



Crops, Foods, Biotechnology and Labeling



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<http://pmb.berkeley.edu/lemaux>



1. Background on genes, genetics and genetic engineering (aka biotechnology, GMOs)

2. What engineered (GE) crops have been commercialized? What's in the pipeline?

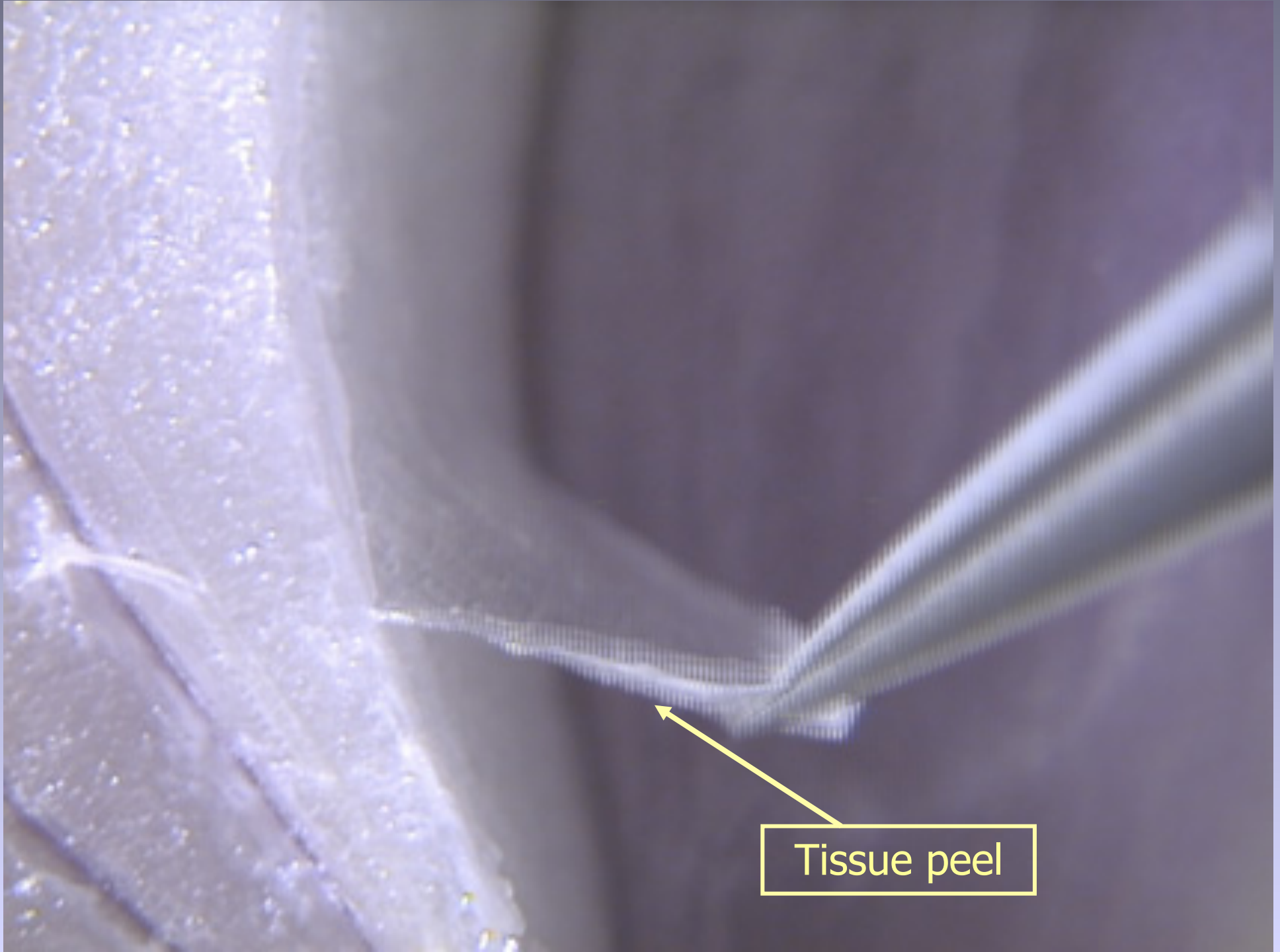
3. What is the regulatory structure for GE crops?

