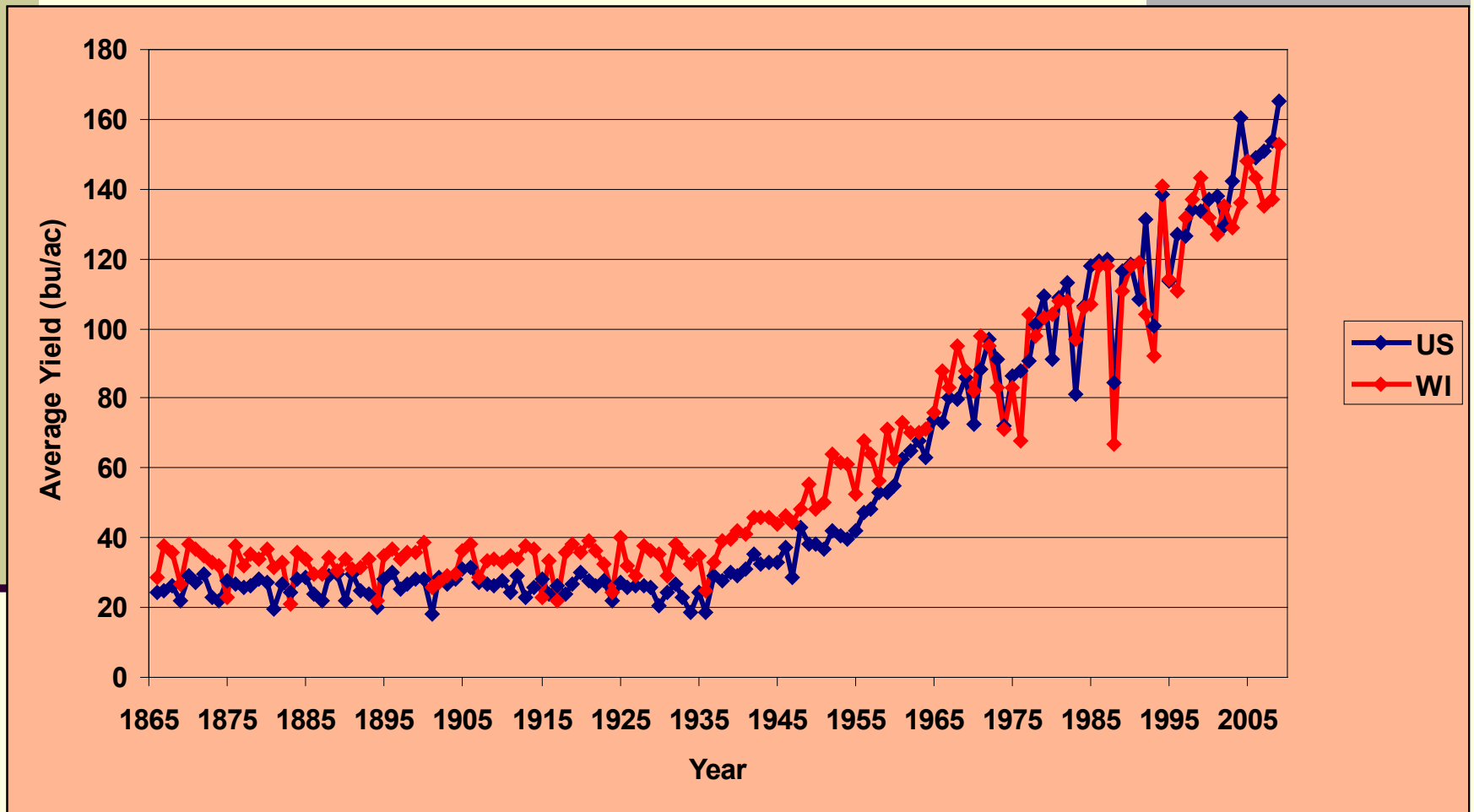


# Corn Seeding Densities and Transgenic Traits: Economics and Farmer Behavior

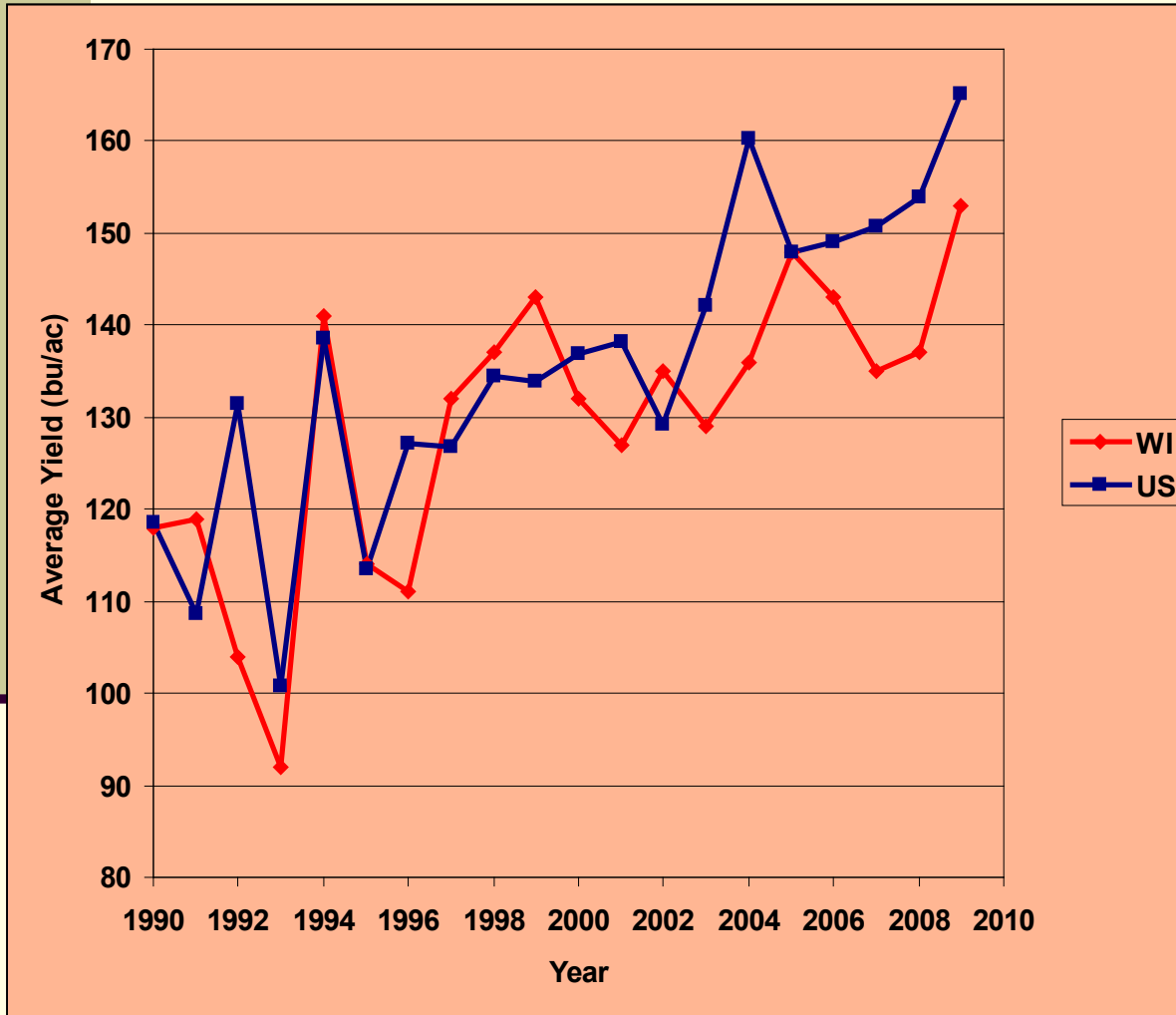
Paul D. Mitchell

Ag & Applied Economics, UW-Madison  
Wisconsin Crop Management Conference  
January 12-14, 2010

