

# ***What is new in transgenic crops for 2015?***

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# *Things to Cover Today*

- Changes to rules regarding saving seeds??
- What is new in field corn
  - Drought tolerant corn – Transgenic and traditional
- What is new in transgenic sweet corn
- Transgenic potato ...
- Retrospective view re) why fight continues against transgenic food products

# *Want to save transgenic seeds?*

- First time ever ... may be possible
- Patent ends in 2015 for RR-soybeans
  - *1<sup>st</sup> generation seed only*
  - *Seed from the 2014 season only*
  - Please check with your seed dealers ...
- What seeds can we not save?







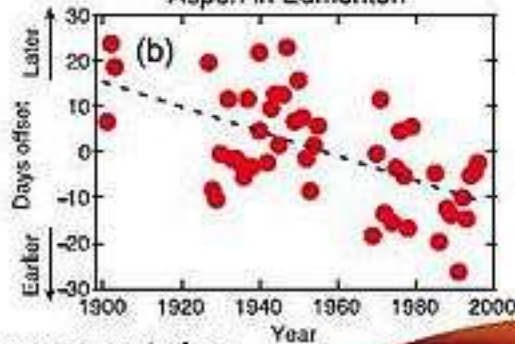
# What is new in TG crops - 2015



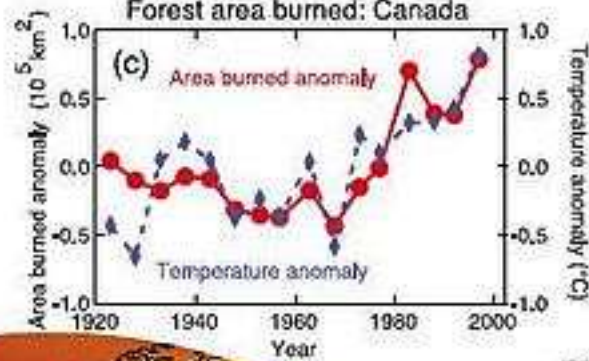
Field Corn

Second generation soybeans ...

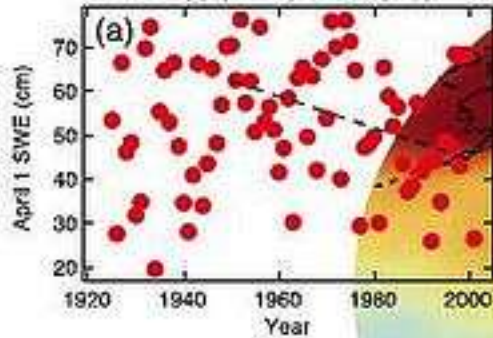
Spring bud-burst dates:  
Aspen in Edmonton



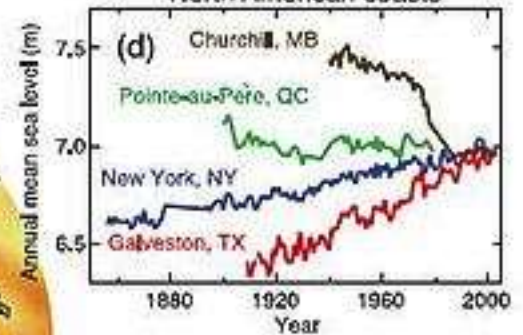
Forest area burned: Canada



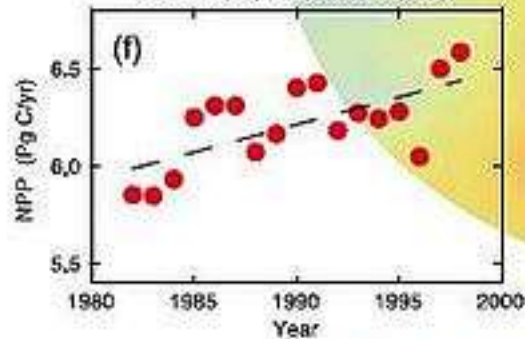
April 1 snow water equivalent:  
Western North America



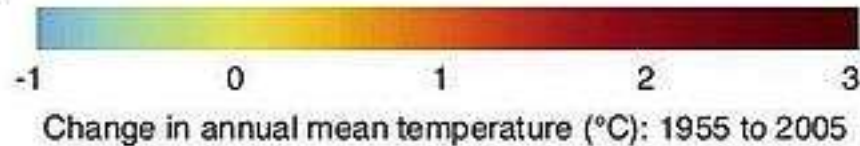
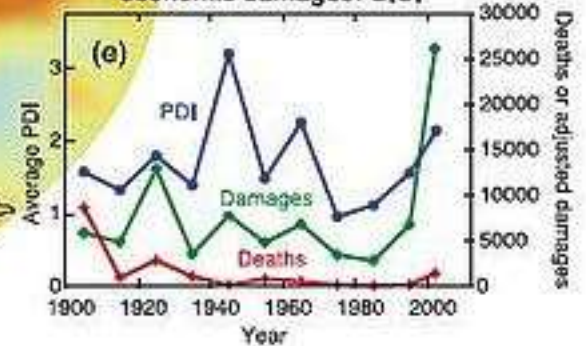
Relative sea level:  
North American coasts