4. What are some food safety and labeling issues with GE foods? What about the environment?

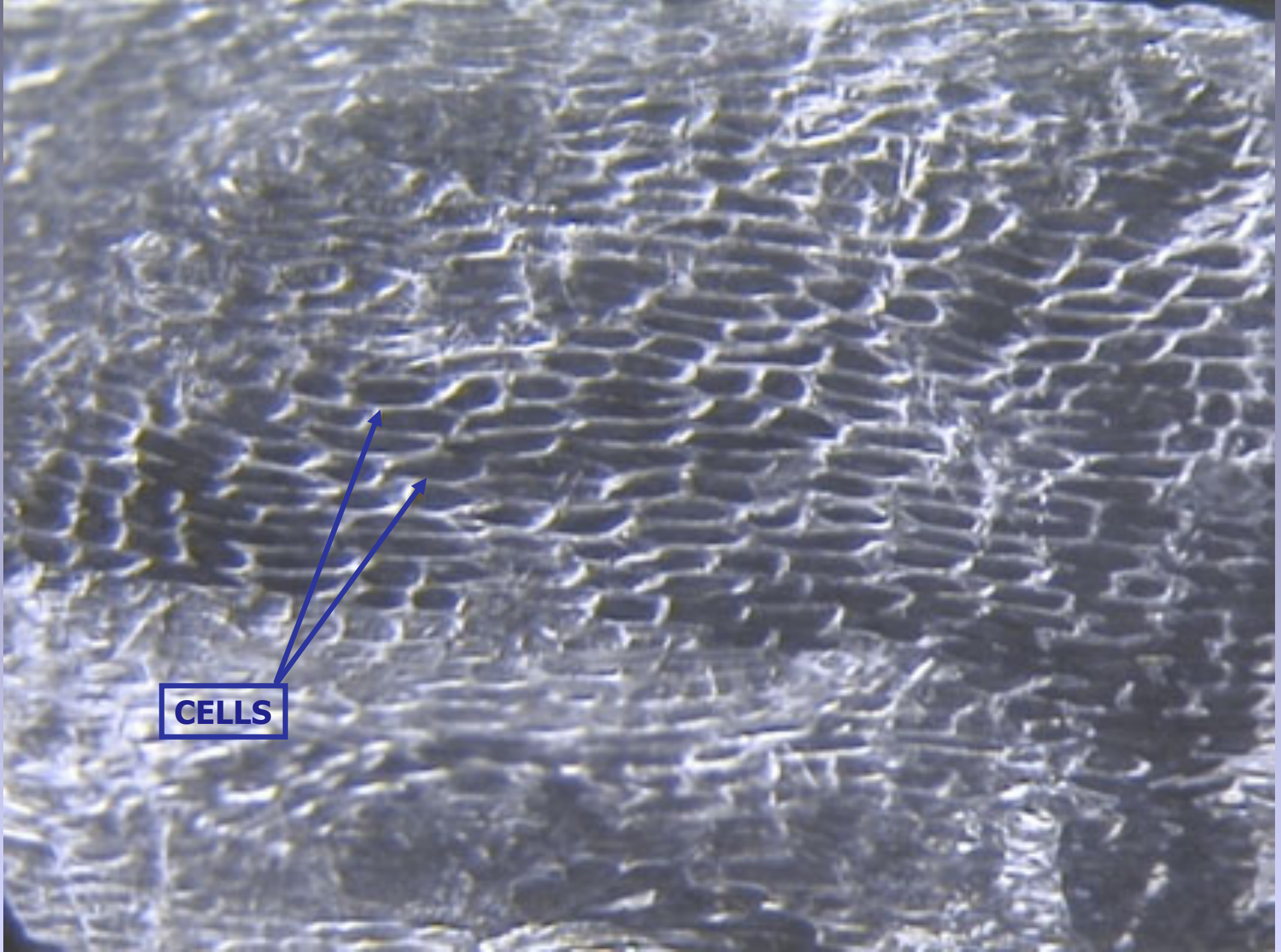
Tour d'Onion



Or what makes an onion, an onion?



