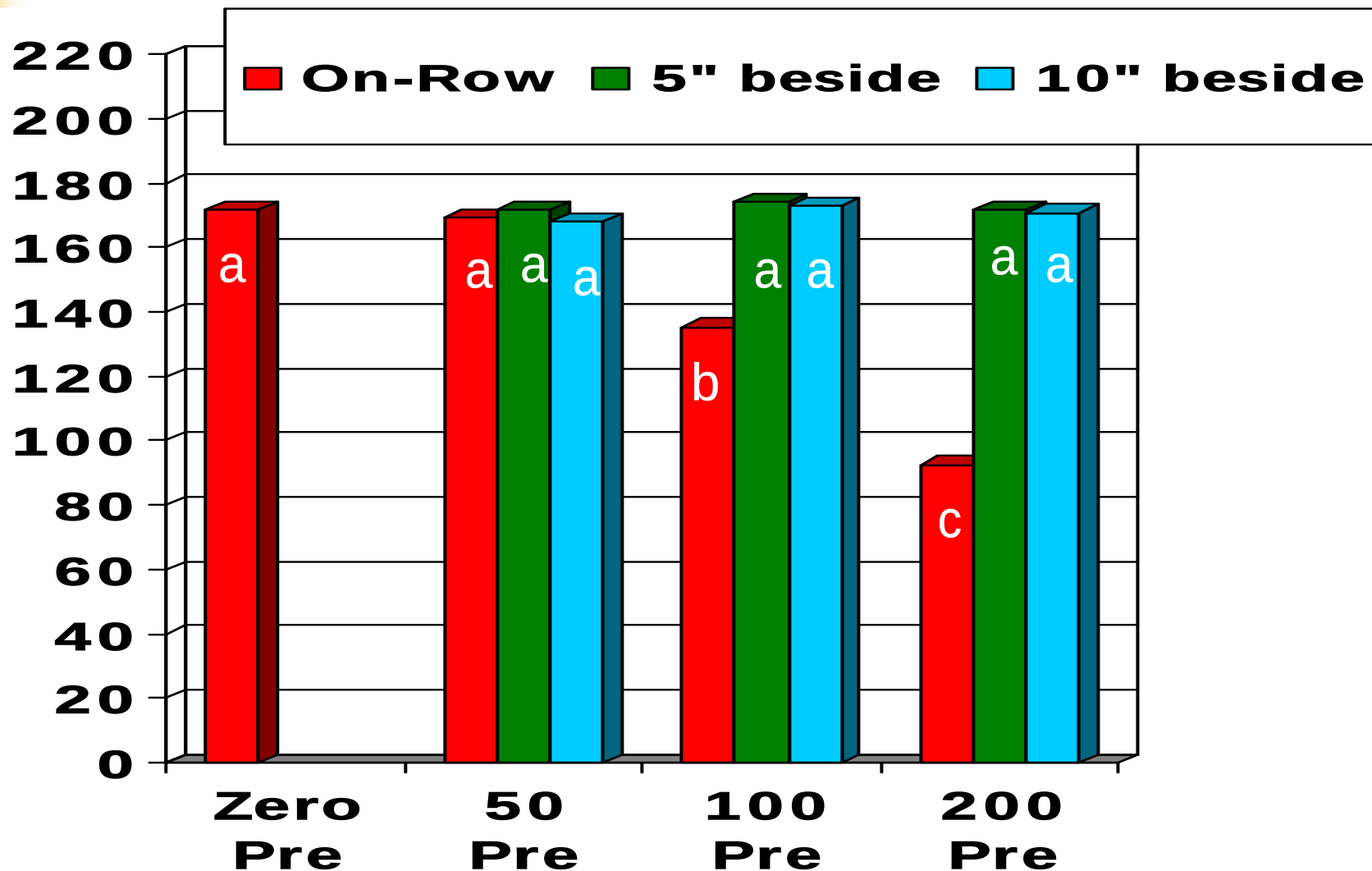
200 N at 5" versus 200 N at 0"



**200 N at 5" (background) vs.
200 N at 0" (foreground)**

RTK Row Position Effects on Corn Yield Response to Pre-Plant UAN Rates

Wanatah, IN, 2006



Corn after Corn with Stover Removal?



