

# What Have Transgenic Crops Meant to Farmers?

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Madison, WI  
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# Overview

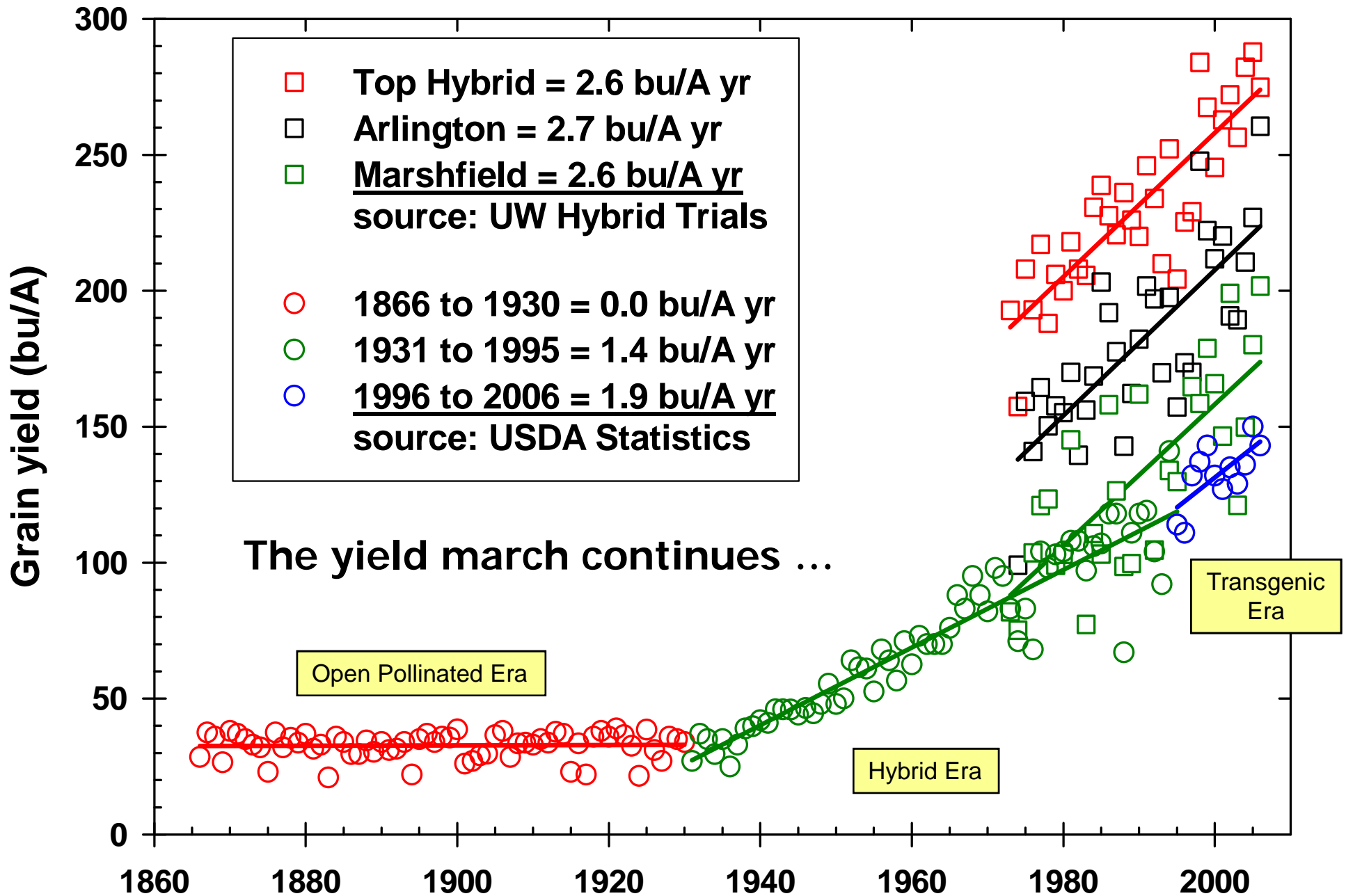
- **The “Grand Experiment”**
  - ✓ Yield progress versus yield protection
- **What do transgenics crops mean for the farmer? Society?**
- **Performance of transgenics**



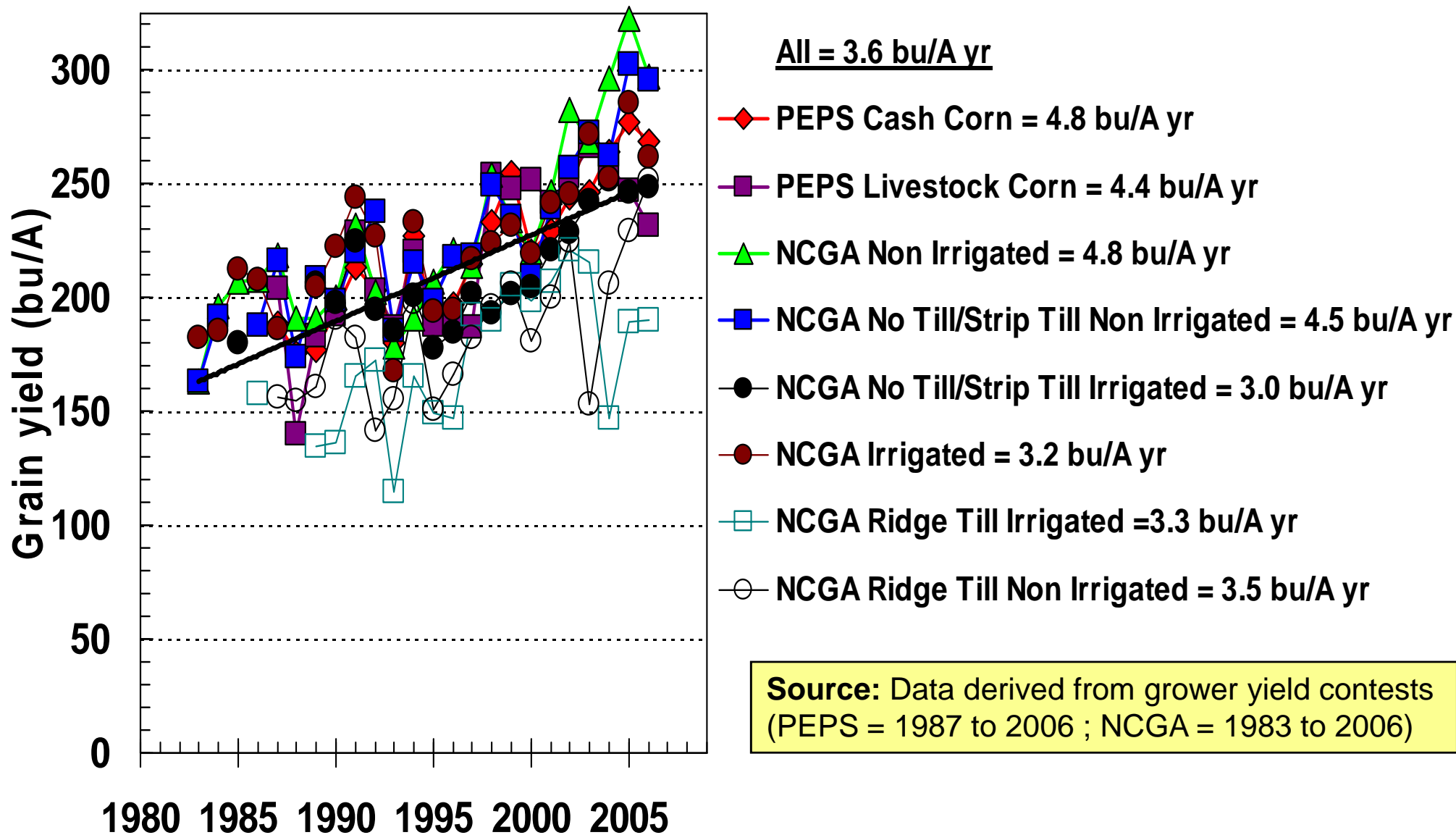
# A "Grand Experiment" is going on in the countryside ...



# Corn yield in Wisconsin since 1866

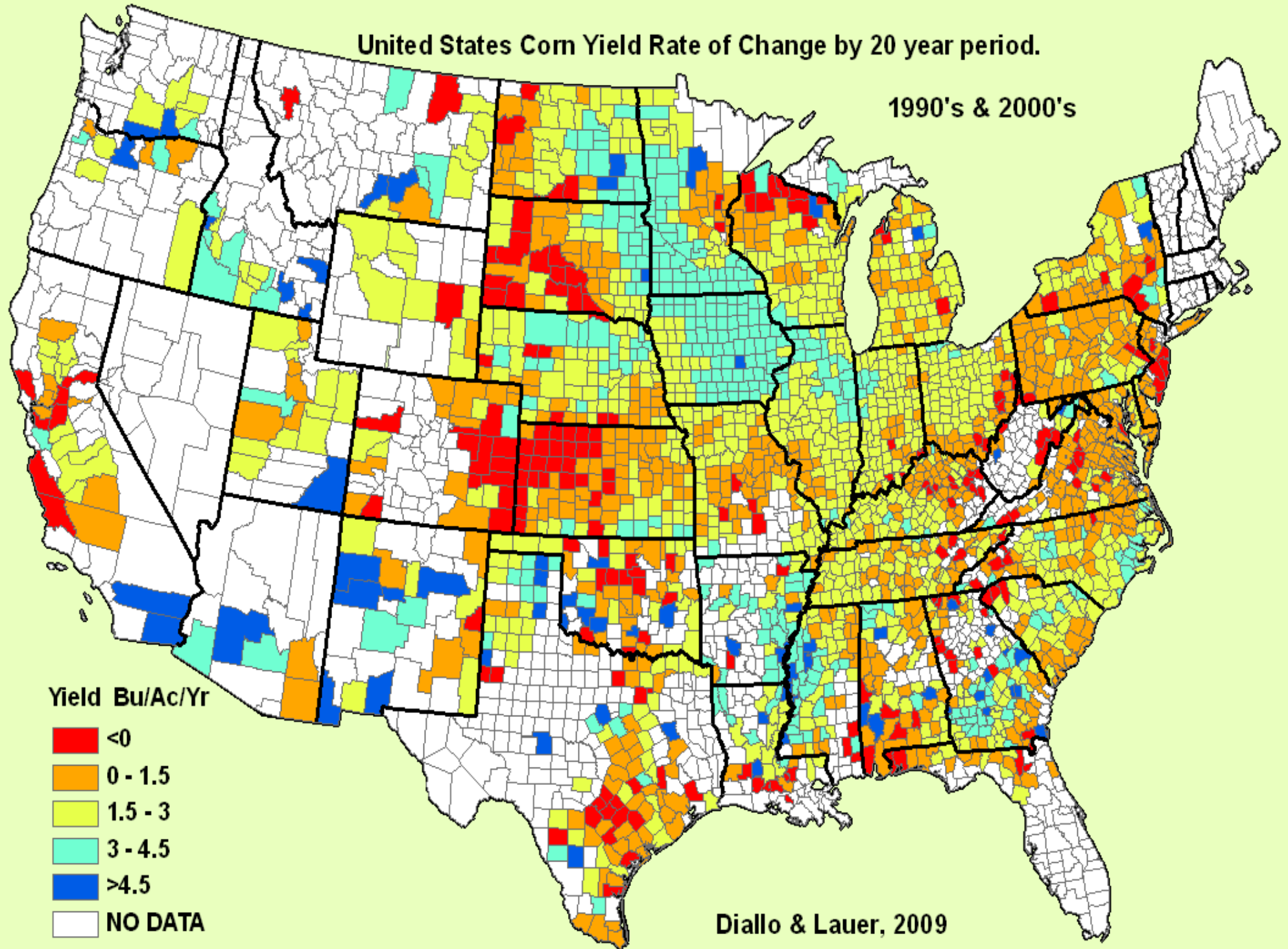


# Corn Yield Progress in Wisconsin (Top Producer in Category)



# United States Corn Yield Rate of Change by 20 year period.

1990's & 2000's



# **“Biotech crops do not add to yield ... they protect yield.”**

**Well managed normal hybrids can yield the same as transgenic hybrids.  
Transgenic hybrids yield at the top AND bottom of a performance trial.**

## **Pros**

- **Efficacy**
- **Value of “ease of use”**
  - ✓ Sprayer cleanup
  - ✓ Herbicide certification
- **Crop safety**
- **Human safety**
- **Perceived risk decrease**
  - ✓ Biotech Yield Endorsement
- **Potential for increased quality/nutrition AND yield**

## **Cons**

- **Potential development of resistance**
- **Unknown implications for the Midwest US (corn / soybean) cropping system.**
- **Cost: When is enough money enough?**
  - ✓ Research and Ramp-up expenses
  - ✓ Patent expiration

# Transgenic Events that have come (*and gone*) in the Wisconsin Corn Trials

## Insecticide Transgenes

### ● European Corn Borer

- ✓ *Bt176 (NaturGard Knockout): 1996-2001*
- ✓ Bt11 (AgriSure-CB): 1996-
- ✓ Mon810 (YieldGard-CB): 1997-
- ✓ *DBT418: 1998-1999*
- ✓ TC1507 (Herculex I): 2003-

### ● Corn Rootworm

- ✓ Mon863 (YieldGard-CR): 2003-
- ✓ MIR604 (AgriSure-CR): 2003-
- ✓ DAS591227 (Herculex II): 2006-

## Herbicide Transgenes

### ● Roundup Ready

- ✓ MonGA21 (RR1): 1998-
- ✓ Nk603 (RR2): 2000-

### ● Liberty Link

- ✓ T25: 1997-

### ● Tissue Cultured genes

- ✓ IMI (IT and IR): 1993-
- ✓ *SR: 1996-1998*



# Single, Paired, Triple and Quad Stacks Making some Sense out of the Options!

- Often more complex to evaluate than normal hybrids. You need to know...
  - ✓ Performance compared to other hybrids with similar trait, if others exist.
  - ✓ Trade-off economics between pesticide tolerant trait and actual pesticide.
  - ✓ Grain yield, output trait “yield” or quality, and other important characteristics.
  - ✓ Finding comparative data in public or private trial reports may be difficult.