Tissue peel



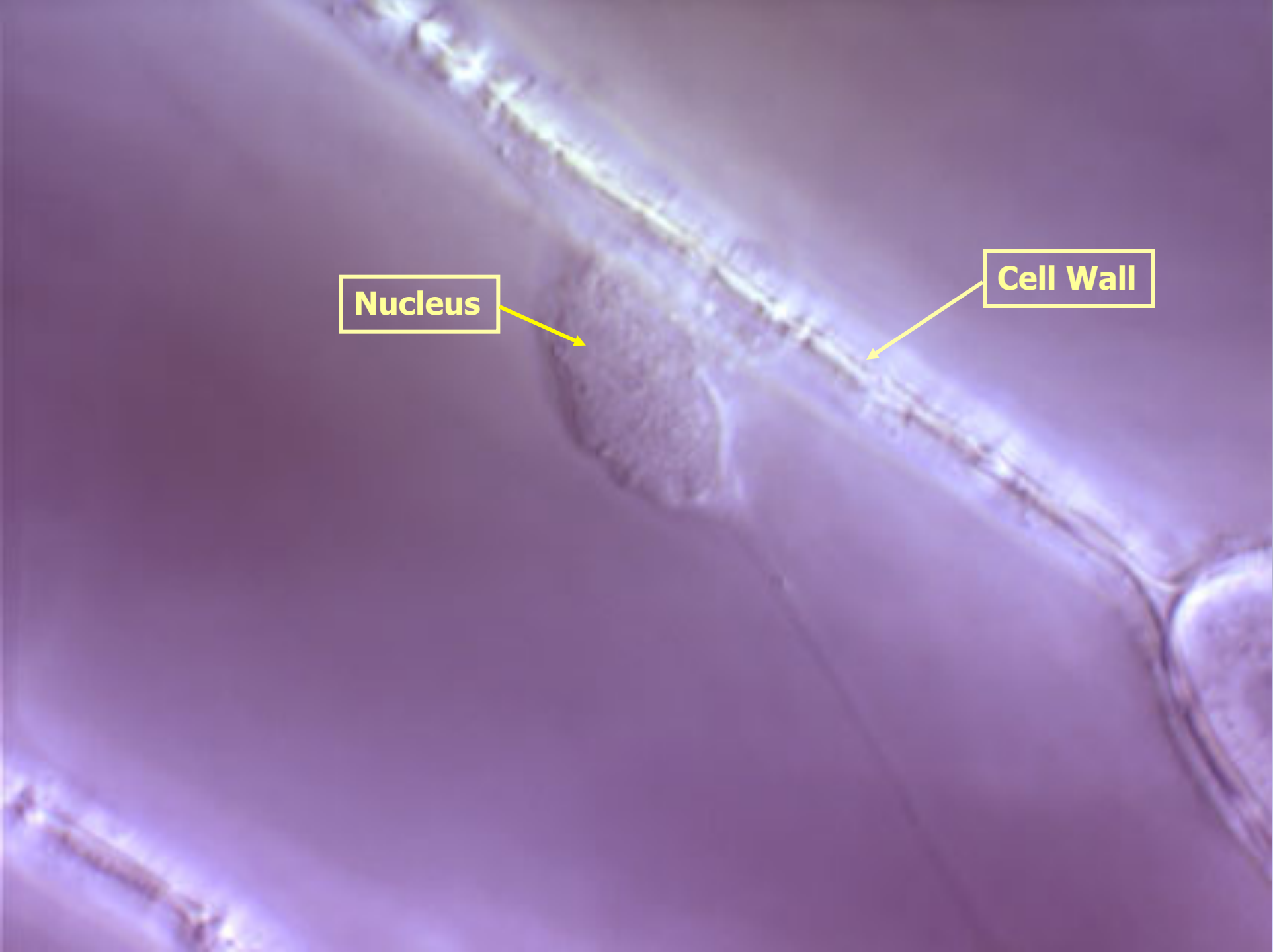
CELLS

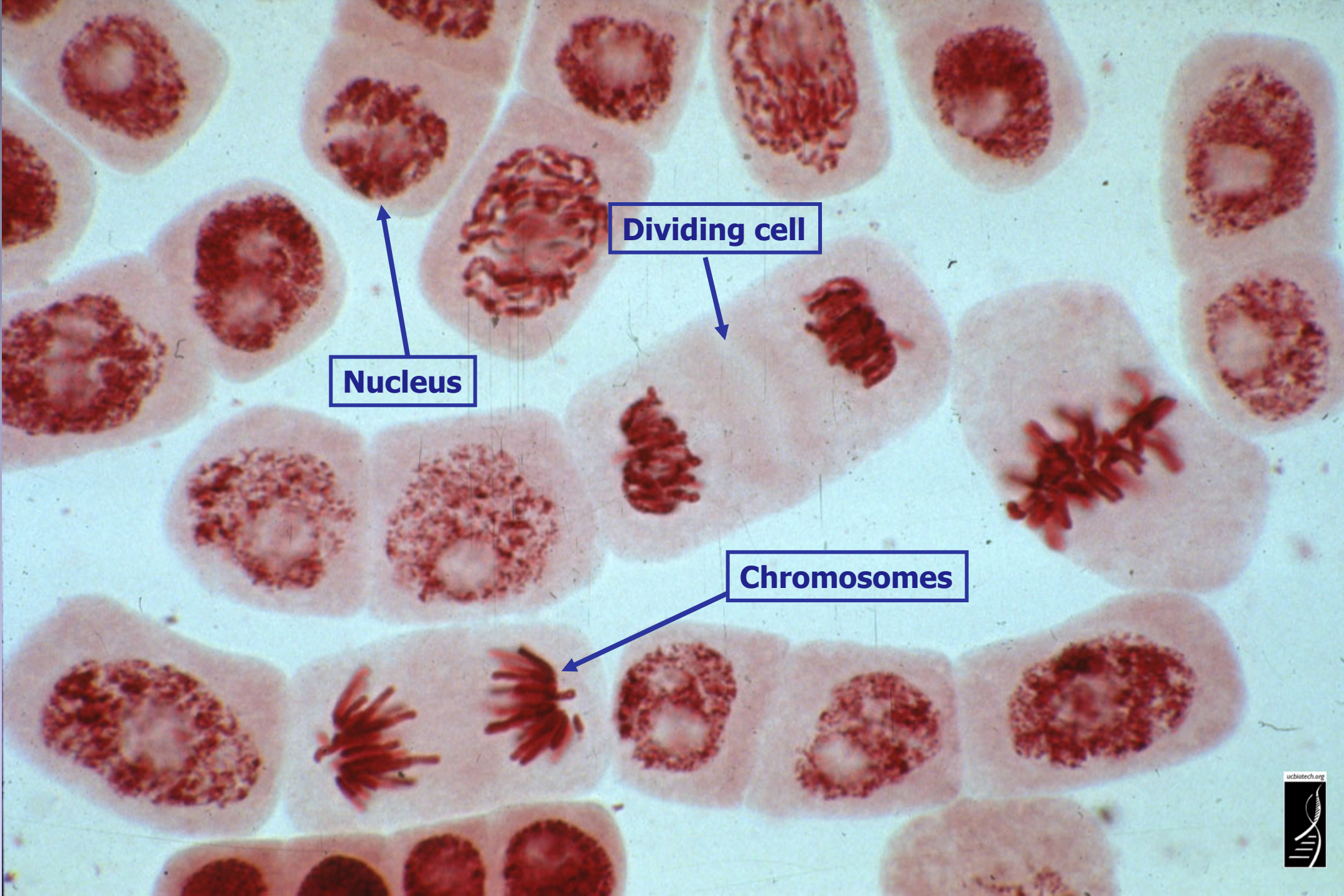


Nucleus



Cell Wall

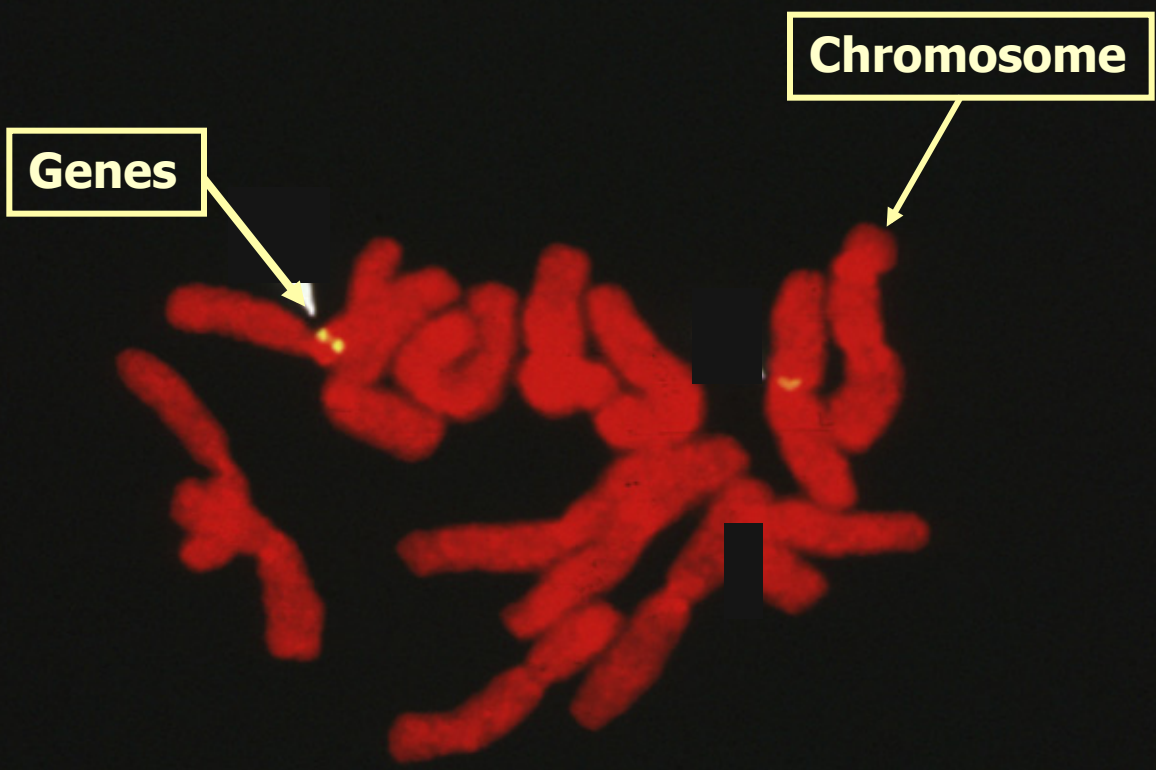




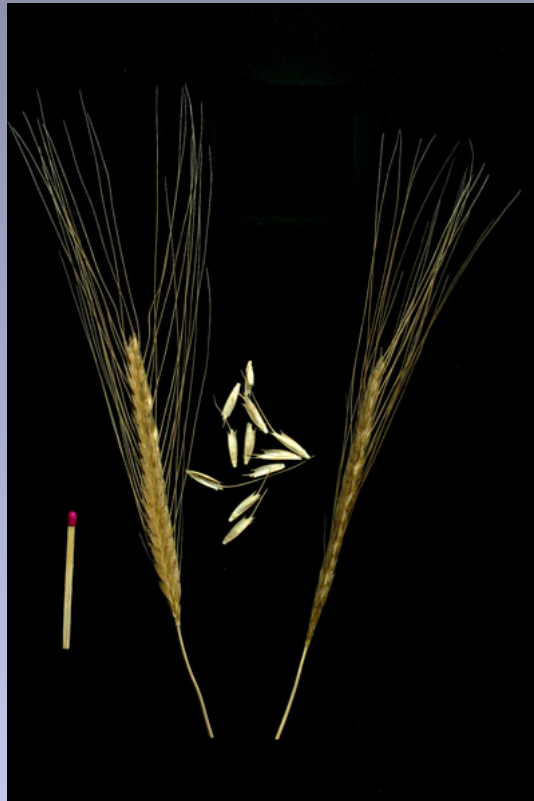
Nucleus

Dividing cell

Chromosomes

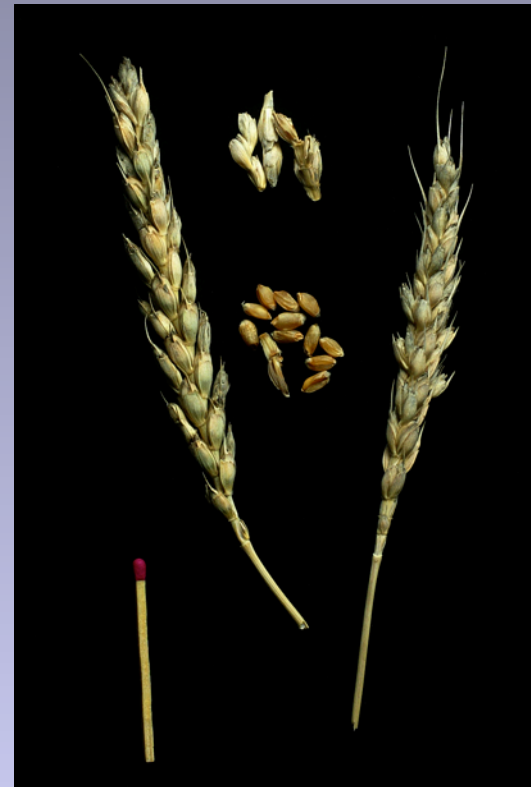


How are the genes and chromosomes manipulated to create a new plant variety by classical breeding?



Triticum monococcum

Ancient variety



