

# What are some of the food safety issues?

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- Pharma crops contaminate food supply
- Changes in nutritional content
- Gene flow from food to intestinal bacteria; increase in antibiotic resistance
- Labeling

“It is difficult if not impossible to test food safety of whole foods and feeds with animal tests. In spite of what non-experts commonly think, animal tests like these are not the gold standard. Compositional analysis and toxicity testing of individual components is much more sensitive than whole foods testing. (ILSI paper; IFT report) There are publications on the toxicity and animal testing of Bts and at least 112 studies of food safety of GM crops in animals.” Bruce Chassy, Chair, Department of Food Science and Human Nutrition, University of Illinois

“Nutritional and Safety Testing of Foods and Feeds Nutritionally Improved through Biotechnology” 2004. *Comprehensive Reviews in Food Science and Food Safety*, ILSI

“IFT Expert Report on Biotechnology and Foods”, 2000. *Food Technology* 54 (8):1-56

“Preventing adverse health effects by maintaining a safe food supply requires application of appropriate scientific methods to problems of predicting and identifying unintended compositional changes that may result from genetic modification of plants, animals and microbes” However “it is the final product of a given modification, rather than the modification method or process, that is more likely to result in an unintended adverse effect.”

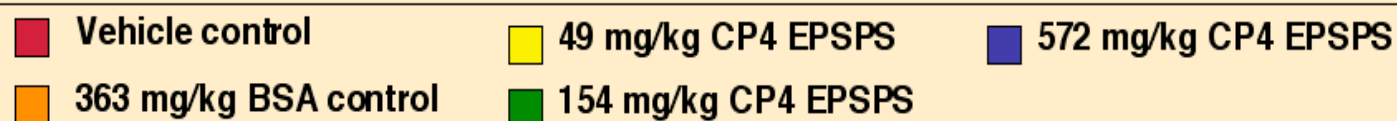
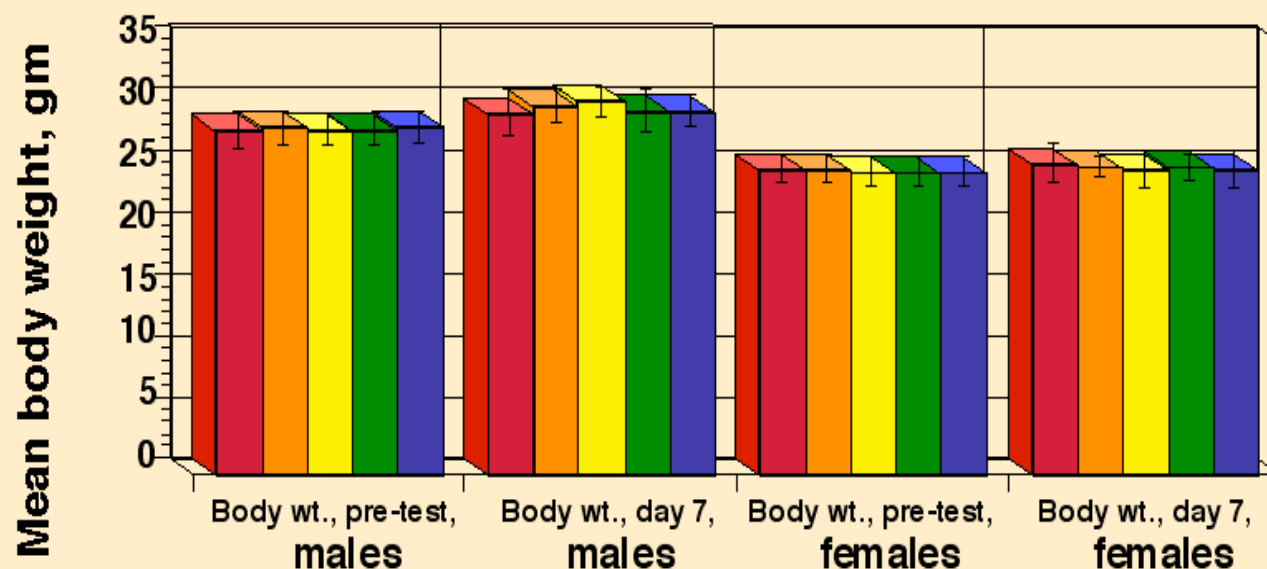
National Academy of Sciences report, ...“Safety of Genetically Engineered Foods: Approaches to Unintended Health Effects” (2004)