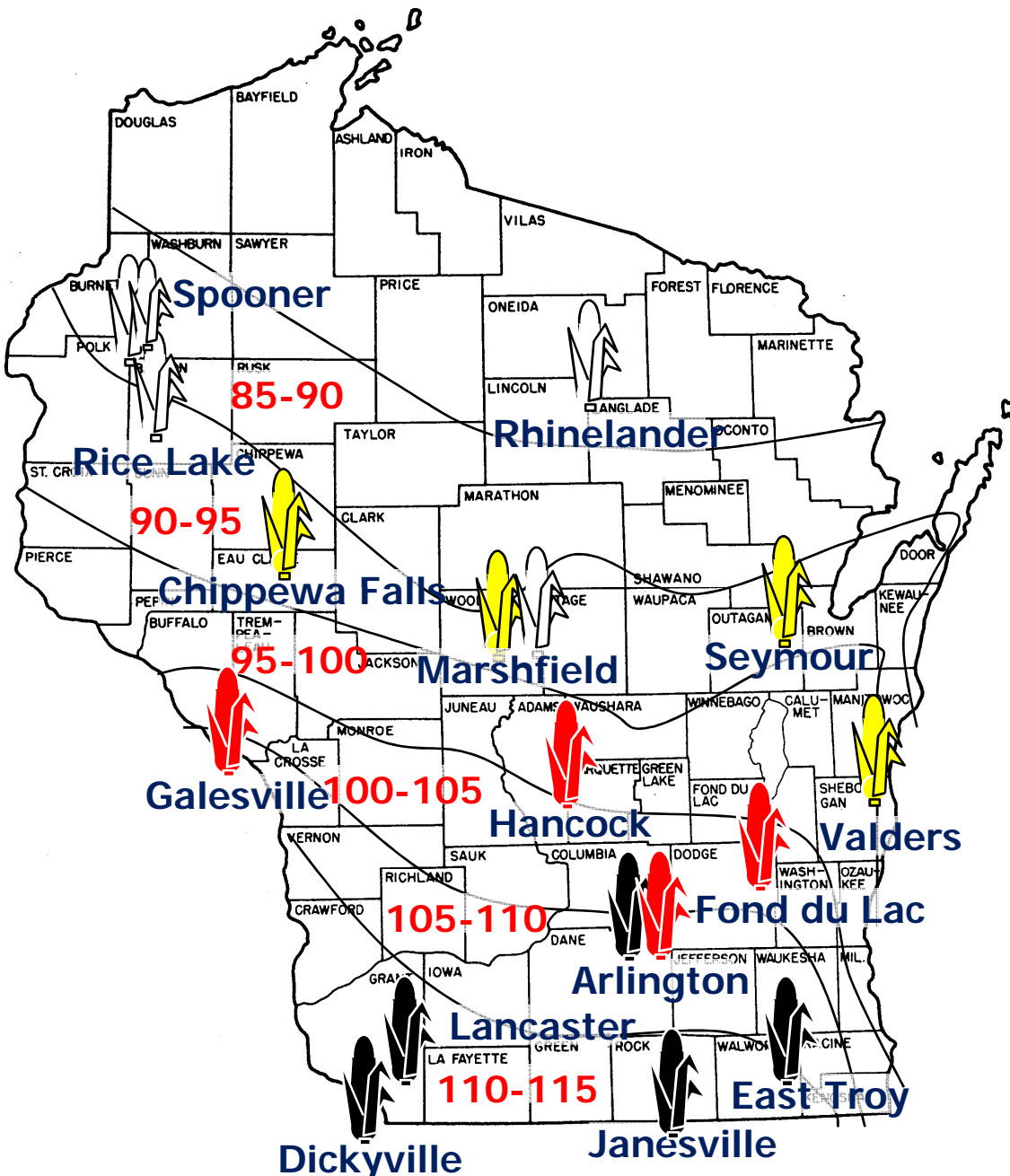
## Corn Agronomy Program 2008

### Rationale and Situation

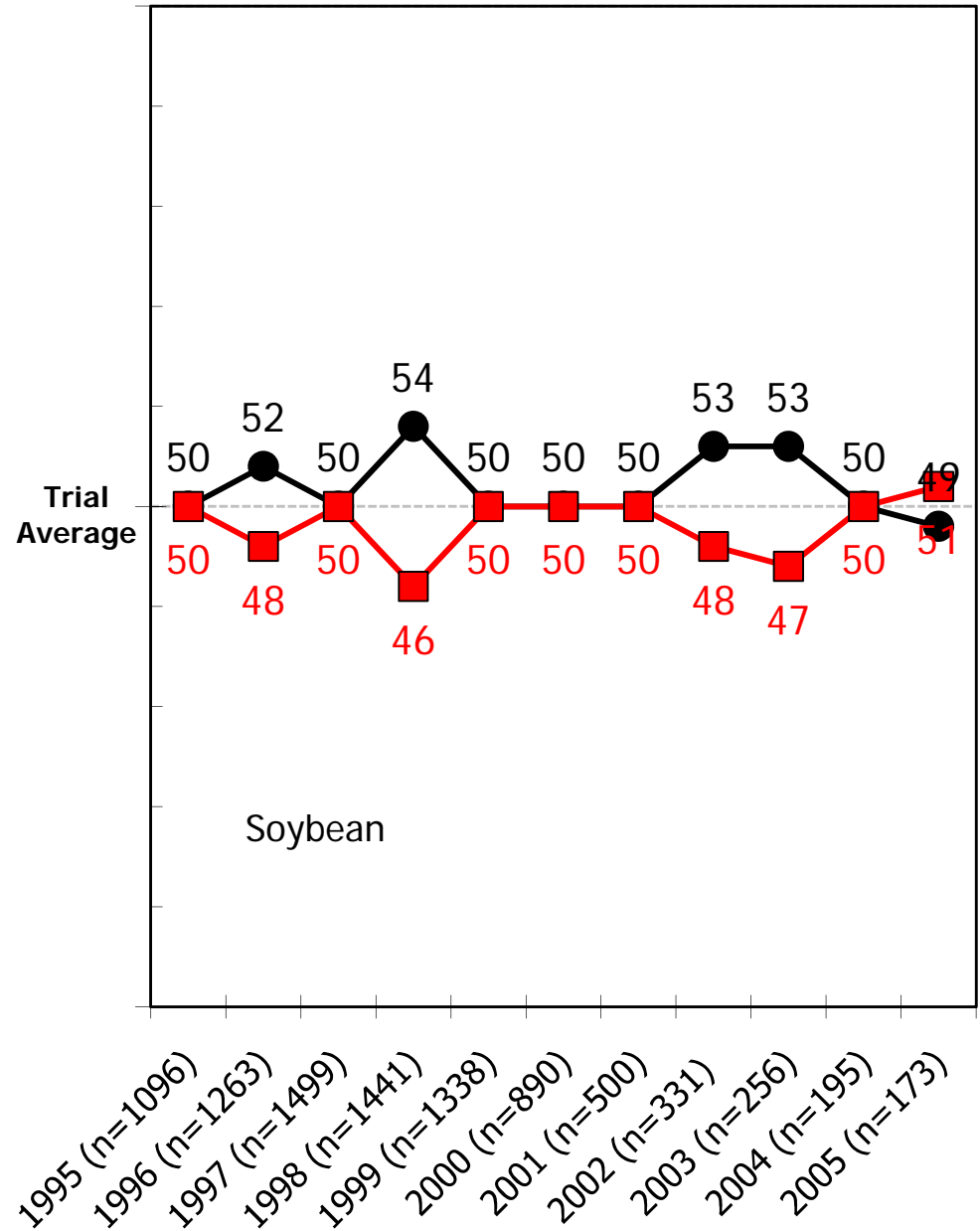
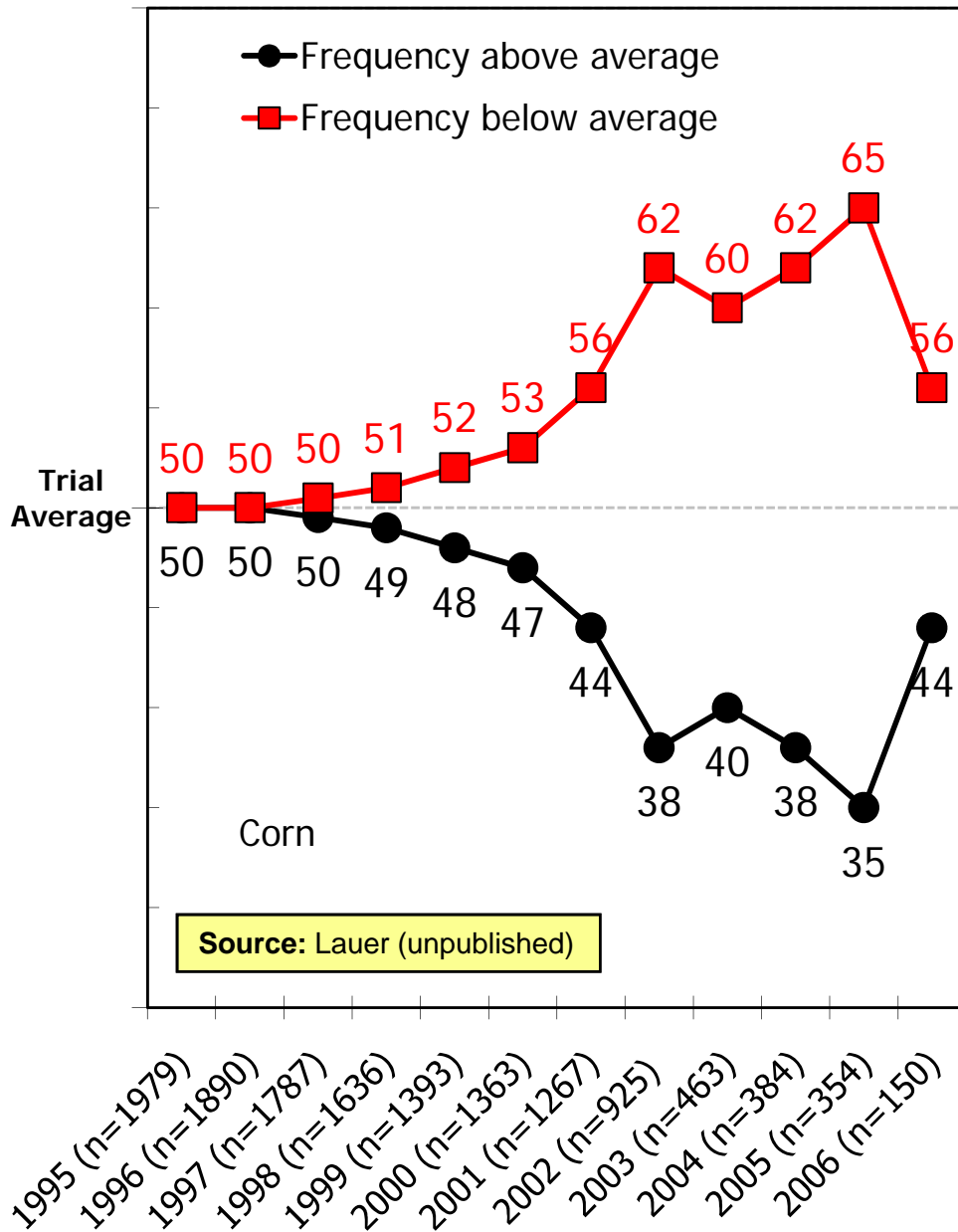
- Corn is grown on 4 million acres in WI. A one bushel increase by farmers increases farm income \$8 to \$16 million dollars annually.
- In 2008, 520 corn hybrids were tested at 14 locations.

### Objective

- To provide unbiased performance comparisons of hybrid seed corn available in Wisconsin.



