

# *Contemporary Food Fights: Communicating about Biotechnology with the Public*



*Peggy G. Lemaux*  
*University of California, Berkeley*





**Comfortable doing research in a laboratory...**





**Comfortable teaching in a classroom...**





**Comfortable doing public outreach...**



...but what about this role?

# County GMO Ordinances

GrowGmoFree.ORG

Paid for by The Committee for Humboldt Green Genes (#1264406) (707)826-1031 (707)442-3481 (707)923-1116 PO Box 4841, Arcata, CA 95518

NO on Q  
It's Bad for Farmers.

No On "D"

Families & Farmers For  
A Healthy Environment

YES Q

HEALTHY FARMS AND FAMILIES

ucbiotech.org



IT ALL STARTED IN  
**MENDOCINO**  
**COUNTY**





**March 2004 MENDOCINO  
MEASURE H -2,579 signatures obtained**

- “unlawful for any person, firm, or corporation to propagate, cultivate, raise, or grow genetically modified organisms in Mendocino County” (excludes microorganisms)
- “DNA or deoxyribonucleic acid means a complex protein that is present in every cell of an organism...”
- The ban does not pertain to properties within city limits, or lands managed by State, Tribal and Federal agencies.
- At election time, no GE organisms were known to be in production in Mendocino County.

...entist argument  
...audacious

**In our opinion**  
Remember there are two sides to every story.

To the Editor:  
The comparison in the article regarding the loss or omission of organic certification if an organic crop is contaminated with GMO pollen is ludicrous! If an organic crop is contaminated with GMO pollen, it becomes inedible. I don't want to eat GMO food. That is my right. If I buy according to the label, I should not be responsible for the contamination. The organic label should be organic and that does not include a vegetable or fruit that has been pollinated by a GMO. Heck, I don't even want to eat GMO pollen. Heck, I don't even want to eat GMO pollen. Heck, I don't even want to eat GMO pollen.

We endorse Measure H!



CRAIG BELL

**YES**  
on the ballot

**Mendocino considers ban of genetically engineered plants**

**NORTH COAST**

**Letters to the Editor, Flyers, Mailings Were Everywhere...**

**GM**

By GLENDA  
The Daily Journal

County supervisors voted to place on the March ballot an initiative that would prohibit the growing of genetically modified organisms in Mendocino County.

Supervisors' only other choices were to adopt the initiative as a county ordinance or to send it for further study because signature gathering turned in enough names to qualify for the ballot.

The initiative was authored by Mendocino Organic Network, a coalition of farmers and consumers who are concerned about genetically contaminated crops. The initiative has happened in other counties as organic farmers could no longer compete with GMO crops.



TONY CRAVER

■ Protect our health!

**What were they writing about?**

**More on GMOs**

To the Editor:  
I've been reading with interest the arguments in support of banning genetically modified organisms in Mendocino County. Unfortunately, the arguments lack a certain amount of forethought. We all know that by cross-pollination, the pollen from a genetically modified plant can cross-pollinate with a non-GMO plant. This is why organic certification is so important. Now we have a process by means of laboratory testing. We have used this new scientific process to test for the presence of GMO pollen in organic crops. The results show that organic crops can be contaminated with GMO pollen. This is why organic certification is so important. Now we have a process by means of laboratory testing. We have used this new scientific process to test for the presence of GMO pollen in organic crops. The results show that organic crops can be contaminated with GMO pollen. This is why organic certification is so important.



TONY CRAVER

- Protect our environment!
- Protect our private property!

**Keep Mendocino County GMO FREE!**

Join us!

...cked, this band of  
...ations includes the  
...ic engineering of food  
...they just happen to be  
...ers of the herbicides  
...high their patented GMO  
...ed to use exclusively.  
...sting to note a November  
...on the Northwest Science  
...nental Policy Center in  
...2003 study by the Center  
...and Environmental Policy  
...Idaho, which... concludes that the  
...million acres of GM corn, soybeans  
...cotton planted in the US since 1994  
...increased pesticide use (herbicides  
...insecticides) by about 50 million  
... (emphasis is mine).  
...So I ask you, dear reader, why  
...interest might the CPRA have?  
...Mendocino County initiative?

**Understood**

...of Marie  
...en, GMO crop

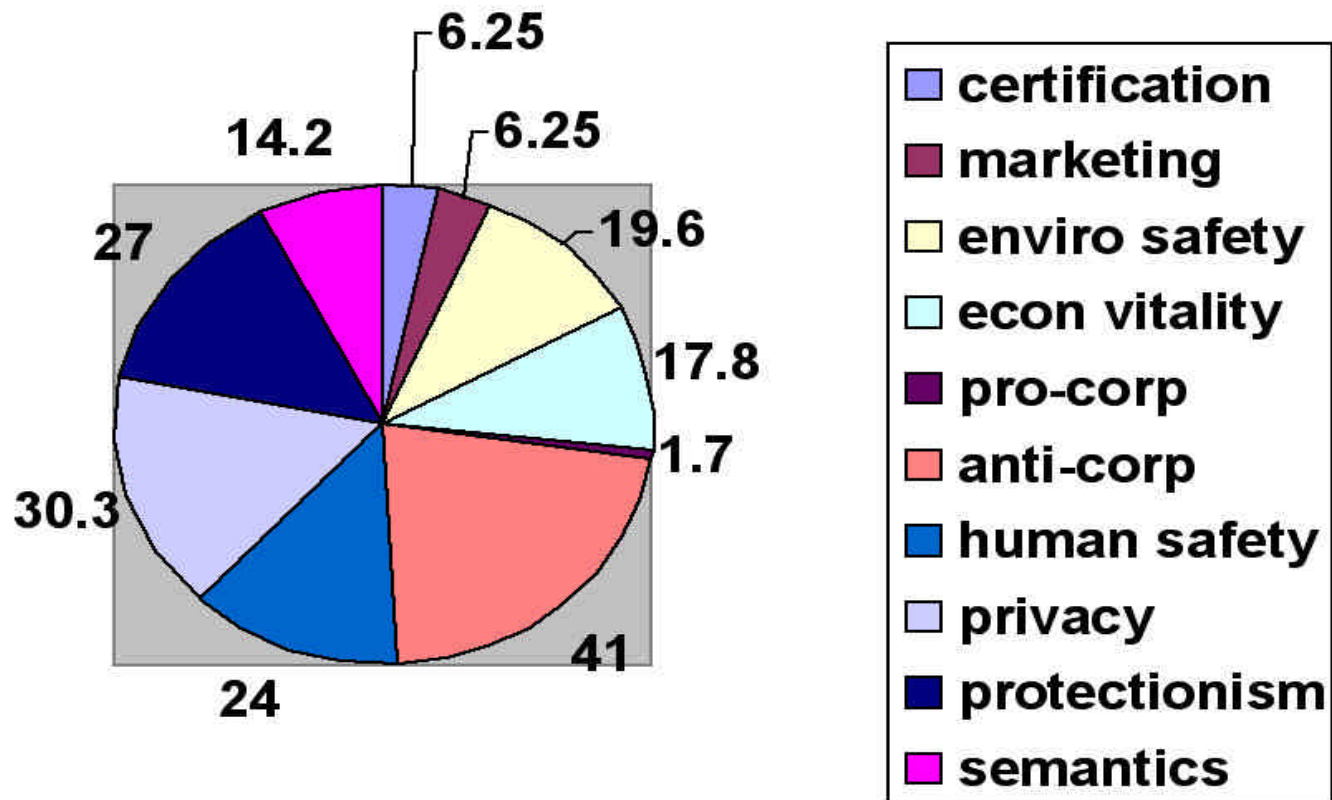
...the arguments from the  
...measure H, but without sex  
...text for measure H, I wa  
...validity of their argument

...argument for measure H wa  
...one planted a field of GM  
...the pollen that would  
...crop onto a neighbor's  
...d the  
...the neighbor's  
...organic certification.  
...little research to find  
...I talked to Ray Green, the  
...organics for the State of Californi





## CHARACTERIZATION OF MEASURE H ELECTION RELATED MATERIALS IN MENDOCINO COUNTY



Giusti *et al.* (2004) Focus on Genetically Engineered Crops and Foods - A Case Study from Mendocino County's Public Debate.

**The discourse was driven in many cases by alarming assertions and facts that are not derived from, nor supported by science**

**“When my son was 6 month (sic) old and receiving chemotherapy for leukemia, he was also receiving soy lipids intravenously because he had lost the ability to eat or drink. The longer he received the lipids, the higher the dose of chemo. When I asked why, I was told that the soybeans used were genetically modified to be “Round Up Ready,” they were putting food into my son’s veins that could withstand the chemicals they were using to kill the leukemia blood cells, making the chemo less effective. In order to keep my son alive nutritionally, the higher doses of chemo almost took him away ”**

Jenny Shattuck-Hale, Ukiah Daily Journal, 2/20/04



**EXCERPTS FROM ORGANIC CONSUMERS ASSOCIATION  
LETTER DISSEMINATED BEFORE NOV. 2 ELECTION**

**Dear Friends,**

**While the rest of the country focuses on one presidential candidate or another, Measure D represents Biodemocracy in action. Rarely do we have the opportunity to change the**

**Contamination is spreading so quickly that we have little time to waste before our entire food supply is lost forever...**

**statewide ban on GE crops. California's future is organic!**

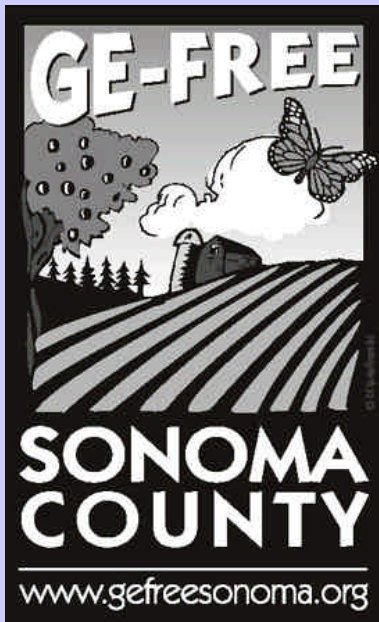
**Yours in organics,**

**Organic Consumers Association**

**[www.organicconsumers.org](http://www.organicconsumers.org)**

## WHY DO WE NEED TO PASS THIS “GE-FREE” INITIATIVE

*A “GE Free Sonoma County” will be good for our farmers, good for our environment, good for business, good for public health, and good for our democracy!*



**We need to protect the right to farm. Those farmers who choose to farm without GE crop varieties must have the right to do so...**

**livestock or fish will lose access to important international markets. We also want to**

**We need to protect our...environmental, public health and economic future...until there is public, peer-reviewed science available, with multigenerational studies on all the long-term impacts of these very new technologies...**

**We need to protect the public health of the people of Sonoma County... Such exposure could occur through GE pollen inhaled or plants eaten, or by increased exposure to toxic herbicides and pesticides used to kill the new “super weeds” and “super bugs”...**







*Feeding the Future*

[www.feedingthefuture.org](http://www.feedingthefuture.org)

Dear Friend of California's Family Farmer,

While the fundamentals of farming are well known, the actual practice

**...special interest groups - professing to have the best interests of family farmers at heart - are challenging the innovation that has made California farmers the leaders in progressive agriculture.**

As farmers, we understand that some people are unsure of

**As farmers, we understand that some people are unsure of biotechnology...Some activists, however, utilize scare tactics in an effort to ban biotechnology and deny everyone the benefits of the best science and the most extensive research in the world today.**

making our planting decisions. We are confident in the future of

**Family farmers want to continue to utilize scientific expertise when making our planting decisions. We are confident in the future of biotechnology and support the regulatory process that approves these crops on a case-by-case basis.**