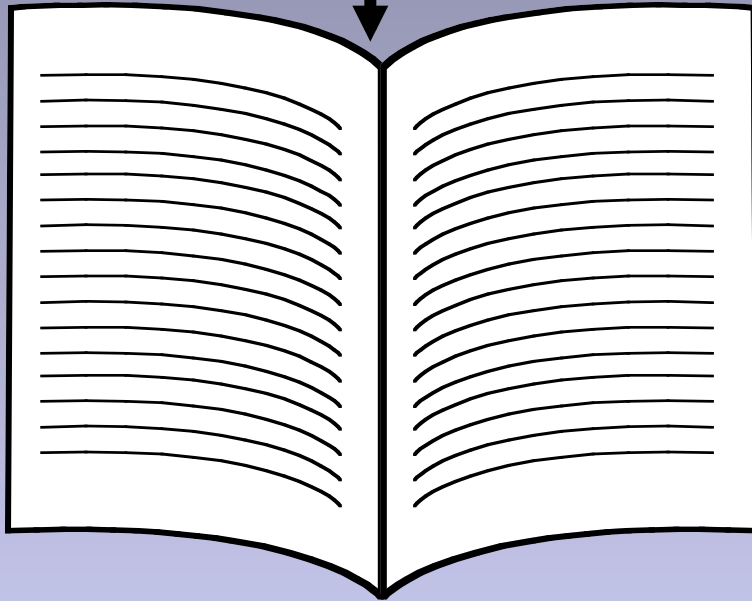
Triticum aestivum

Modern bread variety

Information in the wheat genome

Chemical units represented by alphabetic letters

...CTGACCTAATGCCGTA...

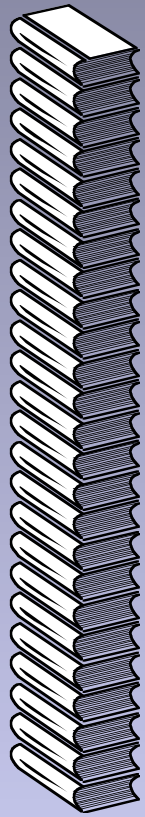


1700 books
1000 pages each



1700 books
(or 1.7 million pages)

Hybridization or cross breeding of wheat



X



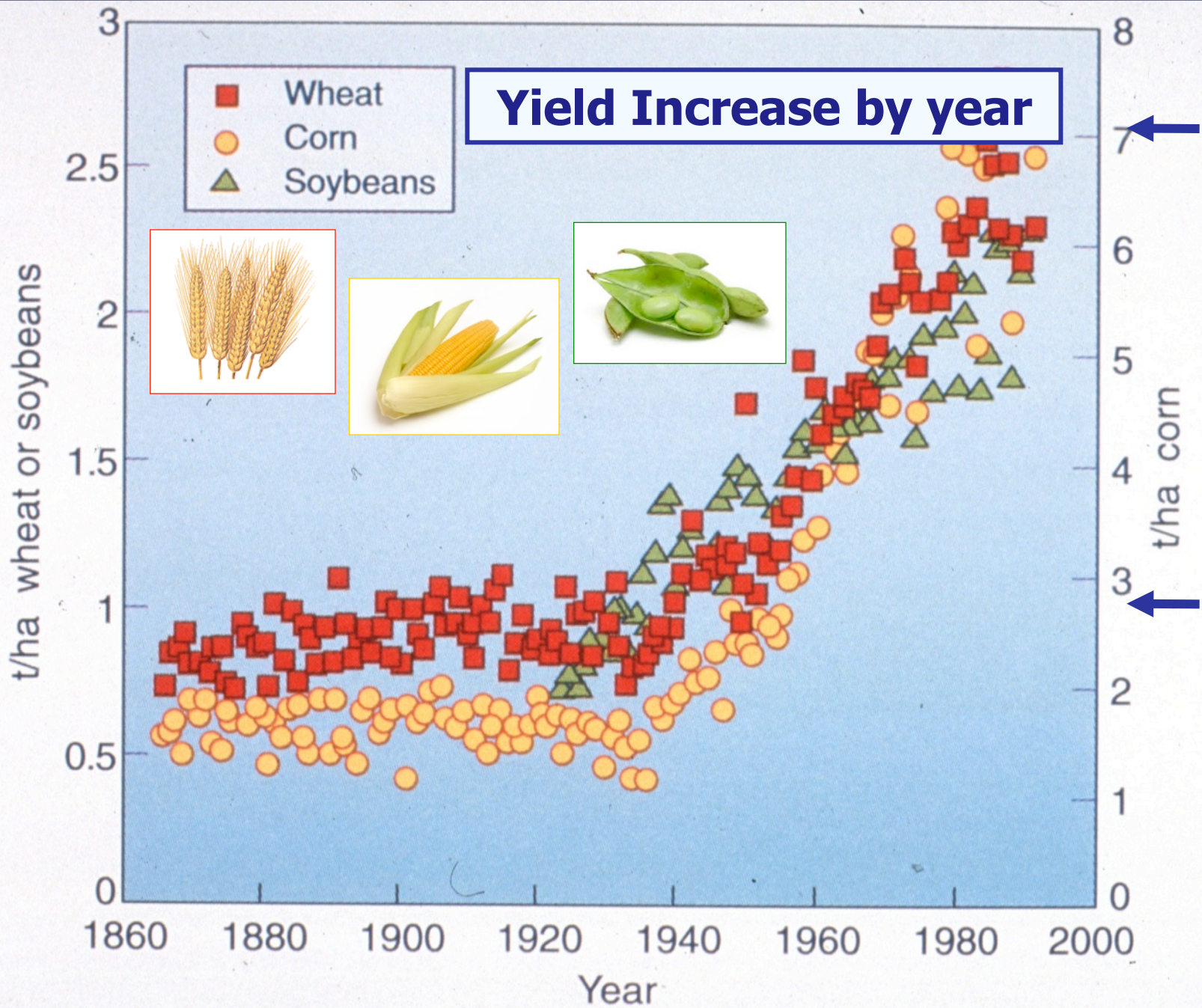
Random retention of information from each parent