# Non-transgenic corn hybrids ... there aren't as many available ... they yield less than transgenic corn hybrids (~ 5 bu/A)



# At the end of the day ...

## How should you compare corn hybrids?

### What is the control treatment?

- **Isoline comparison**

- ✓ Preferred (CAST)
- ✓ Problem: Backcross conversion
  - ❑ "Moving target"
  - ❑ Assumes conversion is clean
- ✓ "Base genetics", "families"

- **Within trials comparison**

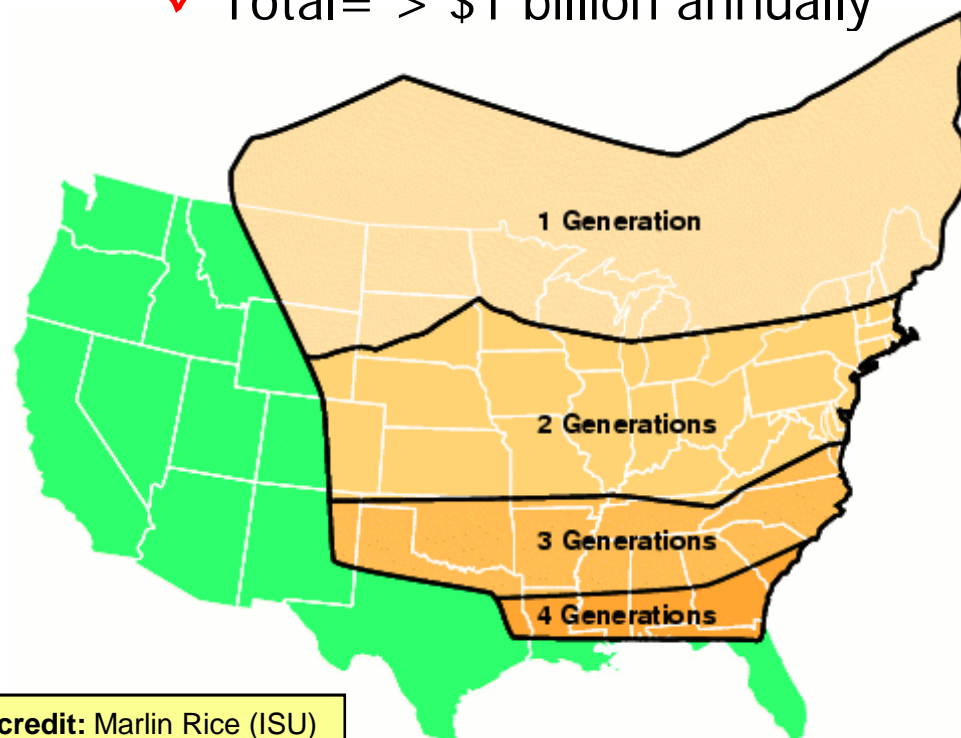
- ✓ Compare to trial average
- ✓ Cohorts
  - ❑ Transgenic versus Non-transgenic
  - ❑ 'Top' hybrids (20%) cohort:  
More 'real world' since farmers  
have access to all hybrids



# Insect Resistant Transgenic Corn Hybrids – European Corn Borer (*Ostrinia nubilalis*)



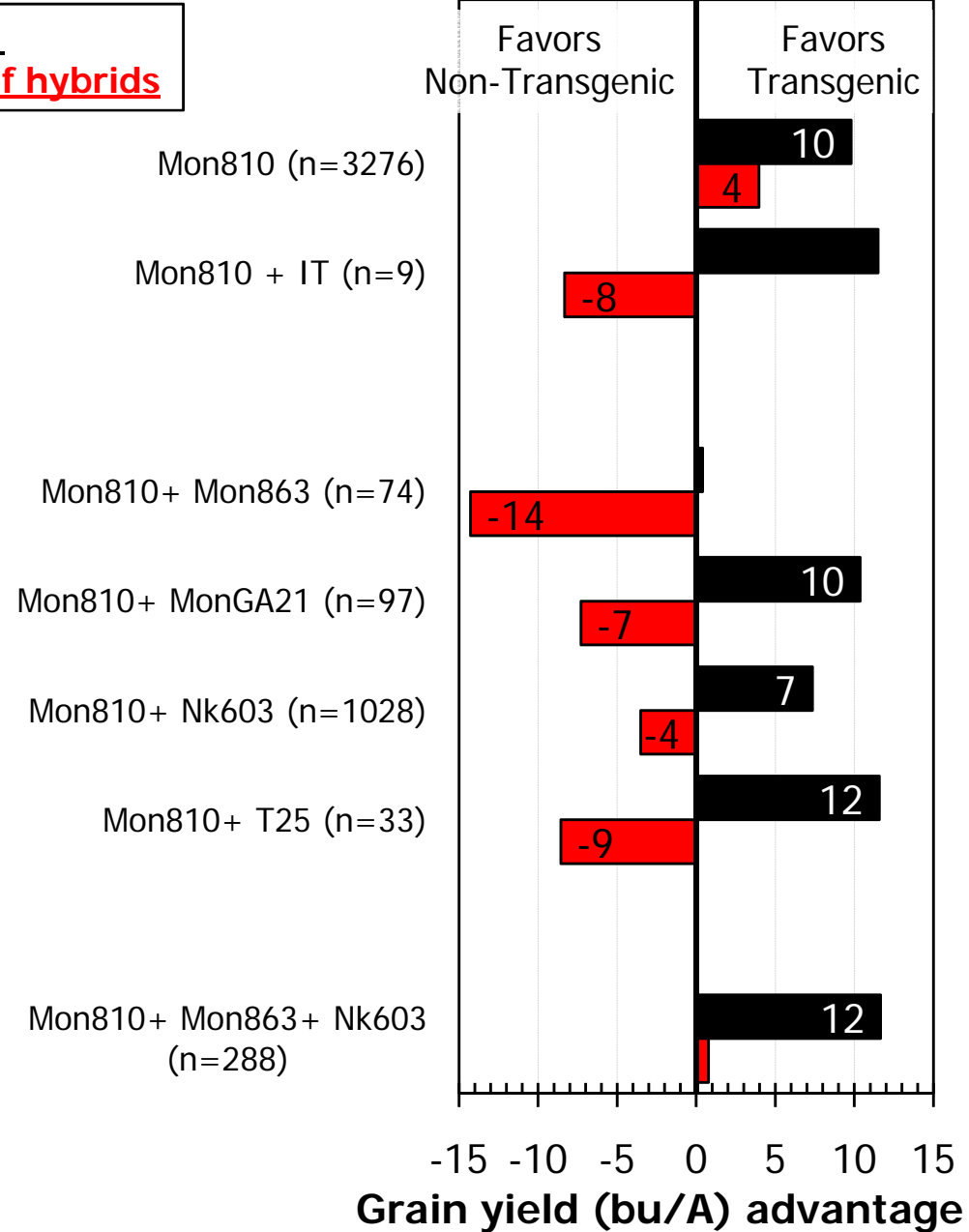
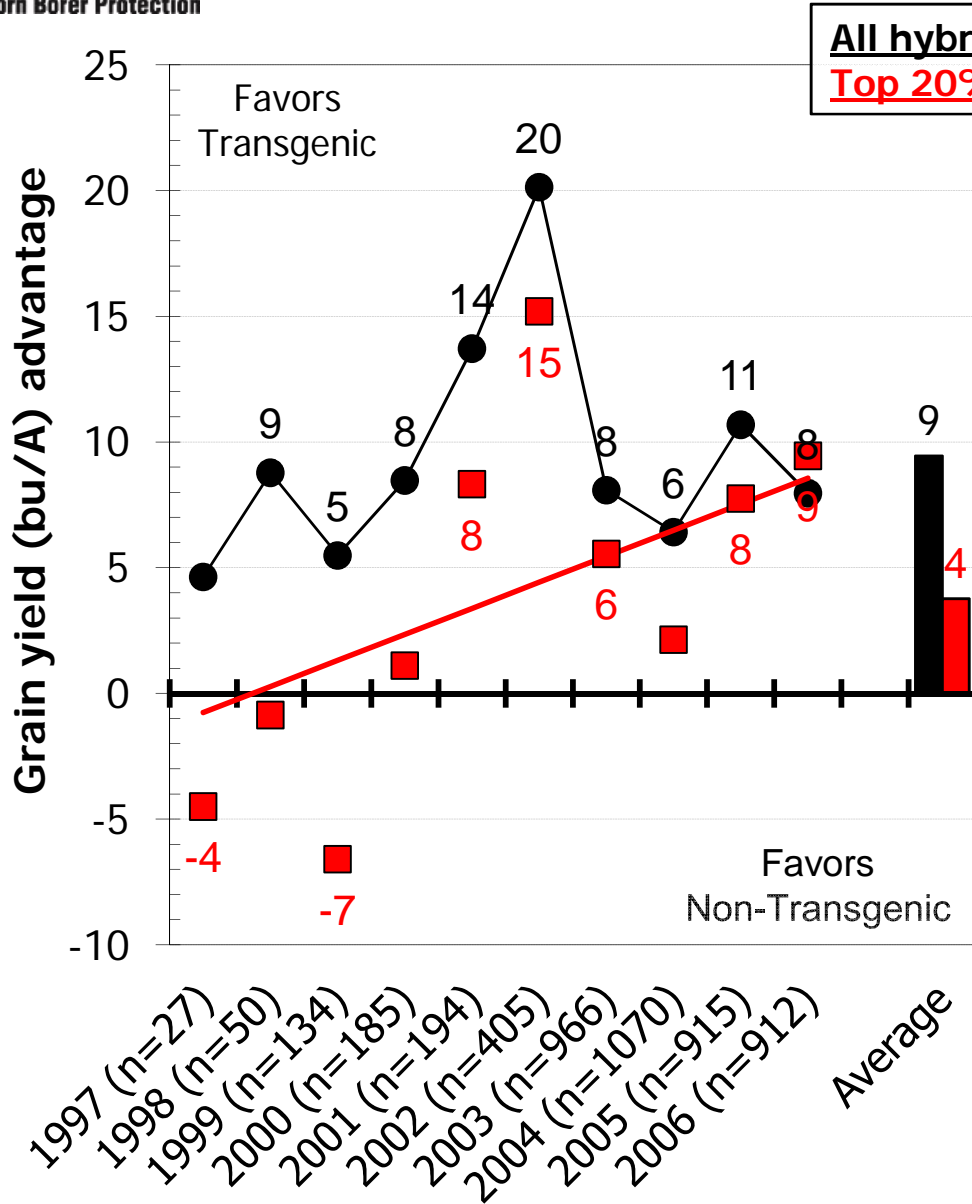
- First discovered near Boston in 1917. Damages >200 plants.
- Economic damage (Ostlie, 1997)
  - ✓ 1<sup>st</sup> generation = \$7 /A
  - ✓ 2<sup>nd</sup> generation = \$13 /A
  - ✓ Total = > \$1 billion annually



Photos and map credit: Marlin Rice (ISU)