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# Toxicity Assessment: Roundup Ready/CP4 EPSPS protein

*No deleterious effects at highest dose (572mg/kg)*





**Starlink corn raises allergy and  
containment concerns**



*Kraft Food recalls all taco shells sold  
nationwide under Taco Bell Brand*

SOURCE: Washington Post, September 19, 2000





# Kiwi Allergies

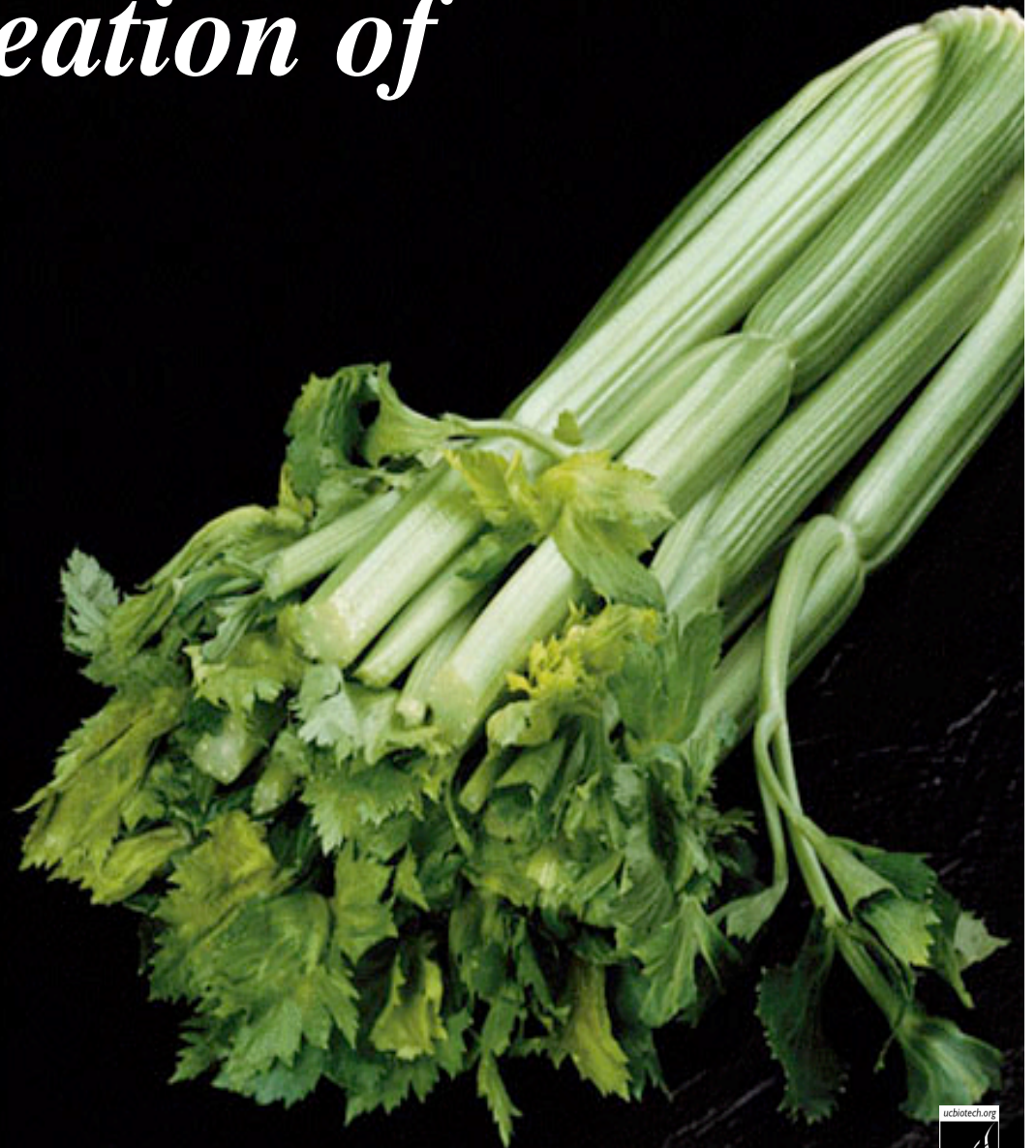
Classically bred foods cause allergy problems also