NPP Trend: North America

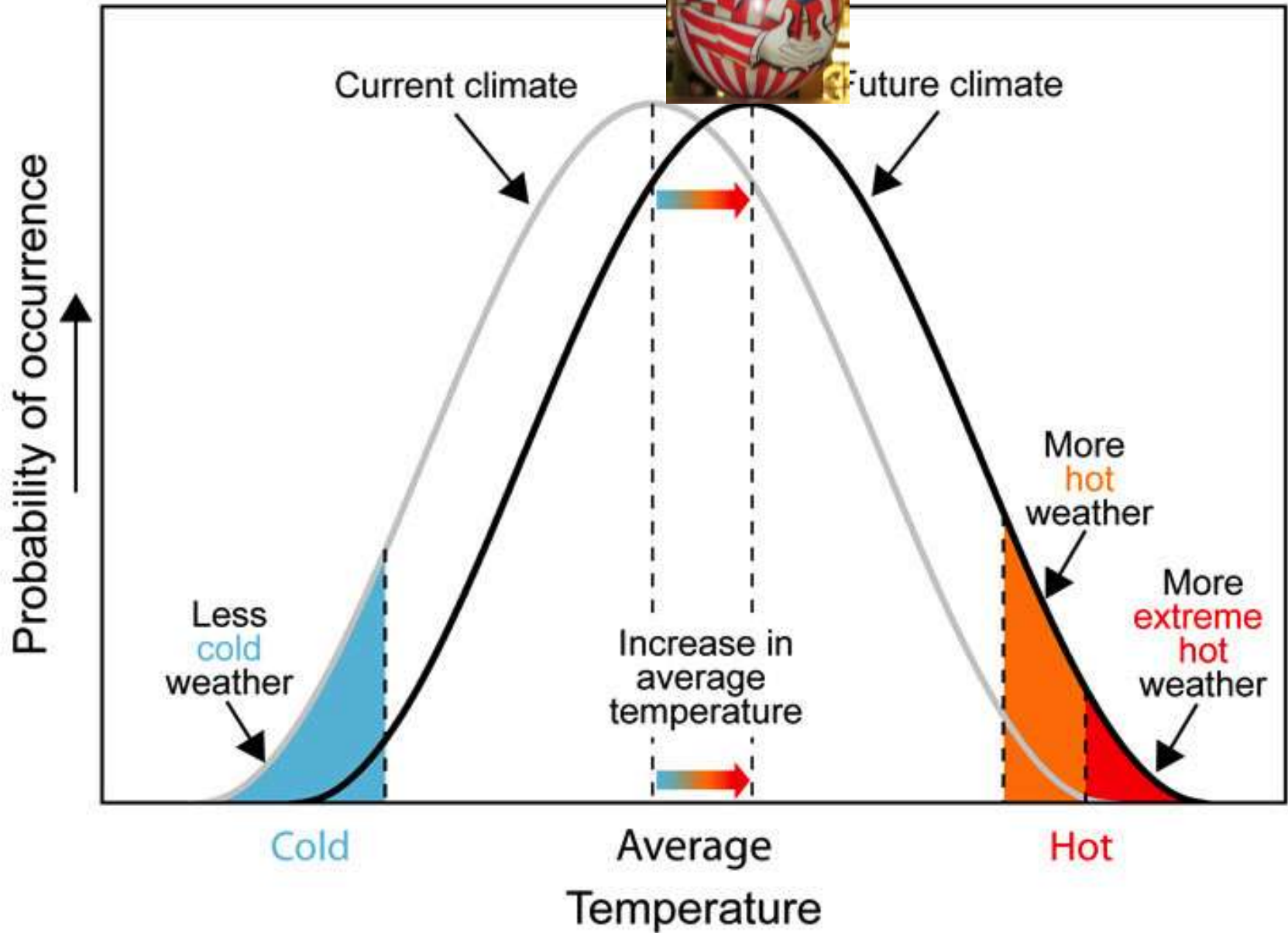


Hurricane energy, deaths & economic damages: U.S.





# Future Climate Shift





Major corn seed  
companies  
paying attention

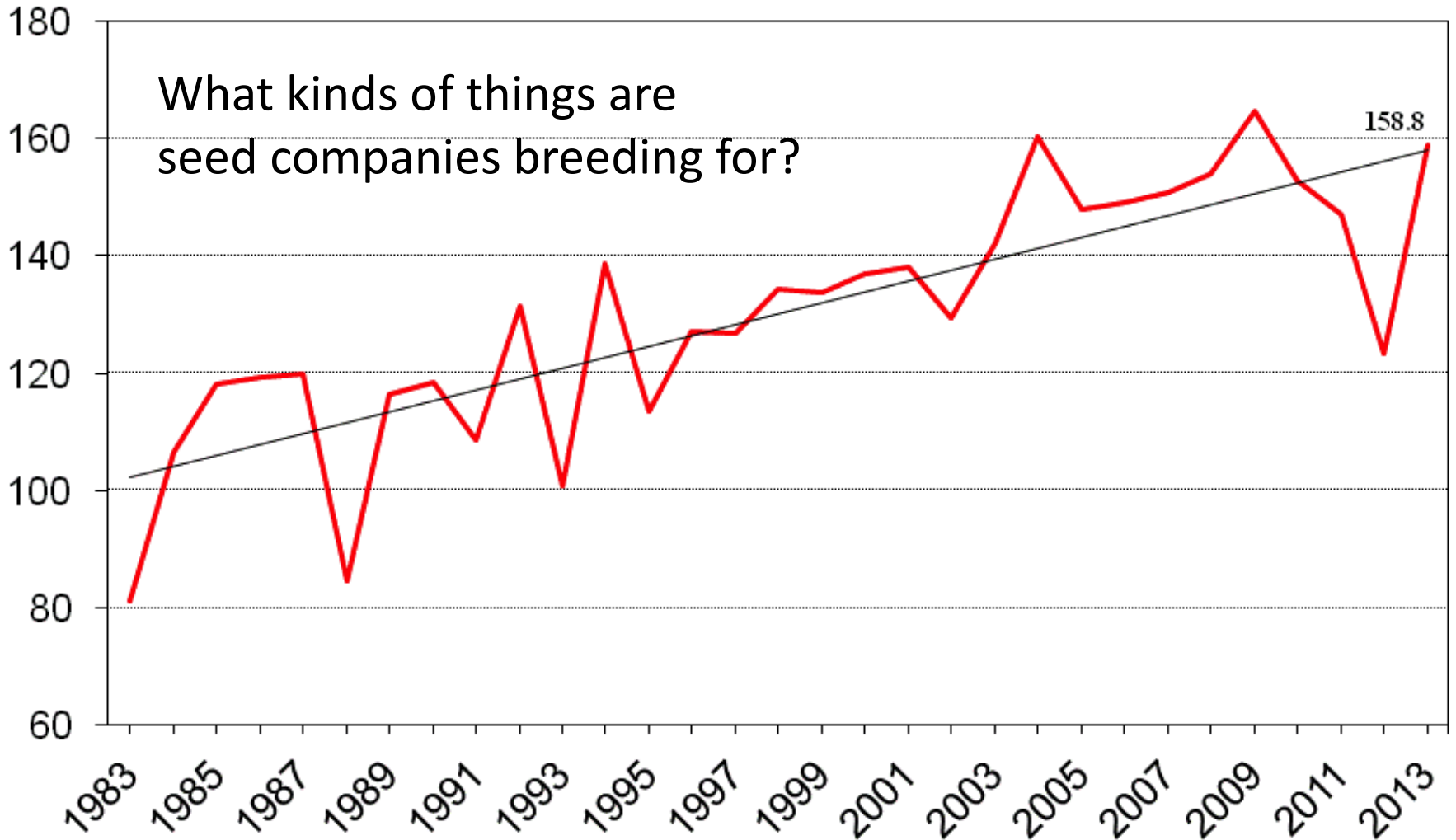




# U.S. Corn Yield



Bushels/acre



158.8

# *Reasons for Yield Improvement*

- Generally improved genetics
  - Improved grain fill under dry conditions / WUE
  - Improvements in pollen/silk fertilization
  - Increased flowering period
- Increased rooting depth – improves water uptake
  - Weed management is better?
- Other keys:
  - No tillage – tillage dries out soil
  - Timely planting / good weed management