Stuart Birrell, Ag and Biological Engineering, Iowa State

Questions about Corn Stover Removal



Feasibility for ethanol production?

Effects on soil properties?

Improved situation for No-till?

Fall Strip Tillage





What are we after?

- **Yields**
(relative to no-till; stability)
- **Planting Timeliness**
(pre-plant soil conditions)
- **Fertilizer Placement Efficiencies**
(systems approach)



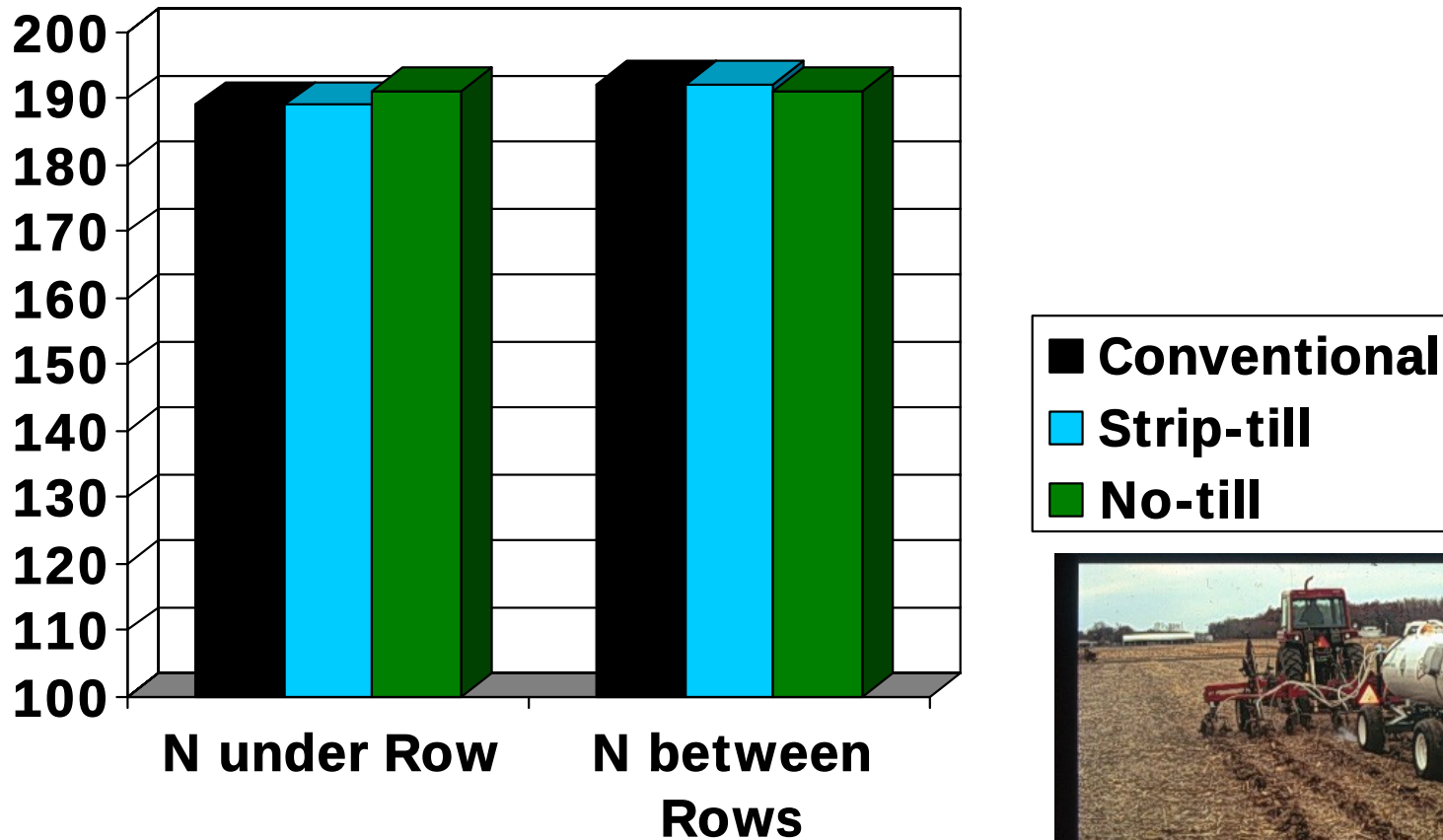


Strip Tillage for Corn after Soybean



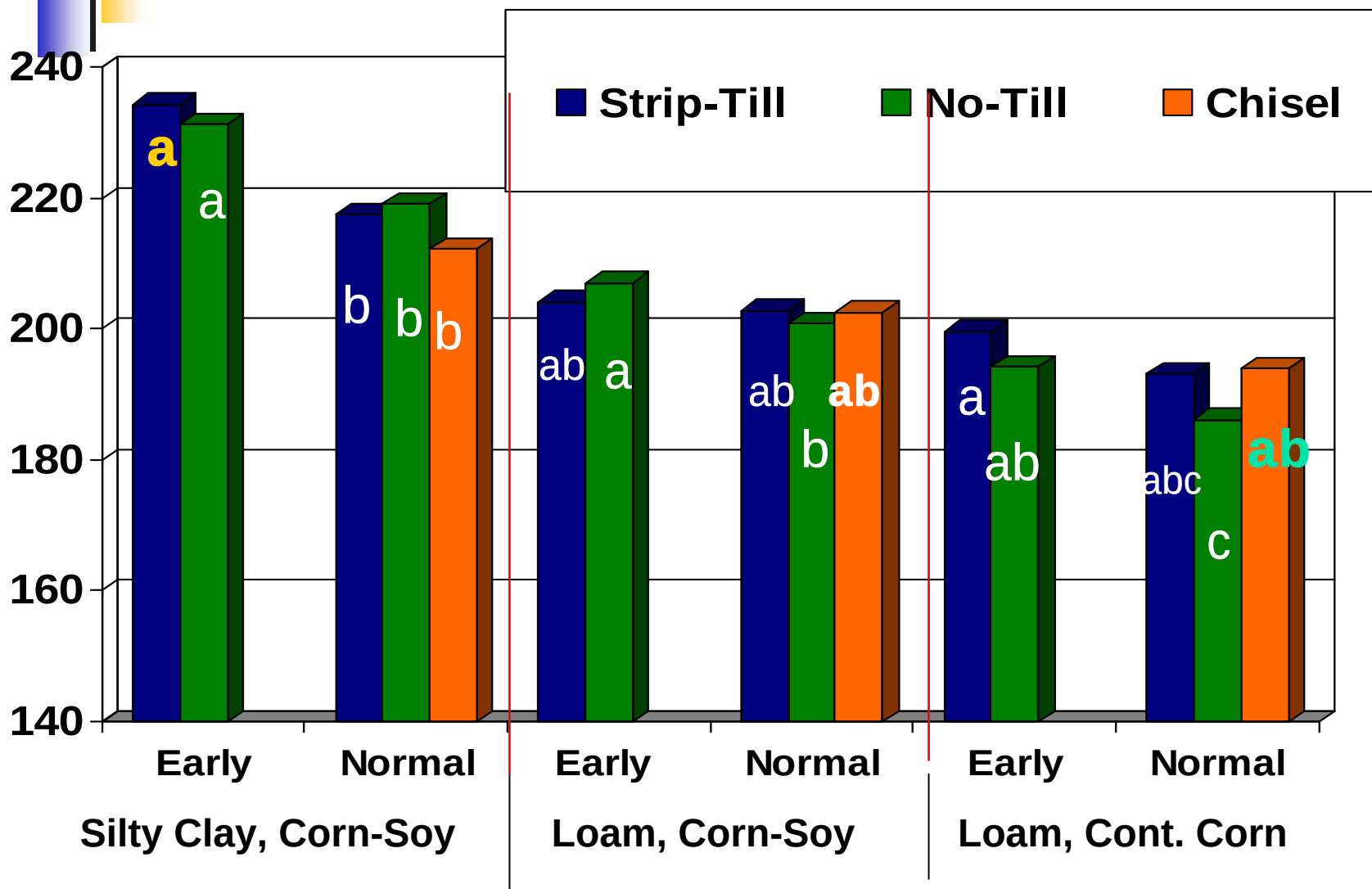
Strip-till Corn Yield Results in Illinois