BILL PAULI  
President  
California Farm Bureau Federation



November 2004, Fresno

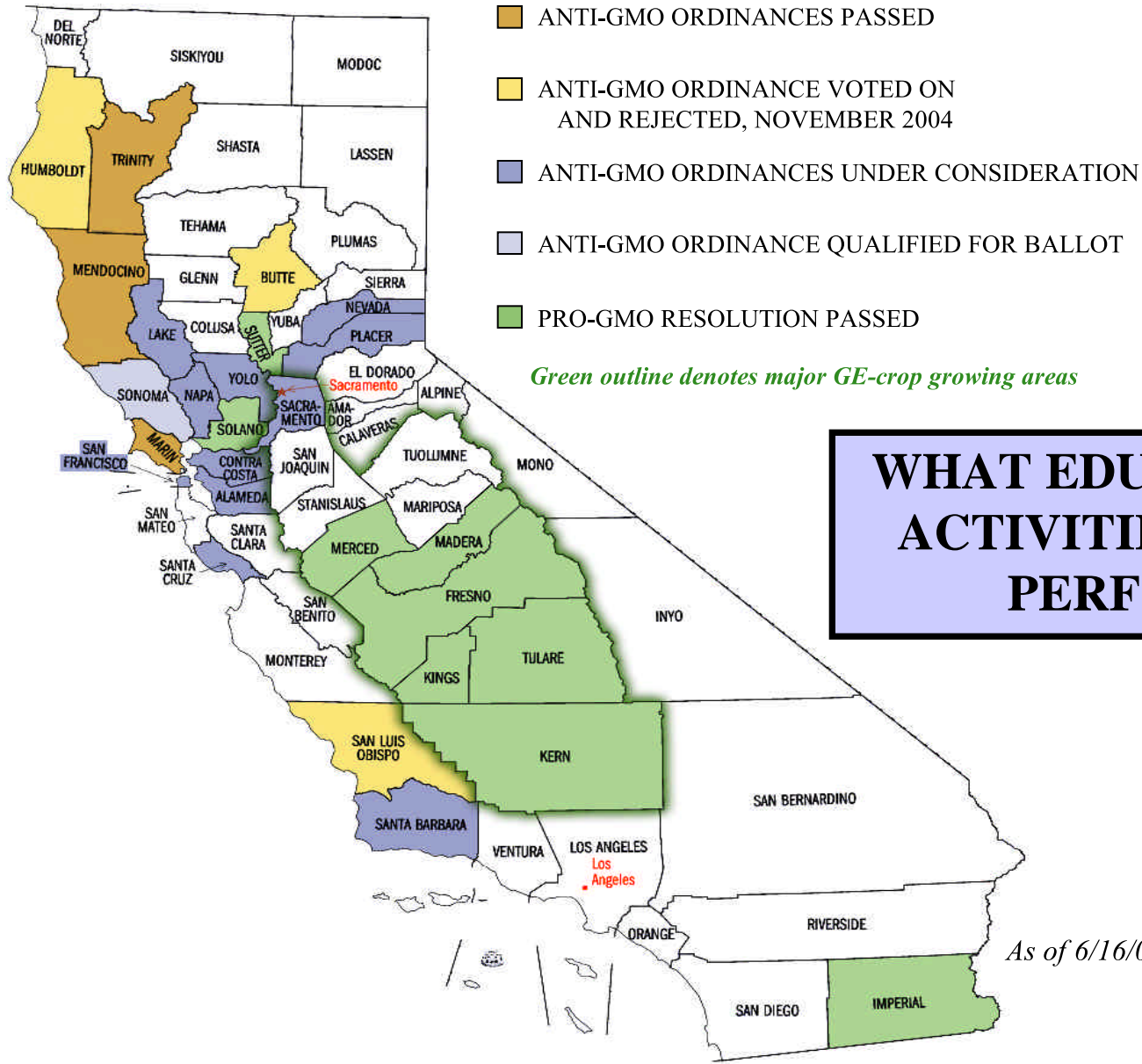
Passed: Board of Supervisors 5 For; 0 Against

- Whereas, biotechnology has the potential to greatly improve the health, nutrition and

**County of Fresno affirms the right for farmers and ranchers to choose to utilize the widest range of technologies available to produce a safe, healthy, abundant and affordable food supply, and that the safe, federally regulated use of biotechnology is a promising component of progressive agricultural production.**

and ranchers to choose to utilize the widest range of technologies available to produce a safe, healthy, abundant and affordable food supply, and that the safe, federally regulated use of biotechnology is a promising component of progressive agricultural production.









Main Menu

Information

- Sales
- Information-Genetic Engineering in California Agriculture
- ANR Programs On-Air
- UCTV Program Times & Time

Sales Information-Genetic Engineering in California Agriculture



# Peer-Reviewed Educational Video

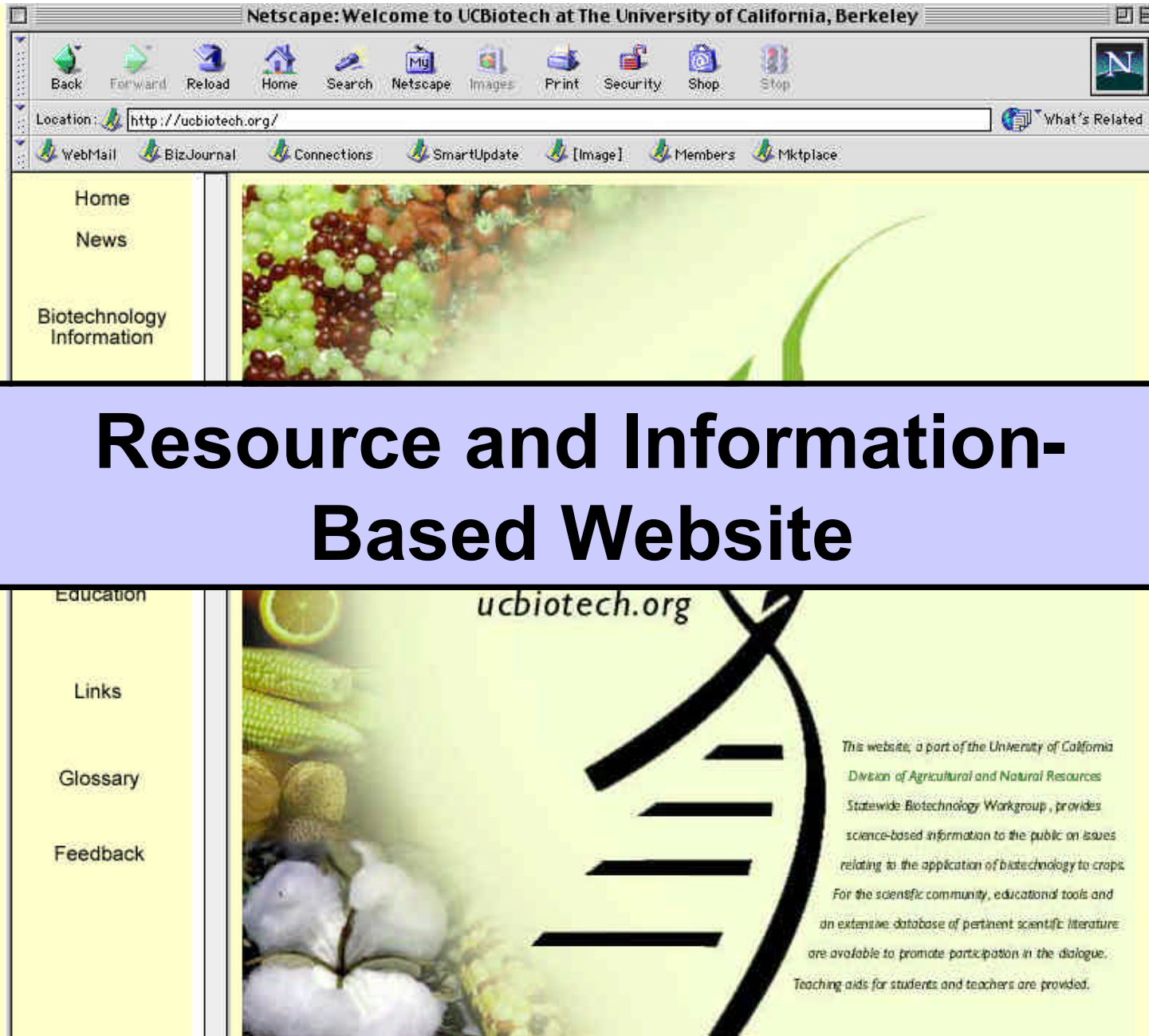
Production Team

your credit card information.

A 30-minute, peer-reviewed video explaining the science behind genetic engineering, its uses in food crops and animals, where and why the technology is being used by California farmers, and some of the science-based concerns pertaining to the use of genetic engineering.

If you want to view the movie

[mms://STREAM.ucanr.org/Windows Media/UCTV\\_04\\_06.asf](mms://STREAM.ucanr.org/Windows Media/UCTV_04_06.asf)



# Resource and Information-Based Website





# Educational Displays for City, County and State Events







# Informational Workshops for County Officials and Staff



PUBLICATION 8153

UNIVERSITY OF CALIFORNIA  
Division of Agriculture  
and Natural Resources  
<http://anrcatalog.ucdavis.edu>



## Genetic Engineering and Pollen Flow

**NORMAN C. ELLSTRAND, PH.D.**, Professor of Genetics and Director,  
Biotechnology Impacts Center, University of California, Riverside

### INTRODUCTION

Pollen grains are the vehicles that transport a plant's male cells or gametes. For most plants that produce pollen, it is transported by wind and insects plus many species are able to self-pollinate some or most of their own female cells or eggs. Typically, the

# Science-based, Peer-reviewed FACT Sheets on the Issues

### What are the consequences when traditionally bred crops cross with wild relatives?

The vast majority of the attention has focused on engineered crop genes in natural populations. For guidance about future problems with engineered crops, we can ask whether traditionally improved crops have hybridized with wild relatives, and if so, whether those hybrids have caused any problems. Most cultivated species naturally hybridize with some wild relative or relatives somewhere in the world (Ellstrand 2003a). In some cases, such as coffee, those wild relatives are geographically restricted. On the other hand, one or more wild relatives of rice are usually found where rice is cultivated worldwide. The vast majority of cases involving hybridization of cultivated plants and their wild relatives has been of little consequence. However, such hybridization, on occasion, has created two classes of problems:

**The evolution of new or more difficult-to-control weeds.** In particular, the evolution of a new weed beet in Europe – a hybrid of sugar beet and an innocuous wild species - has resulted in well over a billion dollars of damage to Europe's sugar industry in terms of reduced yields and increased management costs (Ellstrand 2003a). In California, hybridization between rye and a wild relative has been implicated in the evolution of a new weedy rye variety that has hurt the wheat and rye industry in the northeastern part of that state (National Research Council 1989).



## Grapes are grapes, or are they?

Another Voice  
BY PEGGY LEMAUX

Editor's note: the following introduction by John Harper of the UC Cooperative Service explains this column.

John Harper: In light of the activity concerning Measure H, reading the letter to the editor, and the questions we've been getting at the UC Cooperative Extension office, local farm advisors, including myself, Glenn McGourty and Greg Giusti, have been collaborating with several of our extension biotechnology specialists at three of the UC campuses. Those specialists are Peggy Alan McHughen and Alison Van Eenennaam. In our discussions we have been neutral on the issue. We also

would cross pollen (male cell) variety with eggs (female cell) variety and select a new variety. What happens when you just combine them to make No, genetic rules say only each parent is lost. The control which recipes in the best. This method

## Animal biotechnology

Another voice BY ALISON VAN EENENNAAM

Editor's note: This is the second in a series of articles on biotechnology provided by the Utah UC Cooperative Extension Service Farm Adviser's office. The author of this article is Alison Van Eenennaam, Ph.D., UC Davis.