# Corn Yields Continue to Increase



# 2009 Had Record Corn Yields



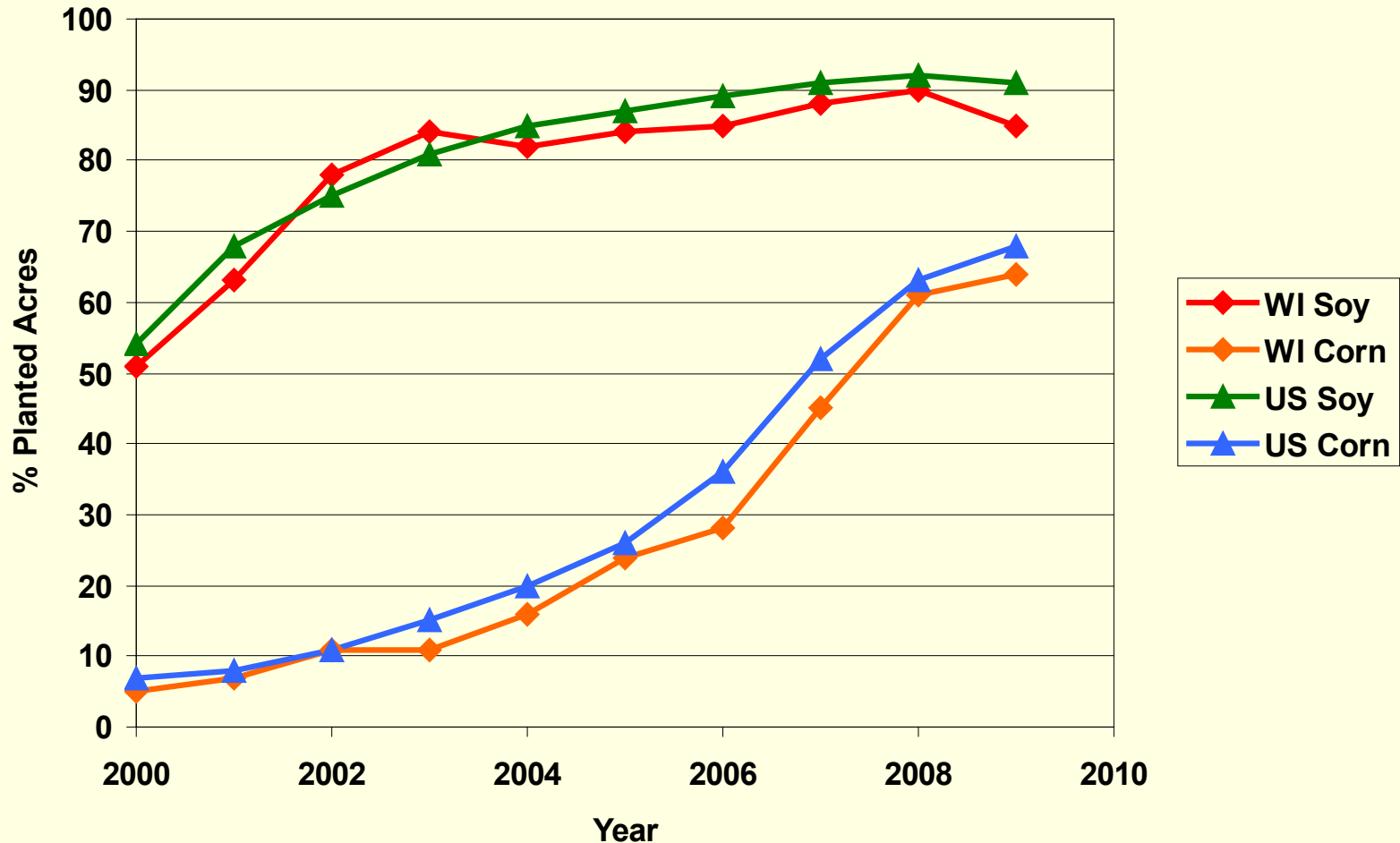
- Even with weird 2009 weather
- WI corn yield a record of 153 bu/ac
- US corn yield a record of 165.2 bu/ac
- Caused the recent price drops on CBOT

# Corn Yields Continue to Increase

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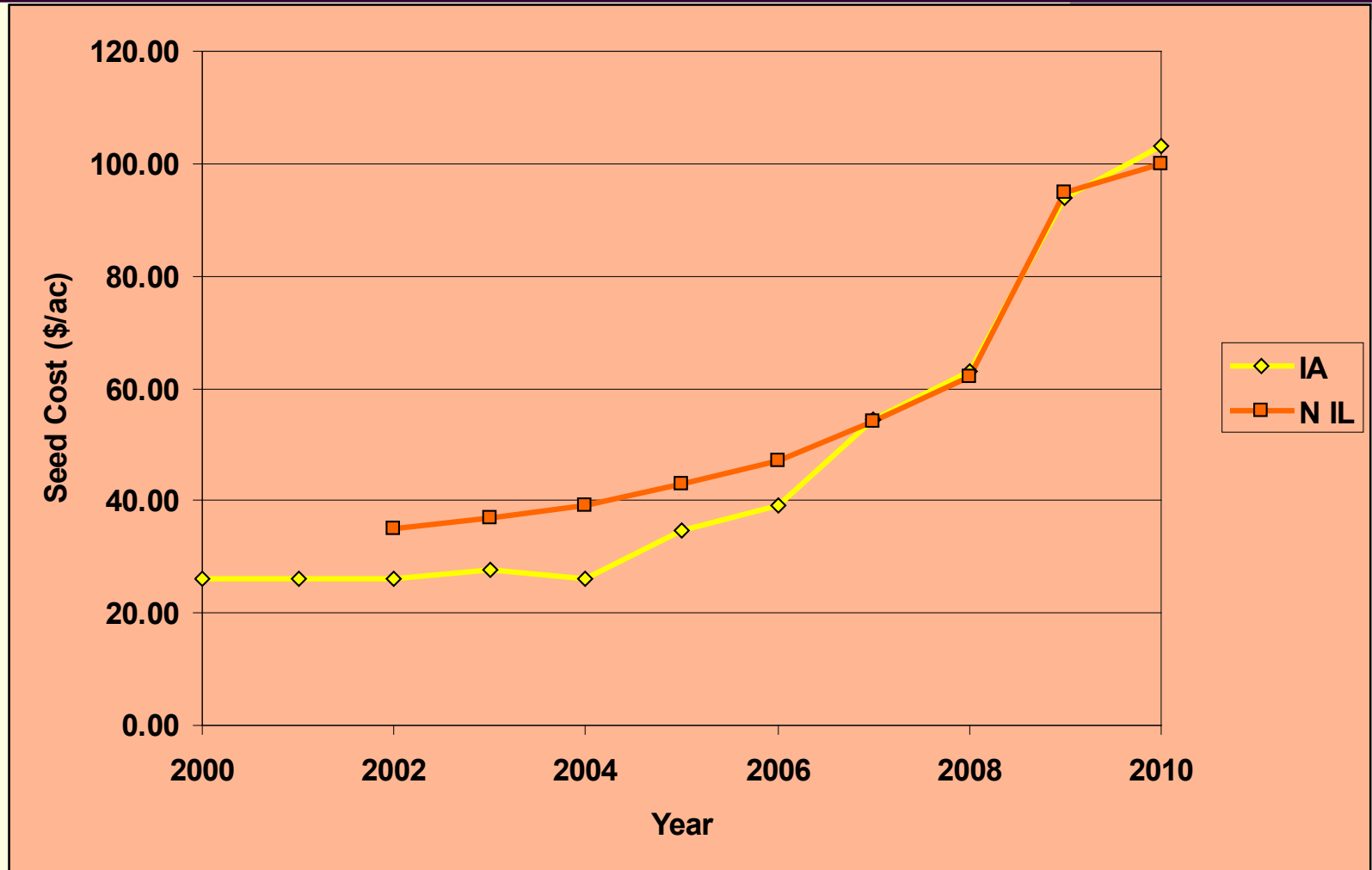
- Genetics has been a major source of corn yield growth over the years
  - Improved management also important
- Breeding for better performance under higher planting densities is part of this
- Hybrid turnover is faster than ever before
  - 7-8 years used to be typical, now 3-4 years
- New transgenic traits are part of this yield increase (CB-Bt, RW Bt, RR Corn, Stacks)