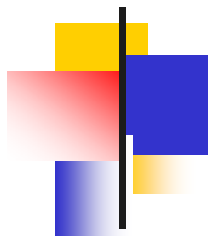
(Mean of 11 site years 1999-2002)



Source: Guebert et al, 2003 IL Fert. Conf. Proc.

Corn Yield Response to Tillage and Planting Date in Indiana, 2003-04





Berm Heights in Spring after Successful Strip Tillage



Other Spring Tillage Options?



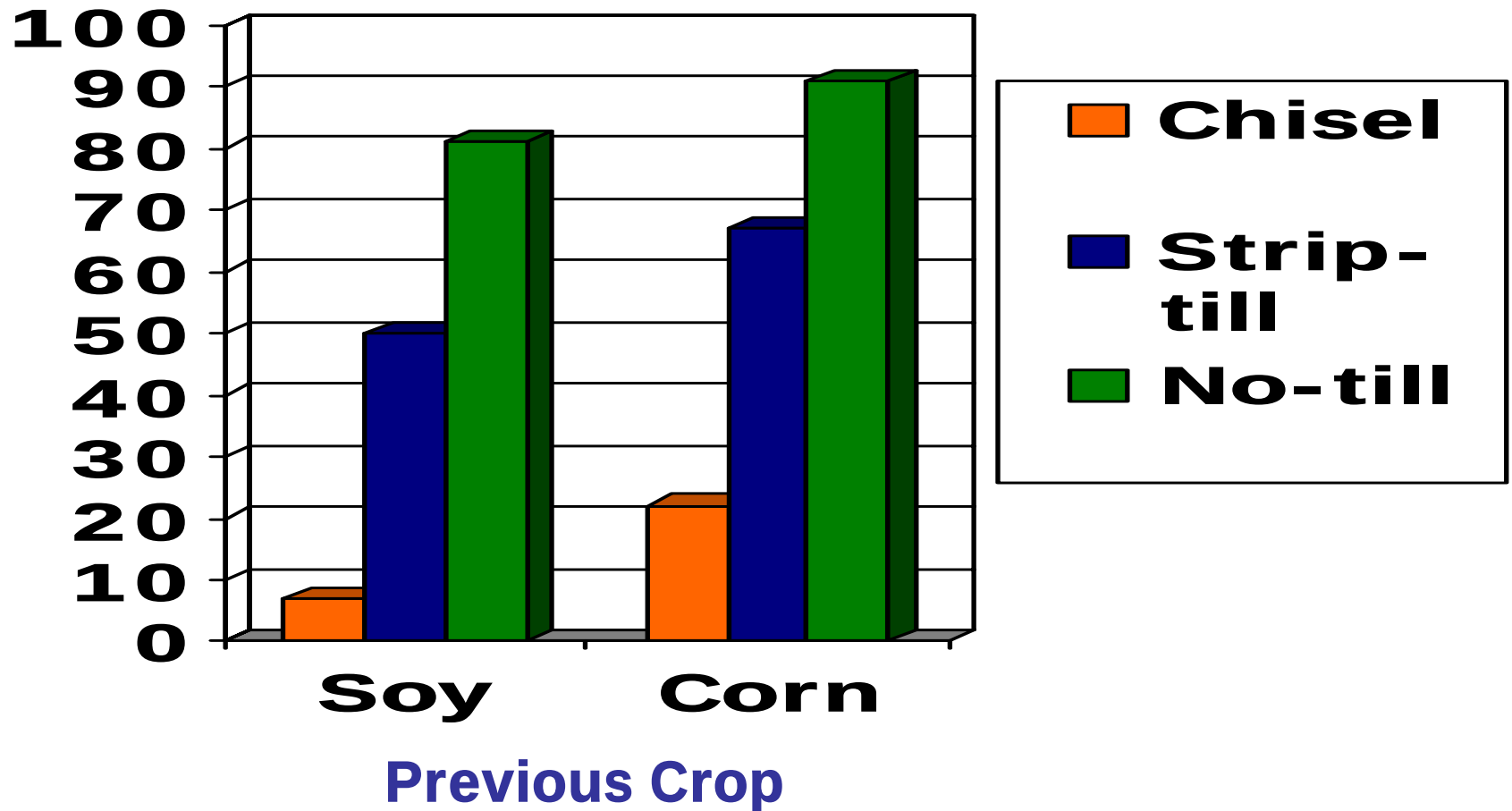


Strip Tillage for Corn after Corn?