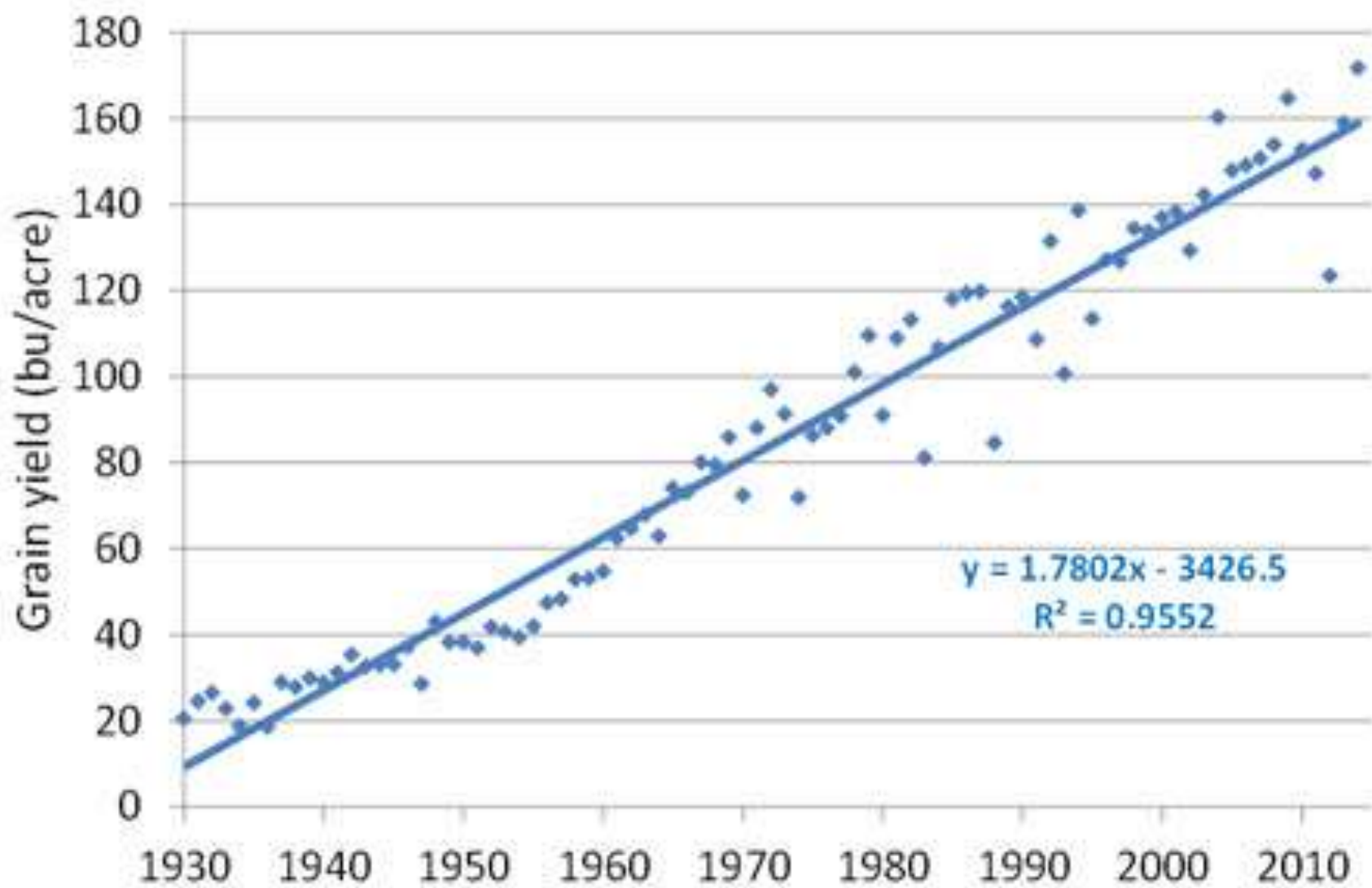
# Monsanto Press Release - 2008

Monsanto's three-point commitment to growing yields sustainably includes:

\* Develop better seeds – *Monsanto will double yield in three core crops corn, soybeans and cotton by 2030, compared to a base year of 2000.*

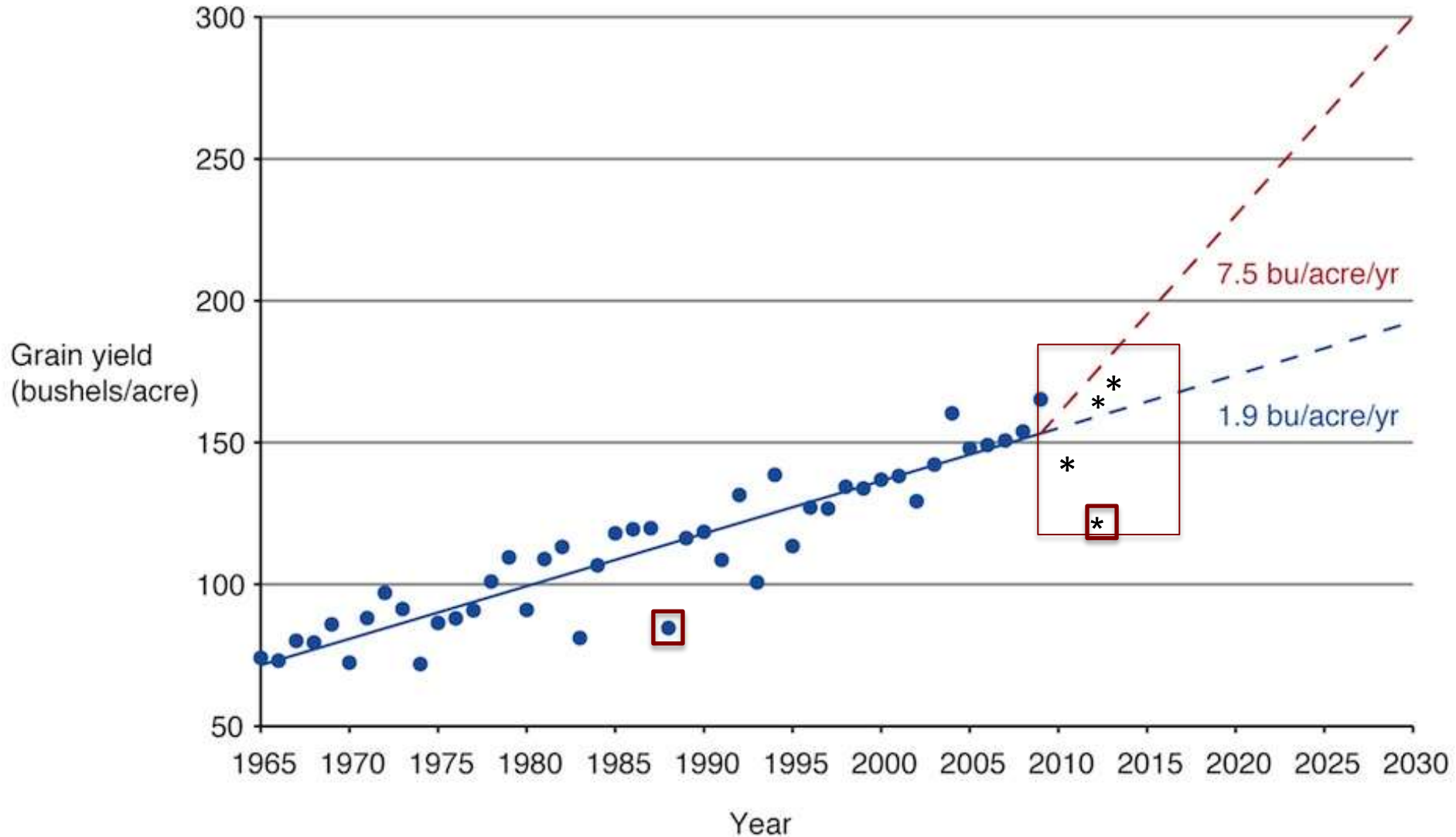
\* Conserve resources - *Monsanto will develop seeds that will reduce by one-third the amount of key resources required to grow crops by the year 2030.* The company will also join with others to address habitat loss and water quality in agriculturally important areas.

