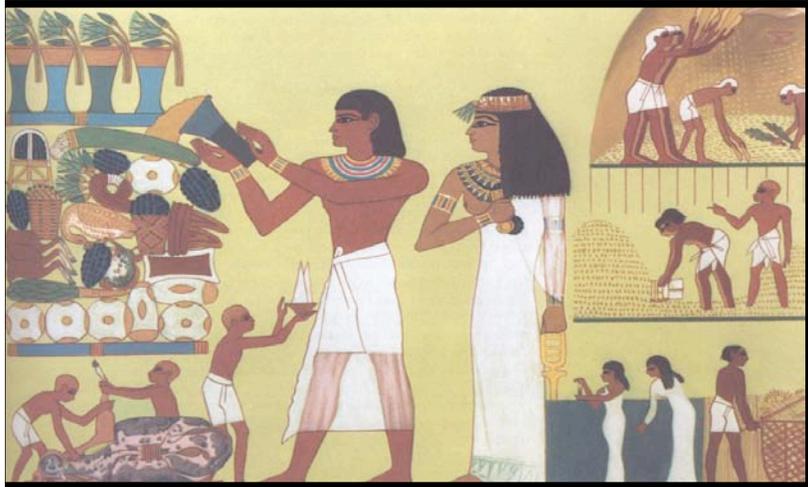




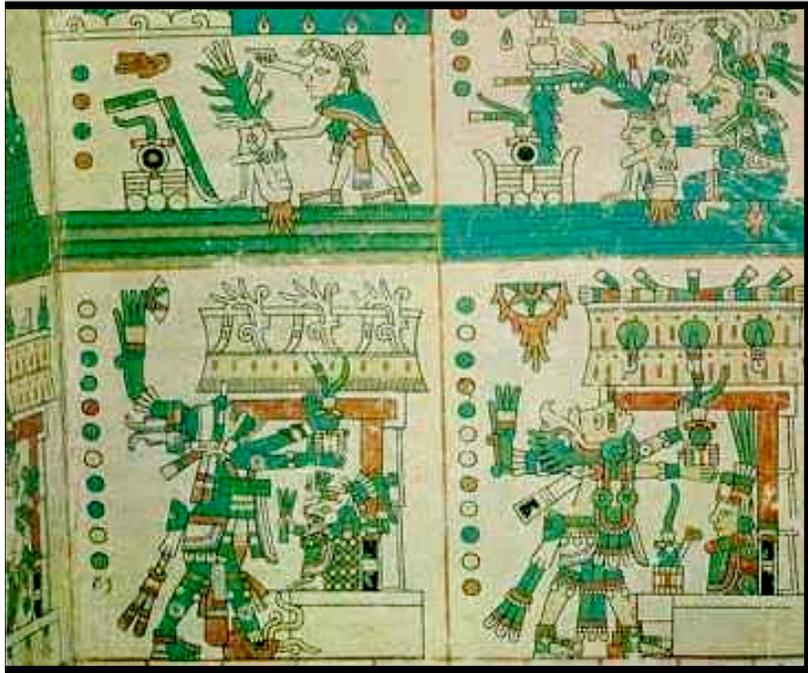
Food Fights in California

**Food and Environmental Safety
Issues with GE Crops and Foods**

Peggy G. Lemaux
UC Berkeley



Egyptian tomb mural ~ 4200 BP



Aztec farmers, 1590 AD



Mayan corn god
700 AD

Agriculture...