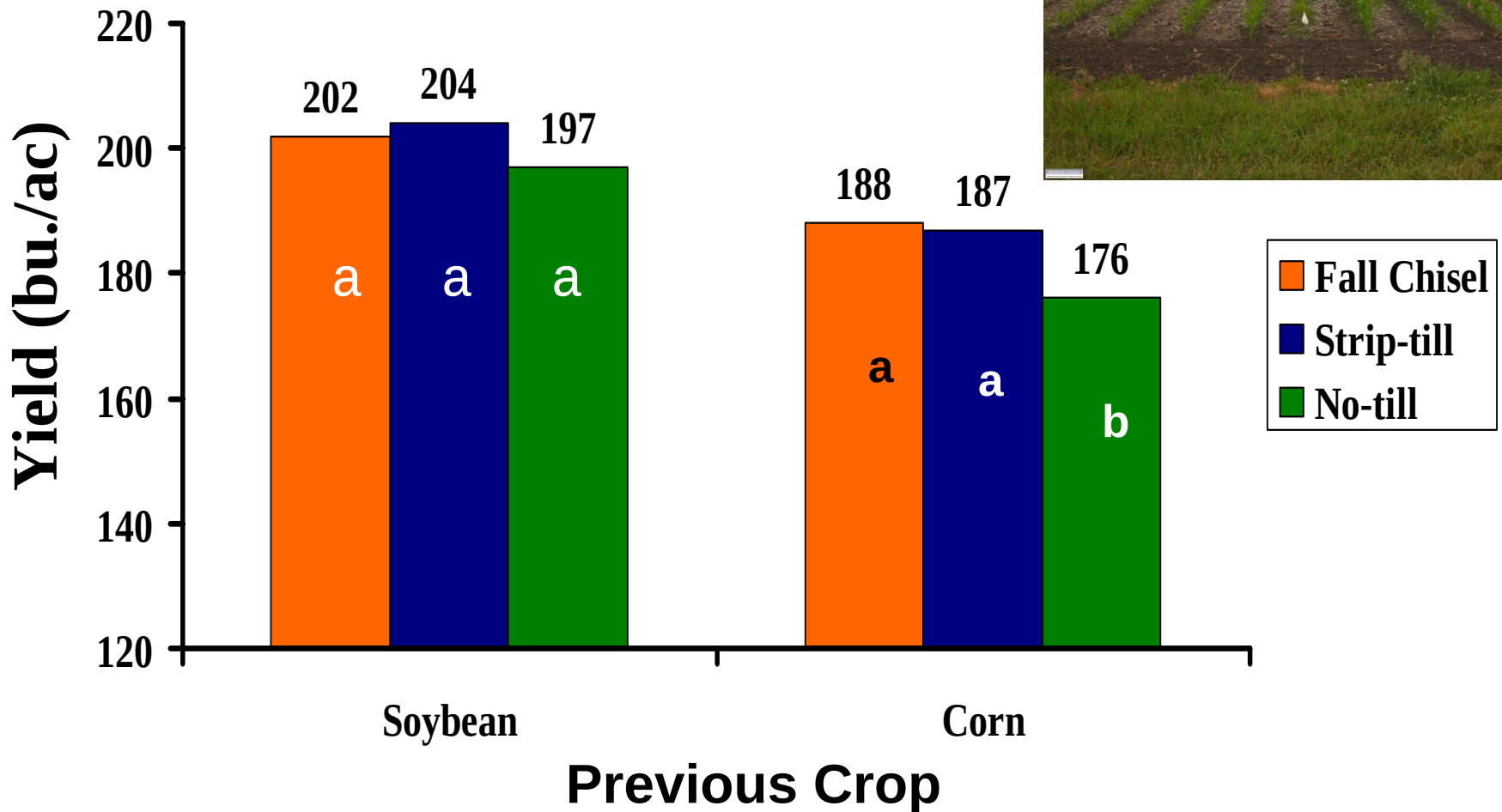




Surface Residue Cover (%) after Planting Loam Soil, Wanatah, IN, 2001-2004



Strip Tillage for Corn after Soybean and Corn in N. Indiana, Loam Soil (2001-2006)





Recent Strip Tillage Options

- Automatic Guidance Systems for Planting Ease
- Berm Building Alternatives (disk, rolling basket)
- Residue Clearance Options
- Strip-till for Soybean??
- Fertilizer Banding Options