# % Acres Planted in Transgenic Varieties 2000-2009



Source: <http://www.ers.usda.gov/data/biotechcrops/>

# Corn Seed Prices Have Also Increased



Source: State University Cost of Production Budgets

# Corn Seeding Densities: Questions Addressed Today

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- Corn Seeding Densities
  - Quick review of recommendations
- Look at farmer survey data
  - What seeding densities have WI and Midwestern farmers actually been using?
  - What about the new transgenic traits?
  - Do corn and seed corn prices affect seeding densities?

# Popular Farm Press

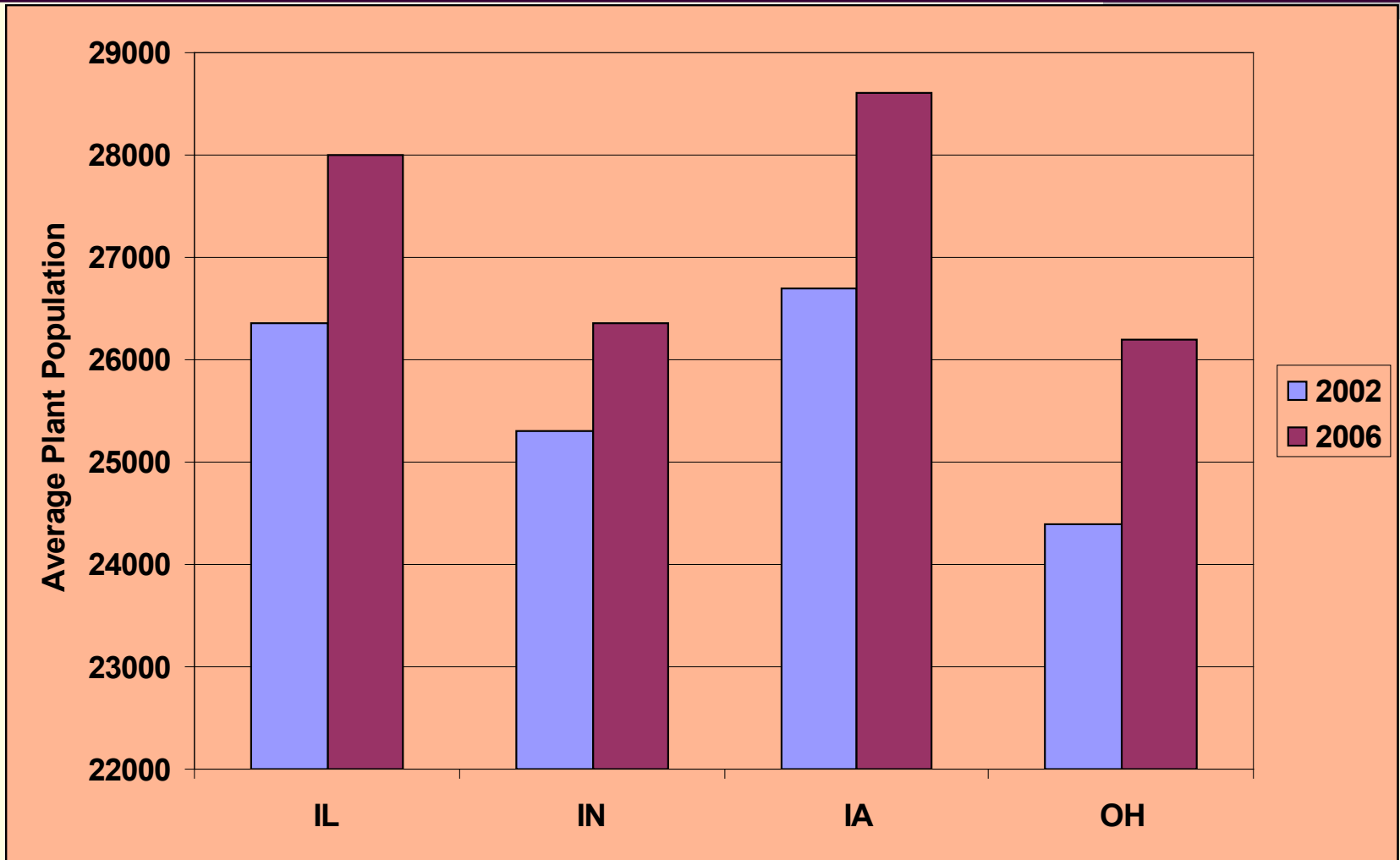
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- “Plant More Corn Per Acre” (Successful Farming)  
<http://www.agriculture.com/ag/story.jhtml?storyid=/templatedata/ag/story/data/1174493858157.xml>
- Interview and quote many Corn Belt agronomist, including Joe Lauer
- Extension agronomists believe that optimal stand count in Corn Belt is 28,000-32,000
- State averages are lower for almost all states