1700 books
(or 1.7 million pages)

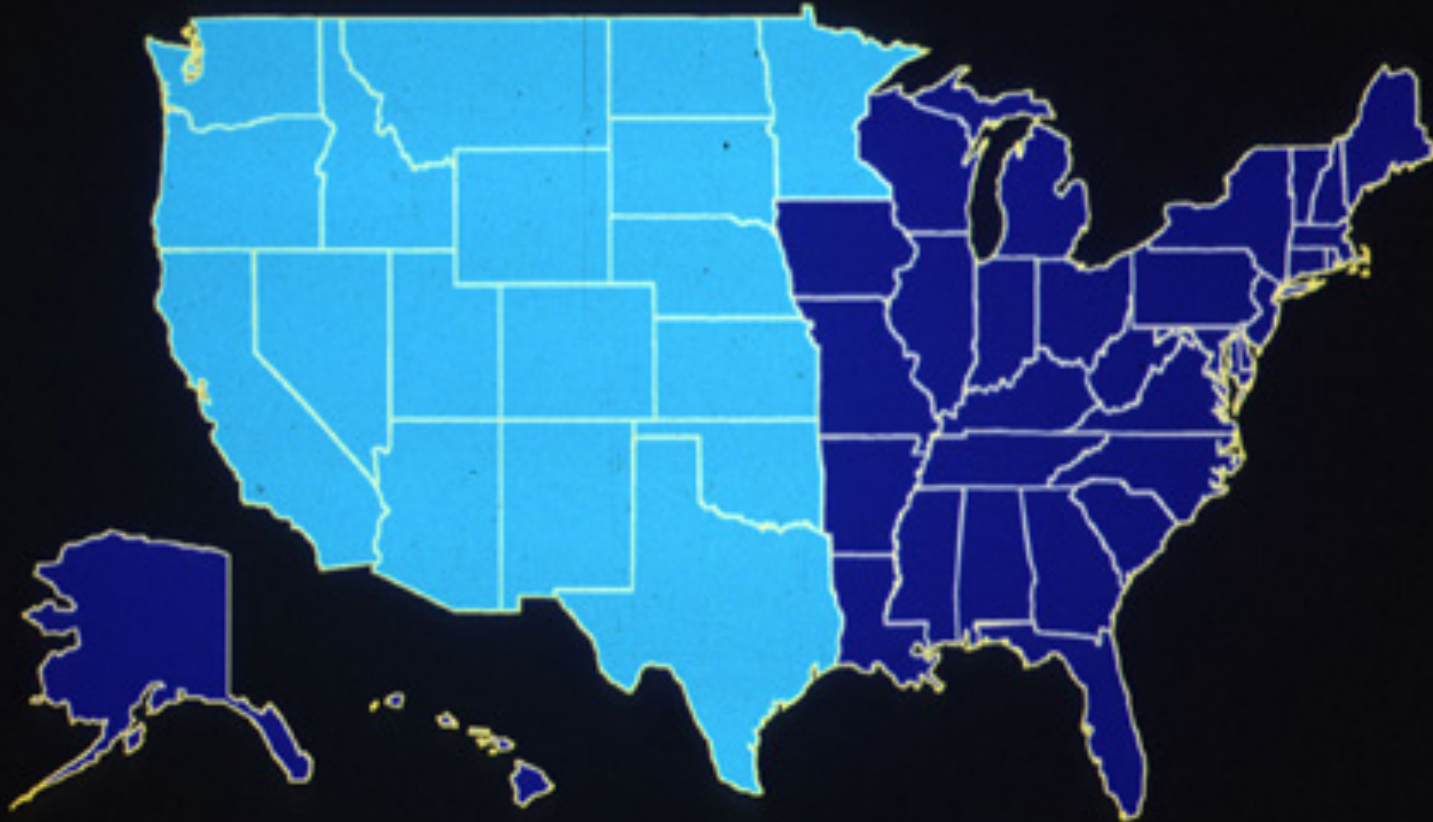
1700 books
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(or 1.7 million pages)