**Long-term Food Safety Studies  
Should They Be Done, How  
and on What Foods?**



# *Inadvertent Creation of Allergens*



*Is This Limited to GE Foods?*

# Fumonisin Reduction with Bt-maize



- Fumonisin contamination due to insect infestation.
- 20- to 30-fold fumonisin reduction with high-level insect resistance in Bt-maize
- 1989: large scale outbreaks of lethal lung edema in pigs/brain tumors in horses high levels of fumonisin

Modified from Drew L. Kershen  
University of Oklahoma



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# **Antibiotic Resistance Markers in GM Plants: A Risk to Human Health?**

**“Although fragments of DNA large enough to contain an antibiotic resistance gene may survive in the environment, the barriers to transfer, incorporation, and transmission are so substantial that any contribution to antibiotic resistance made by GM plants must be overwhelmed by the contribution made by antibiotic prescription in clinical practice.”**

**Gay PB, Gillespie SH.  
*Lancet Infect. Dis.* 2005.  
5:637-646**



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### Different GMO Labeling Regulations in Some Representative Countries

Country	Labeling Threshold	Requirements of Respective Regulations
China	0% (Changing)	Yes / No mandatory labeling system.
Australia & New Zealand	1%	All food and food additives importing into the region containing modified genes and/or their expression products $\geq 1\%$ must be labelled.
European Union	0.9%	All food and food additives importing into the region containing modified genes and/or their expression products $\geq 0.9\%$ must be labelled. Special attention should be paid to soy, corn and their derived products (including highly refined products e.g. oils).
Japan	5%	Food items having $\geq 5\%$ GMO in top 3 ingredients must be labelled as GM food.
Korea	3%	Labeling is mandatory for all food items that contain GMO in their top 5 ingredients.
Taiwan	5%	Food products containing ingredients of genetically modified soy or corn $\geq 5\%$ by weight of finished product shall be labelled as GM.

SOURCE: <http://www.gmocert.com/html/w-gmo.htm>

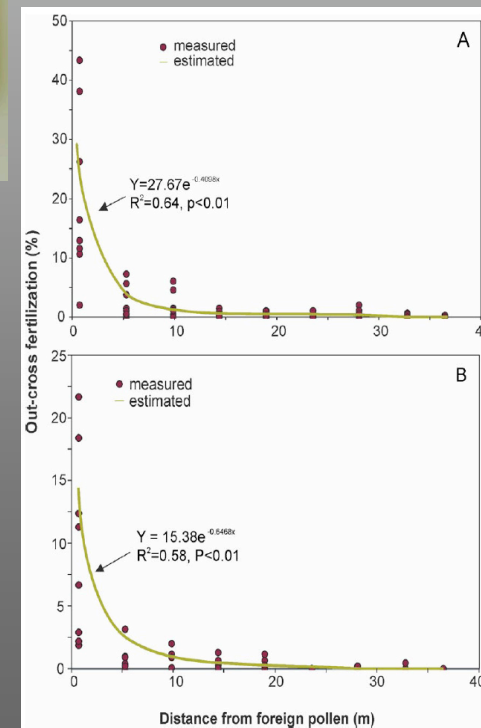
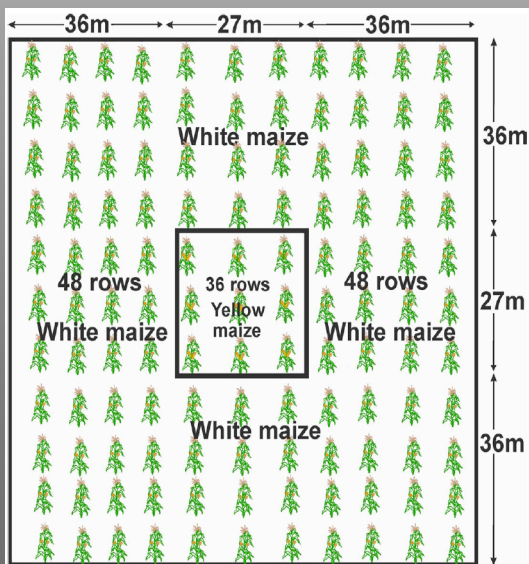
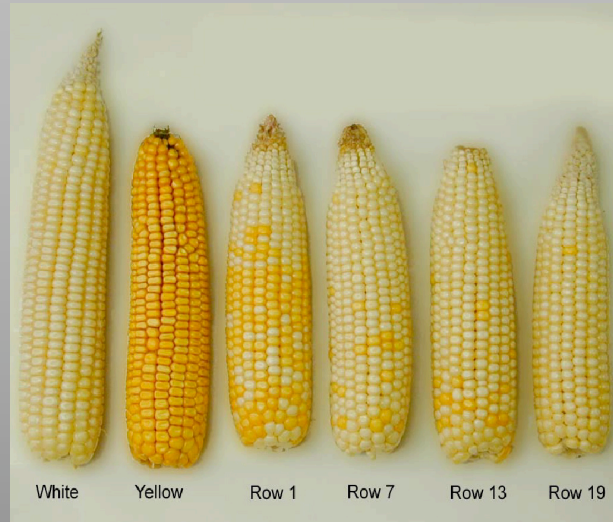