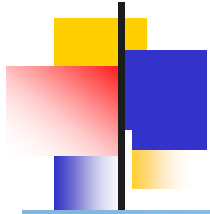


RTK Planting after Strip-Till

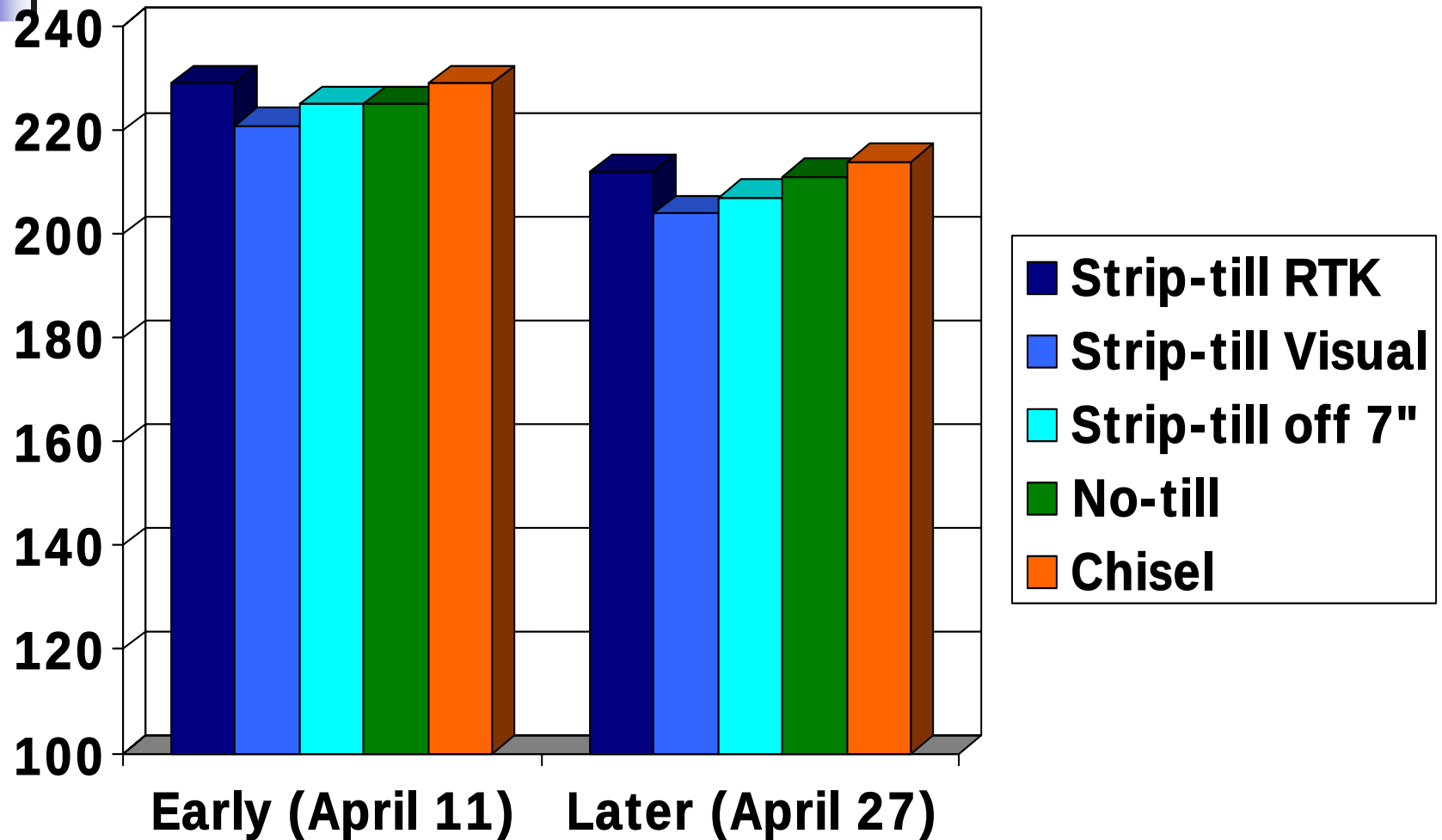
(West Lafayette, 2006)