Yield Increase by year

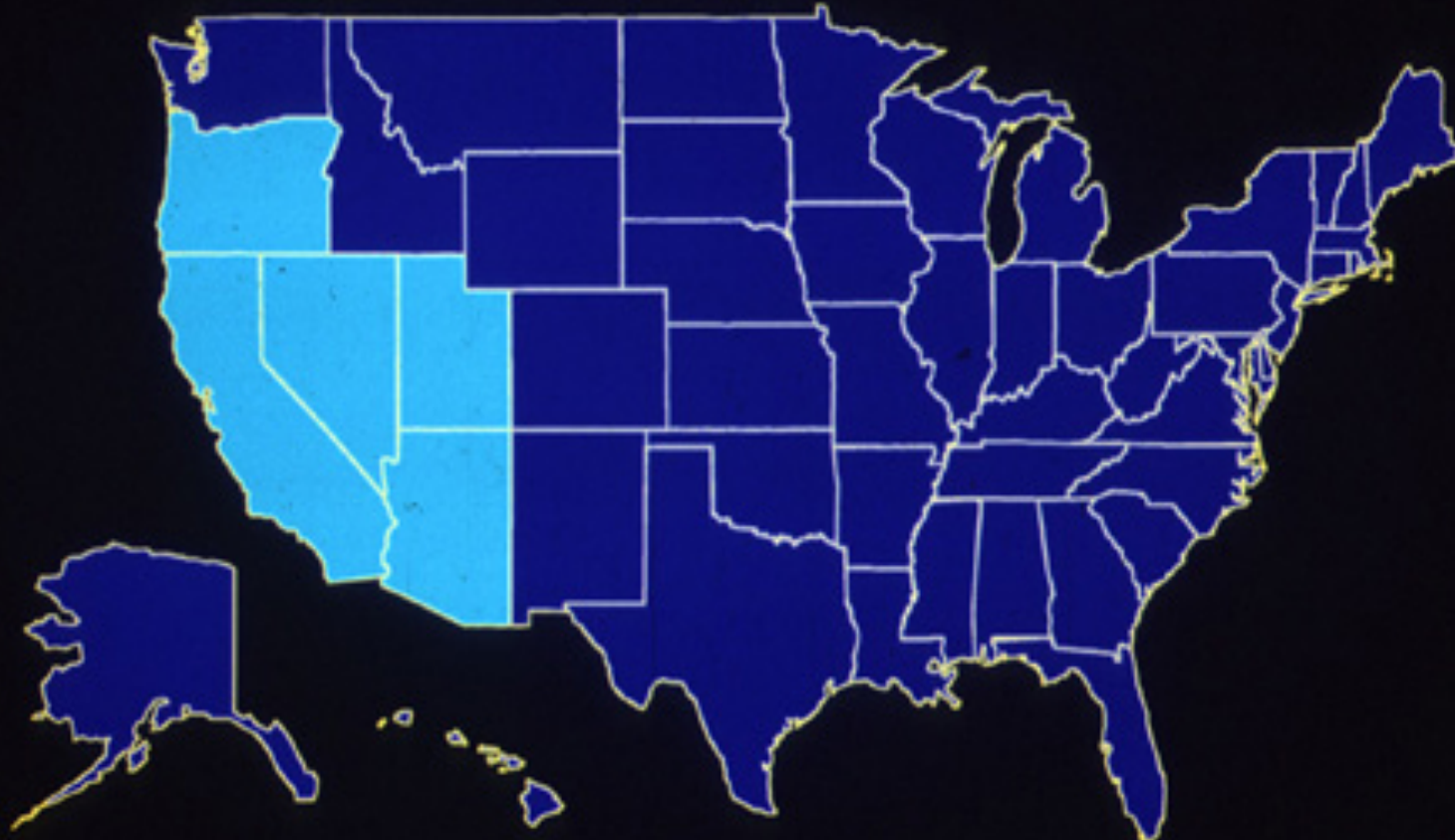


U.S. Cultivated Land



Acreage Needed at 1929 Production Levels

U.S. Cultivated Land

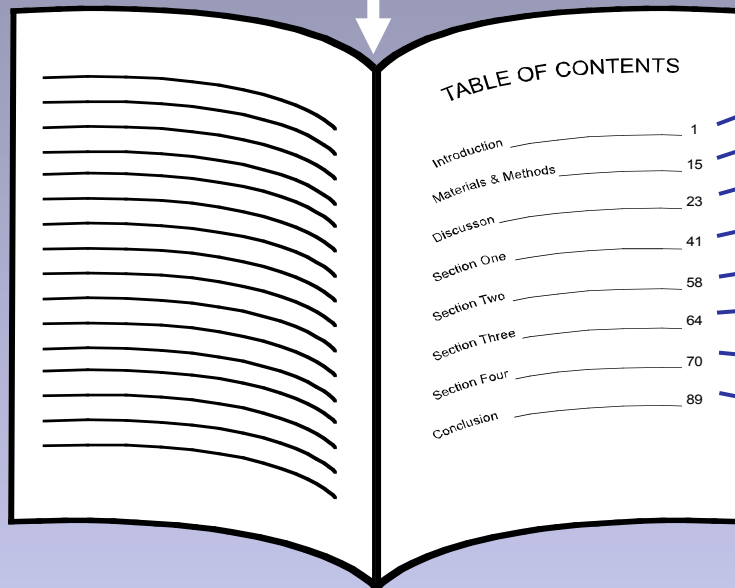


■ 1987 Acreage

There are new ways to do breeding...

Using a table of contents for the genes to perform marker assisted selection

...CTGACCTAATGCCGTA...




1700 books
(or 1.7 million pages)

Genomics



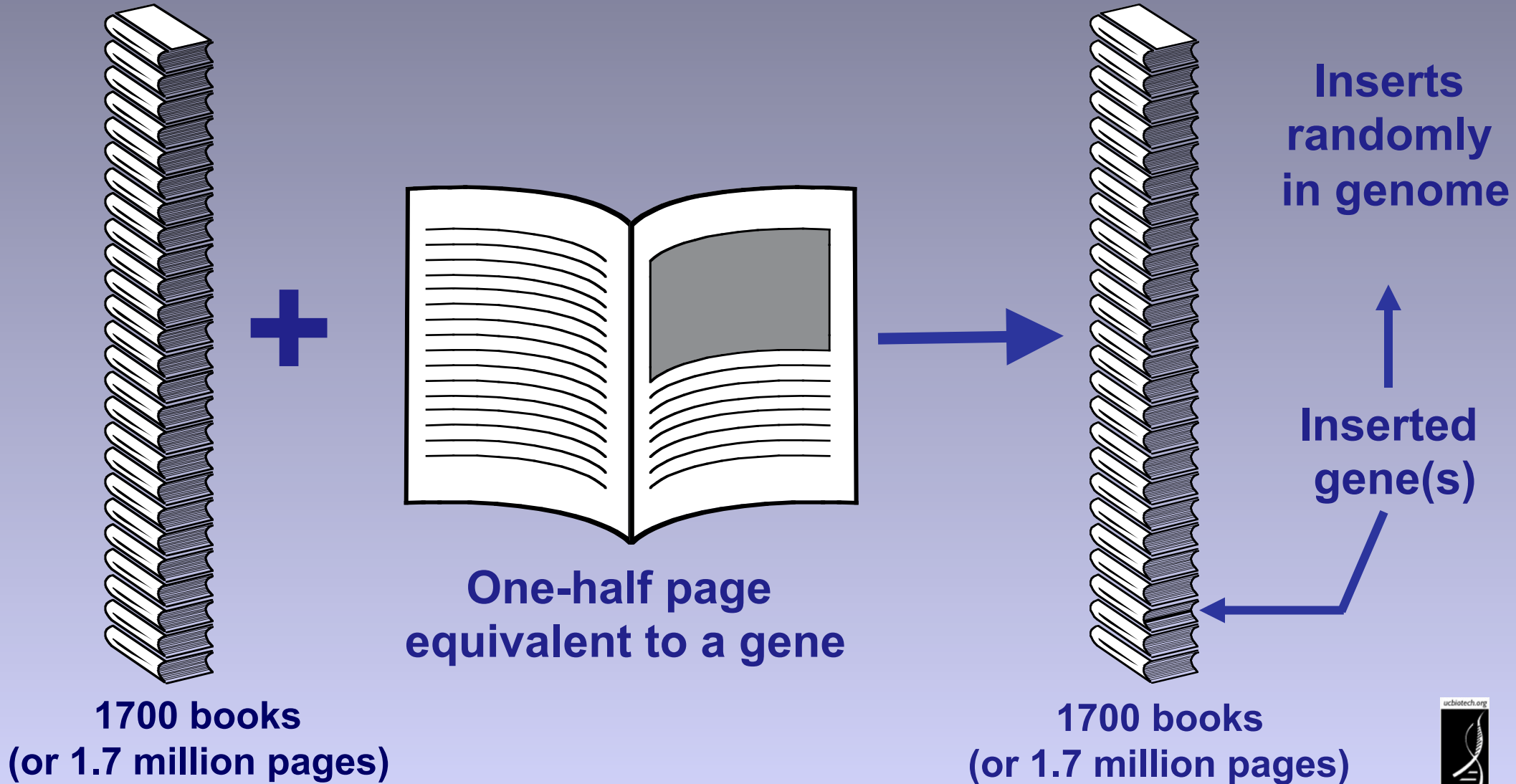
Marker-assisted selection was used to protect rice against bacterial blight and blast disease

