



***Food Fights:
Labeling and Other Issues with
Engineered Foods in the Marketplace***



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<http://ucbiotech.org>
<http://pmb.berkeley.edu/profile/plemaux#a1>***



What will be covered?

1. Background on genes, genetics, genetic engineering

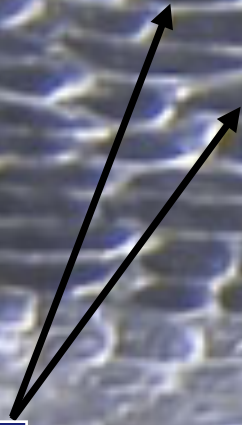
2. What GE crops are commercialized? In the pipeline?

3. What is the regulatory situation for GE crops and foods?

4. What are some of the issues with GE crops and foods?

Animals and plants are made of cells – humans too – billions of them!

CELLS



Inside each of those cells is the genetic information, its DNA, that determines its host's characteristics

Dividing cell

DNA

Genes are the individual recipes in the DNA that specify characteristics. Now we can find where those recipes are on the DNA



How are the genes and chromosomes manipulated to create a new plant variety... by classical breeding?



Triticum monococcum
Ancient variety

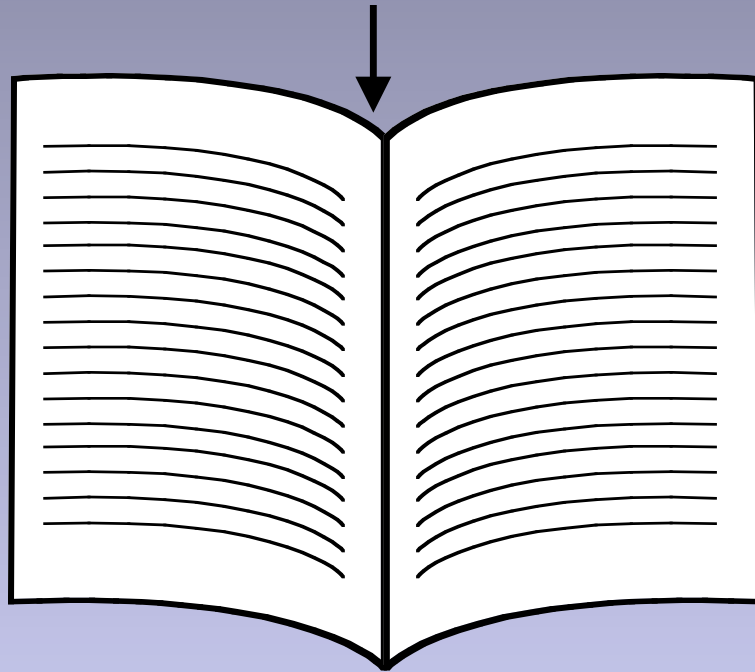


Triticum aestivum
Modern bread variety

Information in the wheat genome

Chemical units represented by alphabetic letters

...CTGACCTAATGCCGTA...

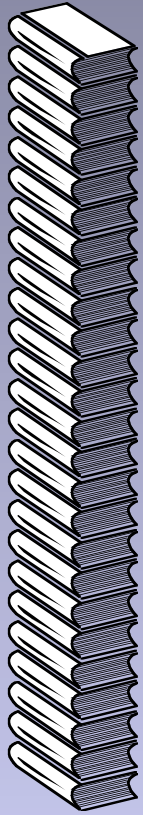


1700 books
1000 pages each



1700 books
(or 1.7 million pages)