A recent study of public knowledge about biotechnology, genetic engineering, and genetic modification by Rutgers University found that the majority of Americans claim to know "very little" (55 percent) or "nothing at all" (22 percent) about biotechnology. This knowledge gap and related discomfort is particularly apparent in the case of animal biotechnology. This is evidenced by the fact that in this same survey the majority of people stating that they knew "nothing at all" about animal biotechnology, also disapproved of its use.

Animal biotechnology encompasses a broad range of technologies including the widely used artificial

and aquatic organisms. Senate Bill 245 "bans aquaculture of salmon, exotic (non-native) and transgenic (genetically-engineered) fish in state waters, including the ocean from 0.3 miles offshore." Put simply, existing regulations already ban GE aquatic animals (e.g. fish, shrimp) from state rivers and streams. Additionally, California Department of Fish and Game regulations require the possession of a permit to raise GE fish in contained onshore systems in California. To date several permits have been granted to medical and scientific research laboratories that conform to strict guidelines designed to prevent the escape of GE fish into the waters of the state.

Federally, the FDA determined not to regulate GloFish because zebrafish

of animals for any purpose. others are concerned with the production of GE animals, and yet others specifically concerned with the use of GE animal food. Reasons for this position include varying personal beliefs, animal welfare, food safety, mental, and ethical concerns.

Although biotechnology has created a glowing market, it has potential to be more vital so. For example, in our body, GE pigs are the organization. They are being

## Questions on Measure H

Another voice BY ALAN MCHUGHEN

Voters in Mendocino are being asked to ban "GMOs" - genetically modified organisms - from being grown in the County. The local media has given considerable coverage to supporters on both sides, but is that enough to provide for an informed, truly democratic decision? Although an "out-of-towner," I am concerned for the state of democracy in all California counties. As a public scientist supported entirely by taxpayers, I conclude that Mendocino taxpayers simply have not been given enough clear and accurate information to make an informed decision, whether for or against Measure H.

Too many crucial questions remain unanswered. What exactly will be banned and what will be allowed? The legal wording is disappointing and what will be allowed? I think the measure will ban seedless grapes, broccoflowers, potatoes and other products of modern plant breeding. Some think it will ban any plants or animals produced using genetic engineering techniques. Others think it will ban transgenic genes from different species. Almost all of the initiative, all of these groups. Yet, according to a survey done where the majority are

Quite apart from the fact that the majority are

Informational pieces for newspapers...

with this... four-part series... "Grapes are grapes, or are they?" compared by Peggy G. Lemaux, UC Cooperative Extension, Berkeley. University of California, Berkeley. Any wine connoisseur knows you can't use Muscat grapes to make cabernet sauvignon wine. In fact, hundreds of different unique varieties of grapes are used for making wine. That uniqueness is due in part to the genetic information in grape, which determines its color, aroma, and wine characters. That information is arranged in recipes, or genes, made of chemical units. If alphabetic letters were used to represent each unit, 52 books of recipes, each with 1,000 pages, are needed to hold all information for a particular variety. A new grape variety, bred by cutting and crossing many grape varieties to add to the existing ones, which are already in the soil, is being developed.

tions performed in a laboratory. Many food animal species have been genetically engineered (e.g. cows, sheep, chickens, pigs, fish), but currently none are available on the market. The Food and Drug Administration is responsible for regulating and ensuring the safety of GE food animals for the consumer. To date one company, Aqua Bounty, has requested approval to market a growth-enhanced GE salmon that is capable of growing four to six times faster (but not bigger) than standard salmon grown under the same conditions.

The GloFish sets "a dangerous precedent" for all future GE animals, whether created as food or pet. California's Fish and Game Commission made a decision to ban the market for GloFish in California in December. This was not founded on evidence-based environmental rather on ethical concerns summarizing one of the points stated that he or she that it would produce a new "just to be" aspect of

any genetic material from other species. Again, I doubt this is what supporters have in mind. Another crucial question that must be answered is how the measure will be enforced. Supporters say Measure H will not cost taxpayers anything, and will not increase government intrusion on farms and land. The county agriculture Commissioner says he will not swoop in people's backyards. But if the Commissioner receives a complaint that "Farmer Smith is growing GMOs," how will he investigate the allegation without swooping in? Smith's backyard is the

With a strict reading of the supporters have in mind. As well, not inserted either by organic plants would be banned, as not all GMOs by simple visual inspection. Instead, he will have to take a sample for laboratory testing. This will also occur in county inspections of plants and seeds coming into the county. Such testing is expensive and time-consuming. Who pays for this testing? This question, at least, is easy to answer. Taxpayers. If the test comes back positive, what if Farmer Smith denies any? Any







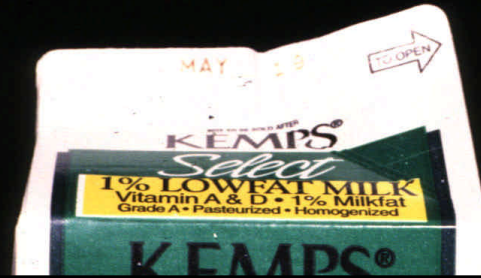
**Science-based educational presentations**