# Corn Stand Counts

Increasing, but still not high enough

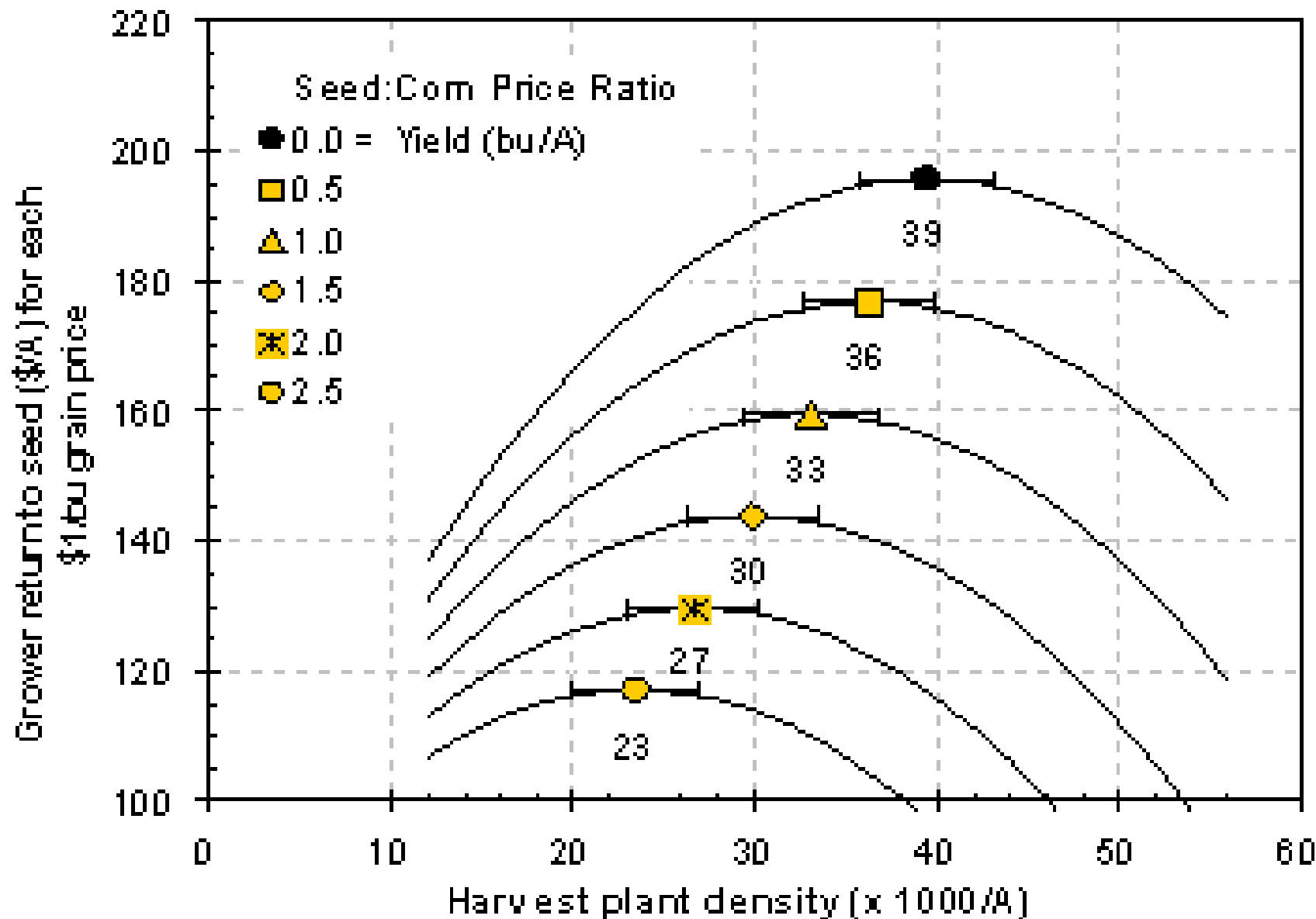


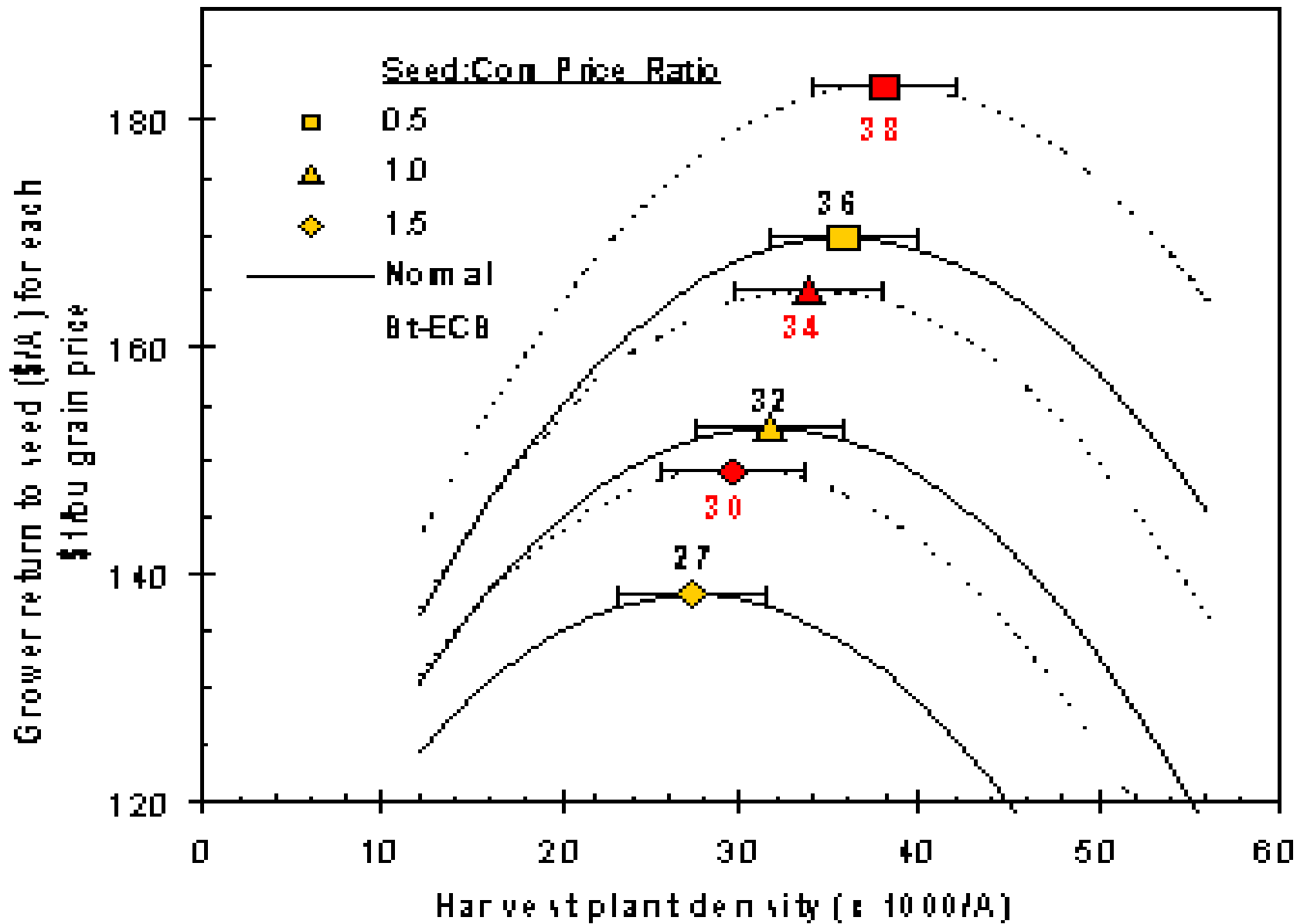
Source: "Plant more corn per acre" based on USDA-NASS data

# WI Recommendations

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- Lauer and Stanger (2008) “Guidelines for Managing Corn Seed Costs”  
<http://corn.agronomy.wisc.edu/AA/pdfs/A044.pdf>
- Lauer (2009) “Getting a Handle on Corn Seed Costs”  
<http://corn.agronomy.wisc.edu/AA/pdfs/A073.pdf>
- Data from field trials to develop decision aid similar to new Nitrogen Recommendations
- Optimal seeding density depends on the ratio of seed corn price to corn price
- Corn Borer Bt and conventional corn have different optimal planting densities





# Seed Price to Corn Price Ratio

Seed Price		Corn Price (\$/bu)								
\$/80K bag	\$/1K seeds	\$1.00	\$1.75	\$2.50	\$3.25	\$4.00	\$4.75	\$5.50	\$6.25	\$7.00
\$40	\$0.50	0.50	0.29	0.20	0.15	0.13	0.11	0.09	0.08	0.07
\$80	\$1.00	1.00	0.57	0.40	0.31	0.25	0.21	0.18	0.16	0.14
\$120	\$1.50	1.50	0.86	0.60	0.46	0.38	0.32	0.27	0.24	0.21
\$160	\$2.00	2.00	1.14	0.80	0.62	0.50	0.42	0.36	0.32	0.29
\$200	\$2.50	2.50	1.43	1.00	0.77	0.63	0.53	0.45	0.40	0.36
\$240	\$3.00	3.00	1.71	1.20	0.92	0.75	0.63	0.55	0.48	0.43
\$280	\$3.50	3.50	2.00	1.40	1.08	0.88	0.74	0.64	0.56	0.50
\$320	\$4.00	4.00	2.29	1.60	1.23	1.00	0.84	0.73	0.64	0.57
\$360	\$4.50	4.50	2.57	1.80	1.38	1.13	0.95	0.82	0.72	0.64
\$400	\$5.00	5.00	2.86	2.00	1.54	1.25	1.05	0.91	0.80	0.71