Limited to diversity in crop and compatible relatives



If a desired trait comes from an incompatible plant or other organism, there are other ways to create new varieties using the modern tools of genetics

Genetic Engineering Methods



Classical Breeding

compared to

Genetic Engineering

Uses plant machinery in plant

Gene exchange is random
involving whole genome

When/where gene expressed
not controlled by breeder

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

When/where gene expressed
controlled precisely

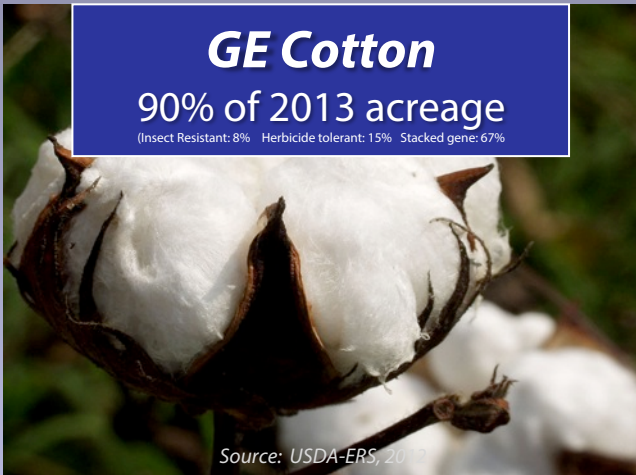
Source of gene from any
organism

Number of different commercially available GE crops is limited

GE Cotton

90% of 2013 acreage

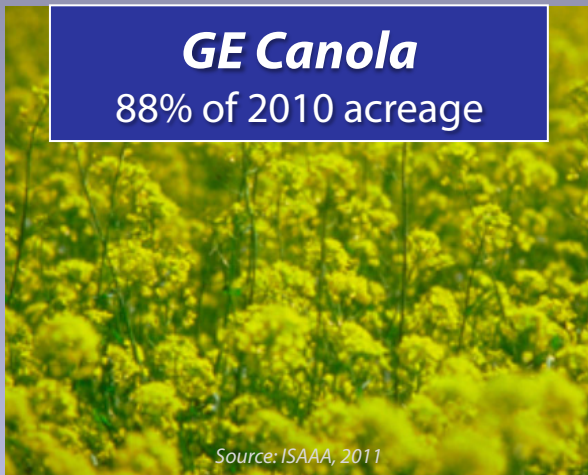
(Insect Resistant: 8% Herbicide tolerant: 15% Stacked gene: 67%)



Source: USDA-ERS, 2013

GE Canola

88% of 2010 acreage

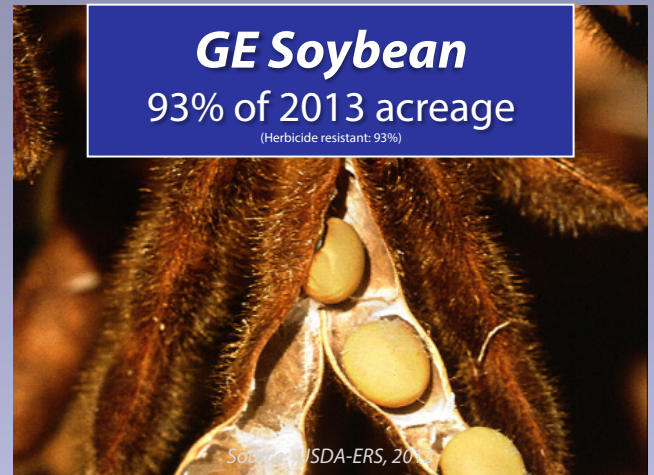


Source: ISAAA, 2011

GE Soybean

93% of 2013 acreage

(Herbicide resistant: 93%)