**What do we present?**



# Genetically engineered foods or GMOs





**This is not the first agriculturally based controversy**



**Pasteurization**



**Other technologically based controversies**

**Nuclear Power**

***Risk:*** *Determined quantitatively*

***Safety:*** *Acceptable risk*



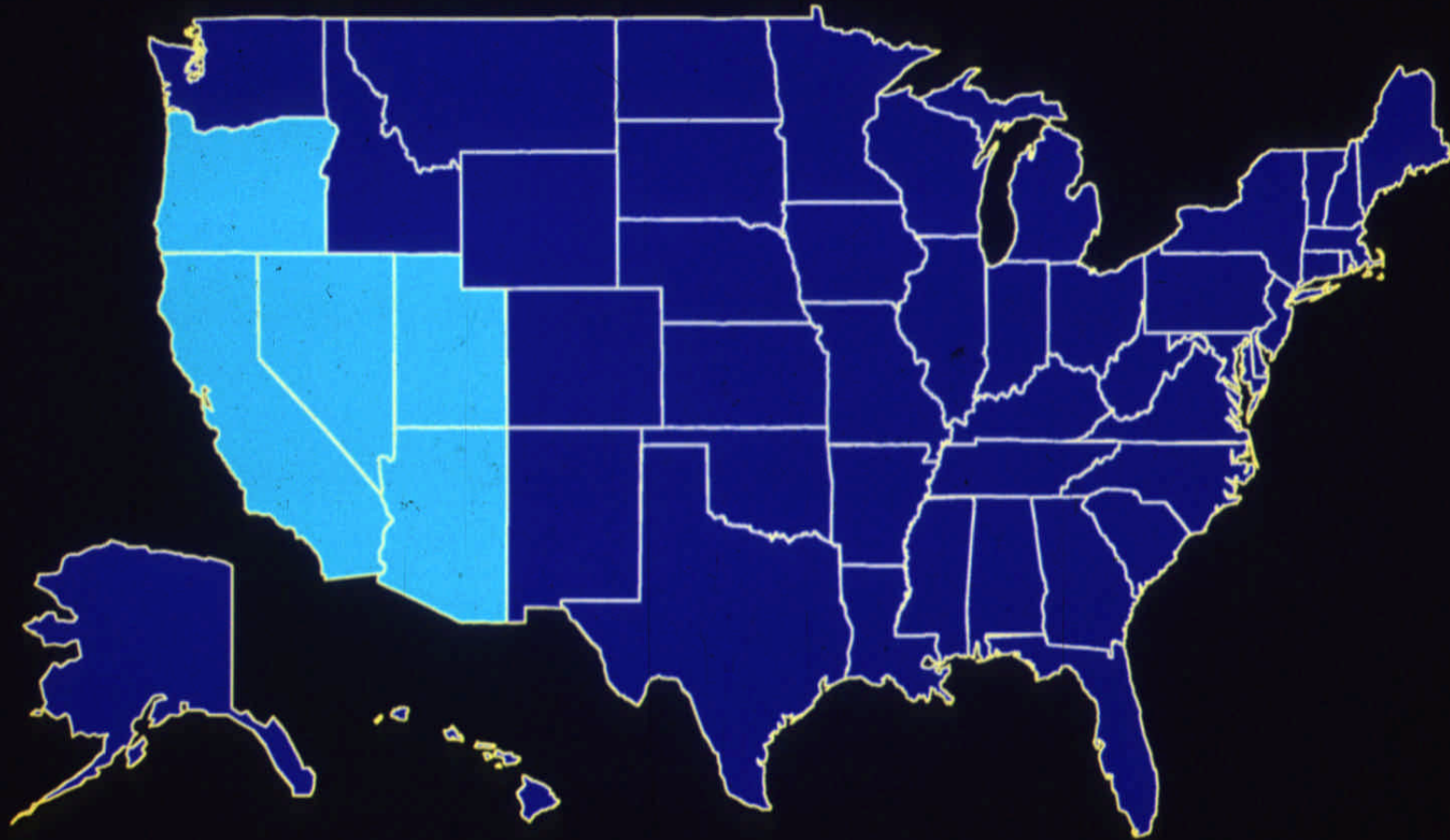
*Agriculture has changed*



Modern Corn and Ancient Teosinte Relative

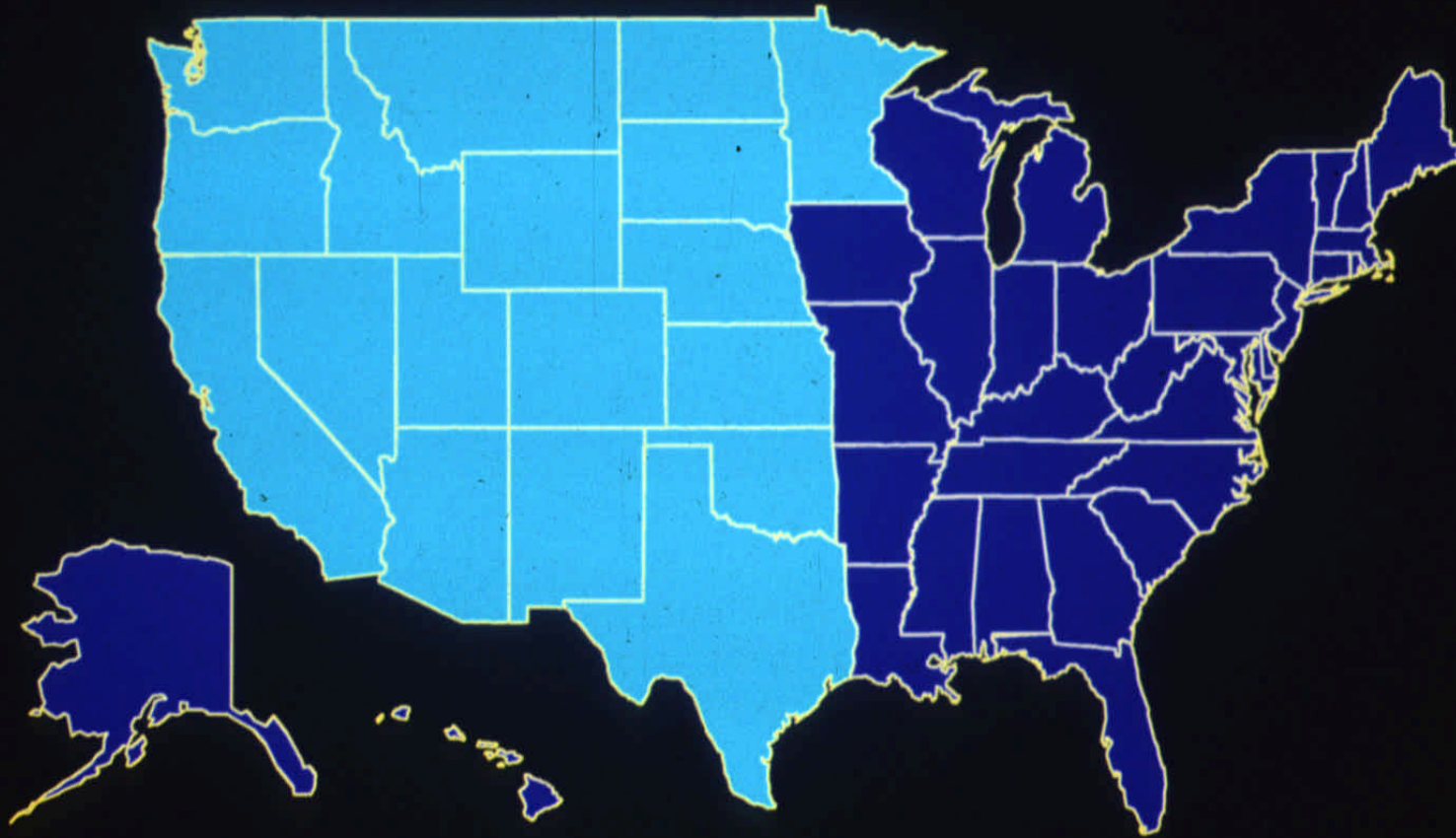


# U.S. Cultivated Land



■ 1987 Acreage

# U.S. Cultivated Land



Acreage Needed at 1929 Production Levels

# ANALOGIES FOR DEMONSTRATING GENETICS

COMPARE NUCLEOTIDES IN WHEAT  
TO LETTERS IN BOOKS



1.5 million pages

COMPARE GENES IN WHEAT  
TO POP-IT BEADS



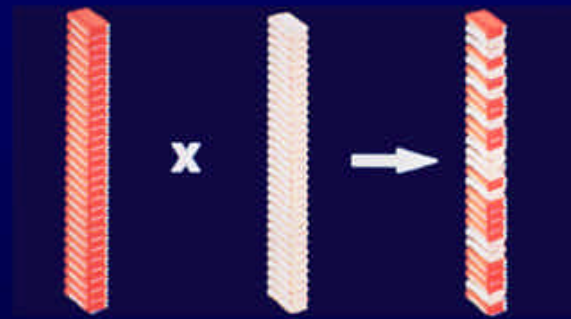
String of beads = quarter of a mile

# CLASSICAL BREEDING

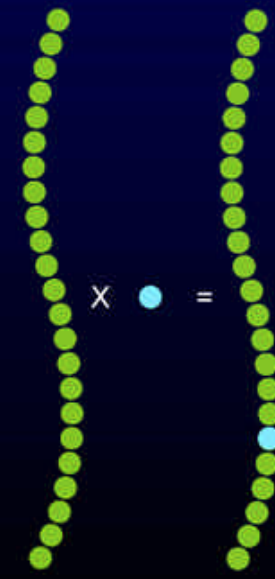
VS

# GENETIC ENGINEERING

## USING BOOK ANALOGY



## USING POP-IT BEADS





## TERMS USED

**GM/GMO**

Genetically Modified Organism

**GE/GEO**

Genetically Engineered Organism

**LMO**

Living Modified Organism

**rDNA**

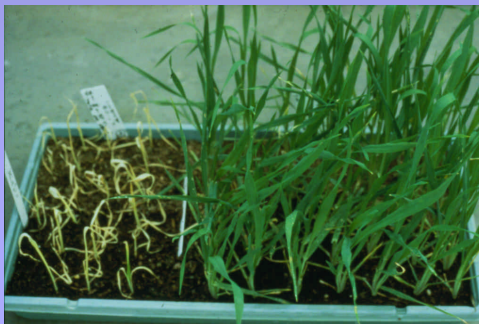
Recombinant DNA

**Biotechnology**

# What Is in a Recombinant DNA Construct?

On  
switch

Gene of interest:  
herbicide, stress or  
disease tolerance



Herbicide tolerance

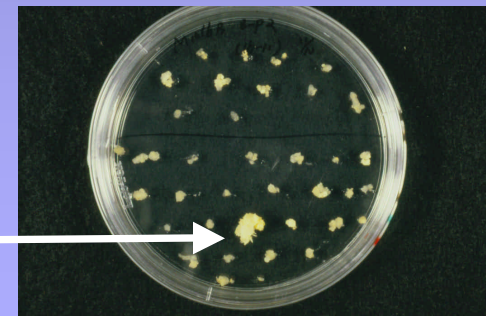
Off switch

On  
switch

Marker gene:  
antibiotic or  
herbicide  
resistance

Off switch

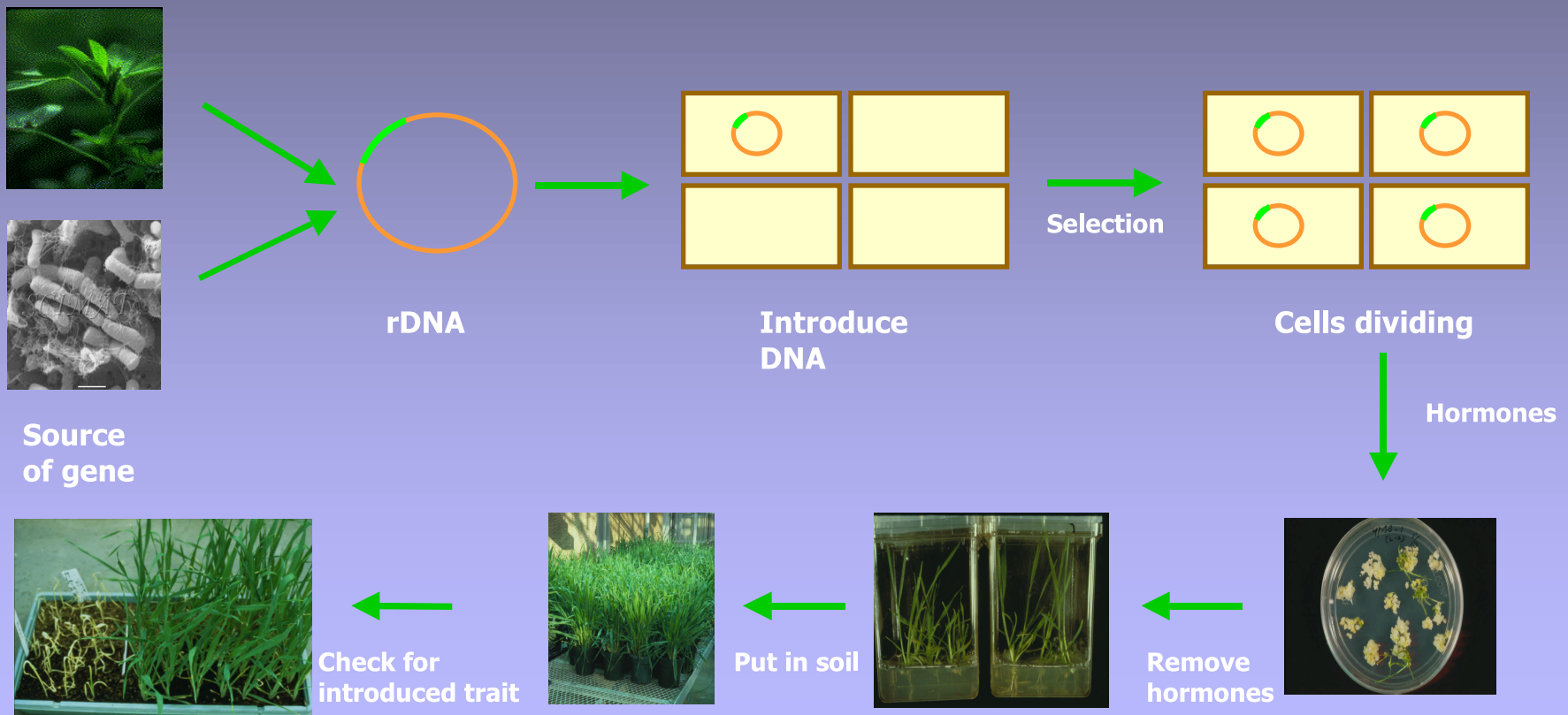
Surviving tissue



Selection plate

# Genetic Engineering

- Create rDNA with gene from same or different organism
- Transfer DNA to plant cell; allow plant cells to divide under selection
- Cue cells to reform plant - every cell will have new DNA
- Confirm introduced DNA and expression of foreign protein in plants