\* Help improve farmers' lives - *The company will help improve the lives of farmers, including an additional five M people in resource-poor farm areas by 2020.*





# University of MN – Institute on the Environment





When this happens is key!

What happens with water stress:

- Stomates close with high temps
- Leaves curl – pineapple
- photosynthesis





What happens with prolonged water stress:

- Leaves begin to senesce
- Tissues die





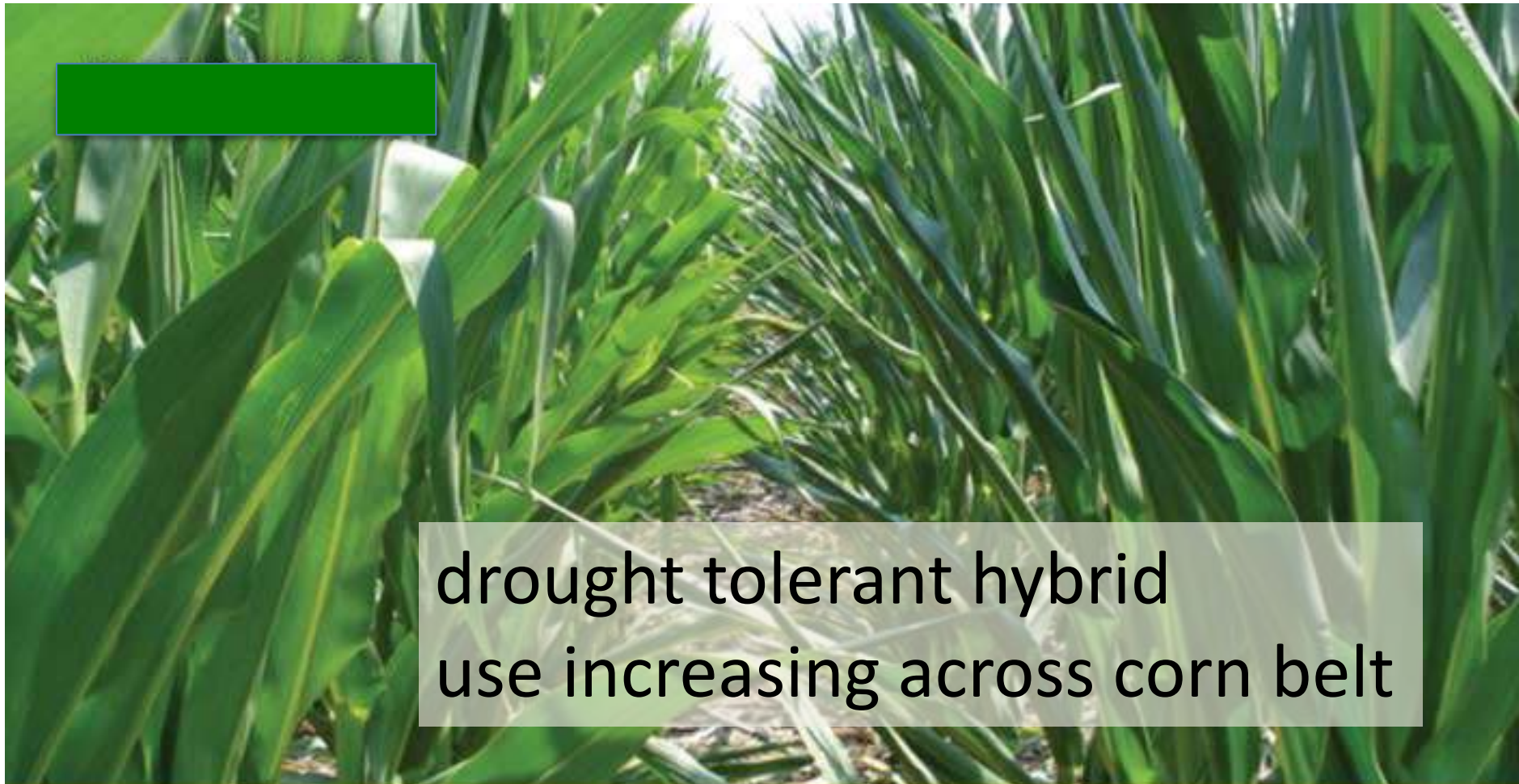




Figure. 1. Future management of drought stressed corn should be based on success of pollination. Some kernel development improves the quality of silage.<sup>2</sup>

# ***New in TG Field Corn***

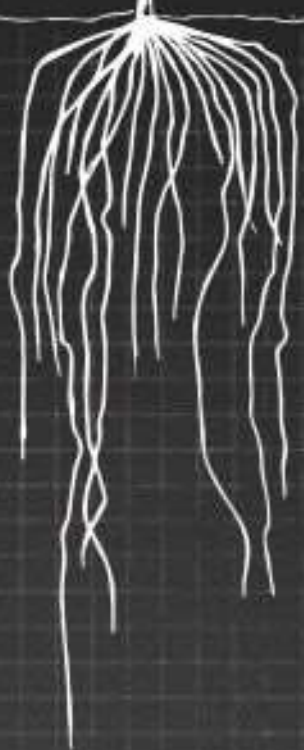
- Always new lines of corn ...



drought tolerant hybrid  
use increasing across corn belt



**58 INCHES**



**70 INCHES**



# *Transgenes for Drought Tolerance*

- Must identify key genetic determinants underlying stress tolerance in plants
- Drought triggers a wide array of responses in plants
- Need to understand the genetics
  - Transgenic or conventional breeding
  - Genes that code for proteins that protect the cell during drought / genes that trigger senescence / genes that signal solute export from guard cells