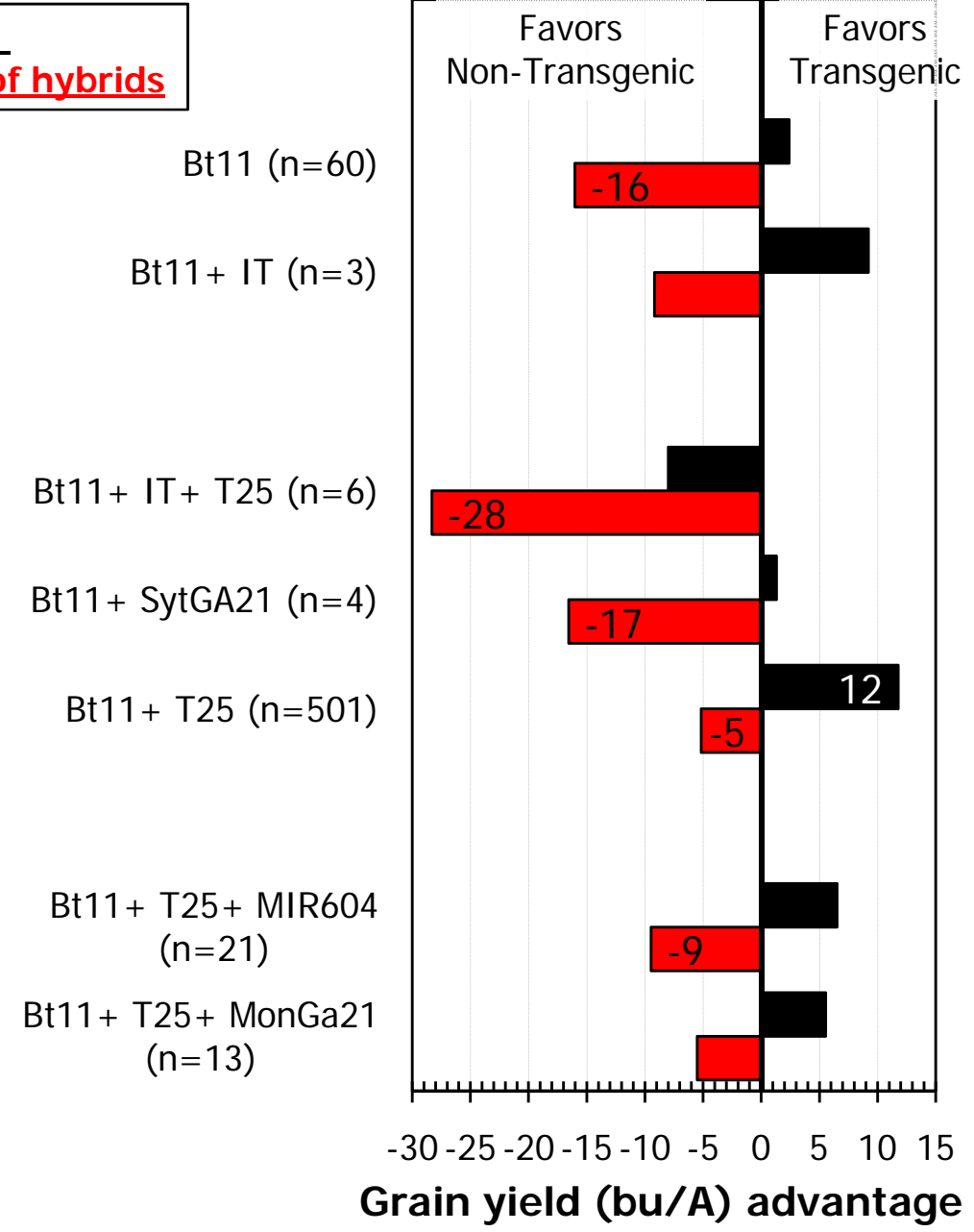
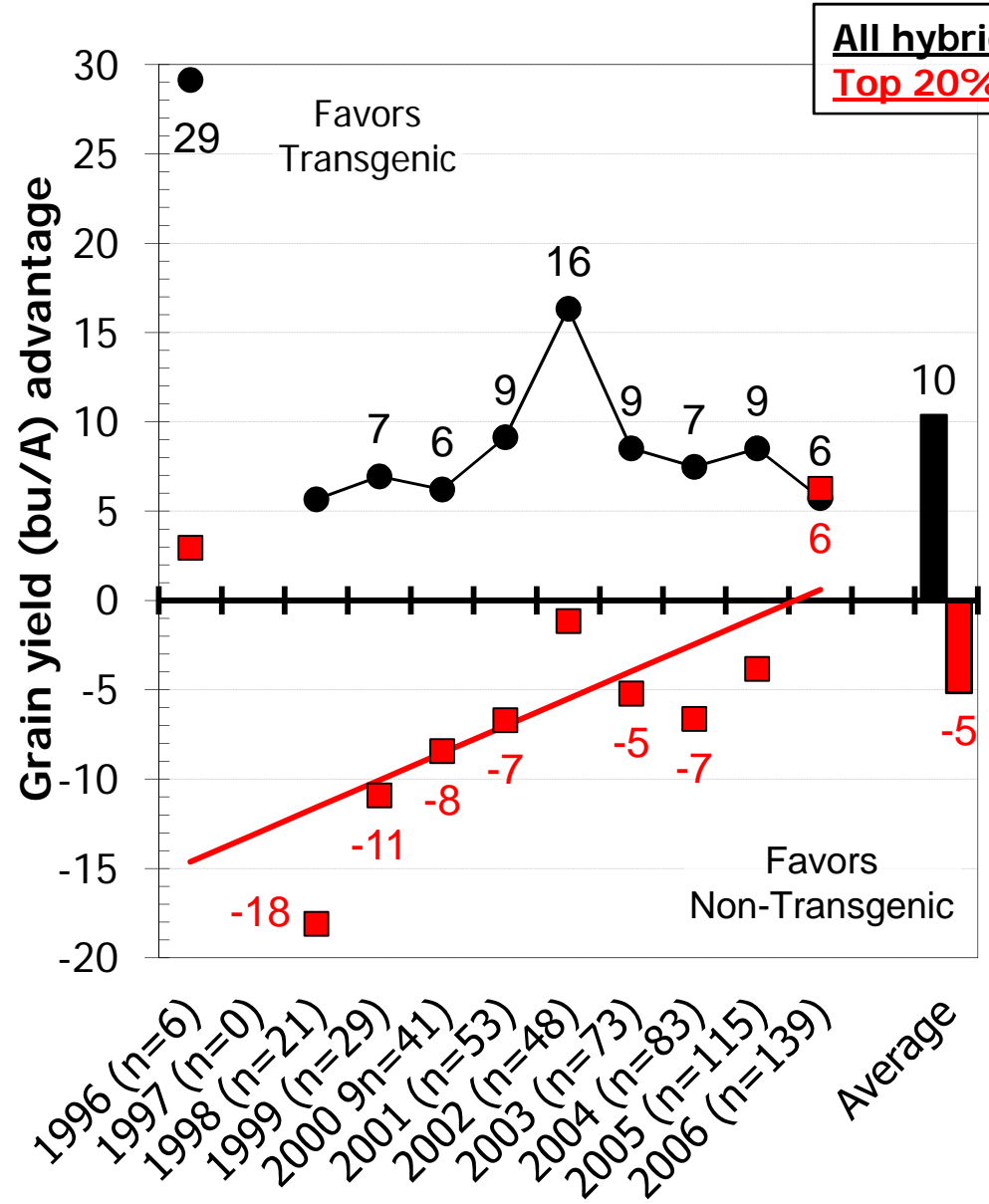


# Mon810 (n= 4858) advantage to non-transgenic (n= 8767) corn hybrids



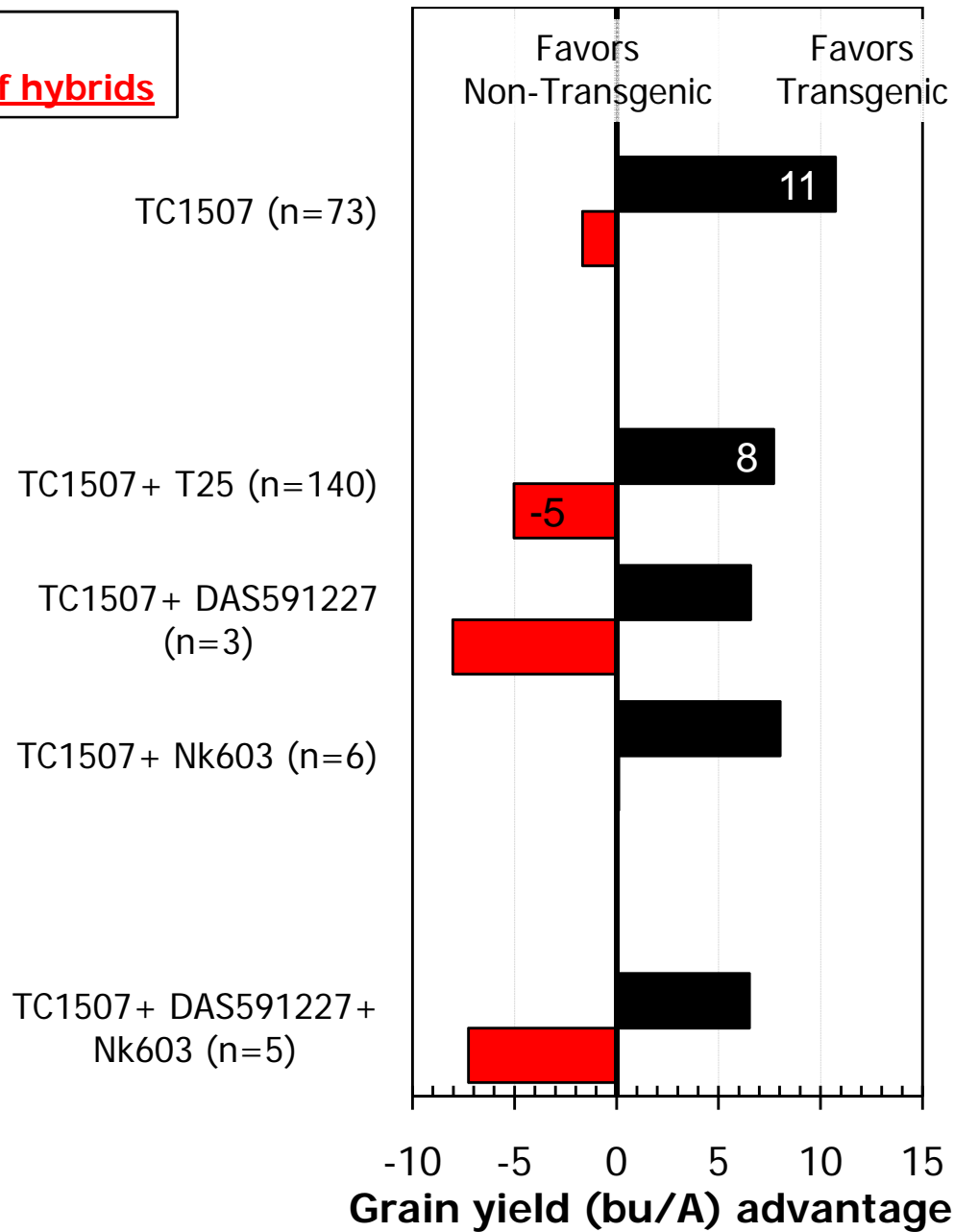
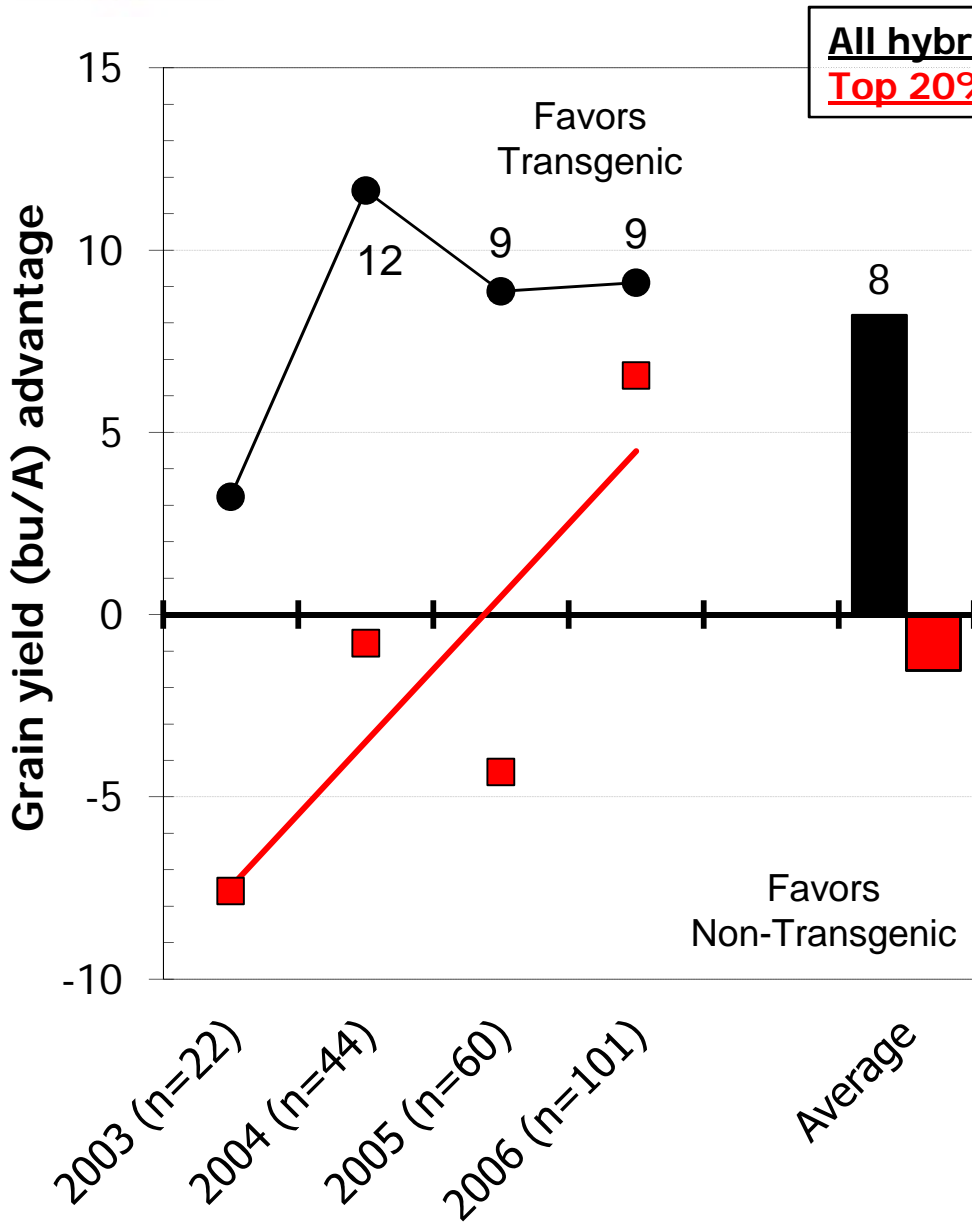