Hybridization or cross breeding of wheat



X

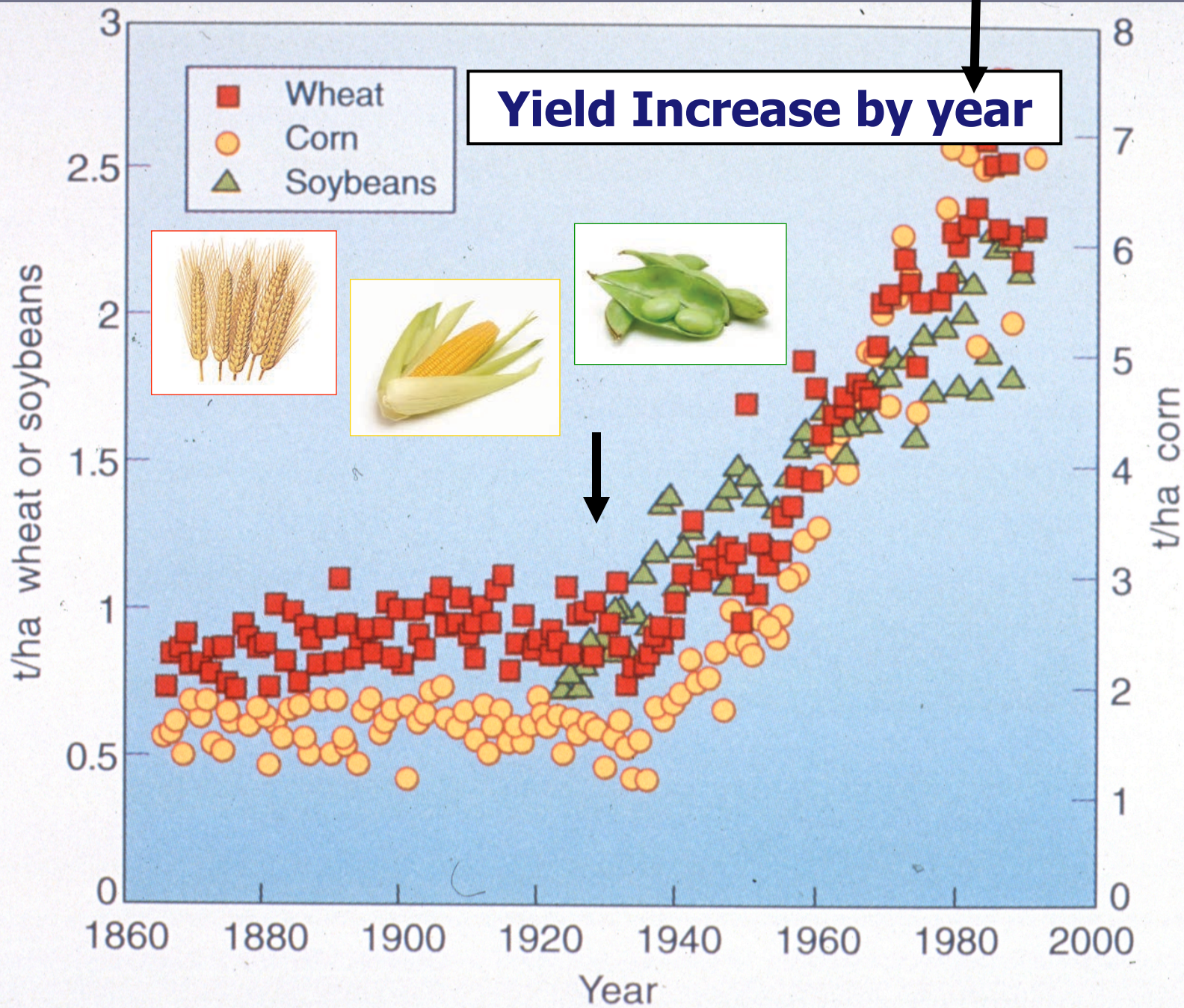



**Random
retention of
information
from each
parent**

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

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(or 1.7 million pages)**

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

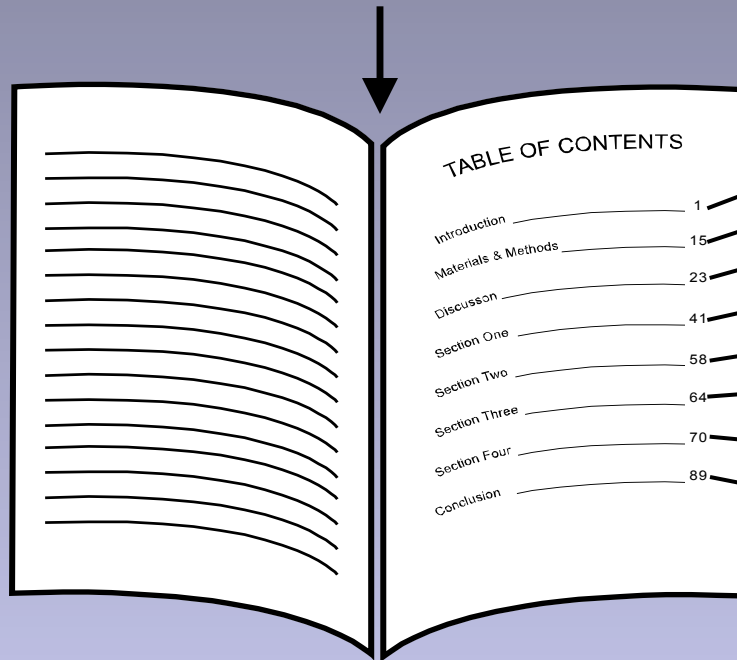


A close-up photograph of a wheat field. The wheat stalks are green and appear to be in the early stages of grain development. The stalks are arranged in rows, and the background is filled with more wheat. A central text box with a yellow background and a dark blue border contains the text.

**But there are other ways to create
new varieties using the modern
tools of genetics**

Table of contents for wheat genes

...CTGACCTAATGCCGTA...



**Used for
Marker-
Assisted
Selection**

Genomics

1700 books
(or 1.7 million pages)



Marker-assisted selection used to protect rice against bacterial blight and blast disease

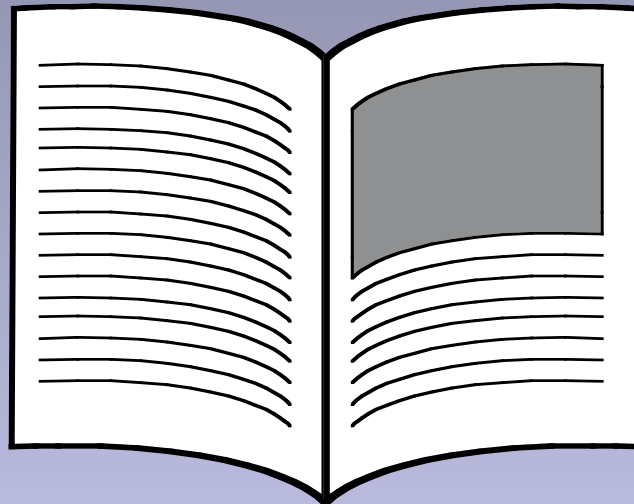
Limited to diversity in compatible relatives

How can limitations be overcome?

Genetic Engineering Methods



+



One-half page
equivalent to a gene



Inserts
randomly
in genome

Inserted
gene(s)

1700 books
(or 1.7 million pages)

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(or 1.7 million pages)

Classical Breeding

compared to

Genetic Engineering

Uses plant machinery in plant

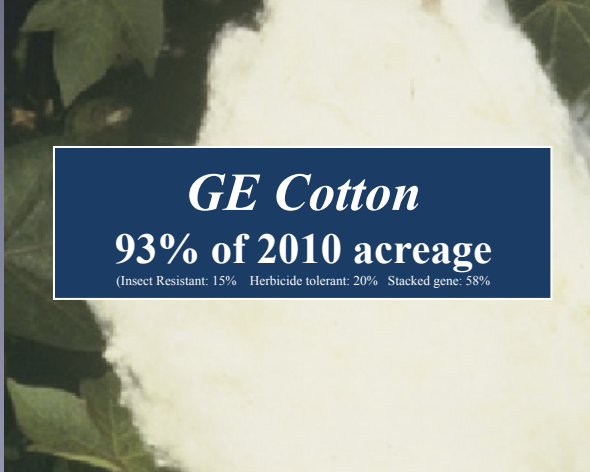
Gene exchange is random
involving whole genome

Source of gene primarily within
genera – not between kingdoms
like plants & bacteria