Lauer: <http://corn.agronomy.wisc.edu/AA/pdfs/A073.pdf>

# Pioneer's Planting Rate Calculator

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- <http://www.pioneer.com/web/site/portal/menuitem.0cbb3257343891dc86738673d10093a0/>
- Decision aid for farmers to help them choose seeding density for specific hybrids they plant
- Enter seed and corn price, hybrid and yield environment, gives planting density using same method as Lauer
  - Pioneer 36V53 (HX1,LL,RR2), \$275/bag, \$3.50/bu, high yield environment (> 190 bu/ac)  
Recommends: 36,952 seeds per acre
- Other companies have similar tools/guides

# Main Point

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- Lots of news articles, company and university research, extension literature, decision aids, etc. saying that farmers should be planting corn at higher seeding densities than they used to use
- What are farmers actually doing?

# What have farmers actually been doing?

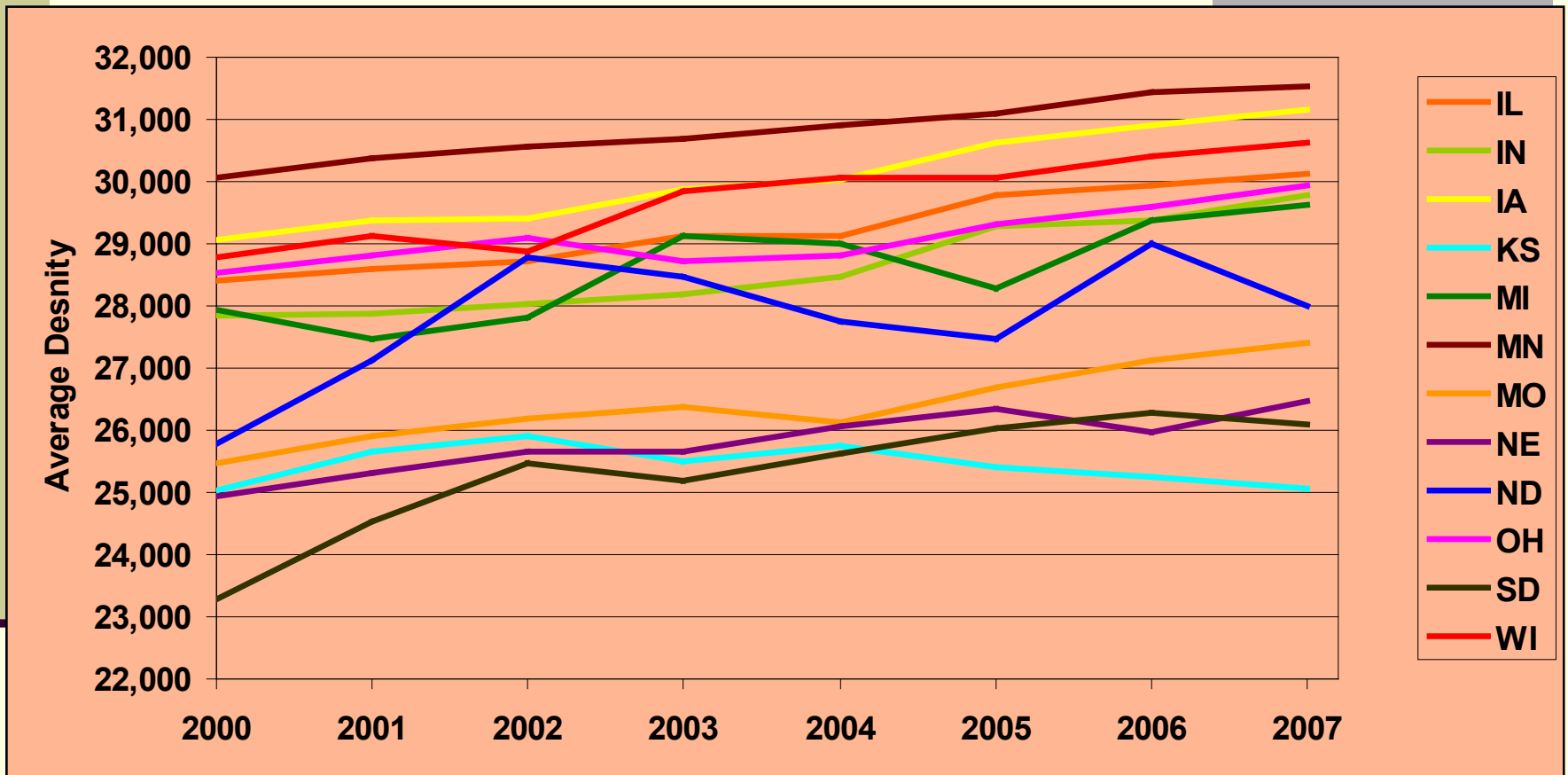
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- Annual telephone survey 2000 to 2007 of US corn farmers by Doane's Market Research
- Several thousand farmers each year, extensive questions on seed corn purchases
  - Focus on the 12 North Central States: IL, IN, IA, KS, MI, MN, MO, NE, ND, OH, SD, WI
  - 29,770 farmers (2,071 WI), 57,762 purchases
- Can construct corn seeding density and cost per acre for each trait purchased
- Data use restrictions: no company specific information, so only report general types



# Planting Density by Year and State

(average across traits)