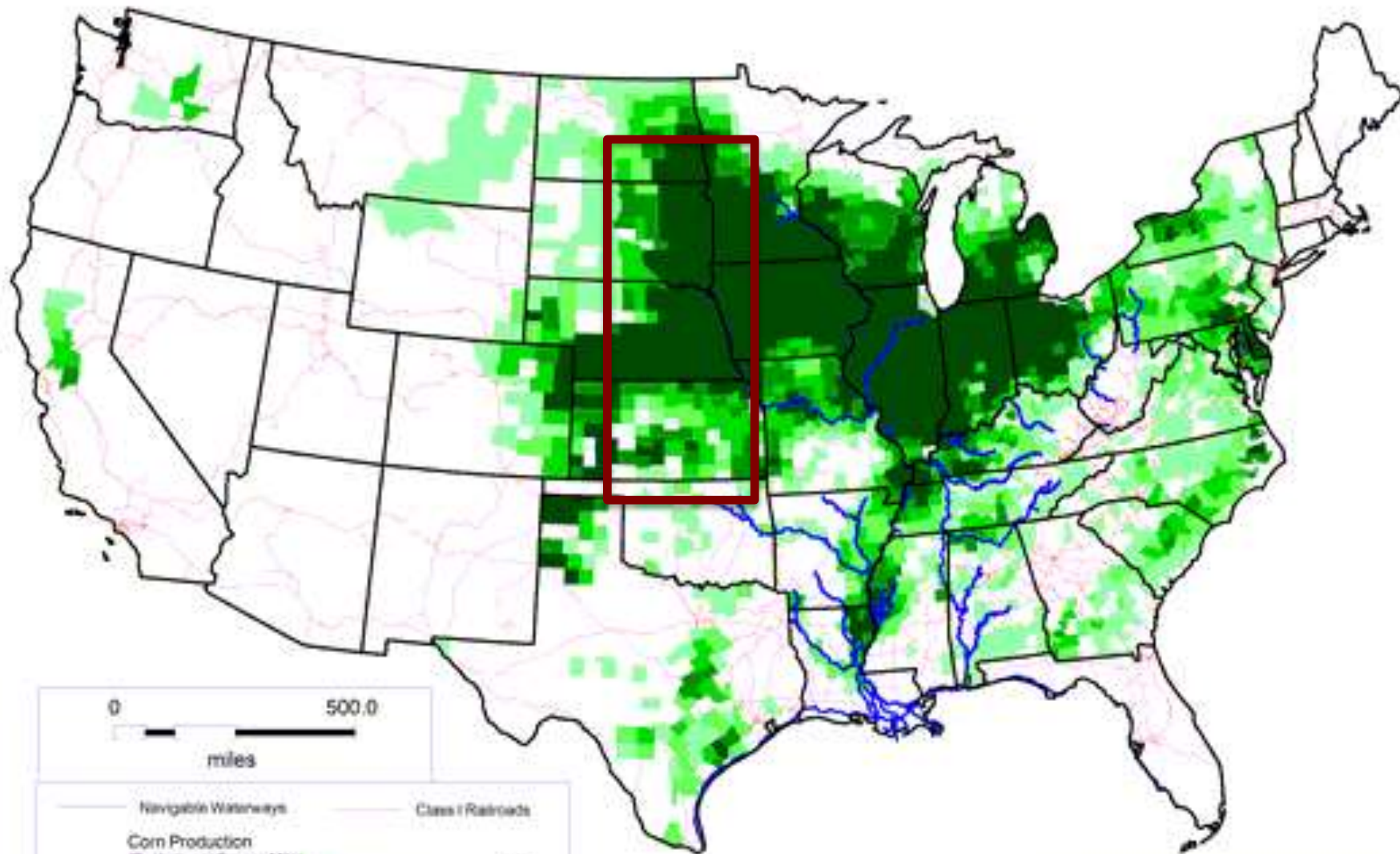


# ***Drought Tolerance in Field Corn***

<b>Companies</b>	<b>Lines</b>	<b>Documented improvement</b>
Monsanto	Genuity <sup>®</sup> DroughtGard <sup>**</sup>	5 bu/ac*
DuPont/Pioneer	Optimum Aquamax <sup>**</sup>	2 – 9 bu/ac*
Sygenta	Agrisure Artesian seed (not transgenic)	No other source – 15%?



US field trial authorizations



0 500.0  
miles

— Navigable Waterways — Class I Railroads

**Corn Production**  
(Bushels per Square Mile)

■ 10,000 and greater	■ 1,000 to 2,500
■ 5,000 to 10,000	■ less than 1,000
■ 2,500 to 5,000	



# *Should You Purchase ... ?*

- Will likely be a part of a stacked elite line?
  - Do you have to keep records for BPC?
- If it comes in a RIB set do you have to keep records?

# ***Elsewise ... New in TG Field Corn***

- Companies have developed double traited rootworm to try to improve control
- Really then a single-traited product with resistant organisms present
  - Risky?

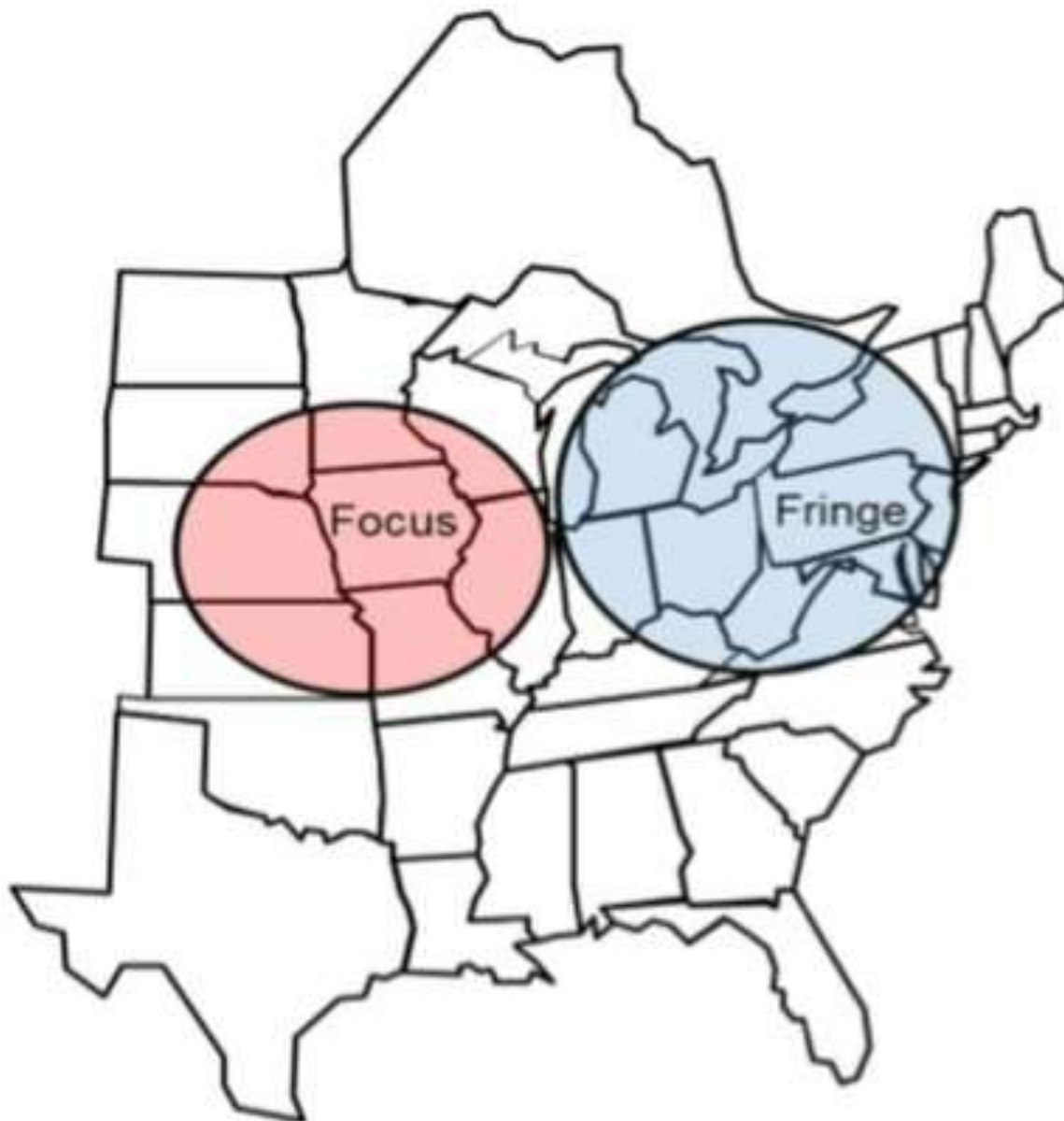
# ***Corn Rootworm Resistance***

- Extent of resistant organisms is growing
- Likely reasons:
  - growing CRW-resistant corn hybrids where not economically justified
  - Continued use of CRW resistant corn year after year
  - Lack of use of appropriate refuges
  - Lack of use of alternative CRW controls

Porter et al., 2012



# Corn Rootworm Resistance to Date





Illinois ...