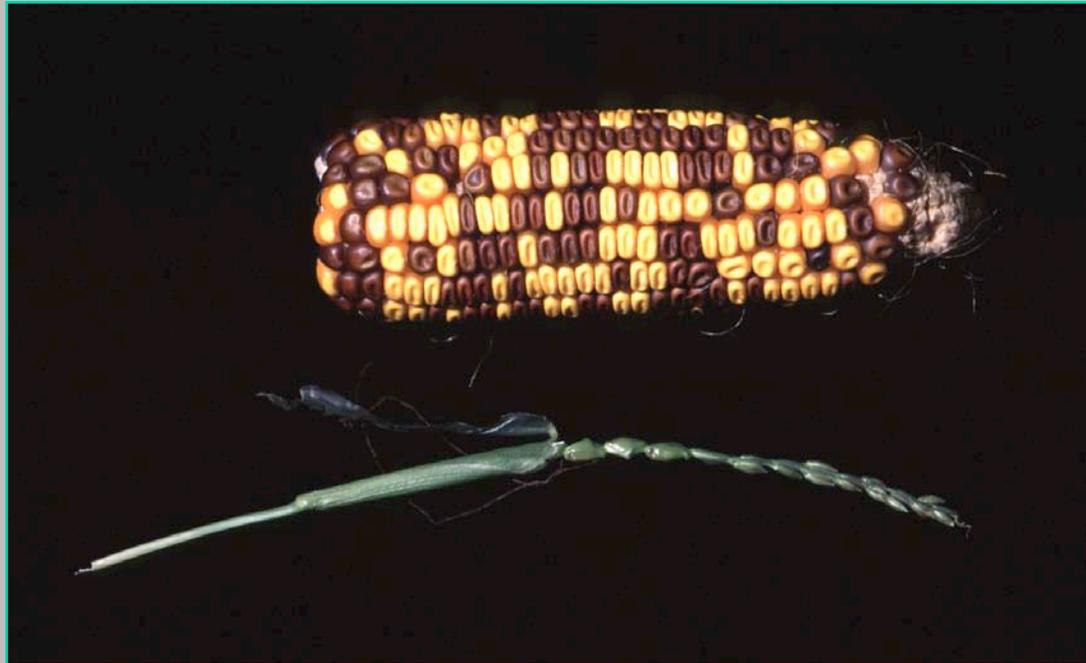
Making tortillas, 1920 AD

**- the driving force in
development of civilizations**

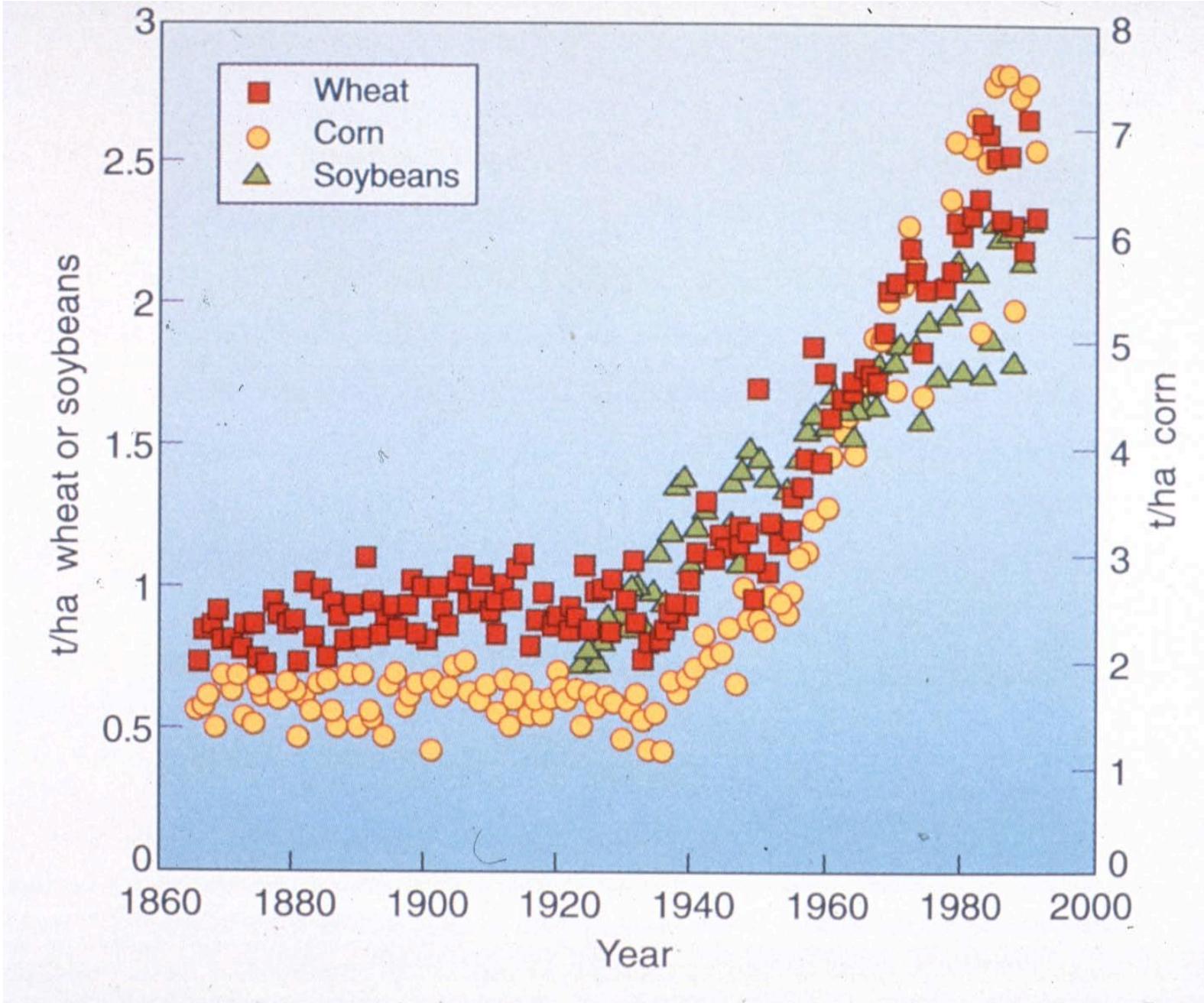


Modern crops developed from wild species through genetic exchange

corn



teosinte





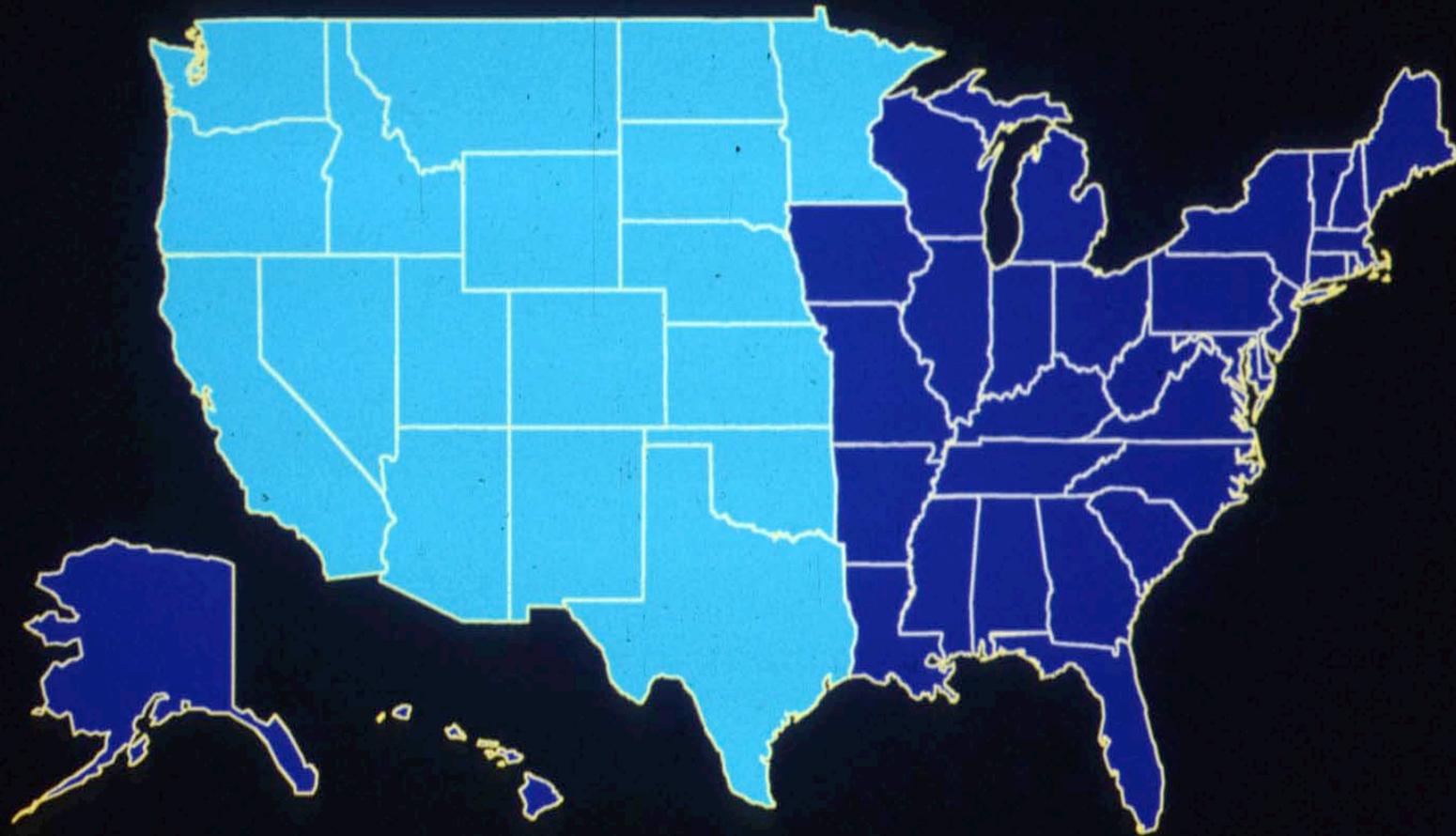
**Besides differences in
the genetics of crops,
other changes in
agriculture occurred**