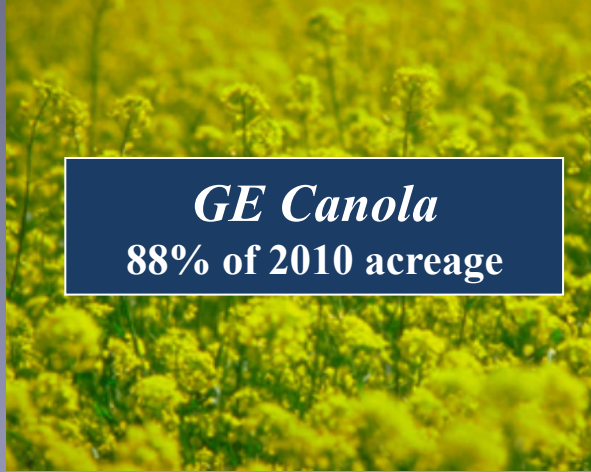
Uses plant machinery in laboratory

Gene exchange is specific
involving single or few genes

Source of gene from any
organism



GE Cotton
93% of 2010 acreage
(Insect Resistant: 15% Herbicide tolerant: 20% Stacked gene: 58%)



GE Canola
88% of 2010 acreage



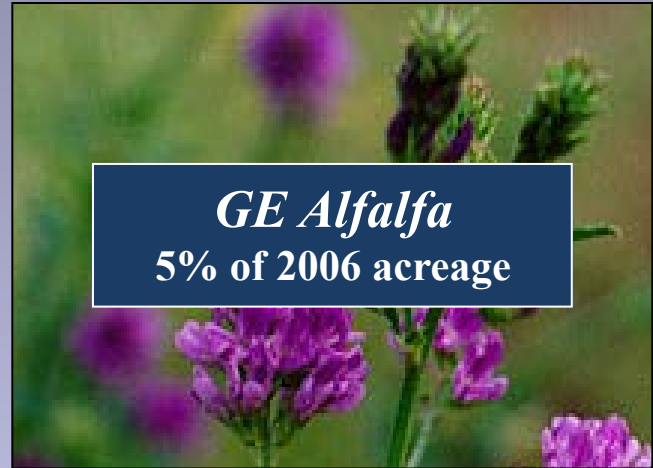
GE Soybean
93% of 2010 acreage
(Herbicide resistant: 93%)



GE Corn
86% of 2010 acreage
(Insect Resistant: 16% Herbicide resistant: 23% Stacked gene: 47%)
 1% of corn with Bt (ECB) + Bt (rootworm) + herbicide