**Annual upward trend**

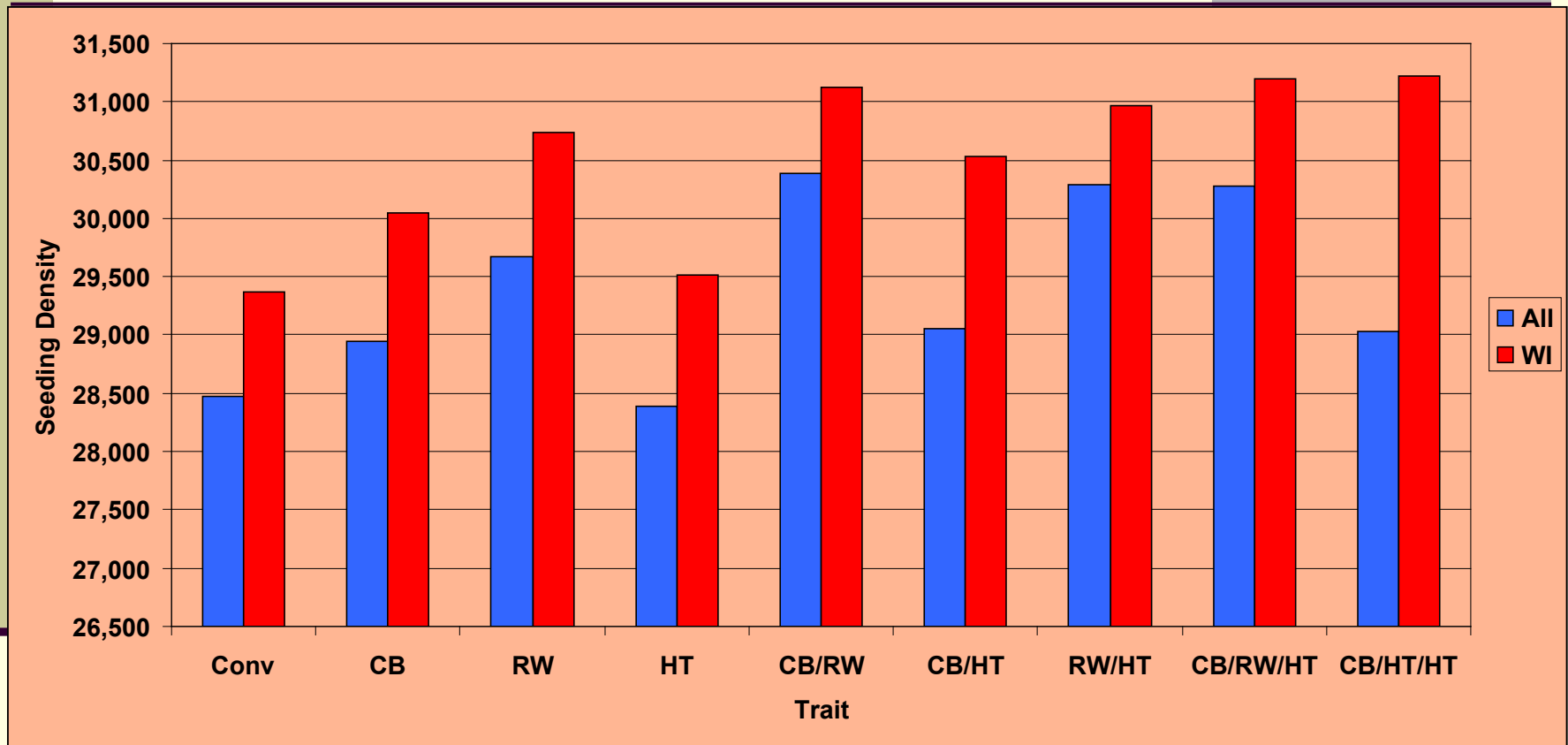
**Strong latitude and longitude effect**

# Transgenic Trait Combinations

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- Conventional
- Single Stacks
  - Bt-CB, Bt RW, HT single
- Double Stacks
  - CB/RW, CB/HT, RW/HT and HT/HT
    - Dropped HT/HT—not enough data
- Triple Stacks
  - CB/RW/HT, CB/HT/HT and RW/HT/HT
    - Dropped RW/HT/HT—not enough data
- Quadruple Stacks
  - CB/RW/HT/HT: Dropped—not enough data

# Seeding Density by Trait: Midwest vs. WI (average across years)



**WI above regional average (latitude effect)**

**Densities vary by transgenic trait**

# Trait Effect on Planting Density

## All Observations

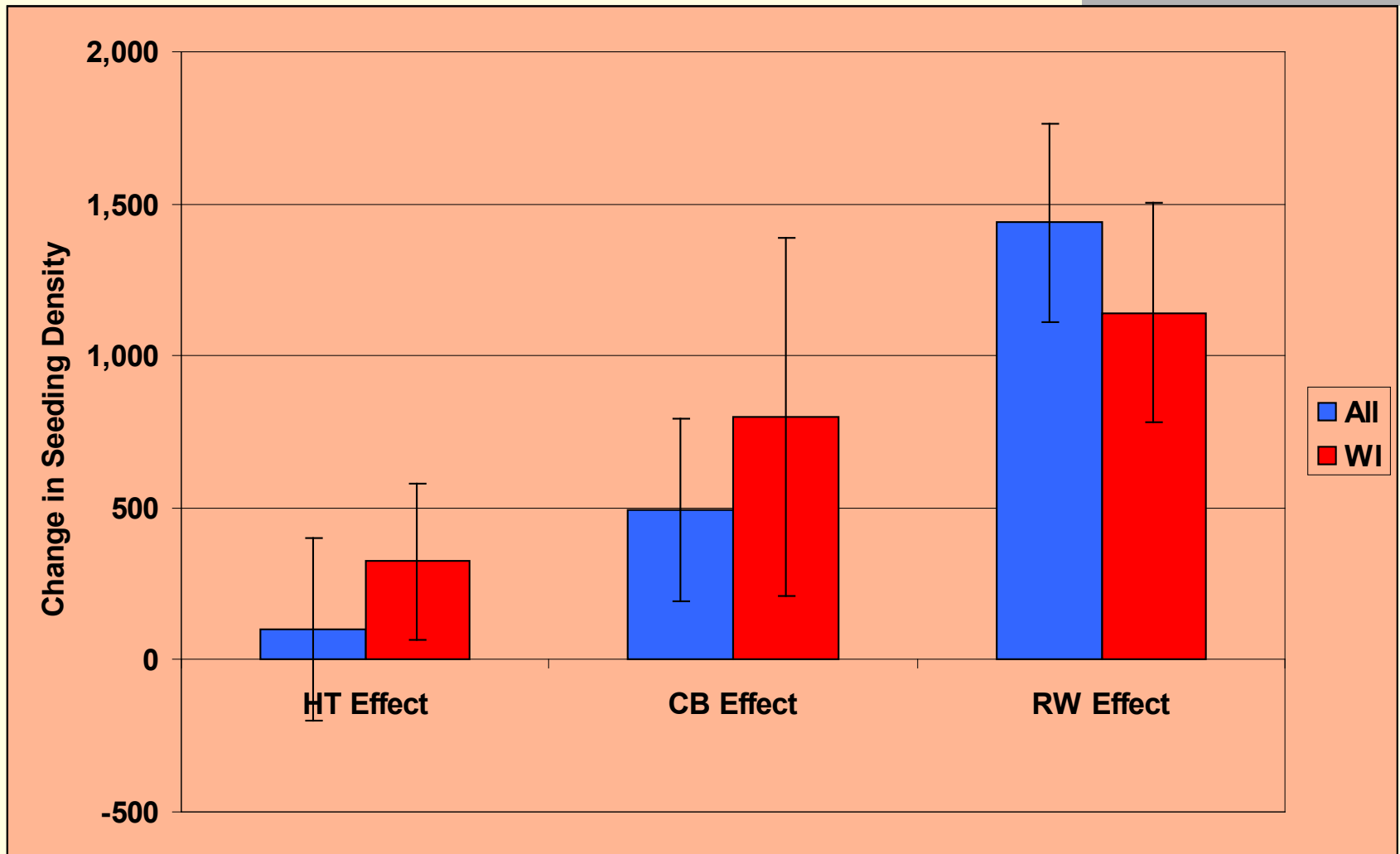
Trait	Density	HT Effect	CB Effect	RW Effect
Conv	28,479			
CB	28,951		472	
RW	29,676			1,197
HT	28,394	-85		
CB/RW	30,389		713	1,438
CB/HT	29,056	105	662	
RW/HT	30,293	618		1,899
CB/RW/HT	30,277	-112	-17	1,220
CB/HT/HT	29,035	-21	641	
Average		101	494	1439

# Trait Effect on Planting Density

## WI Observations only

Trait	Density	HT Effect	CB Effect	RW Effect
Conv	29,374			
CB	30,043		669	
RW	30,742			1,368
HT	29,514	140		
CB/RW	31,123		381	1,080
CB/HT	30,533	490	1,018	
RW/HT	30,972	231		1,458
CB/RW/HT	31,191	68	219	659
CB/HT/HT	31,218	685	1,703	
Average		323	798	1141