Northeast?

How do you know?





# *How Many Grow CRW Hybrids?*

- Actively trying to use it?
- Just want to grow the newest hybrids?
  - “It’s in there”

# *Ways to Avoid CRW Resistance*

- Rotate corn with another crop
- Rotate modes of action
  - Don't use insecticides with TG corn to control CRW
- Grow CRW-resistant corn hybrids only where you have had problems
  - Don't use them every year ...
- Use your refuge ... all spelled out in the paperwork associated with the hybrids ...



Attribute II sweet corn for 2015

Contains vegetative insecticidal  
Proteins ... Not (Cry) proteins

Same source (Bt), similar effect,  
different binding mechanism





Attribute II sweet corn tolerant to glufosinate (Liberty) ... not glyphosate (Roundup)

**\*\*\* *Glyphosate will kill this corn* \*\*\***

Will provide good Black Cutworm control!

# *New GE Sweet Corn Options 2015*



**Performance**

**Series™**

Herbicide Tolerance  
Insect Protection

# Tempation II - Sweet Corn

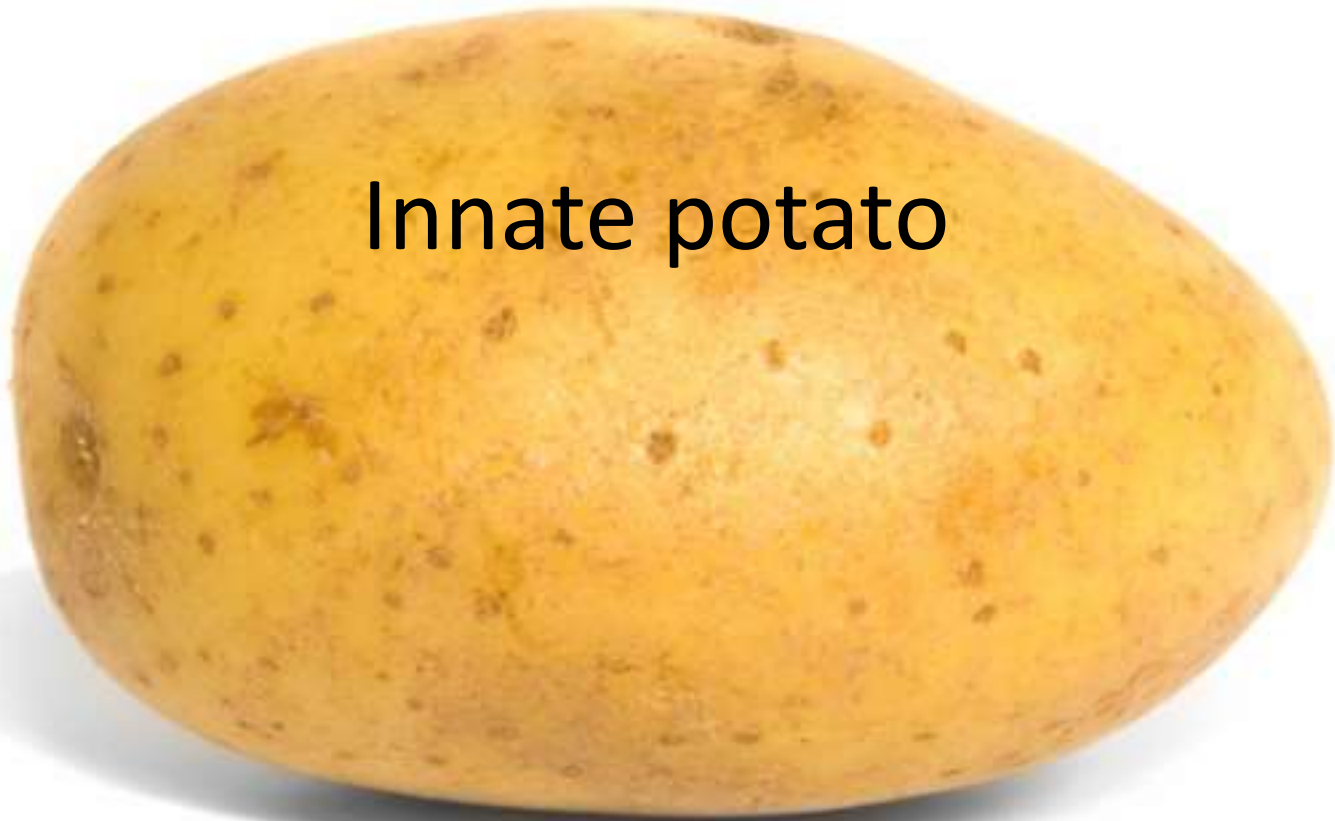
- An agronomic standby .. SC – 74 day ...  
Bt sweet corn varieties that is very effective on corn ear worm, and improved performance with FAW, ECB
- Does well in a variety of climatic seasons
- *Not active* on black cutworm ...

# Transgenic Sweet Corn

- There are no “first early” varieties available with traits
  - Those require standard approaches
- *Time management is best benefit of traits*
  - Reduces time involved spraying at a busy time
- Biggest concerns – labeling
  - Afraid to grow and have to label as Bt corn



# Latest effort at TG potato:



Innate potato

Low acrylamide – low bruising potato

Gene from another solanaceous plant – *Solanum bulbocastanum*

# TG Potato

- Trying to introduce consumer popular traits
  - No browning ... precut potatoes
- *Tech opponents see this as a trojan horse*
  - Way to get insect and herbicide resistance ...
- **Biggest concerns**
  - Lack of intensive long-term testing
  - No labeling



[Learn More](#) 

Arctic® apples' no-PPO antioxidant advantage

**The problem: browning**

**The solution: PPO suppression**



“Arctic apple trees and fruits are identical to their conventional counterparts in every way – until you bite, cut or bruise the fruit, that is. That’s when the handiwork of their silenced PPO genes becomes evident. No PPO, no browning. No enzymatic browning, no “yuck” factor to discourage you from enjoying that delicious apple.”





Learn More 



**The problem: browning**

**The solution: PPO suppression**




# ***Safety of GM Foods ...***

Why labeling and food safety debate continues

# *Safety of GM Foods ...*

“Scientific research has not found any evidence that the production and consumption of genetically modified (GM) foods are either directly or indirectly (e.g., eating meat that was fed GM Feed) hazardous.”