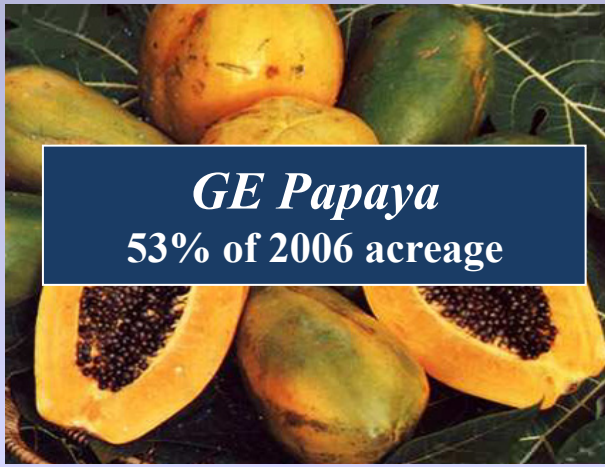


GE Sugarbeet
96% of 2010 acreage



GE Alfalfa
5% of 2006 acreage

**Number of GE
 crops grown
 commercially
 is limited**



GE Papaya
53% of 2006 acreage



GE Squash
10% of 2004 acreage



Number of different traits available in GE crops is limited

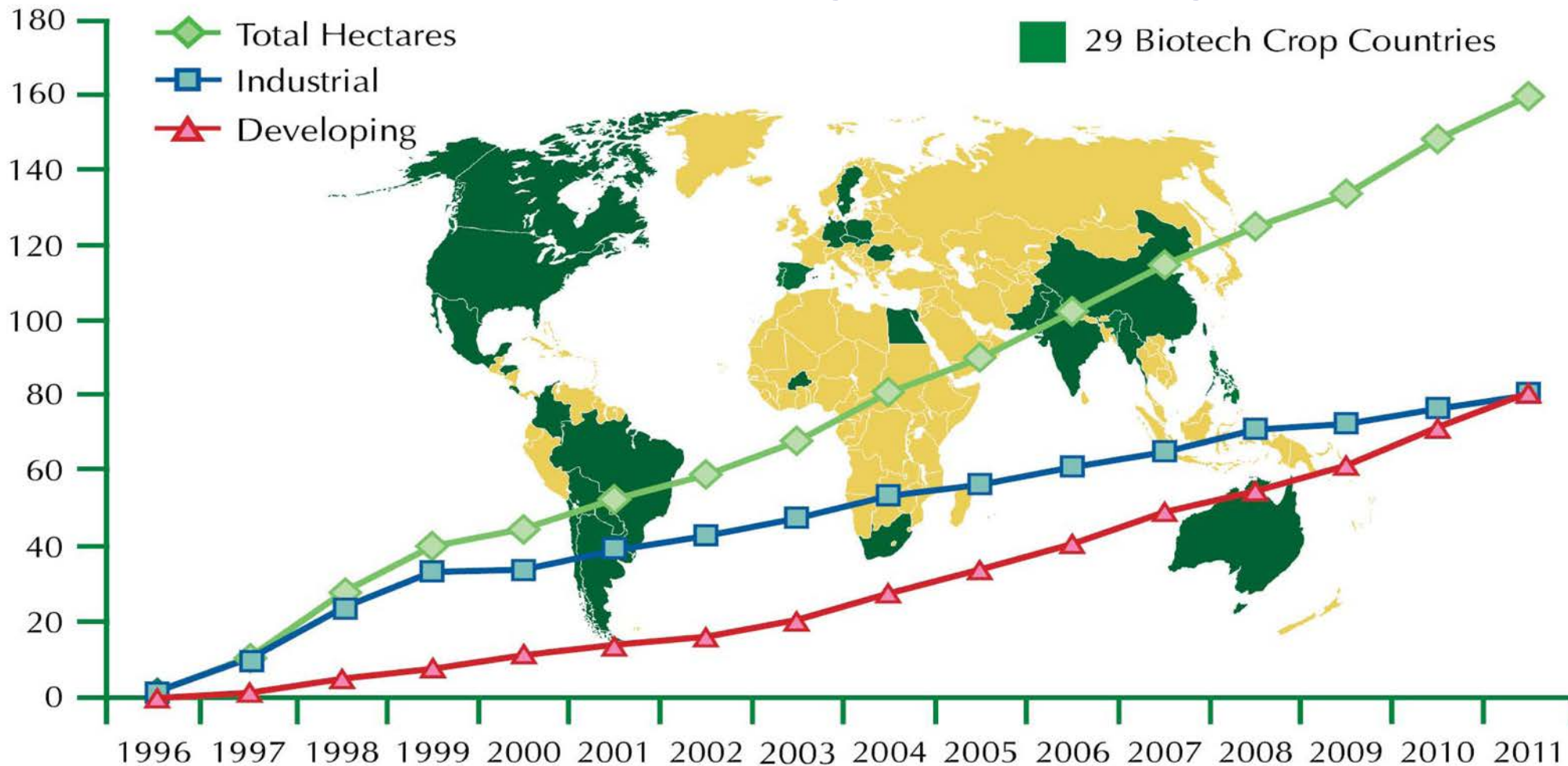


Bt Crops – insect resistance using gene from naturally occurring bacterium



Herbicide-tolerant – tolerate herbicide application

Despite limited crop and trait types, worldwide acreage is increasing



Total worldwide area cultivated = Areas of Texas + California + Colorado + Louisiana

Although there are few GE whole foods, use of ingredients from corn, soybean, canola, sugarbeet leads to estimates that 75% of U.S. processed foods have GE ingredients



WHAT'S IN THE PIPELINE?





Field Trials in California with Grape Root Stocks Engineered to Resist Fanleaf Virus

SOURCE: <http://www.democratandchronicle.com/apps/pbcs.dll/article?AID=/20080806/BUSINESS/808060336/1001>

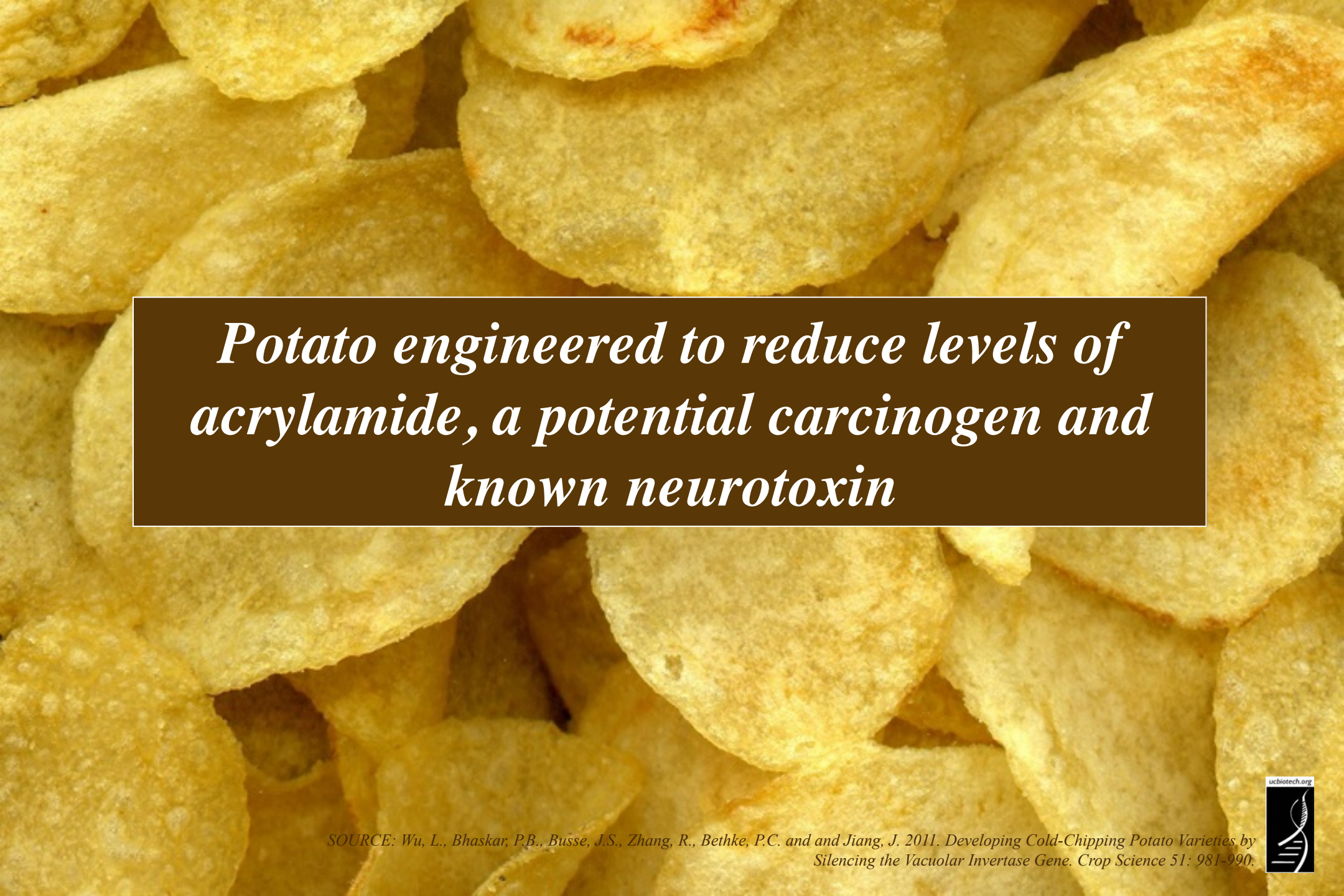




*Engineered Canola That Uses 50% Less
Nitrogen Fertilizer*

SOURCE: http://archives.foodsafety.ksu.edu/agnet/2007/4-2007/agnet_april_10.htm#story0





*Potato engineered to reduce levels of
acrylamide, a potential carcinogen and
known neurotoxin*

SOURCE: Wu, L., Bhaskar, P.B., Busse, J.S., Zhang, R., Bethke, P.C. and Jiang, J. 2011. Developing Cold-Chipping Potato Varieties by Silencing the Vacuolar Invertase Gene. *Crop Science* 51: 981-990.