# Bt11 (n= 608) advantage to non-transgenic (n= 7840) corn hybrids





# TC1507 (n= 227) advantage to non-transgenic (n= 940) corn hybrids

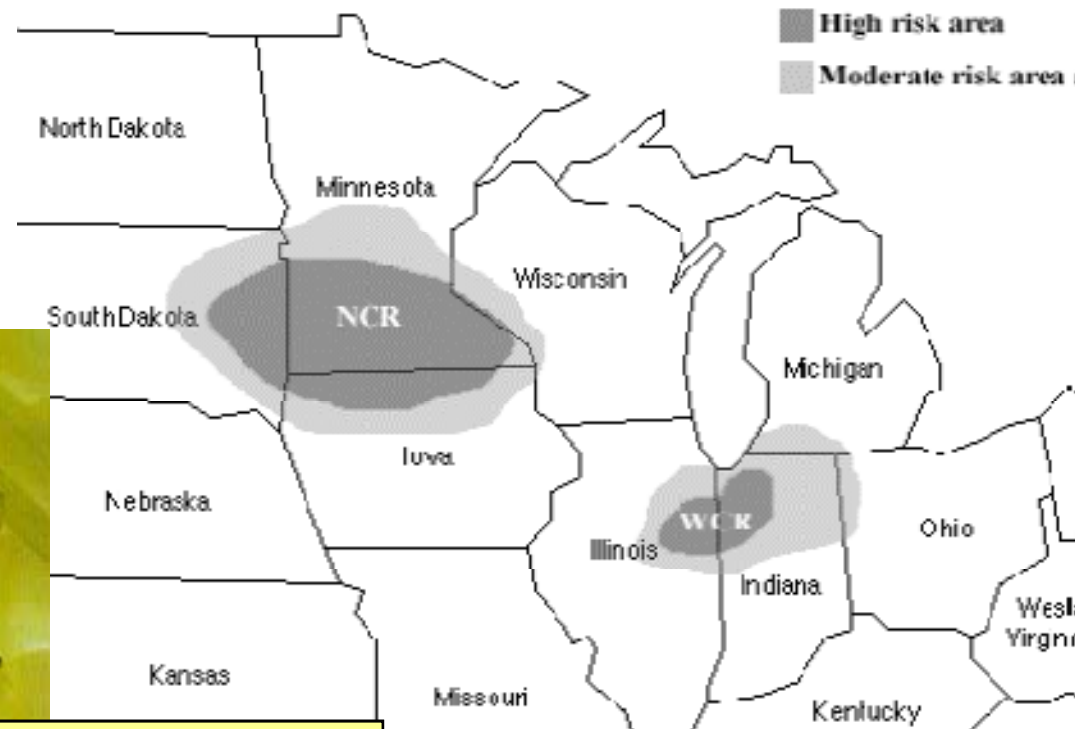




# Insect Resistant Transgenic Corn Hybrids - Corn rootworm (*Diabrotica* sp.)



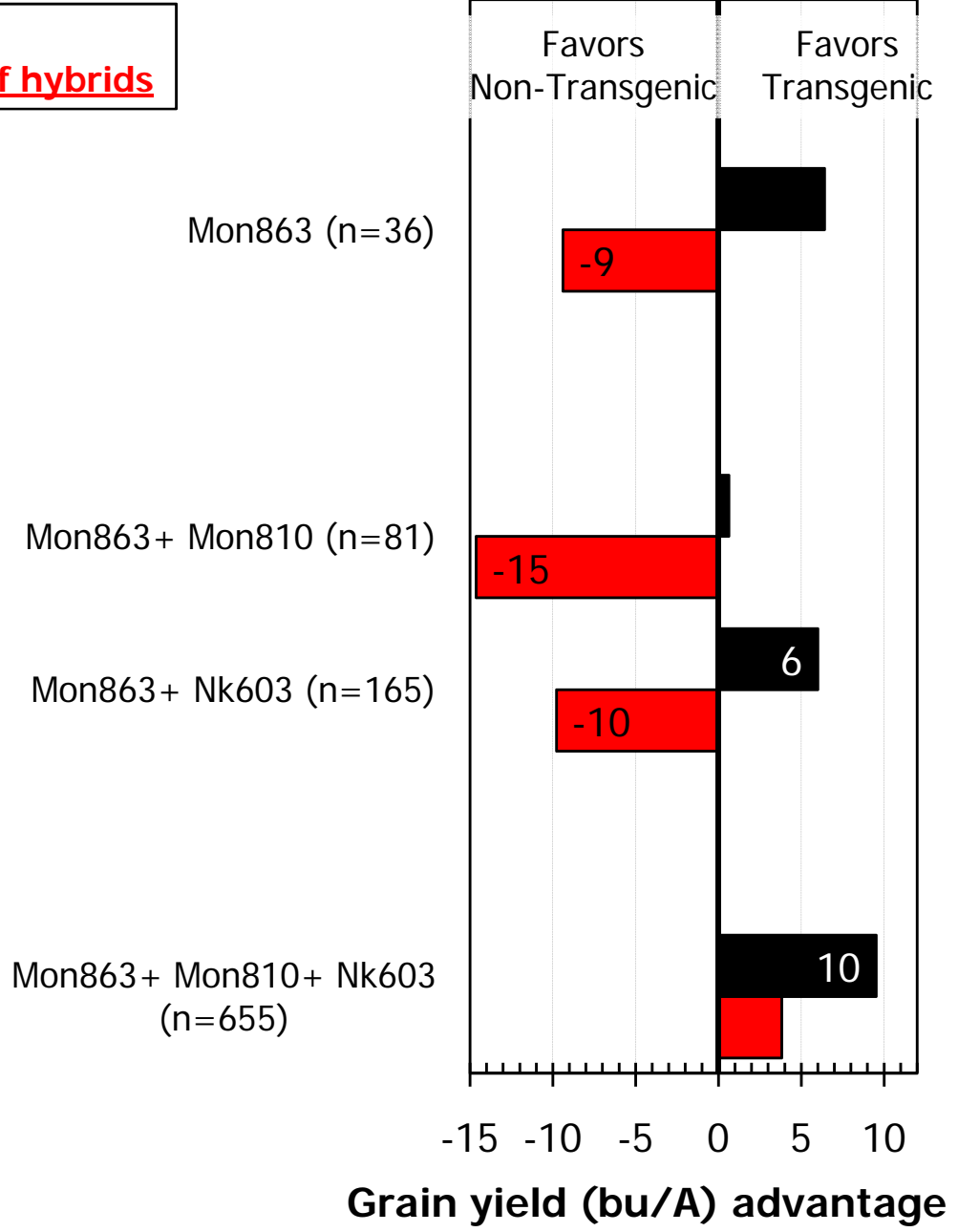
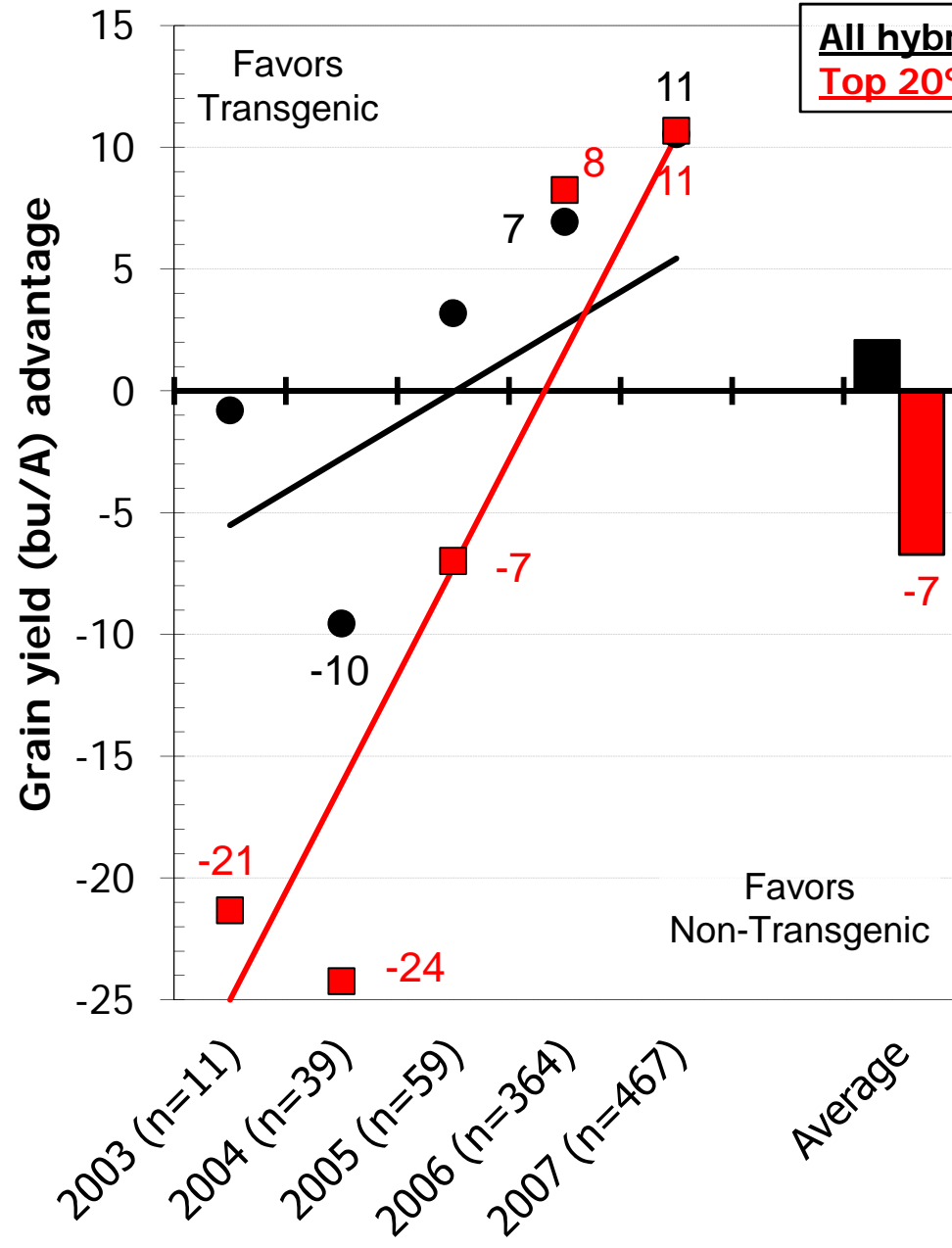
- Annual economic damage=
  - ✓ \$800 million crop loss
  - ✓ \$200 million in control costs
- Current control strategies:
  - ✓ Crop rotation
  - ✓ Insecticide



Photos credit: Marlin Rice (ISU)  
Map credit: Ken Ostlie (MN)



# Mon863 (n=940) advantage to non-transgenic (n=1116) corn hybrids



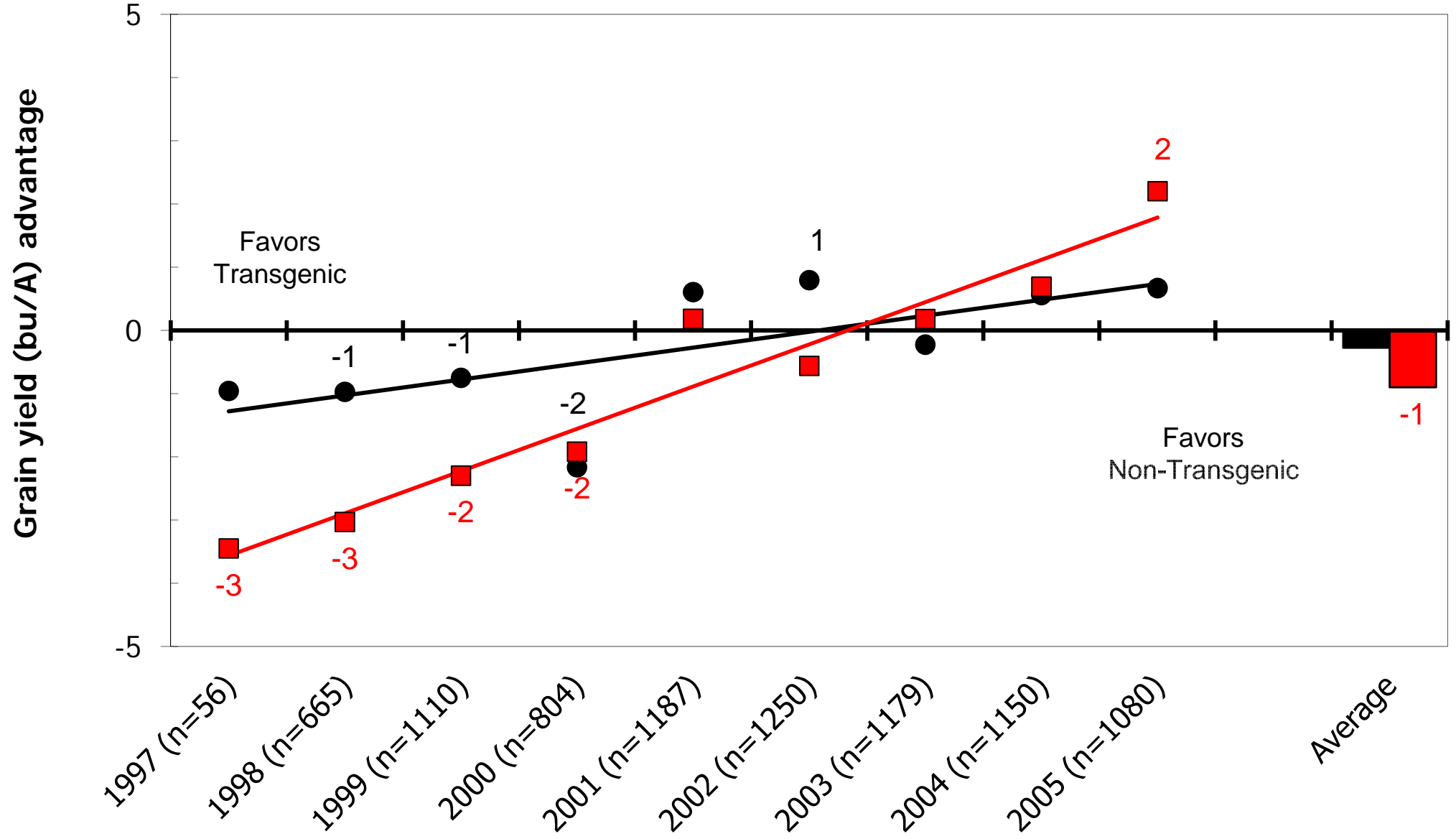
# Herbicide Tolerant Transgenic Corn Hybrids