# 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

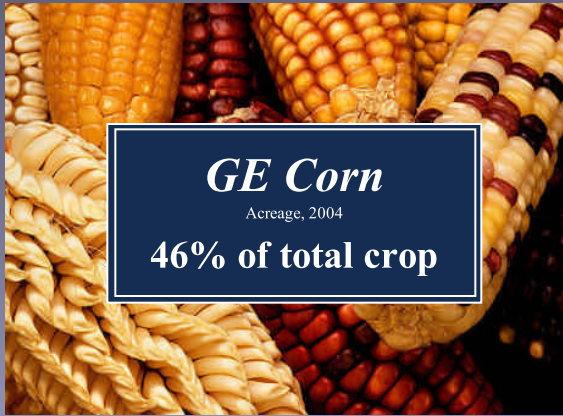
Uses plant machinery in laboratory

Gene exchange is specific,  
single or a few genes

When/where gene expressed  
can be controlled precisely

Source of gene from any  
organism





***GE Corn***

Acreage, 2004

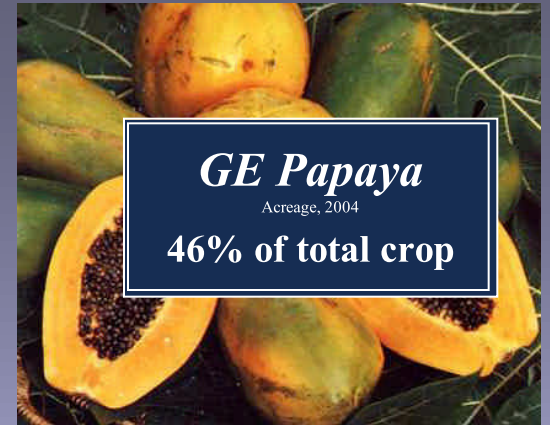
**46% of total crop**



***GE Canola***

Acreage, 2002

**75% of total crop**



***GE Papaya***

Acreage, 2004

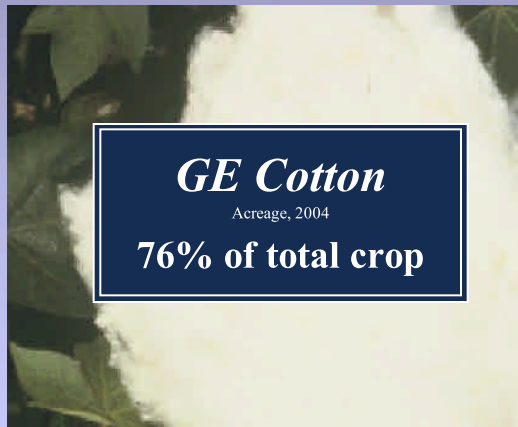
**46% of total crop**



***GE Soybean***

Acreage, 2004

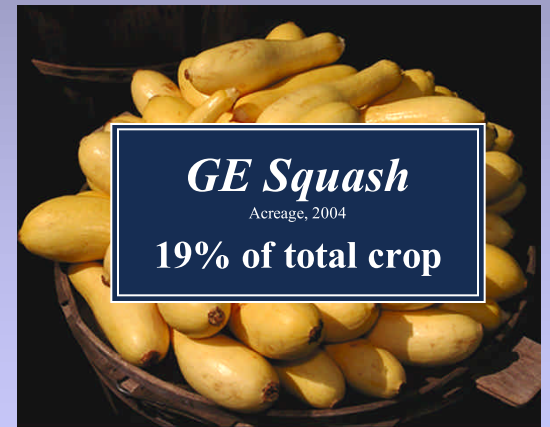
**82% of total crop**



***GE Cotton***

Acreage, 2004

**76% of total crop**



***GE Squash***

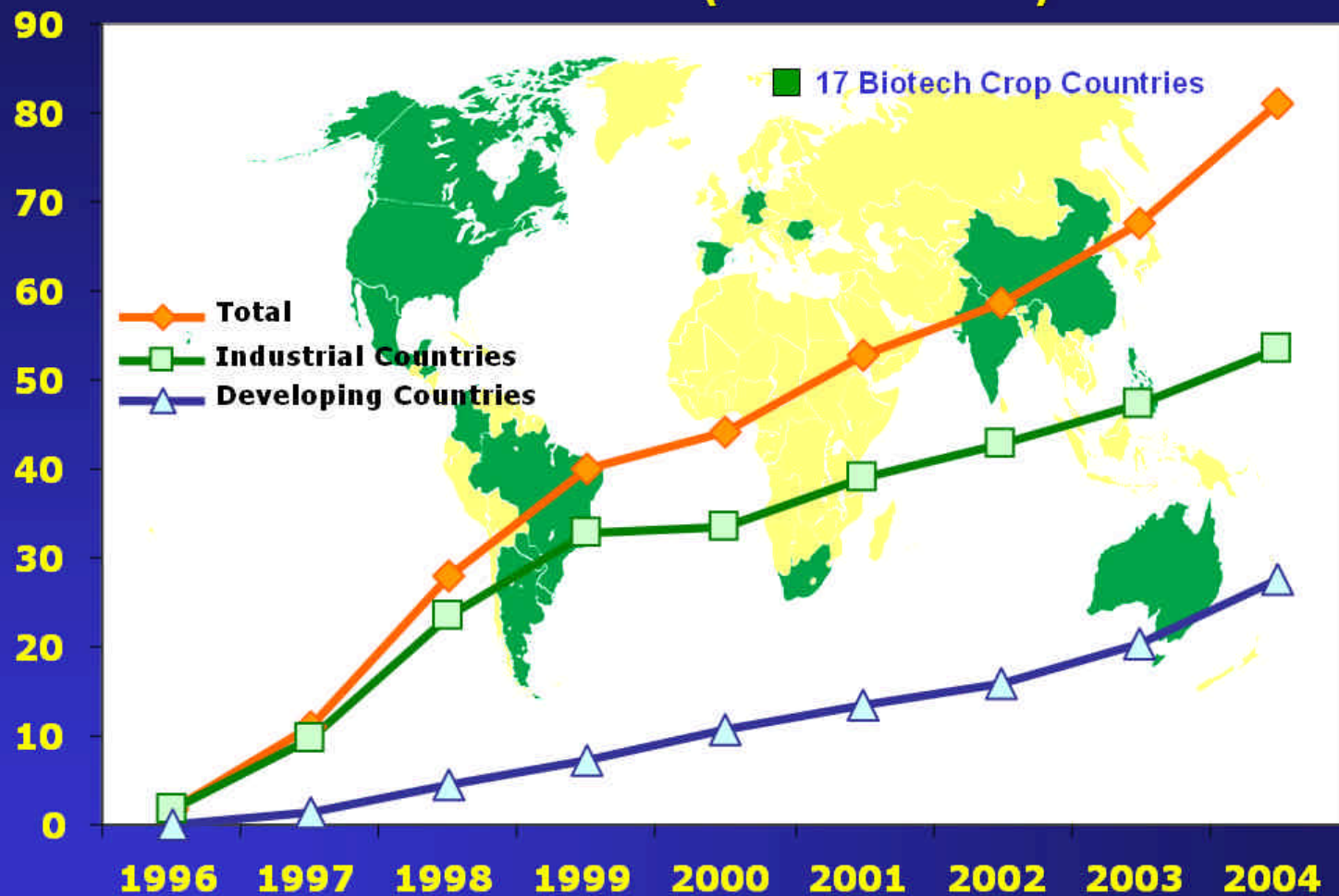
Acreage, 2004

**19% of total crop**

SOURCE: NCFAP; USDA, USA Today



# Global Area of Biotech Crops Million Hectares (1996 to 2004)



Increase of 20%, 13.3 million hectares or 32.9 million acres between 2003 and 2004

Source: Clive James, 2004

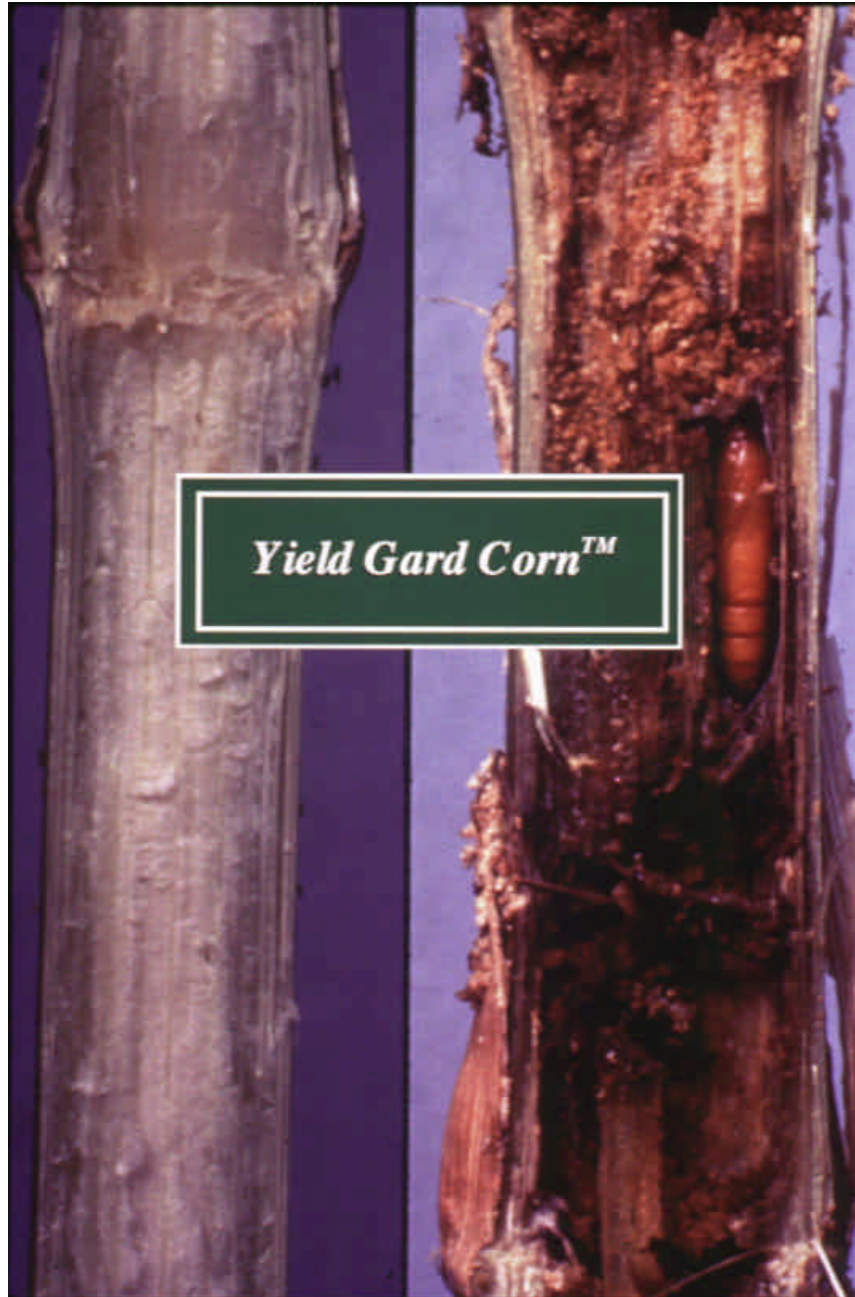




# Estimated 75% of Processed Foods Contain GE ingredient

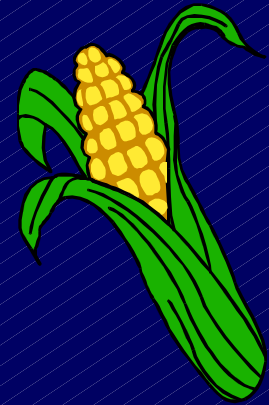








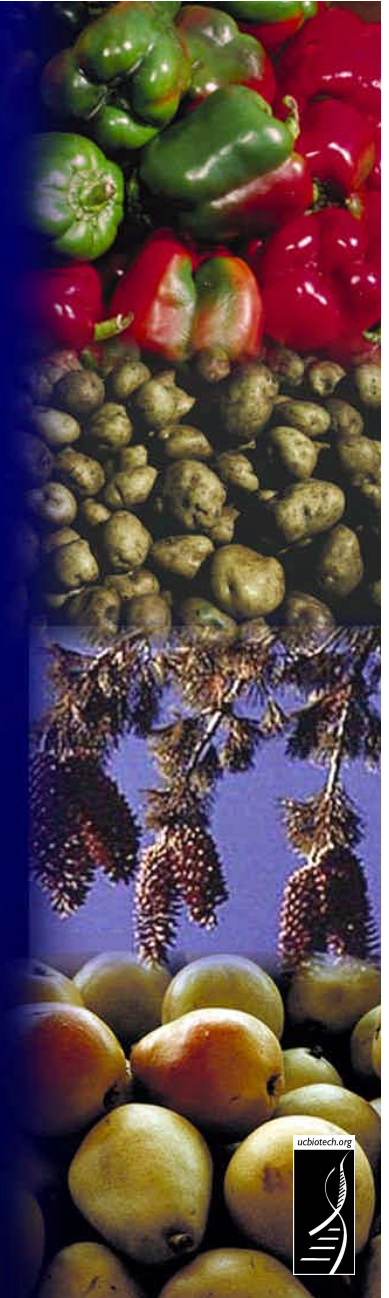
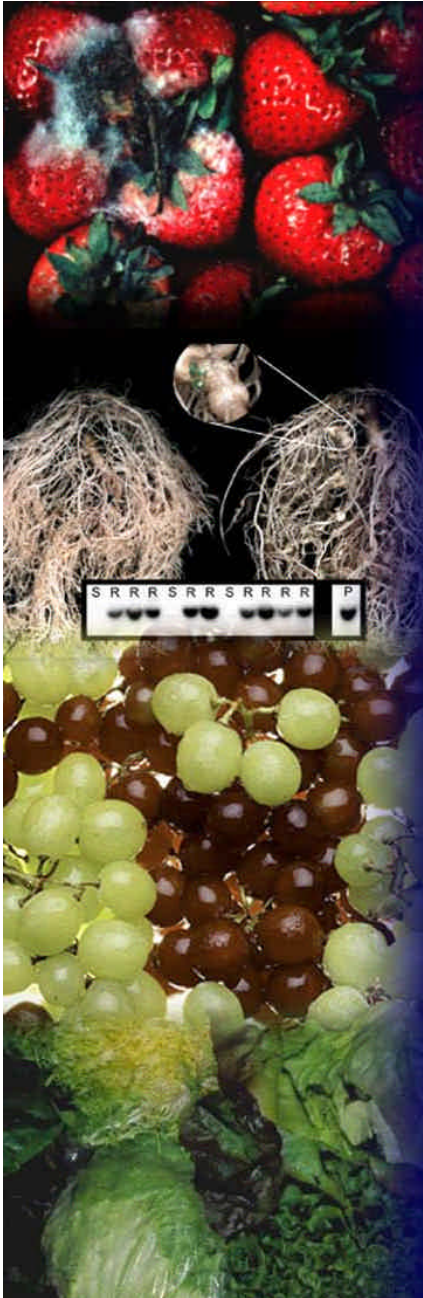
# Insect-Resistant Crops (Bt)



- + Increases yield; profits variable.
- + Decreased pesticide use
- + Reduced mycotoxin content in corn
- Can produce Bt-resistant insects.
- Produces insect toxin throughout plant.
- Can transfer Bt gene to wild relatives.