Heimann, 2014 – Ag Bio Forum



**GMOs are  
Inherently Unsafe**

The GM process  
creates massive  
collateral damage  
in the plant, which  
can cause side-  
effects

What is real?

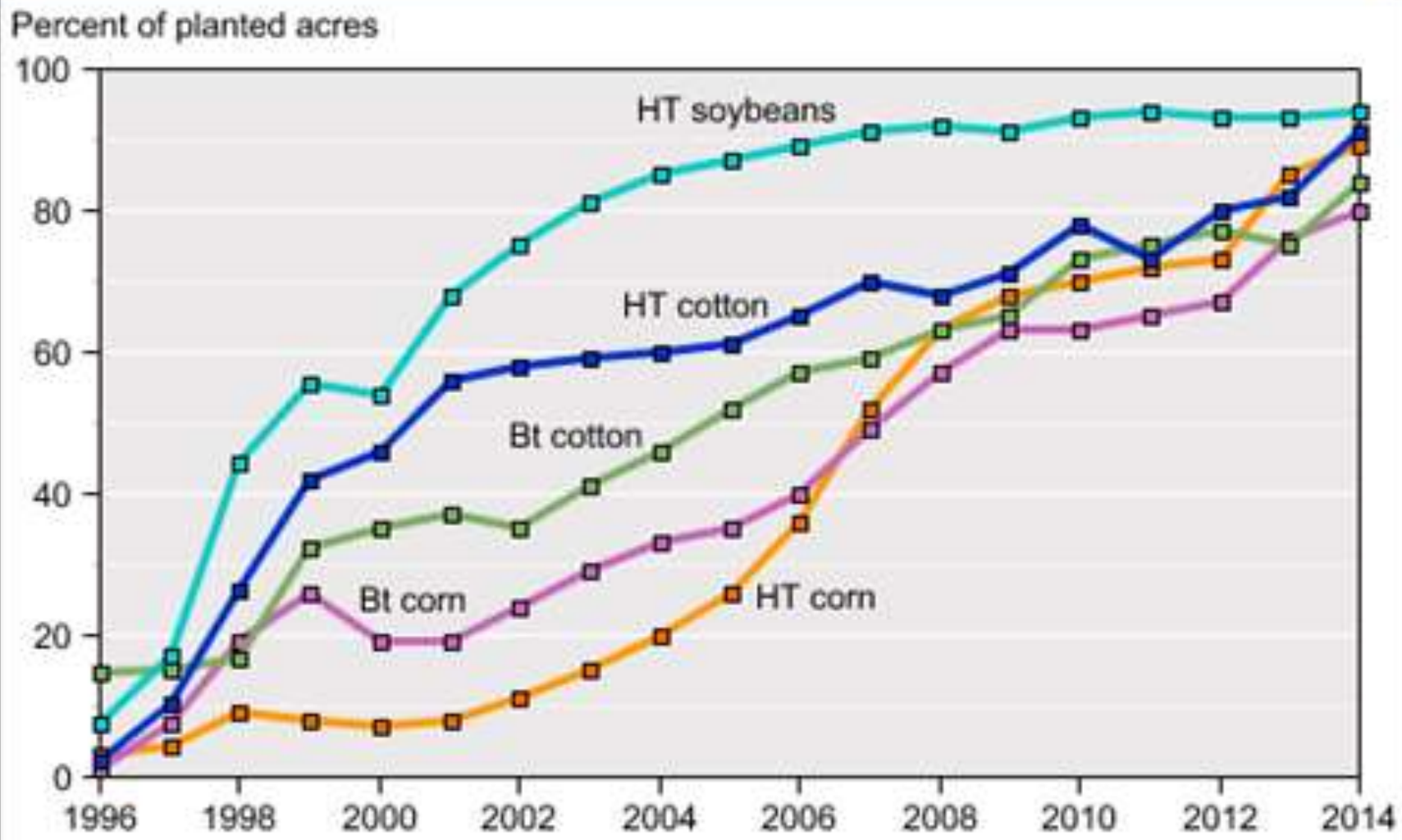


# Why Fight Continues Against TG Foods

- Opposition from other countries continues



# Adoption of genetically engineered crops in the United States, 1996-2014



Data for each crop category include varieties with both HT and Bt (stacked) traits.  
Sources: USDA, Economic Research Service using data from Fernandez-Cornejo and McBride (2002) for the years 1996-99 and USDA, National Agricultural Statistics Service, June Agricultural Survey for the years 2000-14.

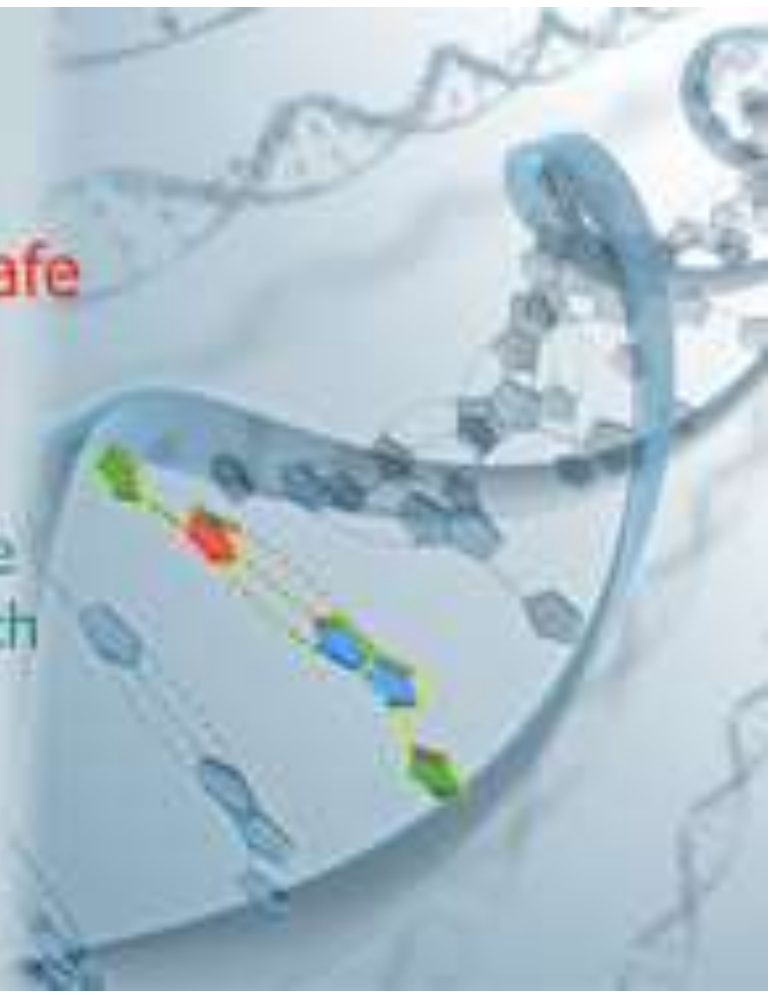
# ***Why Fight Continues Against TG Foods***

- Opposition from other countries continues
- EU to vote this week to allow individual countries to ban GE crops ...
- Why?
  - promote local ag production?
  - serious safety concerns?