**From
small
farms...**



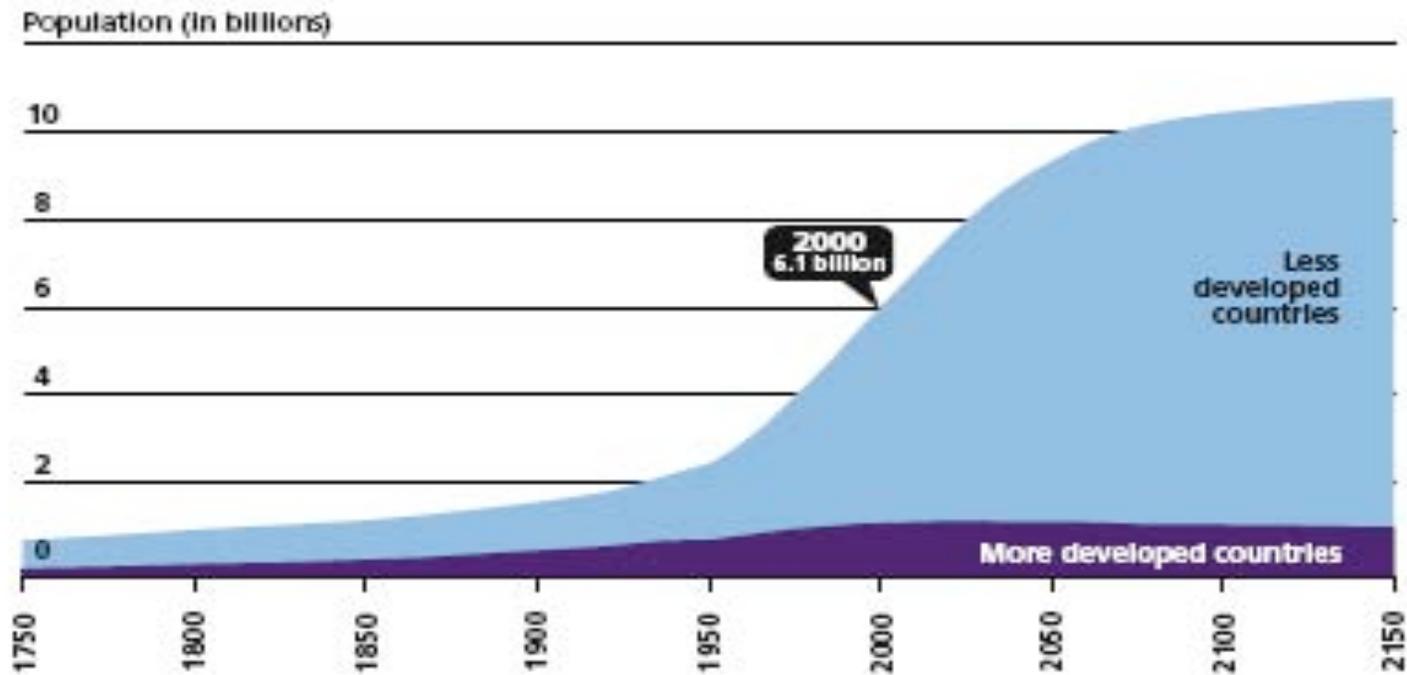
**...to large farms with higher yields
and environmental impacts!**

U.S. Cultivated Land



Acreage Needed at 1929 Production Levels

World population growth, 1750-2150



Source: United Nations, *World Population Prospects, The 1998 Revision* (New York: UN, 1998); and estimates by the Population Reference Bureau.

Copyright © 2001 Population Reference Bureau

How is a new wheat variety created?



Triticum aestivum

Modern bread variety

Triticum monococcum

Ancient variety

Information in the wheat genome

Chemical units represented by alphabetic letters

...CTGACCTAATGCCGTA...



1700 books
1000 pages each



1700 books
(or 1.7 million pages)