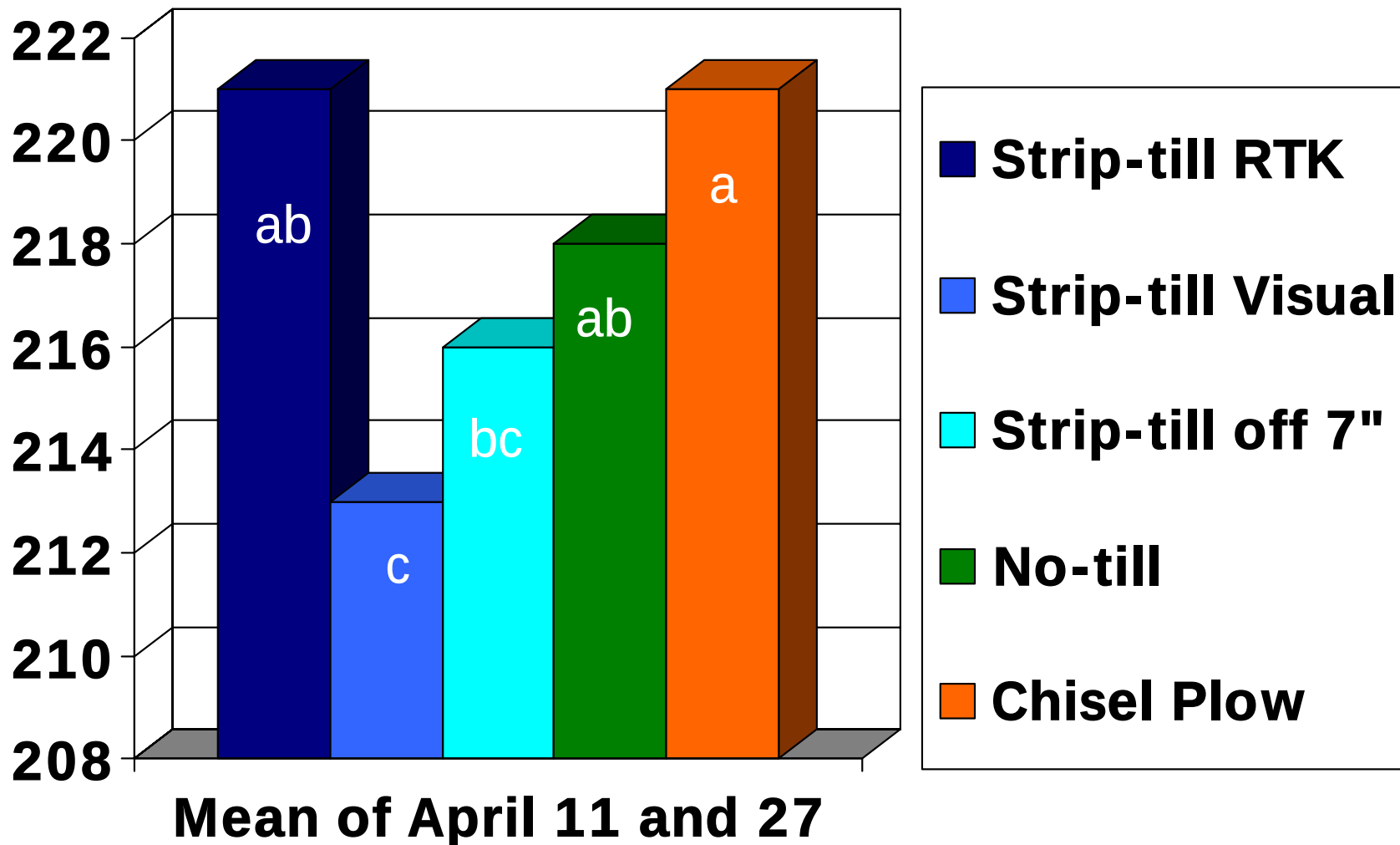
RTK Plot Harvest 2006



Corn Yield Response to RTK Precision at West Lafayette, IN, 2006



Average Corn Yield Response to RTK Precision at West Lafayette, IN, 2006





Strip Tillage with Fertilizer Banding



Strip Tillage with Nutrient Banding in Small-plot Research



Key Drivers of Strip Tillage Adoption in the Future?

- **Automatic Guidance Systems (lower HP and width)**
- **Controlled Traffic Adoption in Both Corn and Soybean?**
- **Improved Fertilizer Efficiency with Banding (especially if no starter fertilizer on planters)?**
- **Back-up Systems when Falls are too Wet to Complete Strip Tillage?**



Conclusions

1. Adopt no-till and strip-till in corn-soybean rotations where possible.
2. Soil Carbon and N gains with continuous No-till aren't hugely significant on all soils.
3. Figure out how to save soil by doing less tillage if you grow corn after corn! Strip-till??



Conclusions (continued)

4. **Manage for uniformity in soil conditions for root growth**
5. **Aim for controlled traffic systems in future**
6. **Automatic Guidance with RTK is a potential benefit**





7. Invest in Research!





Acknowledgments

Funding:

USDA-CASMGS

Purdue University Mary S. Rice Farm Fund

Foundation for Agronomic Research (PPI or INPI)

Fluid Fertilizer Foundation

John Deere & Co.

Equipment:

Case-DMI (Goodfield, IL)

John Deere Cropping Systems Unit

Remlinger (Kalida, OH)

Seed:

Pioneer Hi-Bred, Int.

Beck's Hybrids

Thanks!

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home page: [//www.agry.purdue.edu/staffbio/vyn](http://www.agry.purdue.edu/staffbio/vyn)