*Mitigating food allergies, like
peanut, soy and wheat*



*Engineered Safflower
Oil Enhanced with
Omega-3 and Omega-6
Fatty Acids*

SOURCE: Arcadia Biosciences



What is the U.S. regulatory process governing engineered plants and foods?

U.S. Regulatory Agencies

USDA

- **Field testing**
 - Permits
 - Notifications
- **Determination of non-regulated status**

Plant pest?

FDA

- **Food safety**
- **Feed safety**

Danger to people?

EPA

- **Pesticidal plants**
 - tolerance exemption
 - registrations
- **Herbicide registration**

Risk to environment?

What Are Some Issues with GE Crops?



What are some of the food safety issues?

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

What are some environmental issues?

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

What are some of the food safety issues?

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

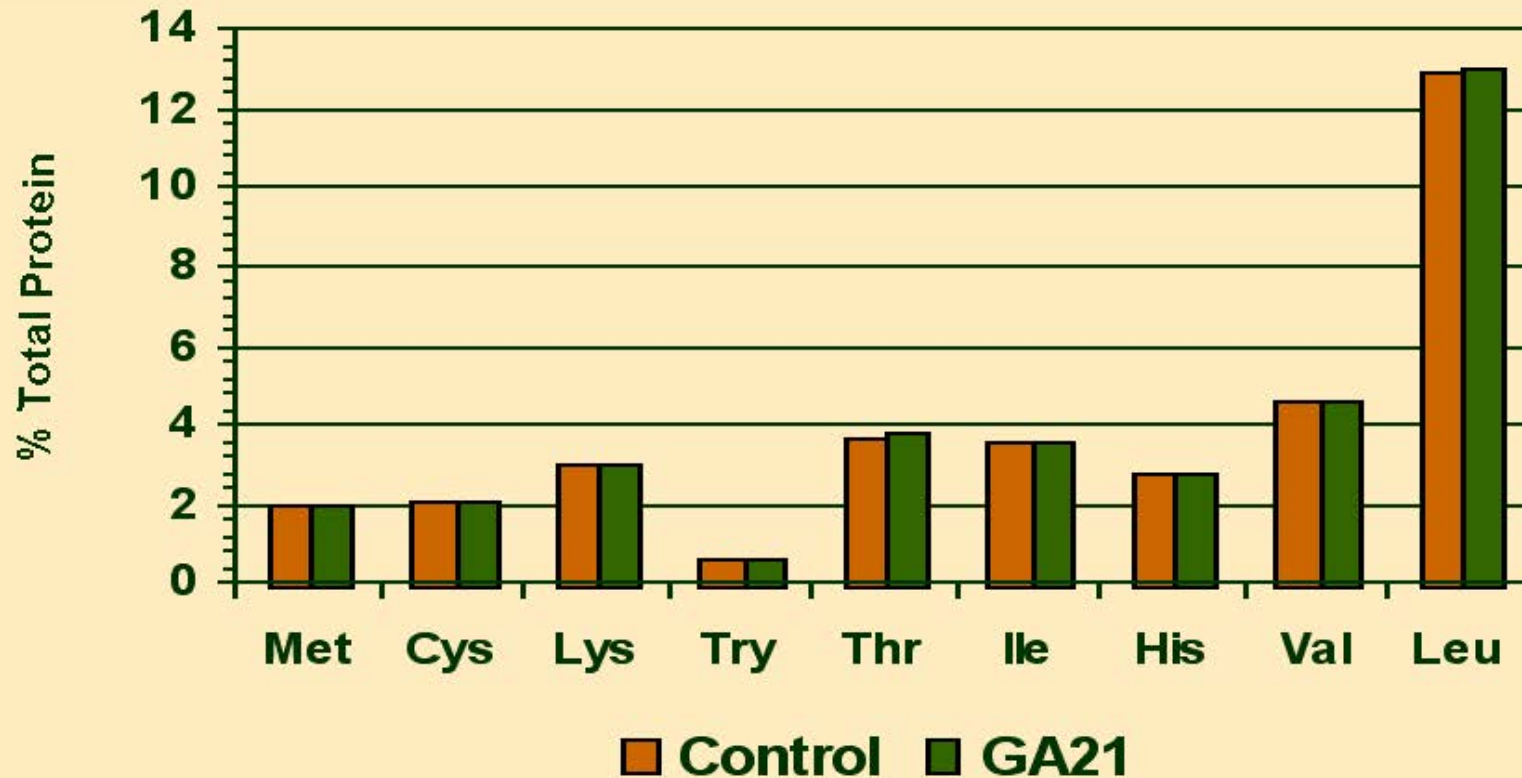
Safety of food is based on principle of Substantial Equivalence.

Is it as safe as the conventional food?

Substantial Equivalence

Modified food has essentially all characteristics of nonmodified food with respect to food and feed value

Substantial 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.

Crops can be engineered with purposeful nutritional alterations

Engineering tomato to increase health-promoting compounds

SOURCE: Butelli, E., Titta, L., Giorgio, M., Mock, H., Matros, A., Peterek, S., Schijlen, E.G.W.M., Hall, R.D., Bovy, A.G., Luo, J. and Martin, C. 2008. Enrichment of tomato fruit with health-promoting anthocyanins by expression of select transcription factors. *Nature Biotechnology*, online first (doi:10.1038/nbt.1506)



Golden Rice engineered to contain bioavailable pro-Vitamin A



Normal portion of Golden Rice 2 provides
half of a child's Vitamin A needs

What are some food safety issues?

- Changes in nutritional content
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Poultry and Egg Study: Bt Protein Analysis

Example of type of animal safety tests conducted

- 14 day poultry feeding study
- Diet: contained 64% grain (Bt or non Bt)
- Eggs collected on days 13 & 14
- Muscle and liver samples collected on day 14

<u>Tissue</u>	<u>Bt Protein Analysis</u>
➤ white muscle (10)	Not detected
➤ dark muscle (10)	Not detected
➤ liver (10)	Not detected
➤ egg whites (10)	Not detected
➤ egg yolk (10)	Not detected

REVIEW STUDY FROM FRANCE

12 long-term (>90d to 2yr) and 12 multigenerational (2 to 5 generations) feeding trials in animals of GE feed

Conclusion: GE foods are nutritionally equivalent to non GE foods and can be safely consumed in food and feed



maize

potato



soy

rice



triticale

What are some food safety issues?