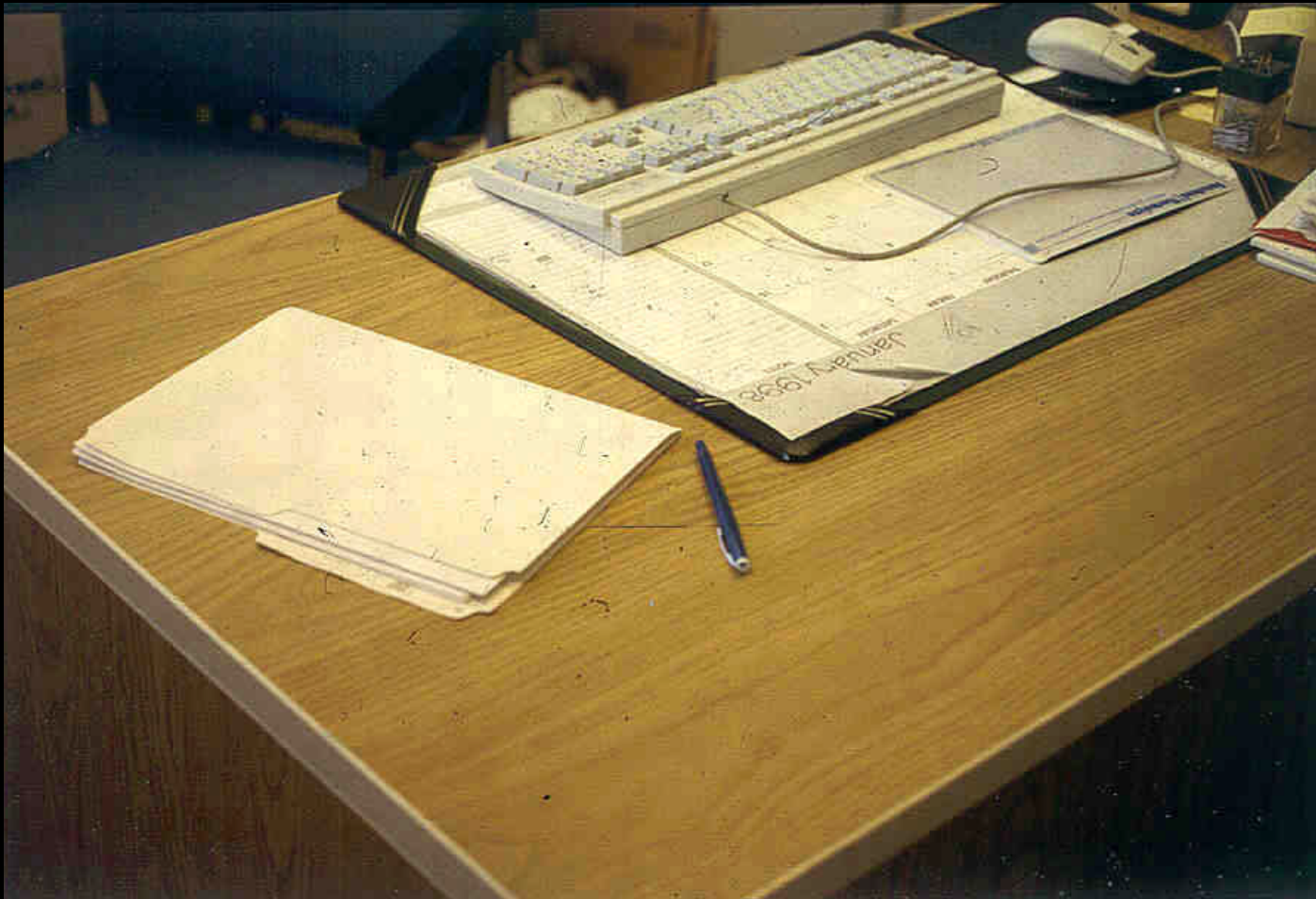
## *Sample of possible engineered fruits and vegetables*

- Strawberries resistant to molds
- Tomatoes not attacked by root nematodes
- Grapes resistant to Pierce's Disease
- Drought tolerant lettuce
- Peppers resistant to bacterial diseases
- Potatoes no longer susceptible to blight
- Sugar pine resistant to white pine blister rust
- Frost-tolerant pears



# Variety release requirements: Conventional cultivars

- Agronomic performance
- Proximate analysis
- Antinutritive factors





# Variety release requirements: Transgenic cultivars

- Agronomic performance
- Proximate analysis
- Antinutritive factors
- *Plus:*

## *Plus:*

### **Molecular/Biochemical Analysis**

- Molecular characterization of inserted DNA,
- Southern and restriction analyses
- PCR for several fragments,
- Various enzyme assays
- Copy number of inserts
- Size of each fragment,
- Source of each fragment
- Utility of each fragment
- How fragments were recombined
- How construct was delivered into flax
- Biological activity of inserted DNA
- Quantitative analyses of novel proteins (western analyses)
- Temporal activity of inserted genes
- Spatial activity of inserted genes
- Complete amino acid analysis
- Detailed amino acid analysis for valine, leucine and isoleucine
- Toxicity (not warranted)
- Allergenicity (not warranted)

### **Biological Analysis:**

- Pathogenicity to other organisms
- Dormancy
- Outcrossing
- Potential for horizontal gene transfer
- Seed production
- Flowering time,
- Flower morphology
- Analysis of relatives
- Stability of genes over generations
- Survivability in natural environment
- Survivability in agricultural environment in presence of herbicide
- Survivability in agricultural environment in absence of herbicide
- Interaction with other organisms
- Interactions with novel organisms
- Changes to persistence/invasiveness
- Any selective advantage to GMO
- Selective advantage to sexually compatible species
- Plan for containment and eradication in event of escape



# CONTROVERSY



## STARLINK CORN ISSUE

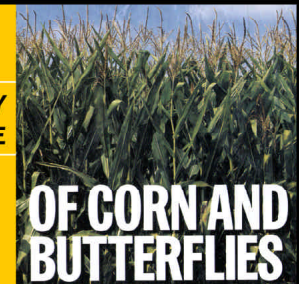
### POSSIBLE FOOD SAFETY RISKS AND BENEFITS

- + Increased nutritional quality of food
- Decreased nutritional quality of food
- + Removal of existing allergens
- Creation of new allergens



Controversy often accompanies the introduction of new technologies, and the application of biotechnology to agriculture is no different. The boundary between risks and benefits is often not distinct; the application of the technology can involve both positive and negative aspects. Considering the appropriateness of the technology involves weighing the two sides and making a decision on the appropriateness of the particular application.

## MONARCH BUTTERFLY ISSUE



## OF CORN AND BUTTERFLIES

### POSSIBLE ENVIRONMENTAL SAFETY RISKS AND BENEFITS

- + Reduced pesticide use
- Increased use of specific pesticides
- + Positive effects on beneficial insects
- Adverse effects on beneficial insects



# *Nonexhaustive List of Issues with GMO Foods*

- *Food Safety*
- *Environmental*
- *Socioeconomical/Ethical*

*Nonexhaustive List of Issues with GMO Foods*

## *Food Safety Issues*

- Create new allergens
  - Activate naturally occurring toxins or create new ones
  - Removal of existing allergens and antinutritionals
- 
- Adversely affect the nutritional quality of foods
  - Enhance the nutritional quality of foods
- 
- Vegetarian and religious issues with GMOs
  - Labeling
  - Increased antibiotic resistance in intestinal flora
  - Horizontal transfer of DNA from plants to humans through foods
  - Unknown, unanticipated risks from GMO consumption
  - Trust in regulatory agencies

# *Regulatory Systems in the U.S. (existing regulations)*

**GE Foods and Crops: Unregulated?**

- ◆ Field testing
  - permits
  - notifications

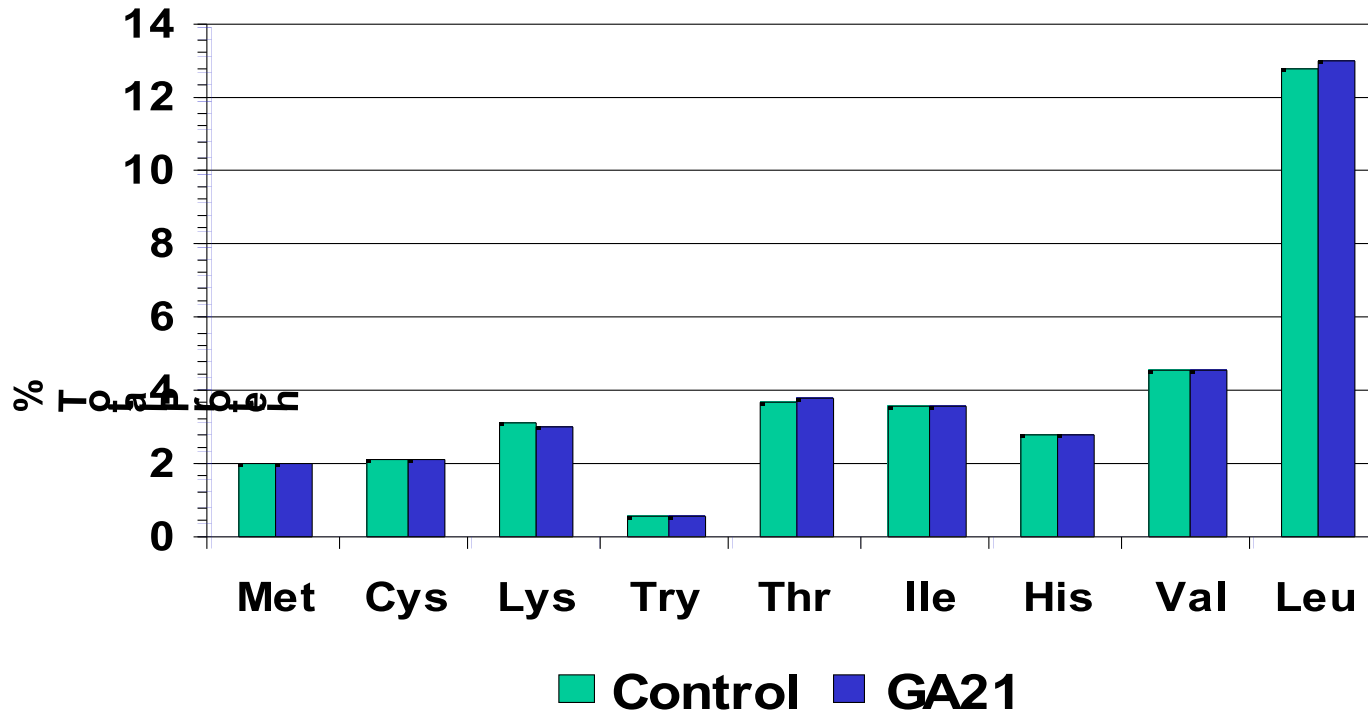
- ◆ Determination of non-regulated status