Hybridization or cross breeding of wheat



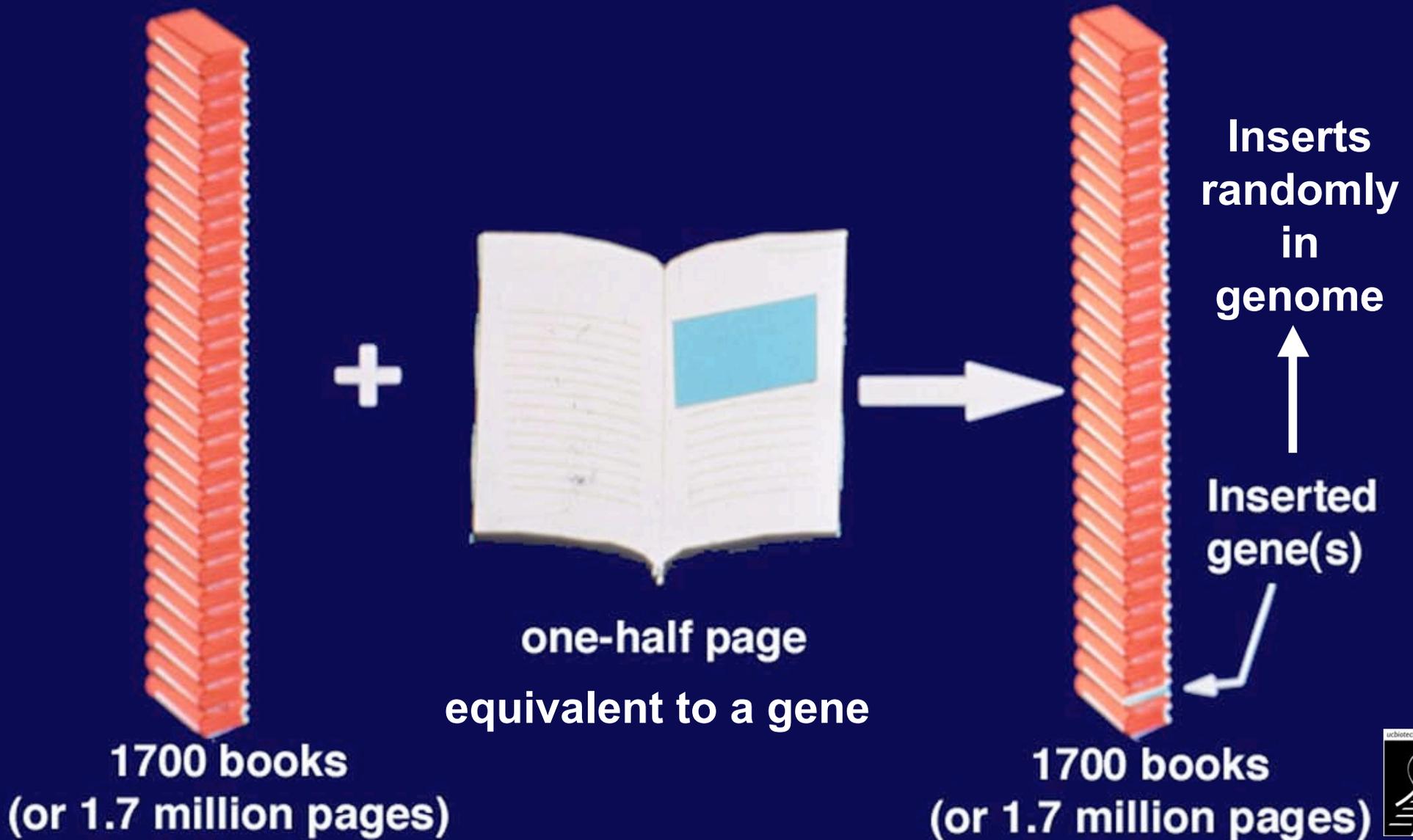
X



Random
retention of
information
from each
parent

1700 books (or 1.7 million pages) 1700 books (or 1.7 million pages) 1700 books (or 1.7 million pages)

Genetic Engineering Methods



Classical Breeding

compared to

Genetic Engineering

Uses plant machinery in plant

Gene exchange is random
involving entire genome

When/where genes expressed
not controlled by breeder

Only between closely related or
within species

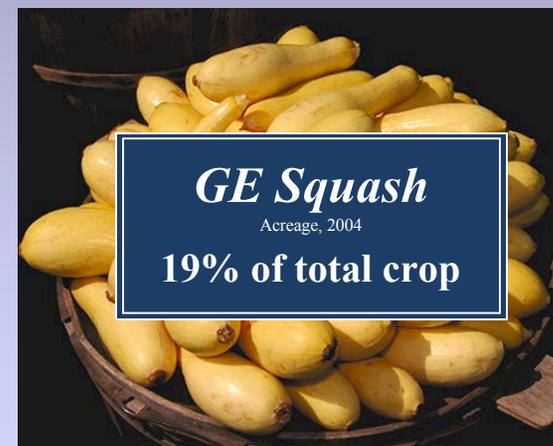
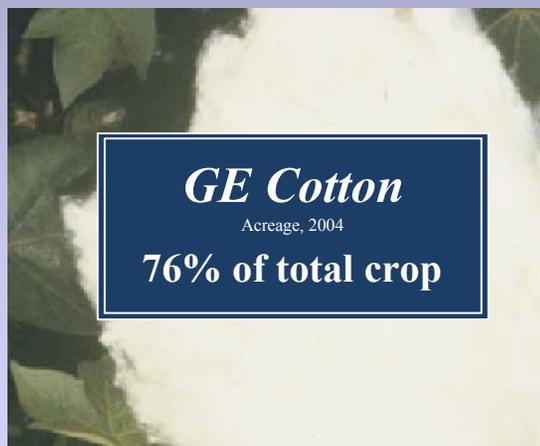
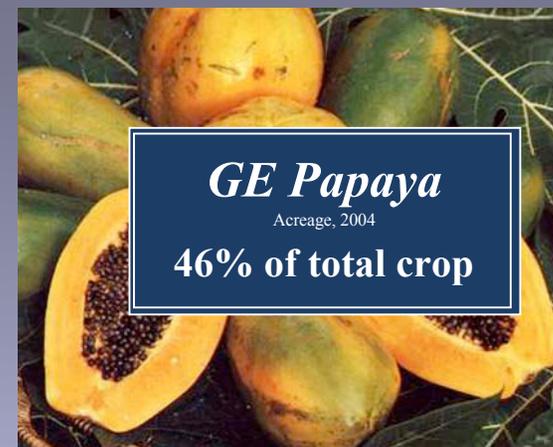
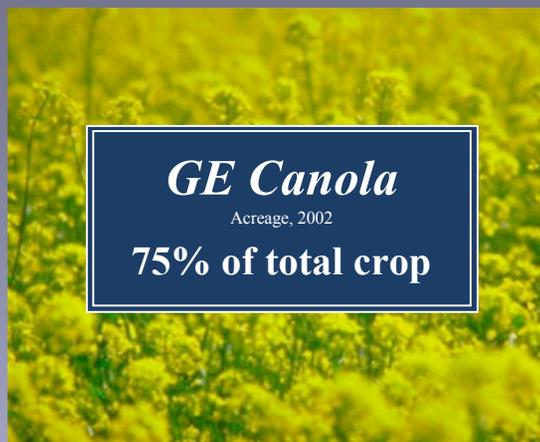
Uses plant machinery in laboratory