- Changes in nutritional content
- Lack of peer-reviewed food safety tests
- Creation of allergens or activation of toxins
- **Labeling**
- Pharma crops contaminating food supply
- Gene flow from food to intestinal bacteria increasing antibiotic resistance

Why Doesn't FDA Have a Labeling Policy for GE Foods?

Actually it does...

GE foods are subject to same labeling laws as all other foods and food ingredients

This label information relates to composition not agricultural or manufacturing practices

No label needed if food is essentially equivalent in safety, composition and nutrition

GE food must be labeled if it has:

- 1. Different nutritional characteristics**
- 2. Genetic material from known allergenic source e.g., peanut, egg**
- 3. Elevated levels of antinutritional or toxic compounds**

BE A STICKLER

PRODUCE CODES DEMYSTIFIED

4 DIGIT CODE
STARTING WITH 3 OR 4



**CONVENTIONALLY
GROWN**



5 DIGIT CODE
STARTING WITH 9



ORGANIC



5 DIGIT CODE
STARTING WITH 8



**GENETICALLY
MODIFIED**



Also, for whole fresh foods, there are existing PLU labels that indicate whether they are GE or organic

PACT

#imPACTfact @wearPACT

SOURCE: WWW.PLUCODES.COM

National GM Labeling Laws and Policies

Type of GM labeling	Countries that enforce labeling policies	Countries with partially enforced or unenforced labeling policies	Countries with probable plans to introduce a labeling policy
<u>Mandatory</u>	Australia, Brazil, <u>China</u> , <u>European Union</u> , <u>Japan</u> , New Zealand, Norway, Russia, Saudi Arabia, South Korea, Switzerland, Taiwan	Croatia, Ecuador, El Salvador, Indonesia, Malaysia, Mauritius, Serbia, Sri Lanka, Thailand, Ukraine, Vietnam	Nigeria, Uganda, UAE, Zambia
<u>Voluntary</u>	Argentina, <u>Canada</u> , Chile, Hong Kong, Kenya, Philippines, South Africa, <u>USA</u>		Peru

But other nations have specific mandatory labeling laws for GE, although the rules and enforcement vary dramatically among countries, making international trade difficult



Do U.K. consumers act on labeling information?



66% of UK consumers think GE food labeling is important...

But only 2% actively look for GE content when buying foods

SOURCE: "FSA survey: Majority of UK consumers back GM labelling", Food Navigator, January 10, 2013. <http://www.foodnavigator.com/content/view/print/728839>
Link to report: <http://www.food.gov.uk/science/research/ssres/foodsafetyss/gm-labelling/#.UPXkHaHr7jm>





In November 2012 California voted on Proposition 37 to require mandatory labeling of foods with GE ingredients.

What did that Proposition look like?

CA Labeling Proposition

Labeling Relating to Genetic Engineering

- Any retail product that has been or may have been partially or wholly produced with genetic engineering must be labeled.
- Any raw retail agricultural commodity must contain on the front of its package in clear and conspicuous words, "Genetically Engineered".
- Any processed foods, unless exempted, must have conspicuous language on package stating, "Partially Produced with Genetic Engineering" or "May be Partially Produced with Genetic Engineering".
- Numerous exemptions for organic, animals fed GE or injected with GE, foods with GE processing aids, alcohol, foods for immediate consumption, medical foods

Labeling Relating to Using "Natural"

- Foods meeting GE definitions, or processed, may not be labeled as "natural", "naturally made", "naturally grown", "all natural".

California voters nix biotech labels

Opponents raised \$46 million to fight proposition

By ALICIA CHANG
Associated Press

LOS ANGELES — Voters spurned a ballot measure that would have made California the first in the nation to affix labels on breakfast cereals, baked goods and other processed foods containing genetically modified ingredients.

The rejection on Nov. 6 followed an expensive offensive from agri-business and chemical conglomerates, which raised \$46 million to blitz airwaves and mailboxes with negative advertising.

We didn't think they'd like the lawsuits, more bureaucracy, higher costs and loopholes and exemptions. It looks like they don't," spokeswoman Kathy Fairbanks said.

Representatives with the California Right to Know campaign tried to put on a positive face.

"No matter what happens, we've raised awareness of a very important issue," said Grant Lundberg, chief executive of Lundberg Family Farms, who co-chairs the California Right to Know campaign.

Consumer activists and the organic food industry said shoppers crave information about what they're eating and should be given all the information they need to decide for them-



After over \$40M was spent convincing voters one way or the other, the proposition was defeated 51.4% to 48.6%

gaining of this campaign and the more voters learned about Prop 37, the less they'd like it.

Genetically modified foods are not significantly different in taste, texture and nutrition.

which are DNA has been tinkered with in the laboratory to resist pesticides and ward off

bugs. Despite scientific consensus that genetically modified foods

have special risks, mandatory labeling exists elsewhere, including the European Union.

Genetically modified foods have not been approved for sale worldwide is pending before the U.S. Food and Drug Administration.



Organic Bytes

Health, Justice and Sustainability News from the Organic Consumers Association

A weekly e-newsletter edited by Katherine Paul and Bonnie Cummins

ESSAY OF THE WEEK

End of Story?

GMO Food Fight: Round Two 2013

"This gives us hope that you can, with a well-funded, well-organized, well-executed campaign, defeat a ballot initiative and go directly to the voters. We hope we don't have too many of them, because you can't keep doing that over and over again . . .".

- Jennifer Hatcher, Food Marketing Institute, on Big Food and Big Biotech's narrow defeat of Prop 37, the California Right to Know GMO ballot initiative.