# What are some of the environmental issues?

- Gene flow occurring via pollen flow to generate “superweeds” (transfer of herbicide tolerance to wild/weedy species)
- Spread of pharmaceutical genes into commercial crops?
- Transfer of transgenes to non-GMO / organic crops?
- Loss of genetic diversity?
- Property rights (gene patents)?

# Pollen Drift of GE Corn



SOURCE: Ma, B.L. 2005. Frequency of Pollen Drift in Genetically Engineered Corn. ISB News Report, February 2005.



## Pollen Flow Distances for Crop Species of Interest

Crop Type	Mode of Pollination	Means of Movement	Fdn Seed Prod Isolation Distance	Measure Pollen Movemnt Dstance
Alfalfa	Self-sterile; obligate outcrossing	Bees	900 ft (0.17 mi)	2000 ft (0.48 mi)
Bentgrass	Clonal (stolons); type outcrossing dep on environment	Wind	900 ft (98%purity) (0.17 mi)	13.05 mi
Canola	Predom. selfing; 30% outcrossing	Wind/insects	>1320 ft (0.25 mi)	1.9 mi
Corn	Almost exclusively outcrossing	Wind	660 ft (0.125 mi)	~2 mi
Cotton	Predom. Seslfing; outcrossing with insects	Insects	>1320 ft (0.25 mi)	n.a.
Rice	Self-pollinating (99.5%); pollen viable 3-15 min	Physical touching/wind	10 ft	30 ft
Squash	Obligate outcrossing	Insects (predom. bees)	1320 ft (0.25 mi)	0.8 mi
Soybean	Self-pollinating (99%)	Physical touching/wind	5 ft	n.a.
Wheat	Self-pollinating (99.9%)	Physical touching/wind	5 ft	>160 ft