- **Glyphosate resistant (Roundup Ready)**
  - ✓ RR – MonGA21
  - ✓ RR2 – Nk603
- **Glufosinate resistant (Liberty Link)**
  - ✓ T25



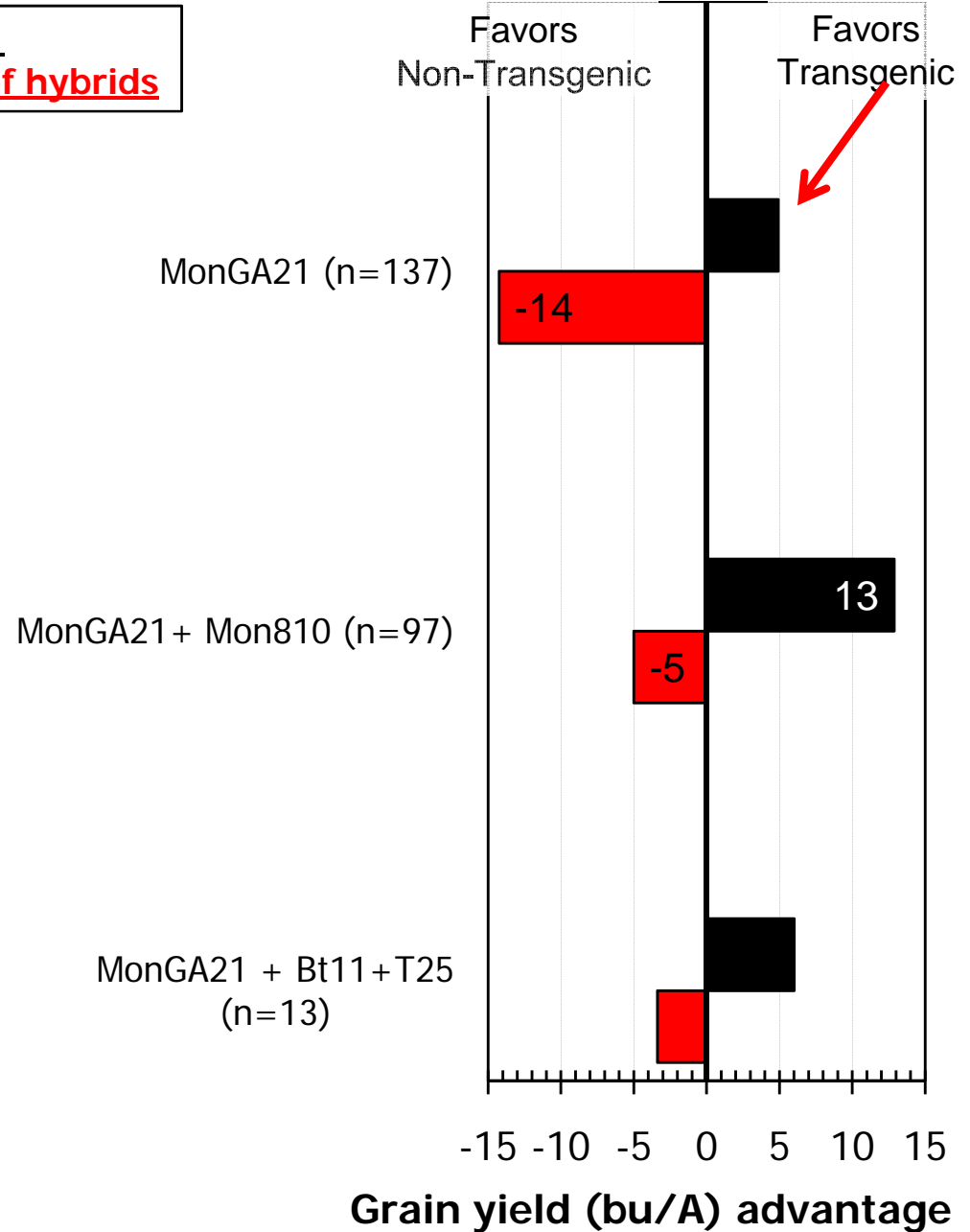
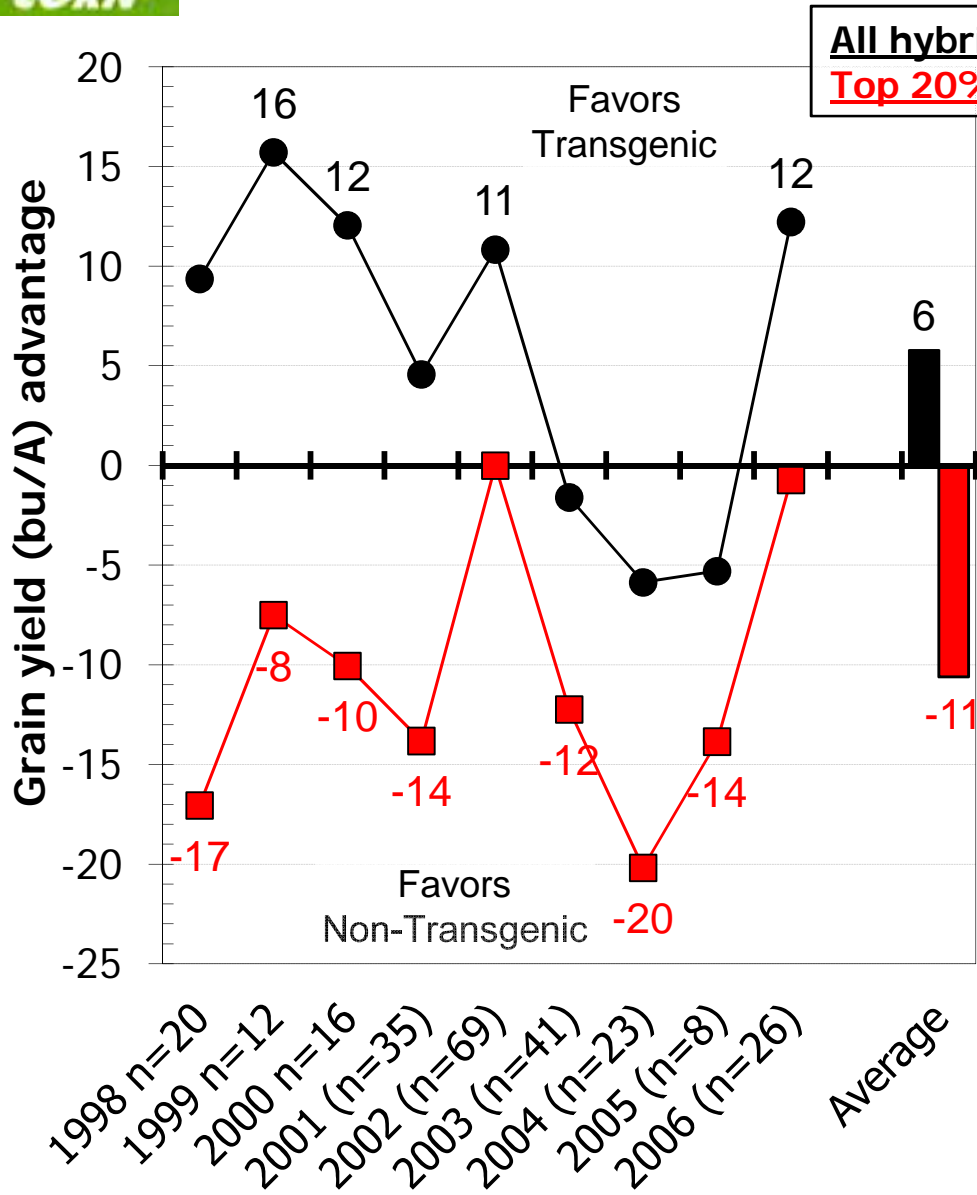


# Roundup Ready (n= 8481) advantage to non-transgenic (n= 6623) soybean varieties



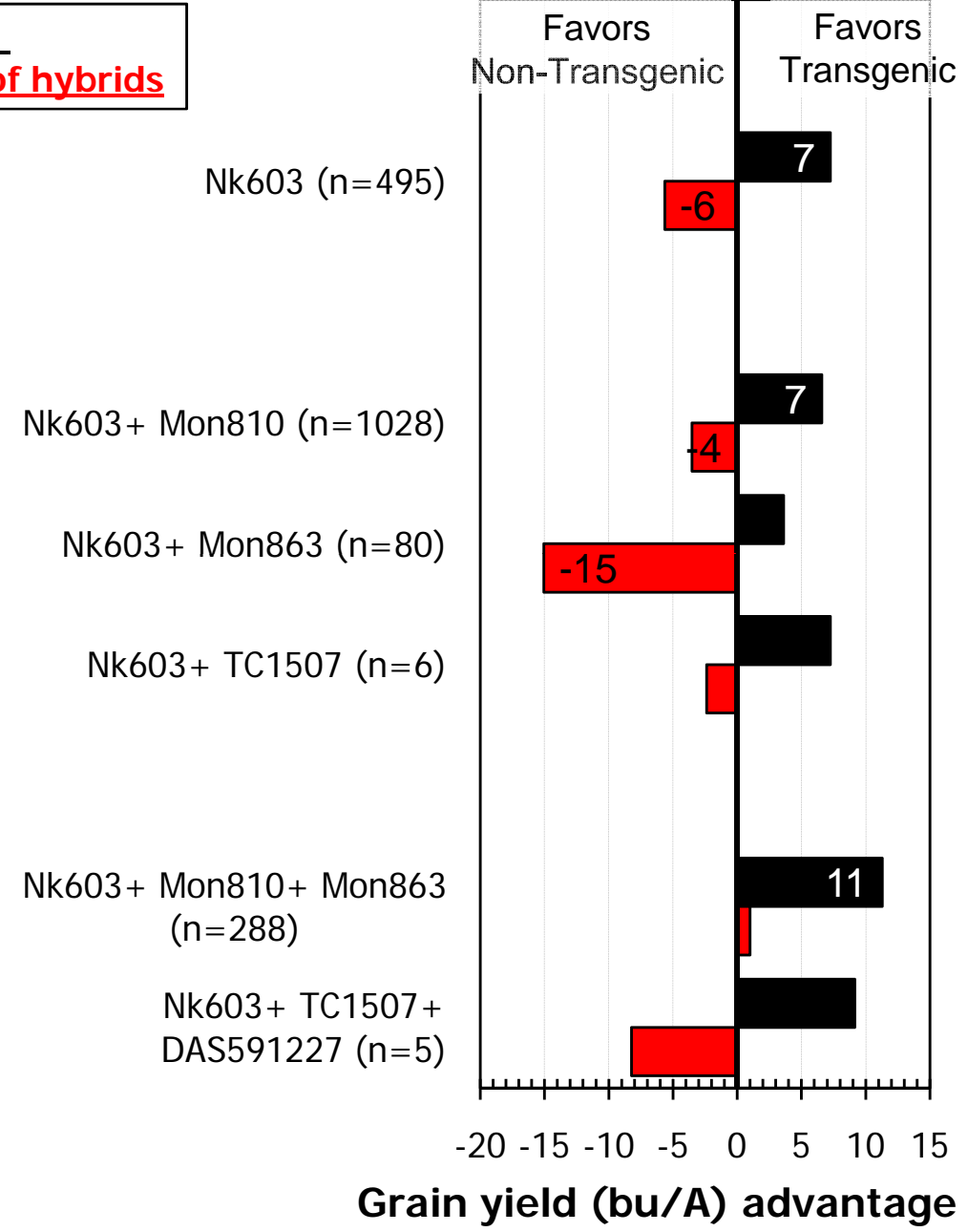
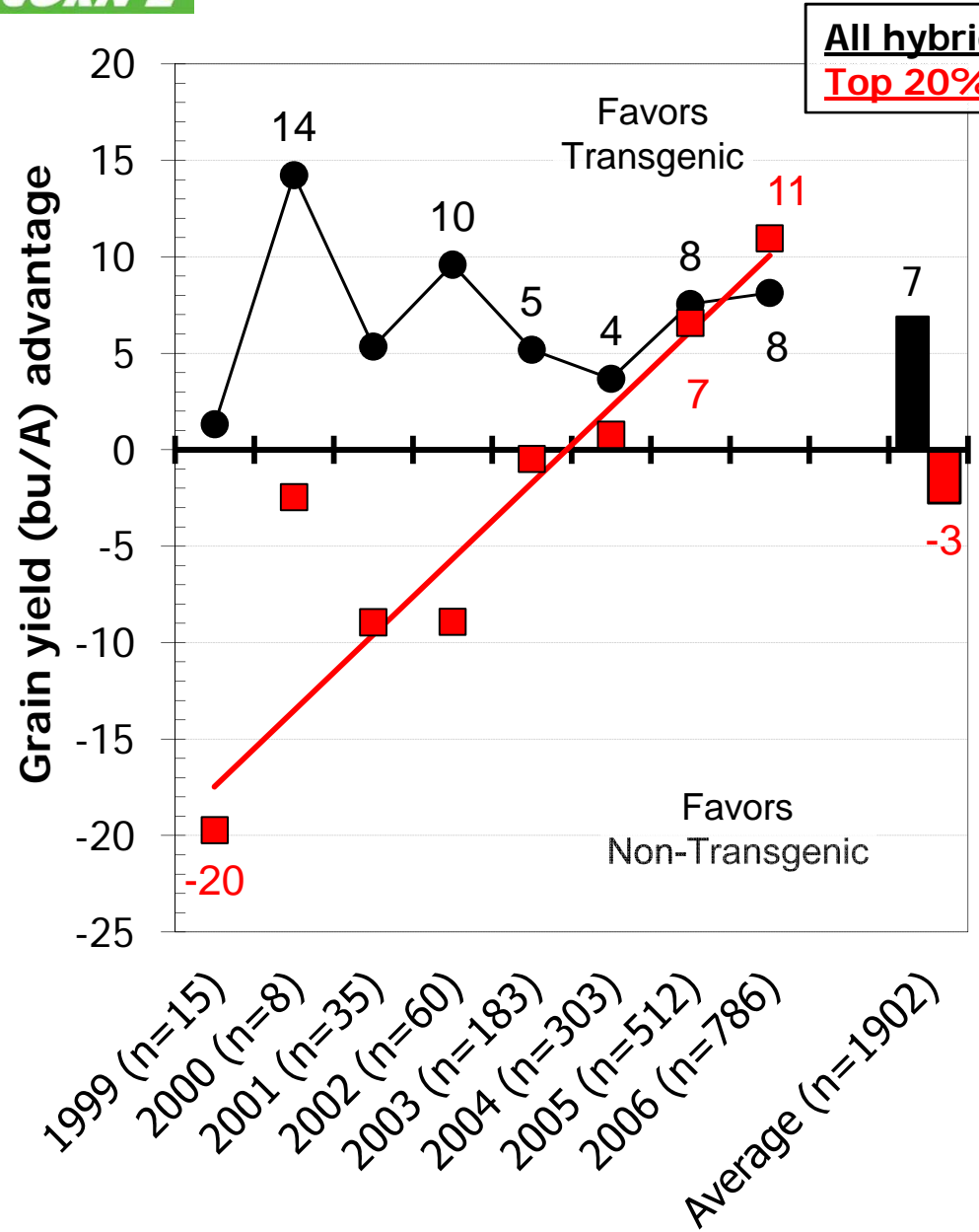