Gene exchange is specific,
single or a few genes

When/where gene expressed
can be controlled precisely

Source of gene from any
organism



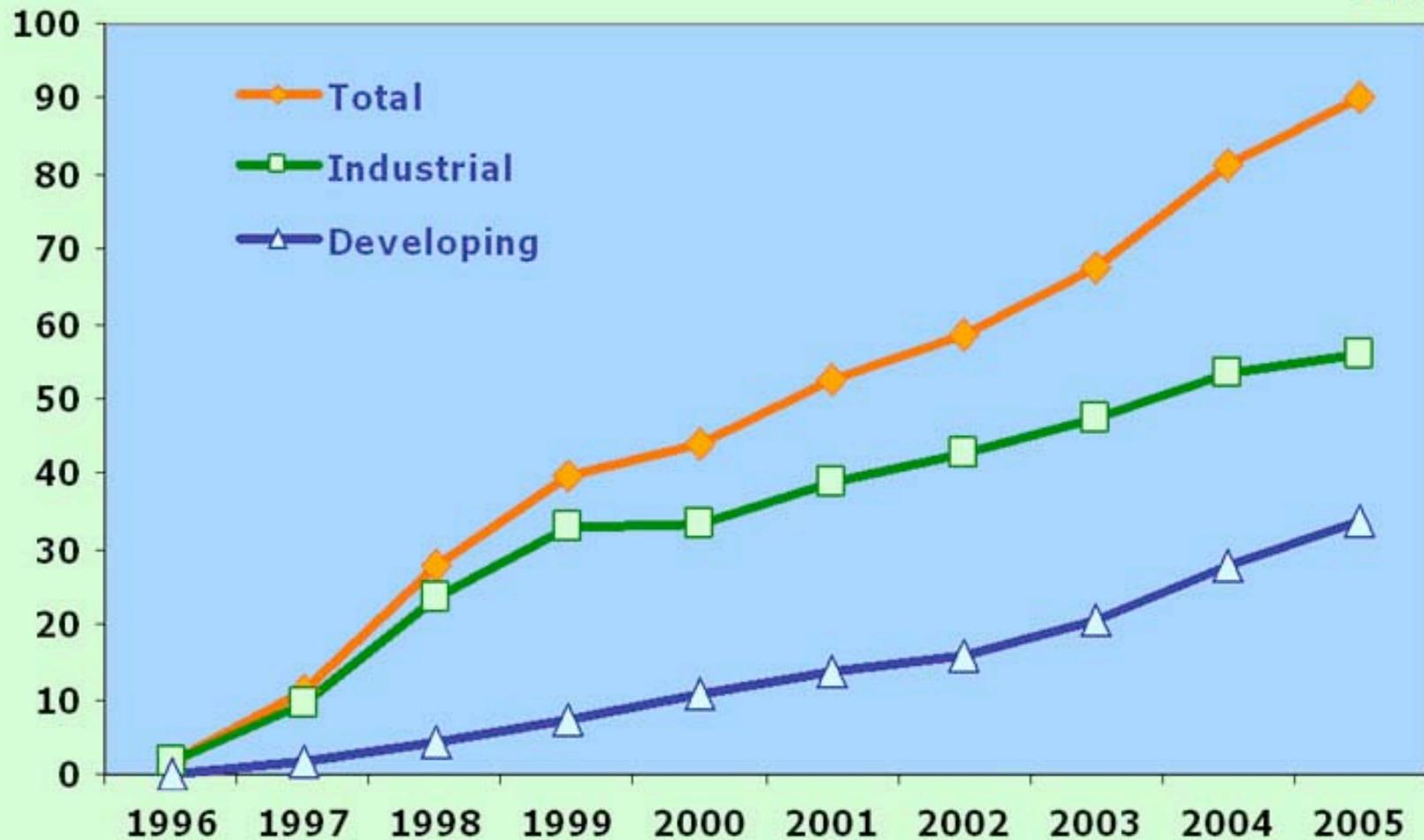


SOURCE: NCFAP; USDA, USA Today



GLOBAL AREA OF BIOTECH CROPS

Million Hectares (1996 to 2005)



Increase of 11%, 9.0 million hectares or 22 million acres, between 2004 and 2005.

Source: Clive James, 2005





Estimated 75% of Processed Foods
Have GE Ingredients



Insect-Resistant Cotton (Bt)



- + Increases yields; profits variable
- + Decreased pesticide use
- + Reduced tillage
- Can result in Bt-resistant insects
- Produces insect toxin throughout plant
- Can transfer Bt gene to wild relatives

The **HORROR**
of Genetically
Engineered Food

IT from the Came Grocery Store



You Can't Avoid
It Because It's
NOT LABELED!

GREENPEACE

From the **LABS** of Monsanto to **YOUR TABLE!**
A **NEW LIFE FORM** Released into the World!



What are some food safety issues?

- No peer-reviewed food safety tests
- Creation of allergens or activation of toxins
- Pharma crops contaminate food supply
- Changes in nutritional content
- Gene flow from food to intestinal bacteria; increase in antibiotic resistance
- Labeling

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“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 are not the gold standard. Compositional analysis and toxicity testing of individual components is much more sensitive than whole foods testing.”

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

“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

“Preventing adverse health effects by maintaining a safe food supply requires application of appropriate scientific methods to 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 unintended adverse effects.”