**Not in California,
nor a number of
other states**



GMO food-labeling bill voted down



- **In some states, like NM, bills were voted down.**
 - **In other states, decisions are pending.**
-
- **In WA, voters will cast their ballots Nov. 5 on GE labeling bill.**
 - **In CT, labeling bill requires 4 other border states to pass laws before labels are required.**
 - **In ME, labeling law requires 5 other states to pass laws before labeling is required.**



By 2018, all products in U.S. and Canadian stores must be labeled to indicate whether they contain genetically modified organisms (GMOs)

The New York Times

March 8, 2013

Major Grocer to Label Foods With Gene-Modified Content

By STEPHANIE STROM

Whole Foods Market, the grocery chain, on Friday became the first retailer in the United States to require labeling of all genetically modified foods sold in its stores, a move that some experts said could radically alter the food industry.

Not only are states entering into the labeling arena, but a variety of companies are becoming involved in different ways.

SOURCE: "Major Grocer to Label Foods With Gene-Modified Content", New York Times, 3/8/13
http://www.nytimes.com/2013/03/09/business/grocery-chain-to-require-labels-for-genetically-modified-food.html?ref=opinion&_r=0



'We intend to label our Arctic apples as genetically modified'

APPLE from Page 1

prohibition that barred the state Legislature from modifying it unless it was made more stringent. Opponents, including Monsanto, DuPont, food companies and grocery stores, spent \$45 million against the proposition.

Carter believes he is about six months away from gaining USDA and U.S. Food and Drug Administration approval to grow and sell genetically modified apples in the United States. He is also seeking Canadian government approval.

His Arctic brand Golden Delicious and Arctic Granny Smith apples have been modified by switching off a gene, so they won't brown when sliced. That could benefit the sliced apple but the extra processing expenses and the extra costs of browning inhibitors in apples is a concern. Some services are available for all apple products. "As



Joel Brooks, marketing communications specialist for Okanagan Specialty Fruits, of Summerland, British Columbia, talks to people about

ing because it undermines the credibility of the FDA, which does its review. It has standards for food safety. This is mandating labeling of something that has no risk. I don't agree with that. It becomes too much negative marketing."

The battle isn't as much about food safety as it is about market share between the organic and natural food side versus big, biotech corporations, Carter said.

"We're a small company," he said. "We can't engage in that."

The recession shrank the organic industry, which "wants to use labeling to scare people into buying organic," he said. That's the wrong motivation, he said, and it should be about food safety.

around for 15 years, fed 4 trillion people and never been a single health risk, yet nine people died from organic bean sprouts in Germany last year," he said. "Organics can kill people with E.coli."

But the Pacific Northwest apple industry, fearing negative public reaction, is on the record against USDA approval of genetically engineered apples.

The Northwest Horticultural Council in Yakima, Wash., representing tree fruit growers and packers in Washington, Oregon and Idaho, sent USDA Secretary Tom Vilsack a letter in 2011 asking him to reject Carter's application for non-regulated status of his two genetically engineered apples.

"While we do not think any

cil president wrote in the letter.

Todd Fryhover, president of the Washington Apple Commission, has said genetic modification raises public concerns and doesn't seem to fit with the image of apples as healthy and nutritious.

Carter and other representatives of Okanagan Specialty Fruits early this month, for the first time, had booths to display and talk about Arctic apples at the annual meetings of the Washington State Horticultural Association and the Great Lakes Fruit, Vegetable and Farm Market Expo in Michigan.

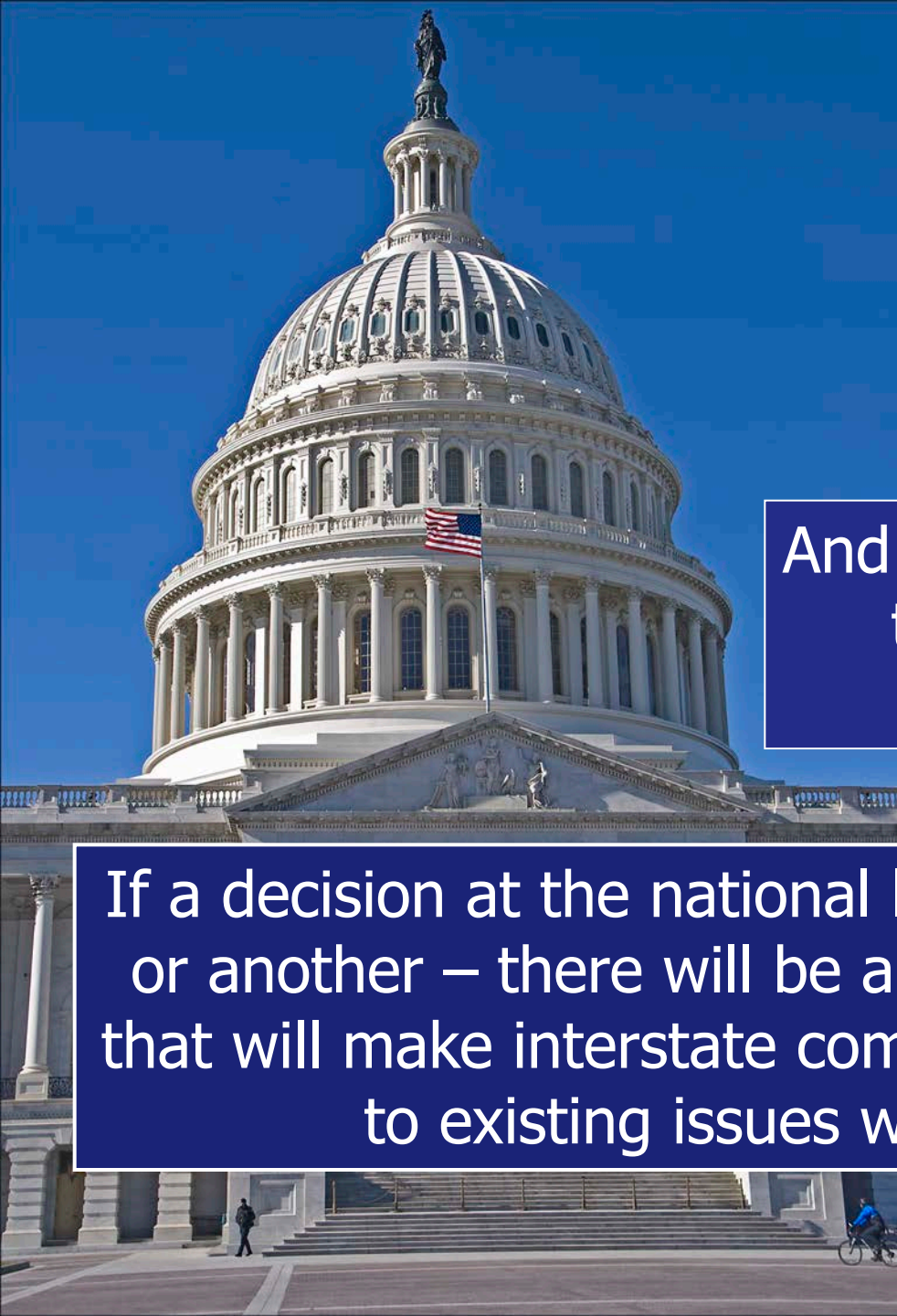
It was an educational outreach with lots of grower questions answered, he said.