- ◆ Food safety
- ◆ Feed safety

- ◆ Herbicide registration

**EPA**

## Compositional Equivalence: Amino Acids

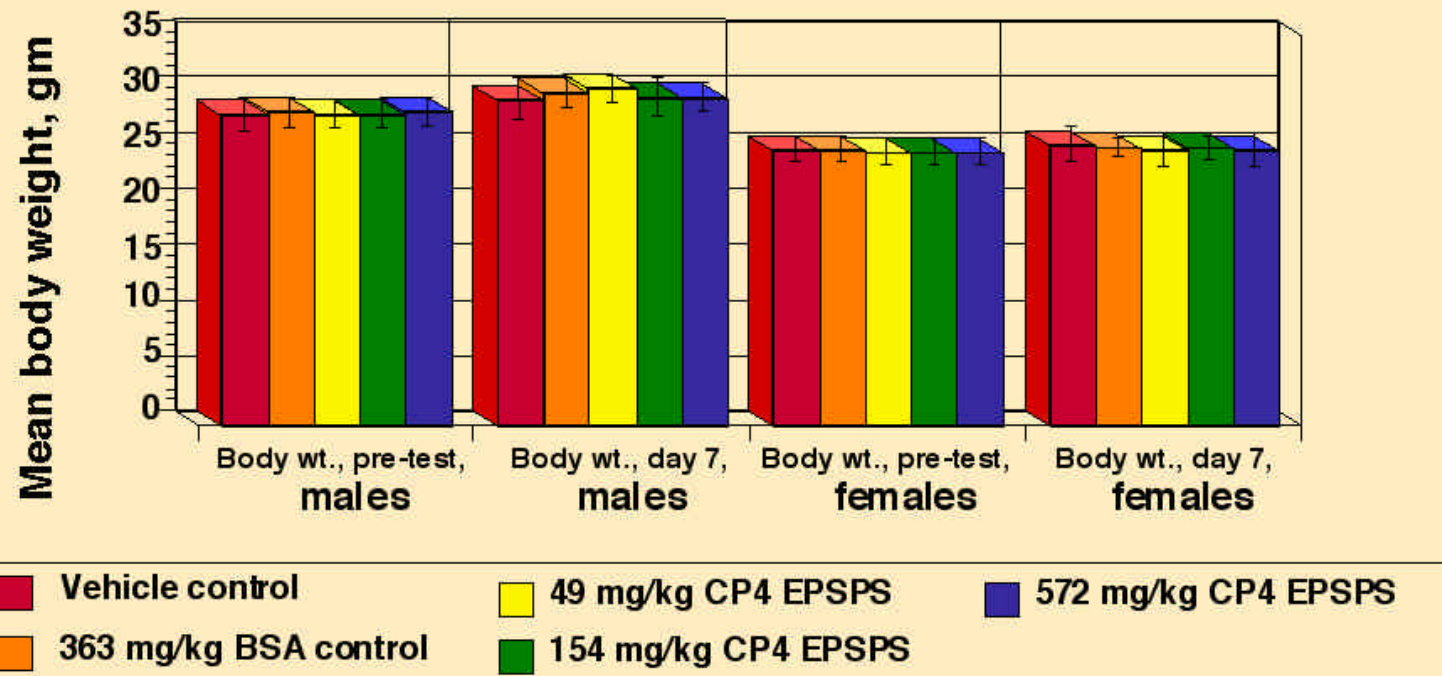


These results have been generated on event GA21. Data showing similar amino acid composition have been generated on the other corn events.



# 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





*Large Scale Grain Movement by Rail Can  
Cause Mixing of Grain*

**Classically bred foods can cause allergy problems also**

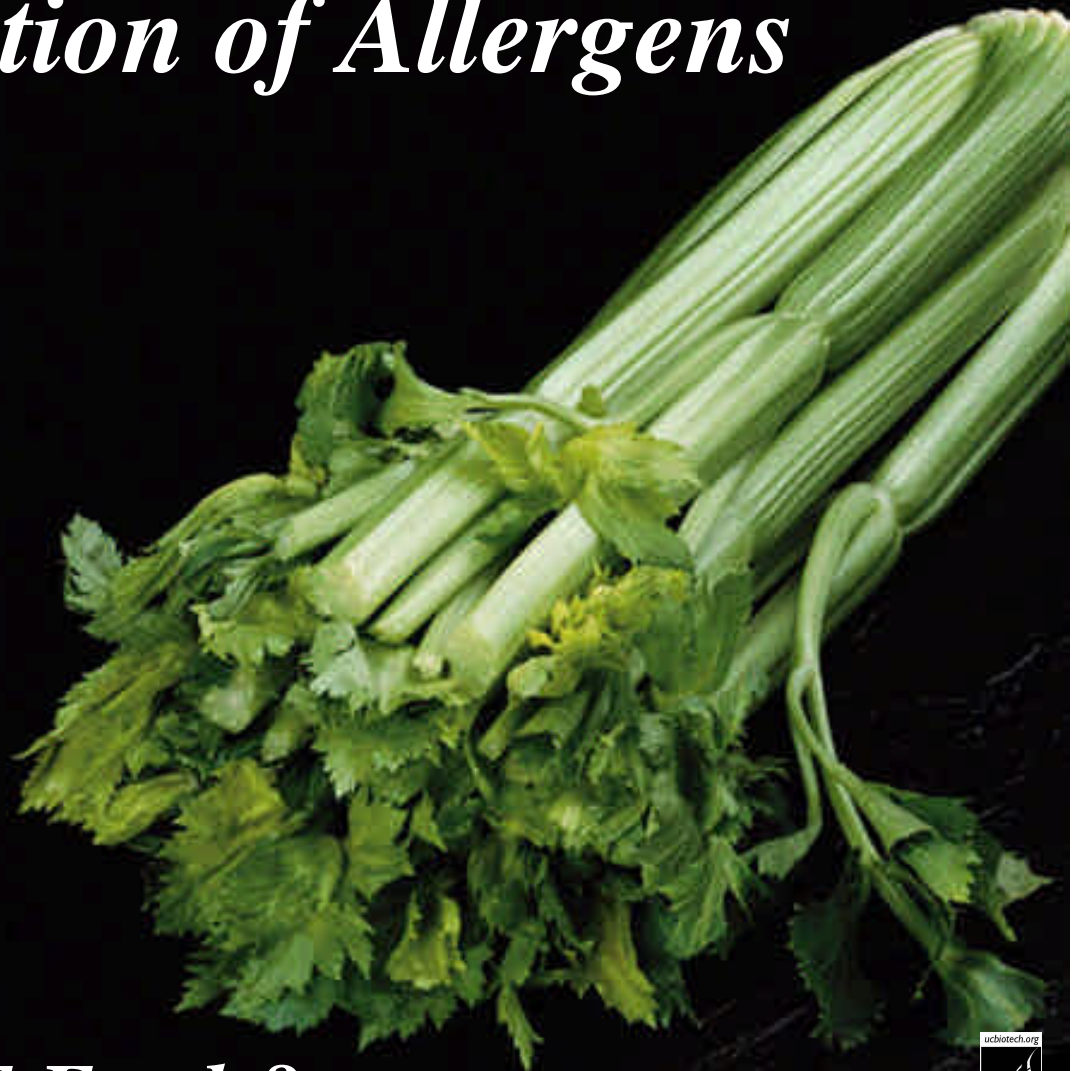
## **Kiwi Allergies**



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



# *Inadvertent Creation of Allergens*



*Is This Confined to GE Foods?*

*Rat feeding studies on  
snowdrop lectin potato*



*Were Pusztai studies conclusive and were  
they pertinent to other GE crops?*

*Nonexhaustive List of Issues with GMO Foods*

## *Environmental Issues*

- Unintended adverse consequences for beneficial insects
  - Unintended beneficial consequences for beneficial insects
- Soil residuals of bio-engineered pesticides
  - Soil residuals of nonengineered pesticides used in the absence of engineered varieties
- Degradation of the environment because of GMOs, *e.g.*, residuals, chemical dependence
  - Degradation of the environment because of current agricultural practices, *e.g.*, tilling, fertilizers, pesticides
  - Improved environmental situation with GMOs, *e.g.*, reduced phytic acid, phyto and bioremediation
- Herbicide-resistant weeds as a result of GMOs, “superweeds”
  - Herbicide-resistant weeds from conventional practices in absence of GMOs

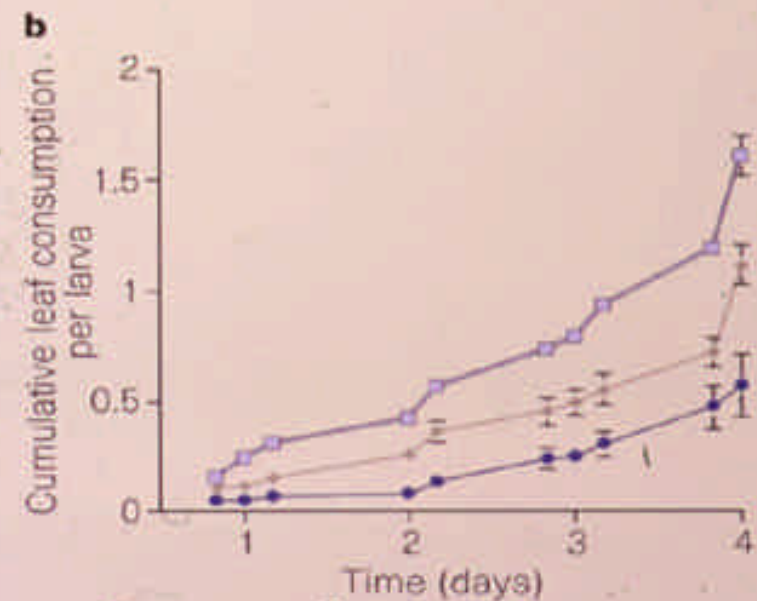
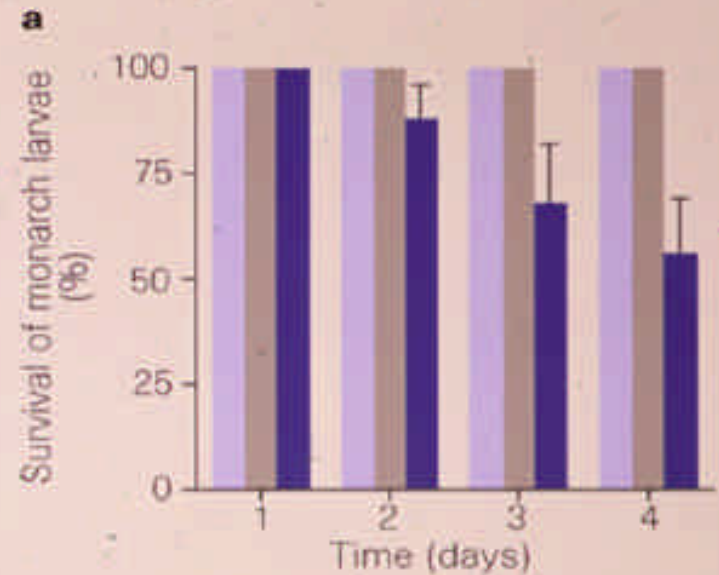
# Effect on Bystanders?