# ***Why Fight Continues Against TG Foods***

- Food allergies on increase ...
  - Jackson et al., 2013. Food allergies up from 3.4 to 5.1% over 15 year period (1997 – 2011)
- Why testing protocols should be done ...
  - possibility of creating new, unknown allergens by either inserting genes into crops or changing the expression of proteins ... (Key et al., 2008)



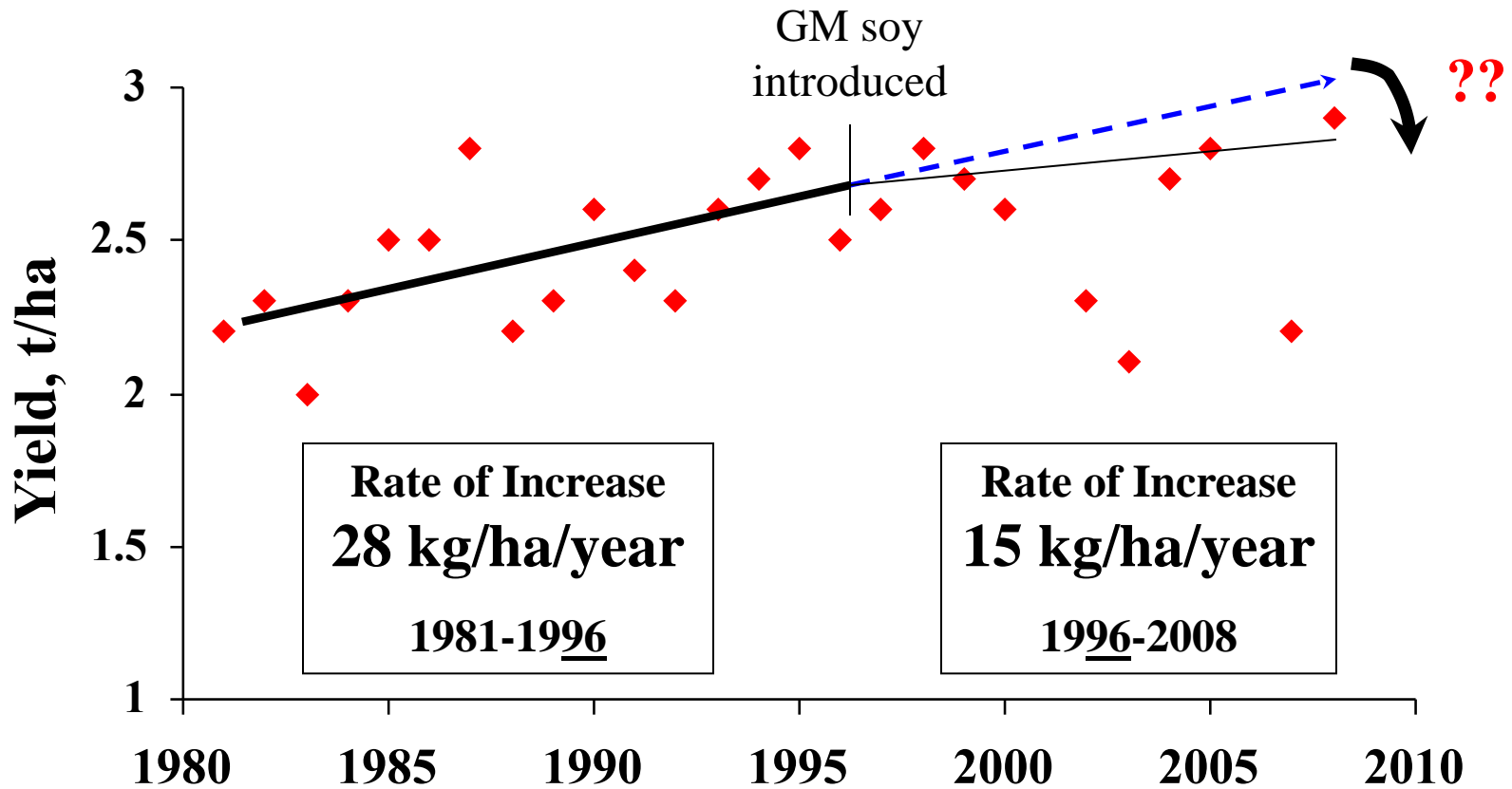


**GMOs are  
Inherently Unsafe**

The GM process  
creates massive  
collateral damage  
in the plant, which  
can cause side-  
effects

Some peer-reviewed science to suggest ... yes

# Has introduction of RR soy flattened ON soybean yields? 1981-2008



# *Deeper in Publications*

- “Most genes that are known to be involved in the regulation of stress responses are also involved in the regulation of plant growth and development. That makes it hard to fiddle with drought response pathways without affecting yield. Genes that confer first-generation traits such as insect resistance and herbicide tolerance often do not depend on these intricate connections to function.”

**Nature Biotechnology (2014) 32:610-614.**

# ***Why Fight Continues Against TG Foods***

- Changing the plant (even single trait type changes) cause more transformations in the DNA
- Zolla et al., 2008 studied the effect of inserting Bt gene on natural gene expression in the corn plant.
  - 43 proteins that had been increased, decreased, newly introduced, or were completely missing.
  - One of the newly introduced proteins not found in normal corn variety was gamma zein, a known allergen. Corn sold on the US market has an unlabeled new allergen that might be provoking reactions in sensitive consumers.



# Possible unexpected changes in the DNA

- Mutations (2-4% of DNA)
- Deletion of genes
- Permanently turned on or off
- Altered gene expression  
(up to 5%)

Pets, owners challenged by increasing allergies ... CNN

<http://www.cnn.com/2009/HEALTH/03/26/pet.allergies/>

Pets reacting badly to grain in diet?

# Purina® Dog Chow® Brand Dog Food Complete & Balanced

## Ingredients:

Whole grain corn, meat and bone meal, corn gluten meal, animal fat preserved with mixed-tocopherols, soybean meal, poultry by-product meal, egg and chicken flavor, whole grain wheat, animal digest, salt, calcium carbonate, potassium chloride, dicalcium phosphate, choline chloride, zinc sulfate, Yellow 6, Vitamin E supplement, L-Lysine monohydrochloride, ferrous sulfate, Yellow 5, Red 40, manganese sulfate, niacin, Blue 2, Vitamin A supplement, copper sulfate, calcium pantothenate, garlic oil, pyridoxine hydrochloride, Vitamin B-12 supplement, thiamine mononitrate, Vitamin D-3 supplement, riboflavin supplement, calcium iodate, menadione sodium bisulfite complex (source of Vitamin K activity), folic acid, and biotin.

# *Things to Cover Today*

- Rules regarding saving seeds??
- Drought tolerant corn
  - Transgenic and traditional / issues ...
- Transgenic sweet corn
- Transgenic potato ...
- Retrospective view re) why fight continues against transgenic food products





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Thank you ... questions, comments