Contacts were made for potentially more grower testing,

Okanagen Specialty Fruits has decided to voluntarily label their GE apples.

SOURCE: "Biotech apples inflame debate", Capital Press, December 20, 2012
<http://www.capitalpress.com/orewash/djw-GMOapples-w-art-121912>





THE HUFFINGTON POST

GMO Labeling Bill Voted Down In Senate

Posted: 05/23/2013 11:31 am EDT | Updated: 05/23/2013 4:08 pm EDT

WASHINGTON -- The United States Senate decided again Thursday that it simply does not want to let states tell people whether or not they are

And now the labeling issue has moved to the national stage...via numerous proposed bills and amendments

on the issue.

But Sen. Debbie Stabenow (D-Mich.), the chair of the Agriculture Committee, argued that the measure "is not germane to the farm bill" in the first place. She also said the labels run counter to science and the public interest in healthy food.

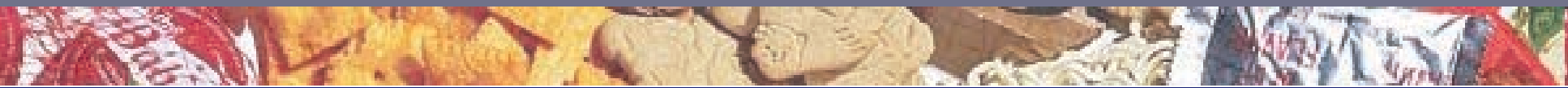
If a decision at the national level is not made – in some way or another – there will be a potpourri of state labeling bills that will make interstate commerce very problematic- similar to existing issues with international trade.

for consumers,"


op diseases and
being done by
though it was not

SOURCE: "GMO Labeling Bill Voted Down In Senate", Huffington Post, 5/22/13
http://www.huffingtonpost.com/2013/05/23/gmo-labeling-bill-genetically-modified-food_n_3325972.html





Consider that 75% of U.S. processed foods have GE ingredients. If mandatory labeling laws were enacted, either manufacturers would have to find alternatives to the GE ingredients – which might be difficult – or the vast majority of processed foods would be labeled that they “contain” or “may contain genetically engineered ingredients”



While the fresh food aisle would change little, the majority of foods in the processed food aisle would contain “warning labels” about GE ingredients.



Consider the following...

Governor Vows to End Prop. 65 'Shake-down' Suits

by Amy Standen | May 8, 2013 — 8:47 AM

- 1986: CA passed Prop. 65 to protect citizens from toxic substances, requiring “warning labels” where toxic substances are present.
- Prop 65 warning labels are so prevalent they have become meaningless.



- Could “warning labels” on GE foods also become meaningless due to their prevalence?

- Such labeling also resulted in frivolous law suits: banks were sued for not having Prop. 65 warnings on ATM’s since nearby smokers might expose ATM users to toxic substances.



***Might there be another
possible market-driven
solution?***

If there is demand, might another solution be to allow the creation of a specialty market for labeled GE-free foods – for which people pay a premium price and for which farmers are paid premium prices to grow them?

And other consumers have the choice to buy unlabeled GE foods without a premium price?



Where to get more information on GE issues including labeling?

<http://ucbiotech.org>



ucbiotech.org SCIENCE-BASED INFORMATION & RESOURCES ON AGRICULTURE, FOOD & TECHNOLOGY

ABOUT US | NEWS | ISSUES & RESPONSES | GMO LABELING | RESOURCES | LINKS | GLOSSARY | SEARCH

Select Language

This website provides educational resources focused broadly on issues related to agriculture, crops, animals, foods and the technologies used to improve them. Science-based information related to these issues is available, as well as educational tools and information, which can be used to promote informed participation in discussions about these topics.

FEATURED LECTURE VIDEO

"Feast, Famine and the Future of Food"

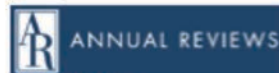
Outreach in Biotechnology
Food for Thought Lecture Series
Oregon State University
January 25, 2012



BIOTECHNOLOGY INFORMATION



Labeling:
Informational resources available.



Review articles:
Focused on food, environmental and socioeconomic issues of GE crops and foods.
[Part 1](#) | [Part 2](#)

RESOURCES FOR OUTREACH & EXTENSION, RESEARCHERS & TEACHERS

DNA for Dinner 4-H curriculum:
For grades 5-8, covers topics from plant diversity to genetic engineering. Each of the five lessons has 3 to 5 activities.



New Game: Who's In Your Family?
A free educational game to teach participants about the diversity of fruits and vegetables, and how they are related.

Slide Archive:
Extensive collection of PP slides on agriculture & biotechnology.

Available on loan:

Teaching Aids: Handouts and cards available, in both English and Spanish.



Educational displays: "Genetics and Foods" and "Genetic Diversity and Genomics" available with companion educational cards and teacher worksheet in English and Spanish.

Gene-IE Juice Bar: Interactive activity to isolate DNA from common fruits and vegetables.

HELPFUL SITES

Academics Review
[Academics Review website](#)
Testing popular claims against peer-reviewed science.

BIOFORTIFIED [Biofortified website](#)
Provides factual information to foster discussion about agriculture, especially plant genetics and genetic engineering.

Animal Genomics & Biotechnology Cooperative Extension Program, UC Davis
Provides education on use of animal genomics & biotechnology in livestock production.