# Trait Effect on Planting Density



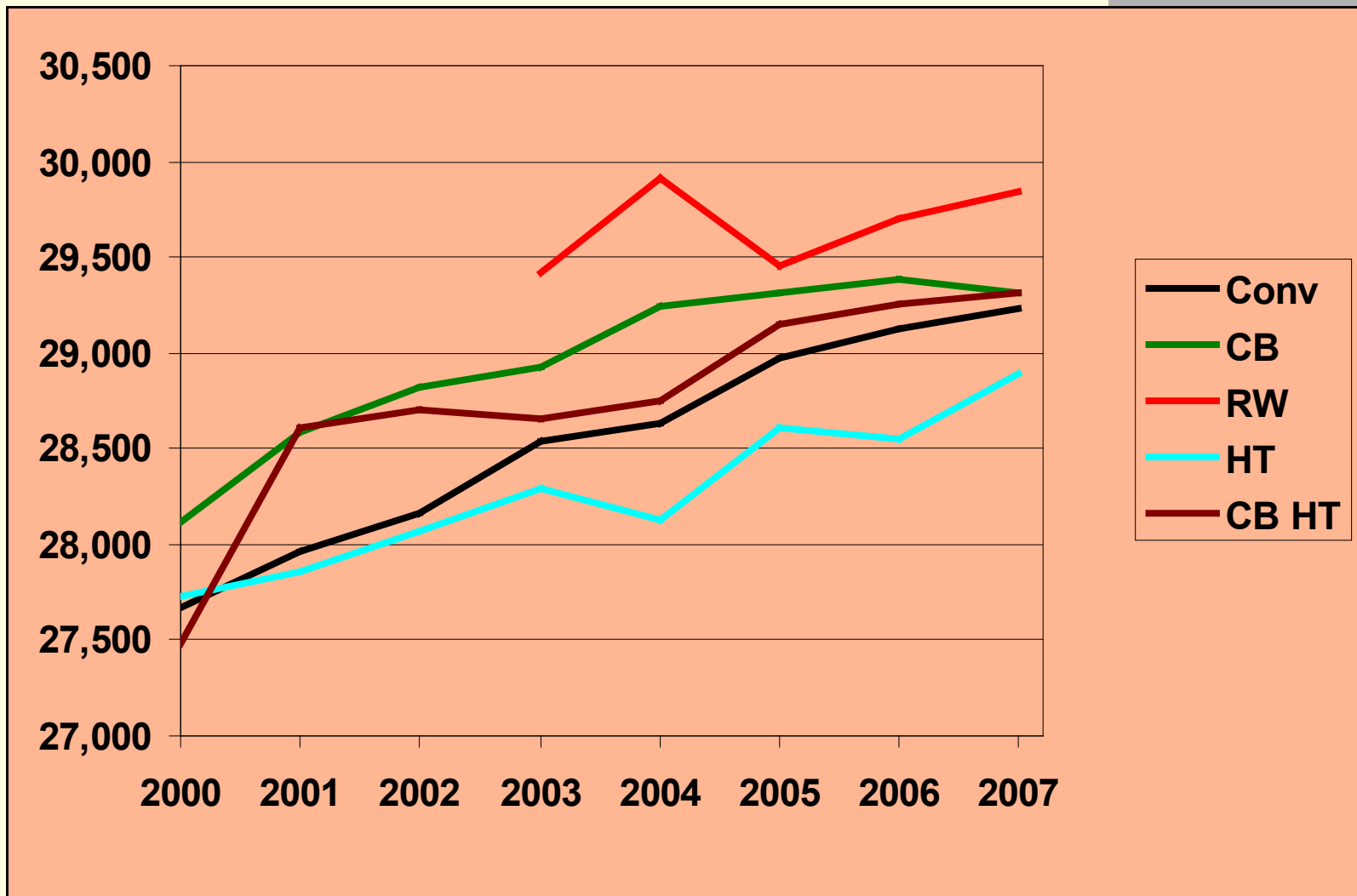
# Trait Effect Summary

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- HT Effect
  - Larger and more consistently positive effect in WI than other states
- CB-Bt Effect
  - Larger and more variable effect in WI than in other states
- RW-Bt Effect
  - Smaller positive effect in WI than other states
- **Problem**: Averages over years and traits
  - Miss annual changes, miss variation

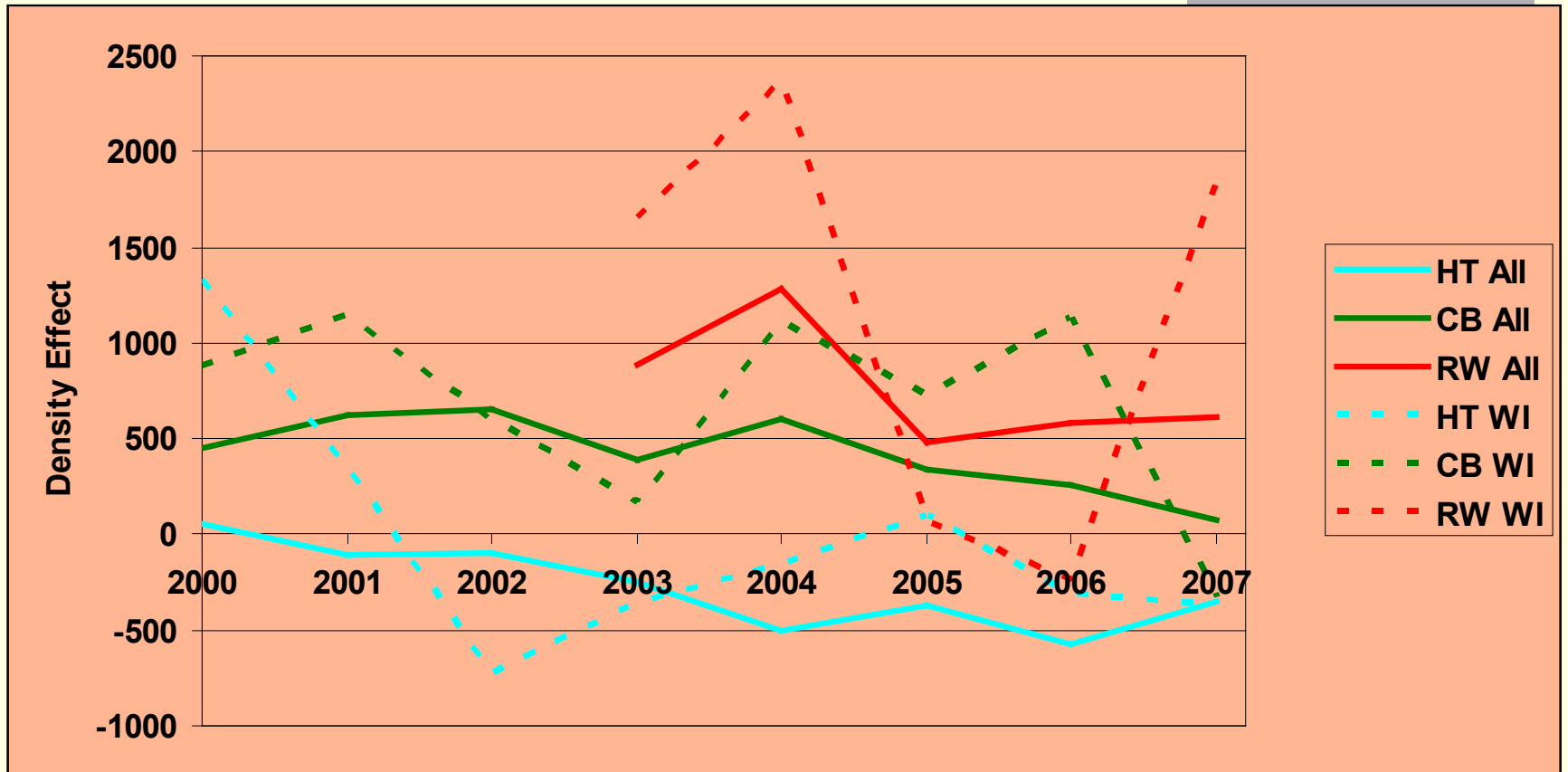
# Trait Effect over Years

(all observations, main traits only)