# MonGA21 (n= 250) advantage to non-transgenic (n= 5574) corn hybrids

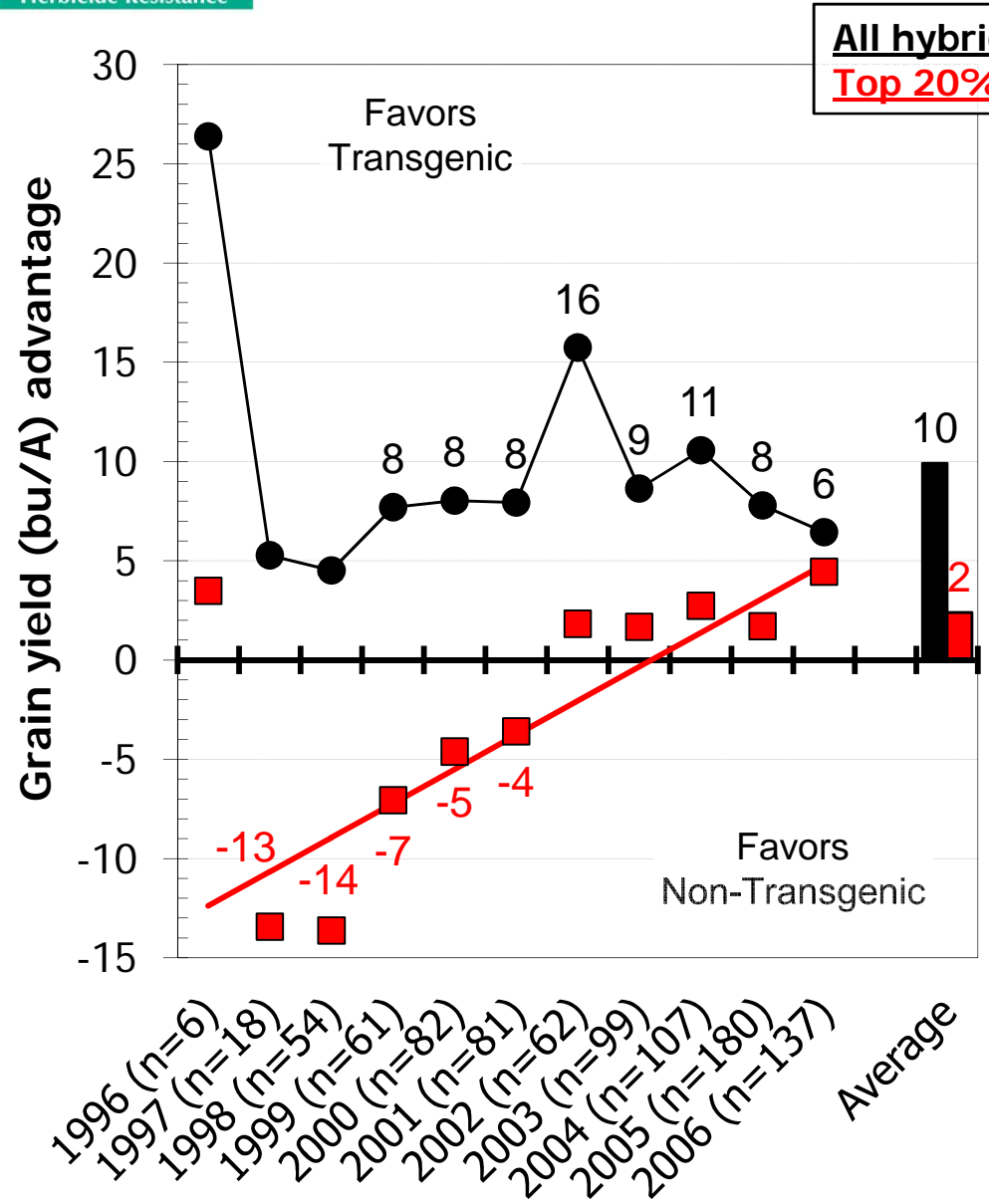




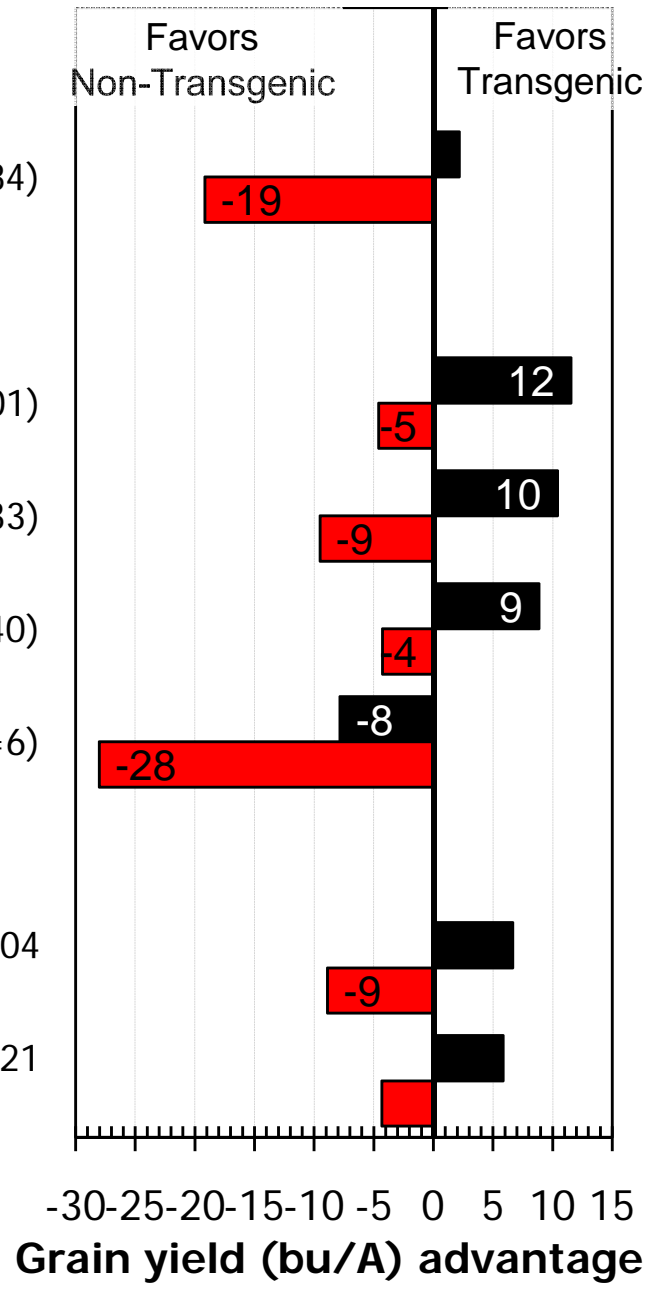
# Nk603 (n= 1902) advantage to non-transgenic (n= 3703) corn hybrids



# T25 (n= 887) advantage to non-transgenic (n= 9909) corn hybrids



Hybrid	n
T25	84
T25+ Bt11	501
T25+ Mon810	33
T25+ TC1507	140
T25+ Bt11+ IT	6
T25+ Bt11+ MIR604	21
T25+ Bt11+ MonGA21	13



# Herbicide Tolerant Tissue Cultured Corn Hybrids

- **Imidazolinone tolerant (Pursuit)**
  - ✓ IT – “Clearfield”
  - ✓ IR
- **Sethoxydim resistant (Poast)**