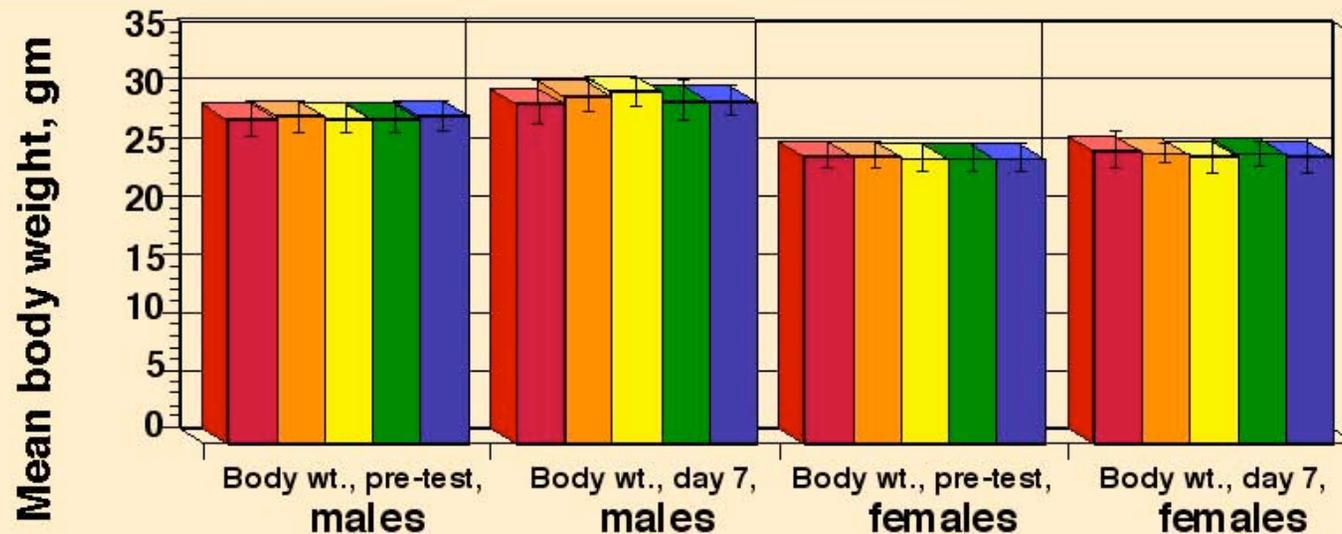
National Academy of Sciences report, ...“Safety of Genetically Engineered Foods: Approaches to Unintended Health Effects” (2004)

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Toxicity Assessment: Roundup Ready/CP4 EPSPS protein

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



Legend:

- Vehicle control
- 363 mg/kg BSA control
- 49 mg/kg CP4 EPSPS
- 154 mg/kg CP4 EPSPS
- 572 mg/kg CP4 EPSPS

Fumonisin Reduction with Bt-maize



- **1989: High levels of fumonisin cause large-scale outbreaks of lethal lung edema in pigs, brain tumors in horses**
- **Fumonisin contamination caused by insect infestation**
- **20- to 30-fold fumonisin reduction with Bt-maize**

Modified from Drew L. Kershen
University of Oklahoma





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

SOURCE: Washington Post, September 19, 2000



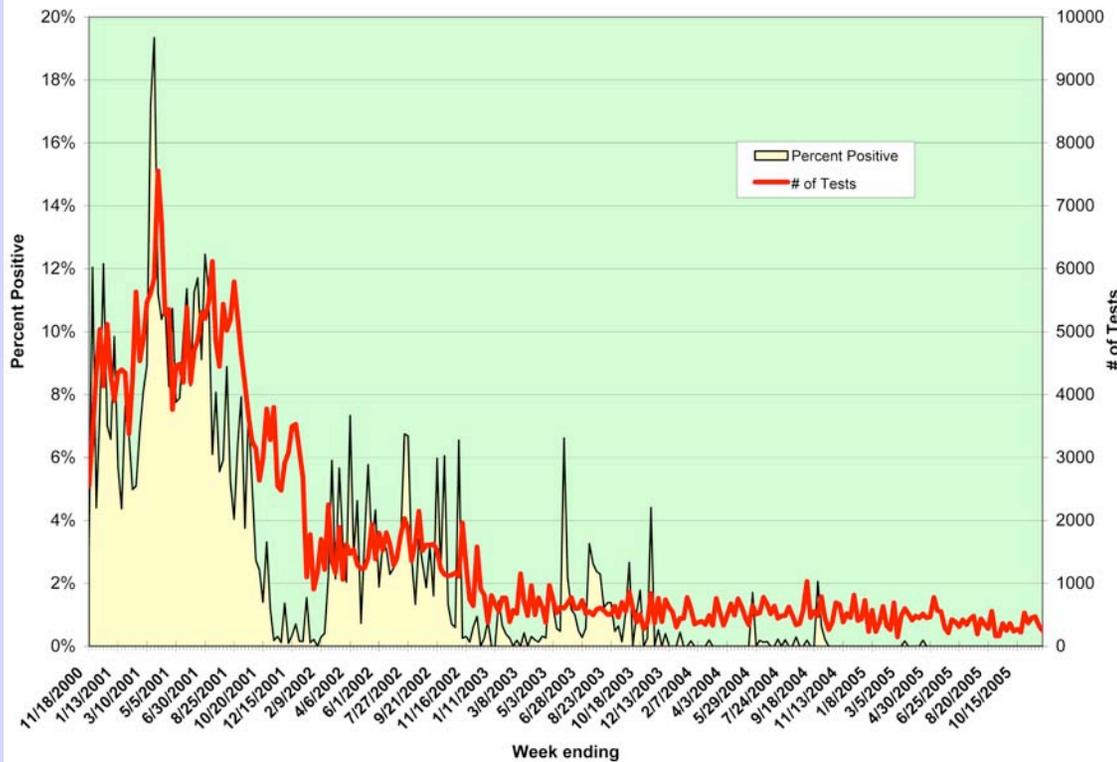


StarLink Corn



- *Bt*-corn approved for animal feed only due to lack of allergenicity testing
- Oct 2000: StarLink *Bt* gene found in foods, forcing massive food recalls
- 51 people complained of allergic reactions
- Immunological studies conducted; samples of food from consumers found no StarLink
- Starlink removed from market