# Trait Effect vs. Conventional over Years



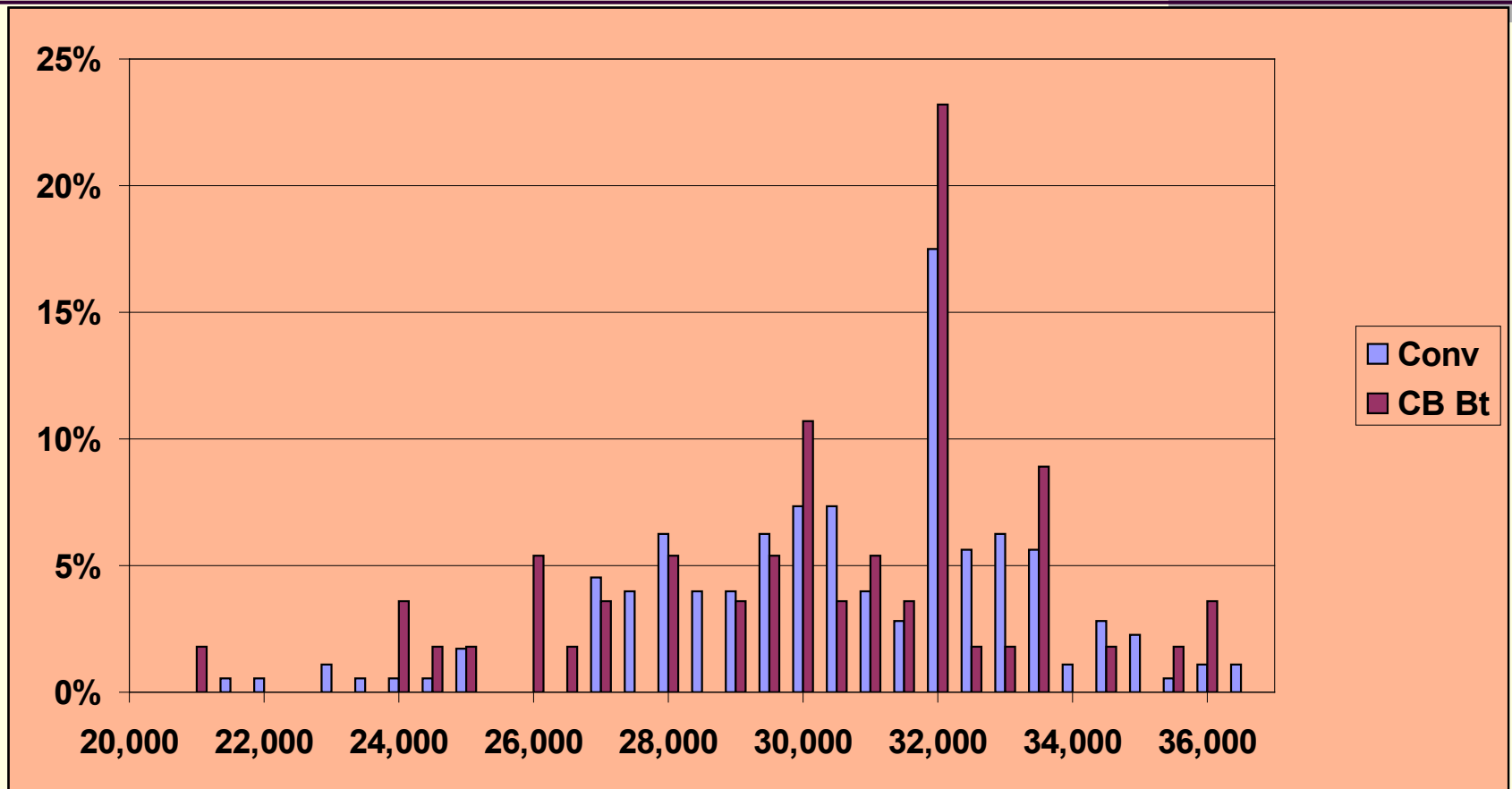
# Trait Effect vs. Conventional over Years

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- WI follows regional trend, but “noisier”
- HT generally negative: farmers plant at lower densities than conventional seed
- RW effect larger than CB effect
- All three generally trend downward
  - CB effect almost zero in 2007 ( $< 0$  in WI)
  - Price effects: traits getting too expensive?
  - Conventional corn densities increasing?

# Substantial Variation Among Farmers

Conventional and CB Bt Corn in WI in 2007



**32,000 most common, then 30,000 and 34,000**

**Some go a little higher, many go lower, especially CB Bt**

# Economic Analysis

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- Examine factors affecting the CB trait effect
  - Detailed economic model, work in progress
- Farmers with incentives to use/seek more information tend to use higher densities
  - Larger size, higher yielding county, more specialized in a specific crop, use more GM, buy from Big 4 seed company, non-livestock grower, buy seed from self or other farmer
- Prices matter too
  - Higher seed prices, fewer seeds per acre
  - Substitute between conventional and Bt corn

# Elasticity Estimates

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Variable	Conventional	Bt Corn
Seed Price: Conventional	0.078***	0.929***
Seed Price: Bt Corn	0.106***	-0.128
Year	-0.001	-0.311***
Total Farm Corn Acres	0.043***	0.149***
Farm Corn Acres % GM	-0.417***	0.811***
Market Concentration	0.006	-0.016
Big 4 Acre Share	-0.026	-0.688***
County Latitude	0.650***	1.754***
County Longitude	-0.381**	-5.816***
County Average Yield	0.404***	1.693***
County Yield CV	0.010	0.134**
County Crop Diversity	-0.092***	-0.668***

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# % Change in Seeding Density

Variable	Conventional	Bt Corn
Purchased from Big 4	15.7%***	35.5%***
Source: Self as Dealer	6.1%***	9.4%***
Source: Seed Company	2.1%***	8.5%***
Source: Other Farmer	2.5%***	9.0%***
Use: Corn Gluten Plant	6.3%	5.4%
Use: Grain/Silage	-6.2%***	-6.1%**
Use: Elevator	0.6%	-13.4%***
Use: Ethanol Plant	-2.1%	-11.3%***
Use: Export	0.4%	6.4%
Use: Feed Mill	-5.2%***	-7.8%**
Use: Grain: Livestock	-2.8%*	0.8%
Use: Grain: Other	-0.8%	7.7%***
Use: Multiple	-3.1%	-11.7%***
Use: Silage	-2.4%	-0.7%

# Summary

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- What seeding densities have WI and Midwestern farmers actually been using?
  - MW: 27,500-29,000    WI: 29,000-31,000
  - Increasing each year, now 32,000 most common
- What about the new transgenic traits?
  - Bt planted at higher densities (especially RW), but effect getting smaller (especially CB)
  - HT planted at lower densities
- Do corn and seed prices affect densities?
  - Yes, may explain recent shifts
  - Other factors matter too: Information effects

# Recommendations

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- Look at company literature and local research to help determine recommended seeding densities
- Optimal density responds to price of corn and seed, use decisions aids and common sense
- Conduct own on-farm experiments
  - If aids, experts, etc. all say higher densities than typically use, try different densities
  - Higher for CB Bt and RW Bt, but not HT
  - Higher where more protected from winds
  - After harvest, analyze yield data and see if higher densities paid off



# Questions?

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