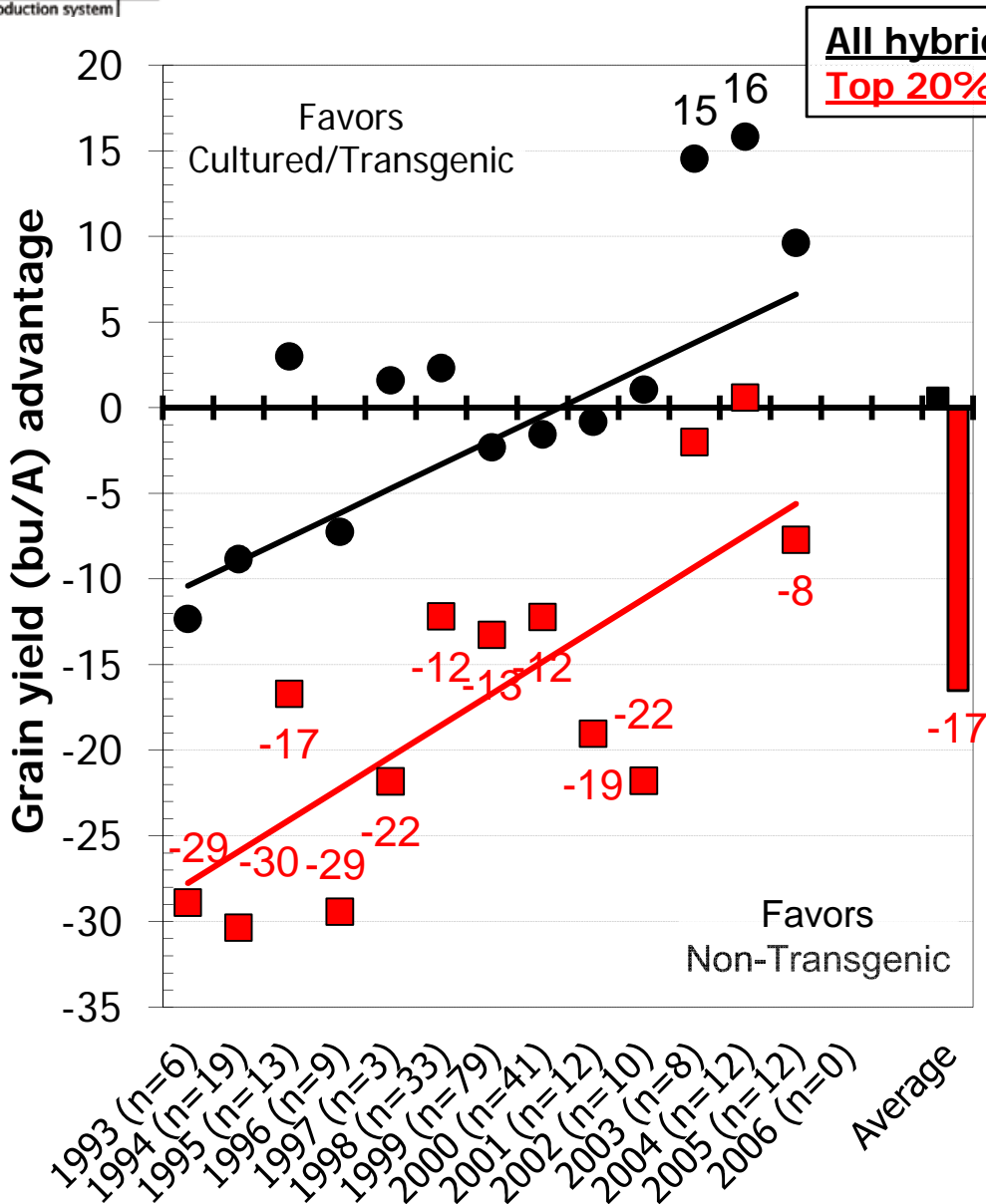






# IMI-IT (n= 257) advantage to non-transgenic (n= 8658) corn hybrids

CLEARFIELD production system



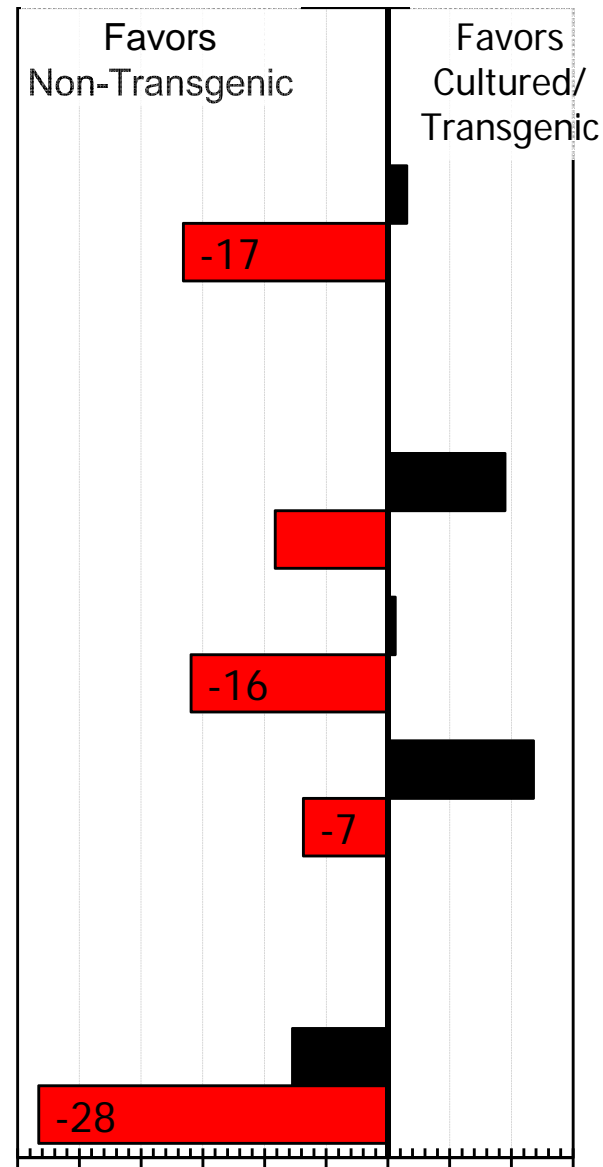
IT (n=219)

IT+ Bt11 (n=3)

IT+ Bt176 (n=3)

IT+ Mon810 (n=9)

IT+ Bt11+ T25 (n=6)



Grain yield (bu/A) advantage

# Summary on Transgenic Performance


- **Hybrids must stand on their own.**
  - ✓ Pick corn hybrids and soybean varieties based upon individual performance.
  - ✓ DO NOT assume that performance is equivalent across a hybrid/variety family or 'base' genetics.
  - ✓ DO NOT assume you are getting a good deal because you got an extra trait.
- **Care must be taken in selecting non-transgenic corn hybrids.**
- **Has the "Yield March" (genetic gain) come to an end?**
  - ✓ Are we now just protecting yield?
- **Roundup ready soybean varieties produce greater yield than normal varieties.**
- **Grain yield of corn hybrids with CB transgenes (Bt11, Mon810 and TC1507) is better than nontransgenic hybrids.**
  - ✓ Bt11, Mon810 and TC1507 stacked with T25, MonGA21 or Nk603 perform well.
- **Herbicide resistant transgenes (T25, MonGA21, and Nk603, as well as IMI) do not add to yield.**
  - ✓ Recommended for problem fields or difficult management situations.
- **CR transgenes ==> Yield lag or drag.**
- **"Variation for grain yield exists among commercial transgenic corn hybrids and soybean varieties sold in Wisconsin."**

# Spreadsheet for Calculating Seed Costs

CropSeedPriceCalculator\_v1.2.xls [Compatibility Mode] - Microsoft Excel

Home Insert Page Layout Formulas Data Review View Developer Add-Ins

S19

1 **Crop Seed Price Calculator v1.2** written by Joe Lauer, University of Wisconsin (September 2008) 

2

3 Predicted Field Yield (bu/A) 150

4

Hybrid / Variety	Hybrid A	Hybrid B	difference
Seed Price (\$/bag)	\$150.00	\$150.00	\$0.00
Kernels/Seeds per bag (no./bag)	80,000	80,000	\$0.00
Seed Population (number/acre)	32,000	32,000	0
Potential plant death (%)	10	10	0
Acres per bag (acres/bag)	2.27	2.27	0.00
Seed Cost (\$/acre)	\$66.00	\$66.00	\$0.00
Herbicide Cost (\$/acre)	\$0.00	\$0.00	\$0.00
Insecticide Cost (\$/acre)	\$0.00	\$0.00	\$0.00
Fungicide Cost (\$/acre)	\$0.00	\$0.00	\$0.00
Insurance Cost (\$/acre)	\$0.00	\$0.00	\$0.00
Harvest Moisture (%)	20.0	20.0	0.0
Drying (\$/point*bushel)	\$0.06	\$0.06	\$0.00
Drying Cost (\$/bushel)	\$0.27	\$0.27	\$0.00
Handling Cost (\$/bushel)	\$0.02	\$0.02	\$0.00
Hauling Cost (\$/bushel)	\$0.04	\$0.04	\$0.00
Trucking Cost (\$/bushel)	\$0.11	\$0.11	\$0.00
Storage Cost (\$/bushel)	\$0.12	\$0.12	\$0.00
Yield adjustment (\$/bushel)	\$0.56	\$0.56	\$0.00
Yield adjustment (\$/acre)	\$84.00	\$84.00	\$0.00
Total Input Cost (\$/acre)	\$150.00	\$150.00	\$0.00

Economic advantage (\$/acre) of Hybrid A or Hybrid B. Seed price difference = \$0 per bag: A = \$150, Hybrid B = \$150.

Yield advantage bushel/acre	Crop Price (\$/bushel)						
	\$1.00	\$2.00	\$3.00	\$4.00	\$5.00	\$6.00	\$7.00
14	\$14	\$28	\$42	\$56	\$70	\$84	\$98
12	\$12	\$24	\$36	\$48	\$60	\$72	\$84
<b>Hybrid A yields less than Hybrid B</b>							
8	\$8	\$16	\$24	\$32	\$40	\$48	\$56
6	\$6	\$12	\$18	\$24	\$30	\$36	\$42
4	\$4	\$8	\$12	\$16	\$20	\$24	\$28
2	\$2	\$4	\$6	\$8	\$10	\$12	\$14
<b>Hybrid A = (Hybrid B)</b>	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2	\$2	\$4	\$6	\$8	\$10	\$12	\$14
<b>Hybrid A yields more than Hybrid B</b>							
4	\$4	\$8	\$12	\$16	\$20	\$24	\$28
6	\$6	\$12	\$18	\$24	\$30	\$36	\$42
8	\$8	\$16	\$24	\$32	\$40	\$48	\$56
10	\$10	\$20	\$30	\$40	\$50	\$60	\$70
12	\$12	\$24	\$36	\$48	\$60	\$72	\$84
14	\$14	\$28	\$42	\$56	\$70	\$84	\$98

Crop Seed Price Calculator v1.2

Ready 115%

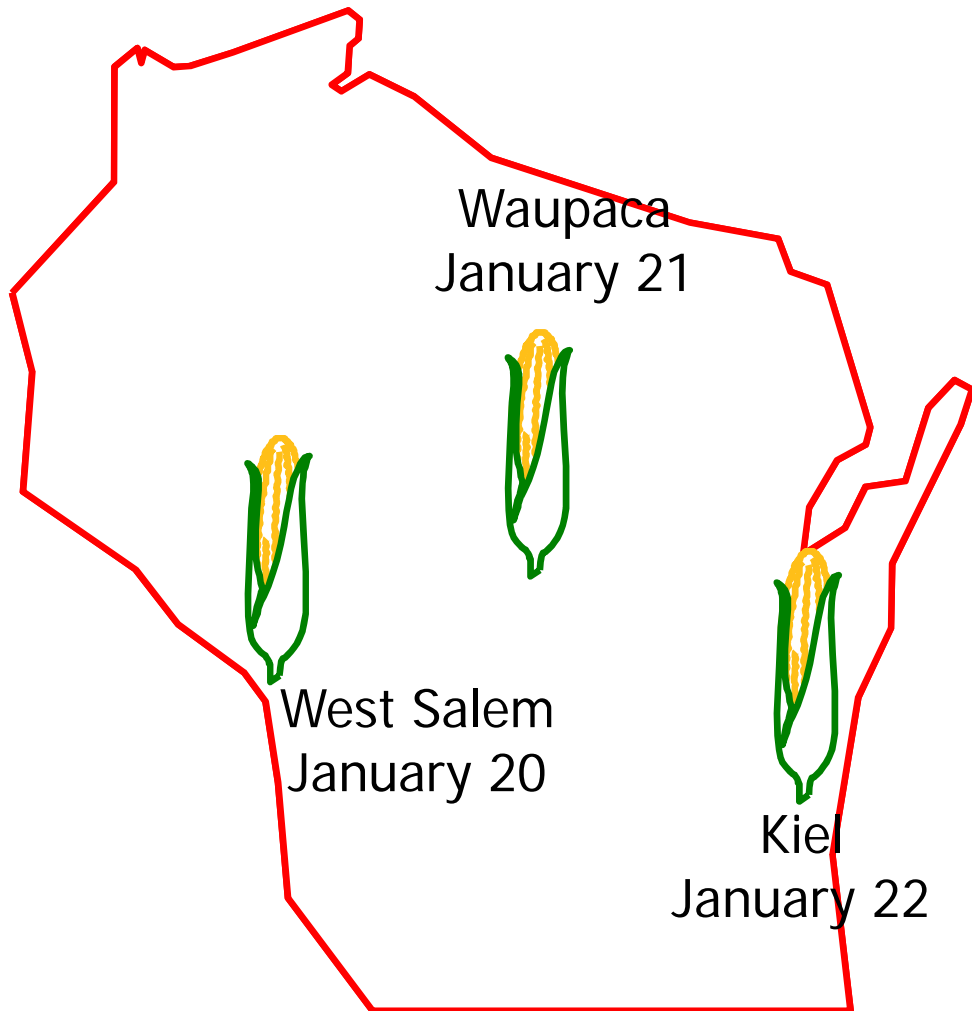
# It is an exciting time to be an agronomist ...



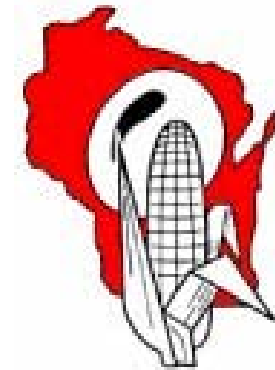
- **The true impact of transgenic crops is unclear for the farmer ...**
  - ✓ Economically = “Wash”
  - ✓ Trade-offs
  - ✓ Corn has “trained” man well.
- **Transgenics are applying unprecedented pressure on Mother Nature ...**
- **Unclear implications for ...**
  - ✓ Crop rotation
  - ✓ Tillage
  - ✓ Plant density
  - ✓ Seed treatment
  - ✓ Grain and silage nutritional quality. Biofuel quality?
- **The “new” agronomics and economics of crop production ...**

Thanks for your attention!  
Questions?

## 2009 Corn Conferences



WISCONSIN  
**Corn/Soy**  
EXPO



**PEPS**

**January 29-30, 2009  
Kalahari Resort  
Wisconsin Dells, WI**