- Monarch butterfly study



Losey et al. 1999

- Criticisms:
  - pollen dosage?
  - lab study





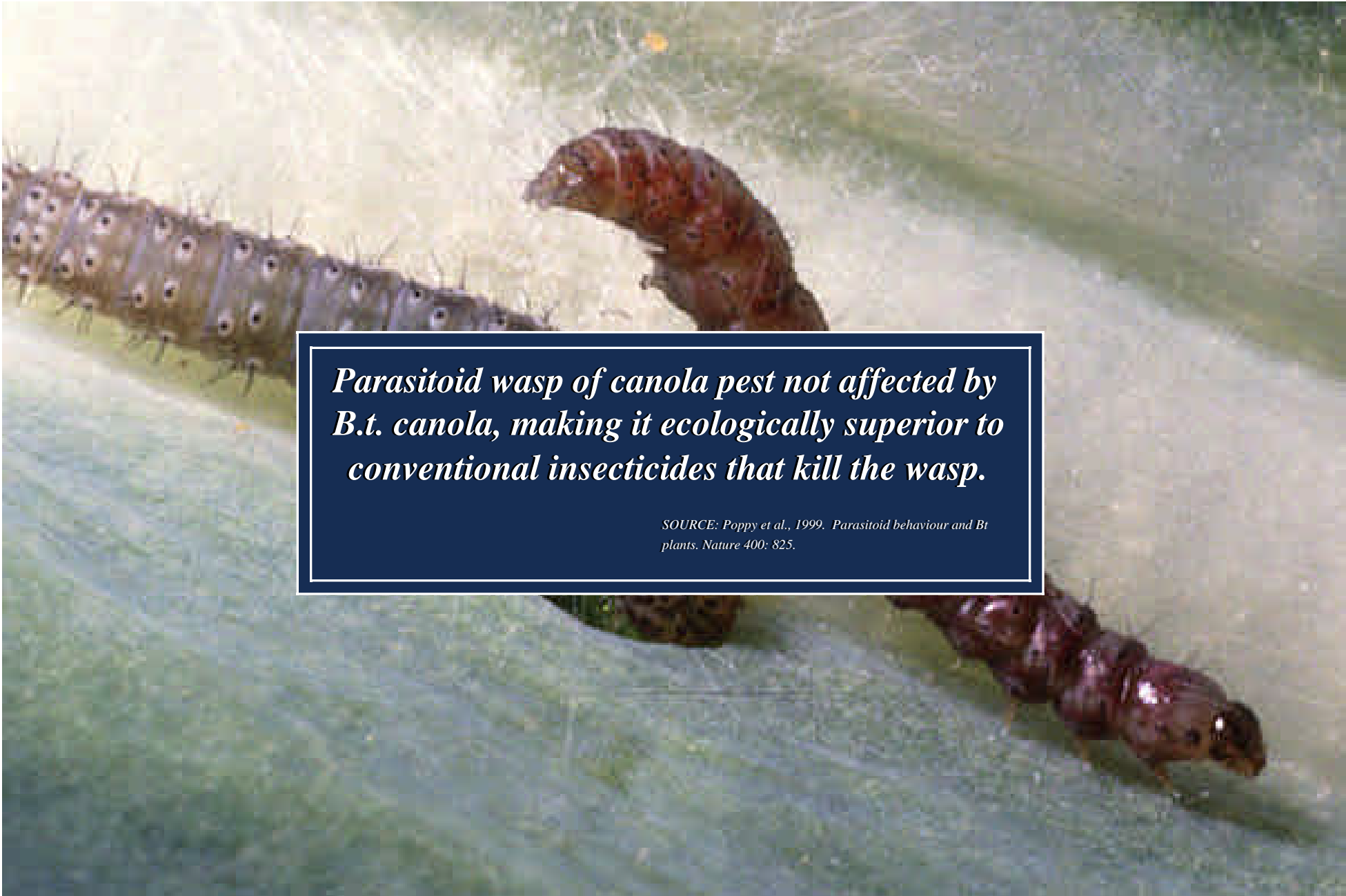


September 8, 2001

# Data on Genetically Modified Corn Reports Say Threat to Monarch Butterflies Is 'Negligible'

By ANDREW POLLACK

Genetically modified corn poses a "negligible" risk to monarch butterflies, according to a package of six papers that will soon be published in a scientific journal. The papers, the most comprehensive peer-reviewed publications on this issue, could lay to rest one of the biggest controversies over genetically modified crops.



*Parasitoid wasp of canola pest not affected by B.t. canola, making it ecologically superior to conventional insecticides that kill the wasp.*

SOURCE: Poppy et al., 1999. Parasitoid behaviour and Bt plants. *Nature* 400: 825.

# *Movement of genes between crop species and wild relatives*



**Charlock**



**Buchan weed**



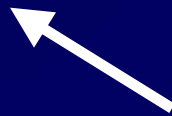
**Canola**



**Wild radish**

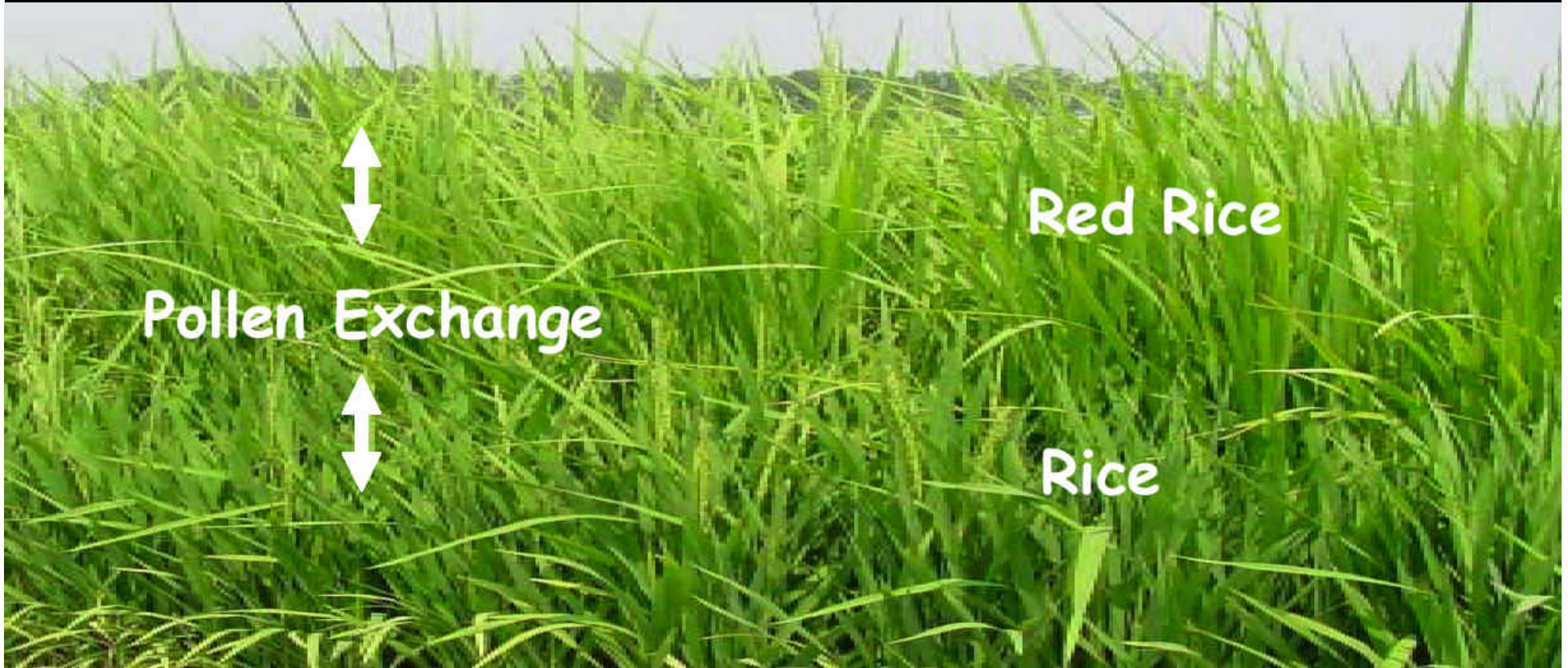


*Brassica tournefortii*





*Gene flow from rice to  
weedy red rice*







- Planted soybeans in field previously used for transgenic corn.
- USDA discovered "volunteer" corn plants growing among soybeans. Instructed ProdiGene to remove corn plants.
- Soybeans harvested before all corn was removed, mixed with 500,000 bushels of soybeans.
- Soybeans destroyed, ProdiGene paid \$250,000 civil fines, reimbursement for lost crops; \$1 million higher regulatory fees.

A photograph of a cornfield in Mexico. The foreground is filled with rows of corn plants, some showing signs of being harvested or dried. In the background, there are rolling green hills under a clear sky. The image has a slightly grainy texture, suggesting it might be a scan of a printed photograph.

# *Genetic Modification Taints Corn in Mexico*

*SOURCE: New York Times, October 2, 2001*

# Gene flow in Mexican Maize: consequences for genetic diversity?



How did pollen and gene flow occur in Mexico?

Is this the first time gene flow has occurred into Mexican landraces of maize?

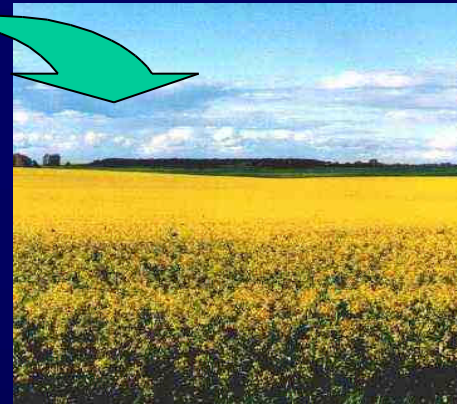


What implications does transgene flow have for wild and domesticated maize?

*Consequences of pollen spread  
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



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ucbiotech.org

The 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 institutions and an extensive database of pertinent scientific literature are available to promote participation in the dialogue. Teaching aids for students and teachers are provided.







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**BIOTECHNOLOGY INFORMATION**

ucbiotech.org  
Plant Biotechnology Group

In-depth understanding of biotechnology and its issues is a necessary factor in informed dialogue and making wise decisions about the use of this technology and its products. This section has commonly raised issues associated with a variety of topics relating to biotechnology and agriculture. The issues are paired with responses, which contain links to relevant scientific references. The content of the Issues and Responses section and the choice of literature cited is the sole responsibility of Peggy G. Lemaux and Petra Frey at the University of California, Berkeley, in collaboration with the Plant Biotechnology Group, ETH, Zurich, Switzerland and Dr. Alan McHughen, Cooperative Extension Specialist, University of California, Riverside.

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### Do Bt plants affect beneficial insects?

The effect of Bt plants on non-target insects has been studied using a broad range of different insects, both in the laboratory and in the field. In one of these studies Bt176 corn pollen and a control corn pollen were fed to lady beetle larvae, where 69% of the larvae survived on Bt pollen and 61% of the larvae survived on the control pollen [Pilcher, 1997]. Another group tested the effect of Bt 176 corn on aphids feeding on leaves and the effect this would have on their natural predators, the green lacewings. They could not find any significant effect of the Bt corn on aphid larvae development or green lacewing mortality [Lozza, 1998]. A further study tested the predation and parasitism of the European corn borer, using the same Bt176 corn variety, in the field. Also in this case, the predation and parasitism was the same on Bt and on non-Bt corn [Orr, 1997]. No significant negative effect of the Bt corn could be found in any of these studies. The results of two recent studies, however, showed that monarch butterfly larvae could be adversely affected by pollen from certain varieties of Bt corn (Bt 11 [Losey, 1999] and Bt176 [Hansen Jesse, 2000]). These laboratory studies demonstrated that monarch larvae were more likely to die when fed milkweed leaves dusted with pollen from Bt corn than when fed leaves dusted with pollen from conventional corn. Both of these laboratory studies used Bt pollen at very high concentrations that are not encountered beyond the edge of a field [Betz, 2000]. An analysis of the results from a field-study of effects on swallowtail larvae, where mostly lower pollen