Percent Positive Starlink

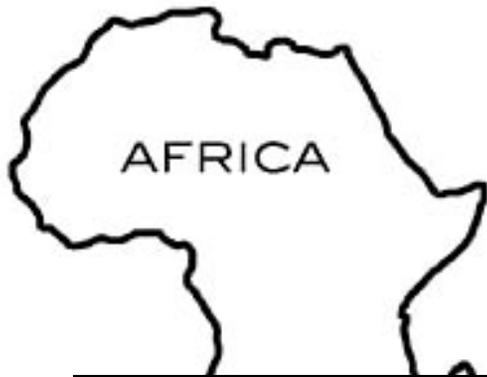


Percentage of Positive Starlink Tests

Week ending:	
November 25, 2000	12.05%
November 30, 2002	1.19%
November 1, 2003	0.26%
November 27, 2004	0.00%
April 16, 2005	0.19%
May, 2005	0.00%
June, 2005	0.00%
July, 2005	0.00%
August, 2005	0.00%
October, 2005	0.00%
November, 2005	0.00%
December, 2005	0.00%



Zimbabwe and Zambia stand united on GMOs



THE HERALD (Harare) Wisdom Mdzungairi

October 11, 2005

International scientists, including those from the United States, have praised Zimbabwe and Zambia for rejecting genetically-modified food donations from the West to

But fears of Starlink contamination still linger about exports to Africa



However, Dr. Luke Mumba, chairman of the Bio Safety Council of Zambia, said "Extreme views have tended to confuse many African policymakers and the public because of lack of reliable information and guidance available to the groups."

Kiwi Allergies

Classically bred foods cause allergy problems also



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



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The Mercury News

March 30, 2004

'Pharm crop' debate takes root in California Biotech

April 2004

**California company seeks to grow
Pharma rice expressing two proteins
from animal genes**

YUBA COUNTY
quantities
internatio

commercial

Sacramen

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



USDA tightens rules on Pharm/Industrial Crops

- **Crop inspection 7 times; 5 in growing season, 2 after harvest**
- **Field isolation distances increased**
- **Dedicated farm equipment required**
- **Permits required for industrial crops, like pharm crops**

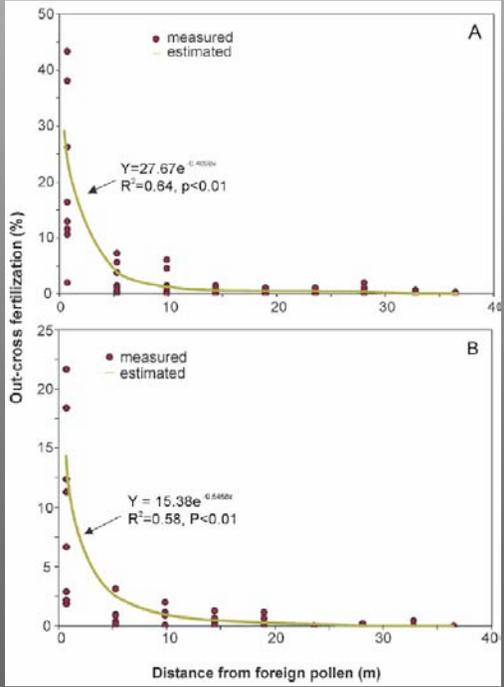
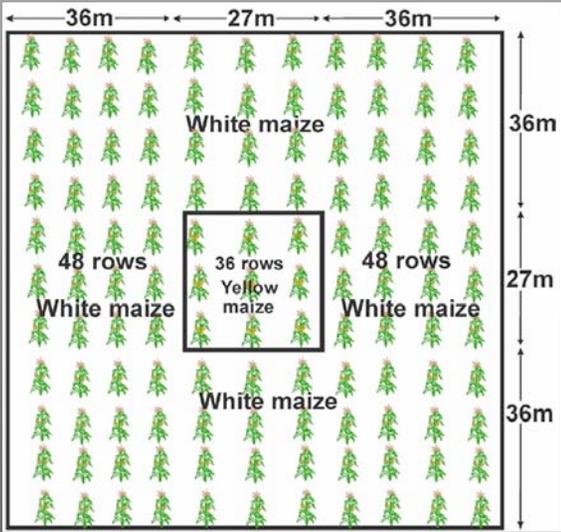
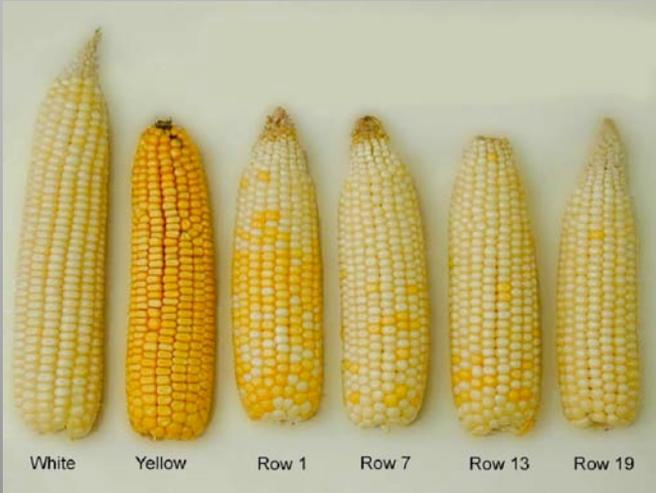
What are some environmental issues?

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

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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

**Question – What Are the Consequences of Gene Flow?
Consider Vitamin A Genes vs. Herbicide Tolerance
Genes from GE Rice to Weedy Red Rice**



Pollen Flow between Herbicide-Tolerant Canola: Cause of Multiple Resistant Canola Variety



crossing



"Triple-resistant canola"

Hall et al. (2000)

Consequences of Triple-Resistant Canola and HT-Wild Hybrids?



canola

What is the actual risk?

- HT doesn't necessarily translate into increase in weediness
- HT gene only helps plant if you spray target herbicide
- Eventually can't use specific herbicide

Who stands to lose?