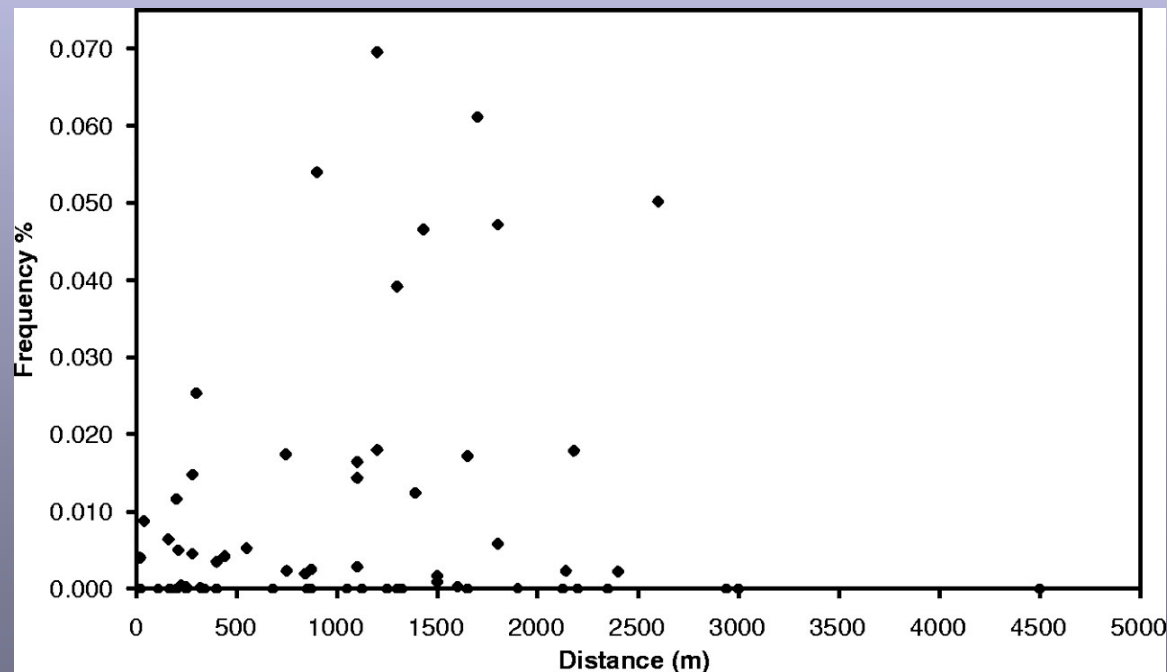
# Gene flow from rice to weedy red rice



Consider gene's impact in assessing risk:  
Vitamin A vs. herbicide tolerance trait

# Pollen flow does occur between canola fields, but...

- Adjacent non-GMO fields have less than 0.030% herbicide resistance (300 seeds in 1 million)
- Resistance was not detected in fields >3km from source



Reiger et al. (2002)





# Pollen flow between herbicide-resistant canola is the cause of multiple resistant varieties



crossing  
→



"Triple-resistant canola"

Hall et al. (2000)



# Consequences of triple-resistant canola and HT-wild hybrids?



canola

## What is the real risk?

- HT doesn't necessarily translate into increase in weediness
- HT gene only protects plant if you spray the herbicide
- Unable to use same herbicide

## IS THIS REALLY A SUPERWEED?

## Who stands to lose?

- Herbicide manufacturer
- Farmer

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March 30, 2004

# 'Pharm crop' debate takes root in California Biotech

By Paul Jacobs and Lisa M. Krieger  
Mercury News

**YUBA CITY** - An experimental new form of rice, engineered to produce commercial quantities of prescription drugs, is placing California in the middle of a raging international dispute over the use of genetically modified crops.

Sacramento-based Ventria Bioscience is seeking state approval to grow rice that can make two human proteins, normally found in breast milk and tears, for use in treating human illnesses.

If it gets the necessary approvals, the decade-old company would become the first commercial producer of genetically engineered ``pharm crops." Scientists

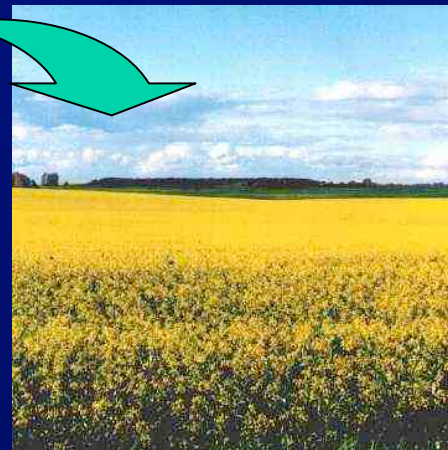
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*Consequences of pollen spread  
from GE crops to organic crops in the  
field*



GM canola



non-GM canola