- Herbicide manufacturer
- HT plant developer
- Farmer

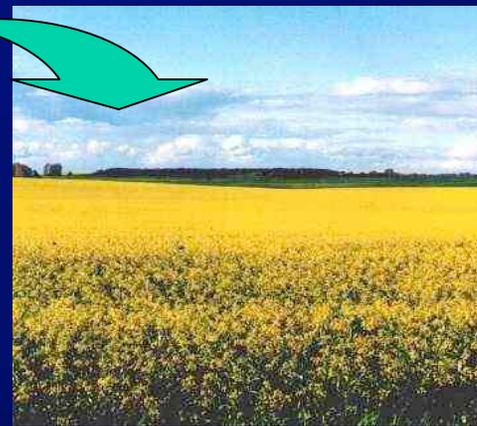
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Consequences of gene flow from GE crops to organic crops in the field



GM canola



non-GM canola



Will an organic farmer automatically lose accreditation if his/her crop is found contaminated with a GE crop?

No.

“As long as an organic operation has not used excluded methods and takes reasonable steps to avoid contact with the products of excluded methods, as detailed in their approved organic system plan, the unintentional presence of the products of excluded methods should not affect the status of an organic product or operation.”

SOURCE: AMS National Organic Program Q&A



Capital Press, September 16, 2005

Communicate to avoid pesticide drift, winemaker says

By **MATEUSZ PERKOWSKI**
Freelance Writer

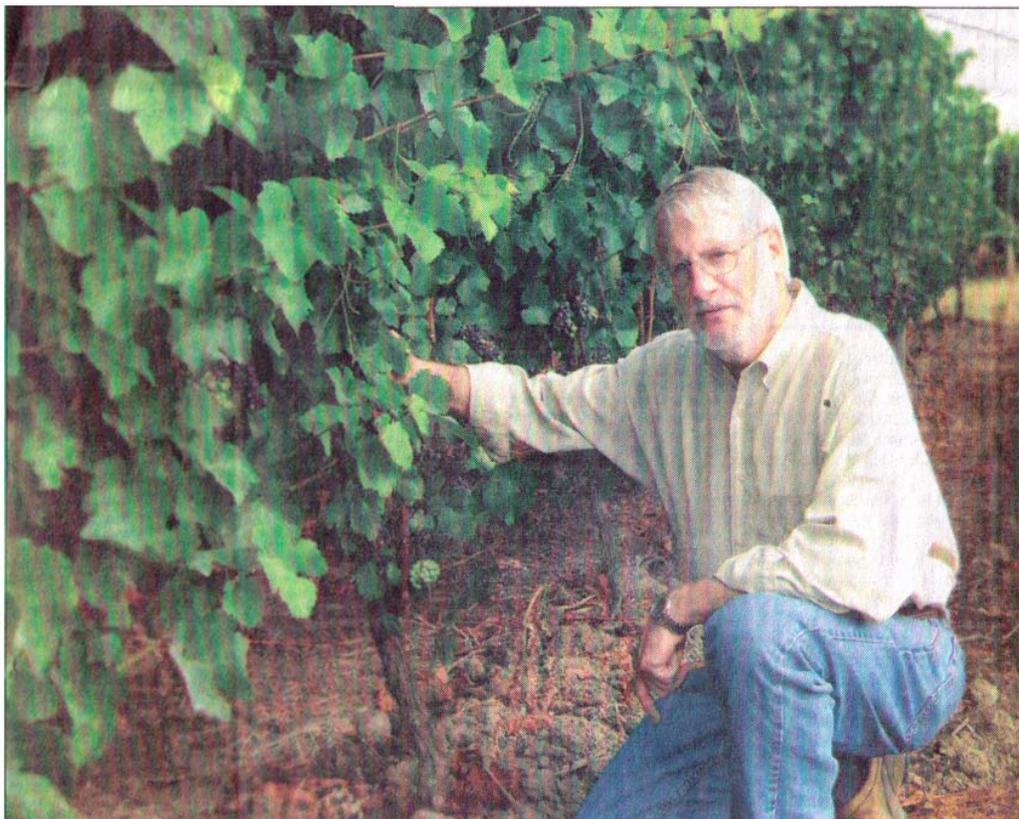
Fifteen years ago, David Adelsheim received some bad news. His vineyard manager had noticed that a section of his vineyard, located near Newberg, Ore., was producing vines with badly distorted leaves.

"Instead of being a full leaf shape, they might have been only half-leaf shape, or they were smaller and fanned together," said Adelsheim. All the symptoms pointed to one thing: the plants had been damaged by an herbicide.

As it turned out, a neighbor had sprayed half an acre of his land that was overgrown with blackberry bushes with a growth regulator herbicide containing 2,4-D. Aside from killing the blackberries, some of the herbicide had drifted onto the rows of grapevines growing only 15 feet away.

Roughly five acres were affected by the drift, which was about a third of Adelsheim Vineyards at the time. The first several rows were the most badly damaged, but even grapevines 30 rows down were showing some deformation. Because the neighbor had sprayed in mid-spring – after the grape bud break but prior to bloom – much of the year's crop had been aborted, and the remaining vines were too damaged to ripen any grapes.

In the decade and a half since then, Adelsheim Vineyards has managed to overcome the injury caused by the incident – the company has expanded to 180 acres, and the five acres ravaged by the herbicide have largely recovered. Nonetheless, Adelsheim said the effects of the



MATEUSZ PERKOWSKI/For the Capital Press
David Adelsheim examines some grapes at his vineyards near Newberg, Ore. Fifteen years ago, herbicide drift damaged several acres of his grapevines, and Adelsheim said the affected plants have never fully recovered.

One of the most divisive issues regarding genetic engineering is the thought that a choice must be made between EITHER “organic agriculture” OR “GMOs”.

As long as these issues are polarized into “all is permitted” or “nothing is permitted”, rational social discussion is impossible.

Dualism (right versus wrong) makes compromise difficult.

Co-existence

development of best management practices to minimize adventitious presence of unwanted material and effectively enable different production systems to co-exist to ensure sustainability and viability of all production systems.

General concept of co-existence is well-established in California with conventional, organic and IPM systems working together.

Netscape: Welcome to UCBiotech at The University of California, Berkeley

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ucbiotech.org

This website, a part of the University of California Division of Agricultural and Natural Resources Statewide Biotechnology Workgroup, provides science-based information to the public on issues relating to the application of biotechnology to crops. For the scientific community, educational tools and an extensive database of pertinent scientific literature are available to promote participation in the dialogue. Teaching aids for students and teachers are provided.