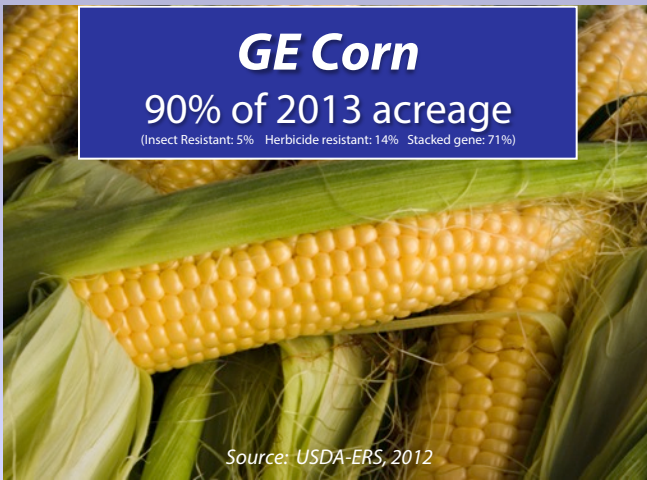


Source: USDA-ERS, 2013

GE Corn

90% of 2013 acreage

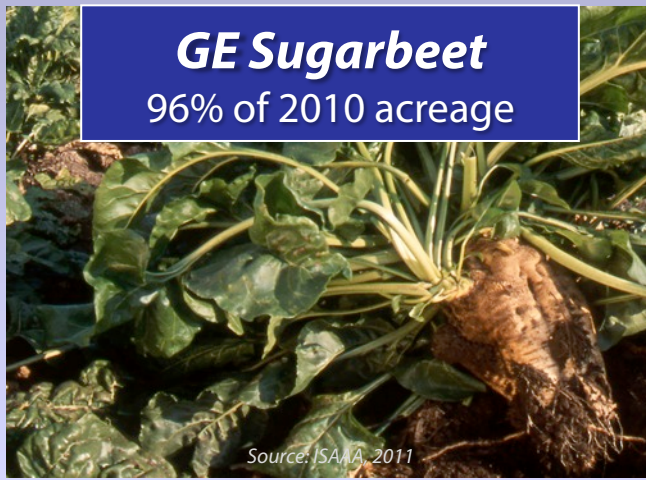
(Insect Resistant: 5% Herbicide resistant: 14% Stacked gene: 71%)



Source: USDA-ERS, 2013

GE Sugarbeet

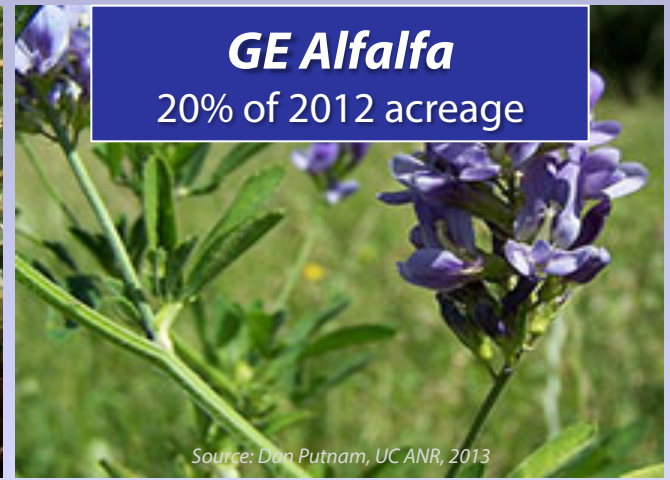
96% of 2010 acreage



Source: ISAAA, 2011

GE Alfalfa

20% of 2012 acreage



Source: Dan Putnam, UC ANR, 2013



Number of different traits available in GE crops is also limited



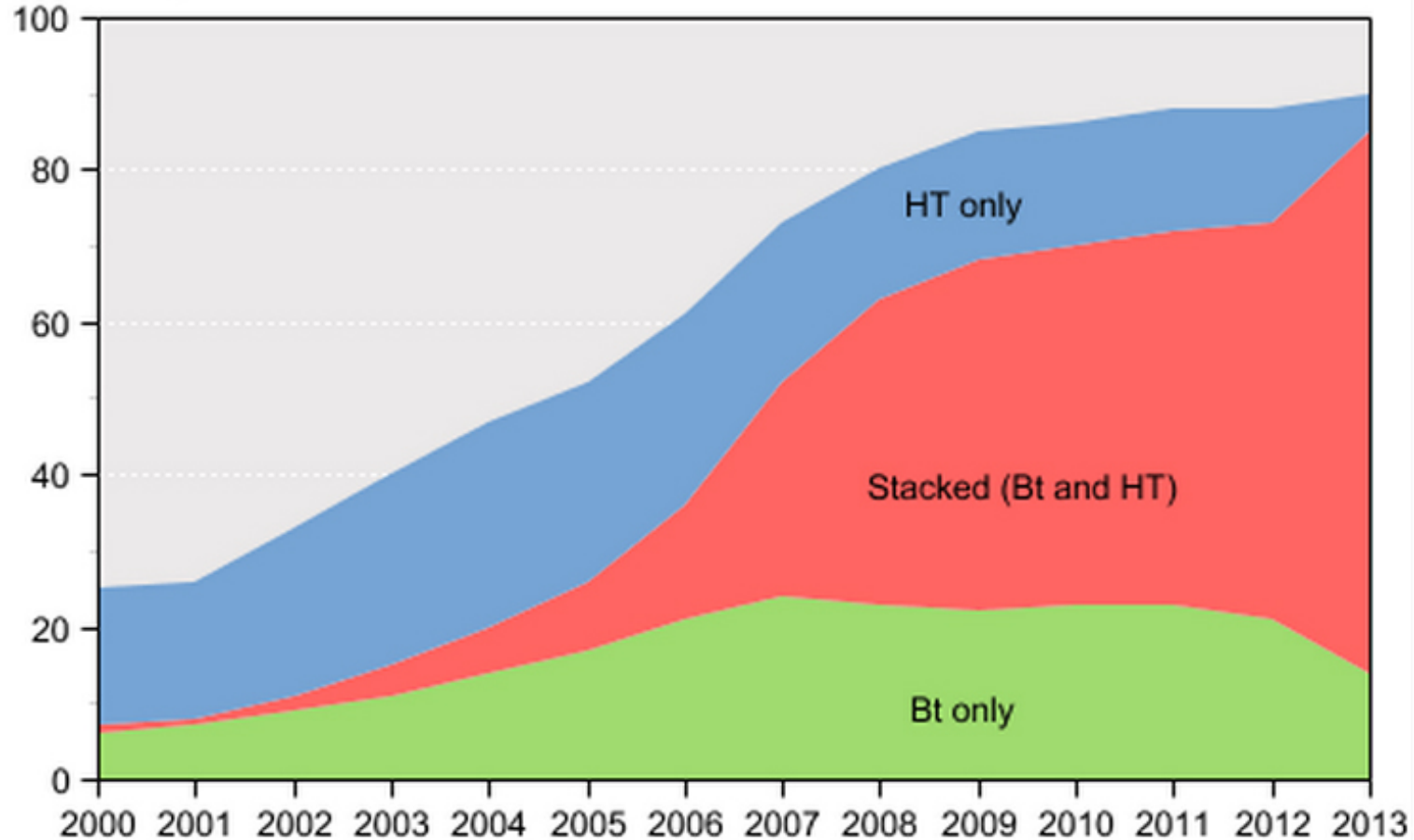
Bt Crops - engineered for insect resistance using gene from naturally occurring bacterium



Herbicide-tolerant - engineered with genes to tolerate herbicide application

Adoption of genetically engineered corn in the United States, by trait, 2000-13

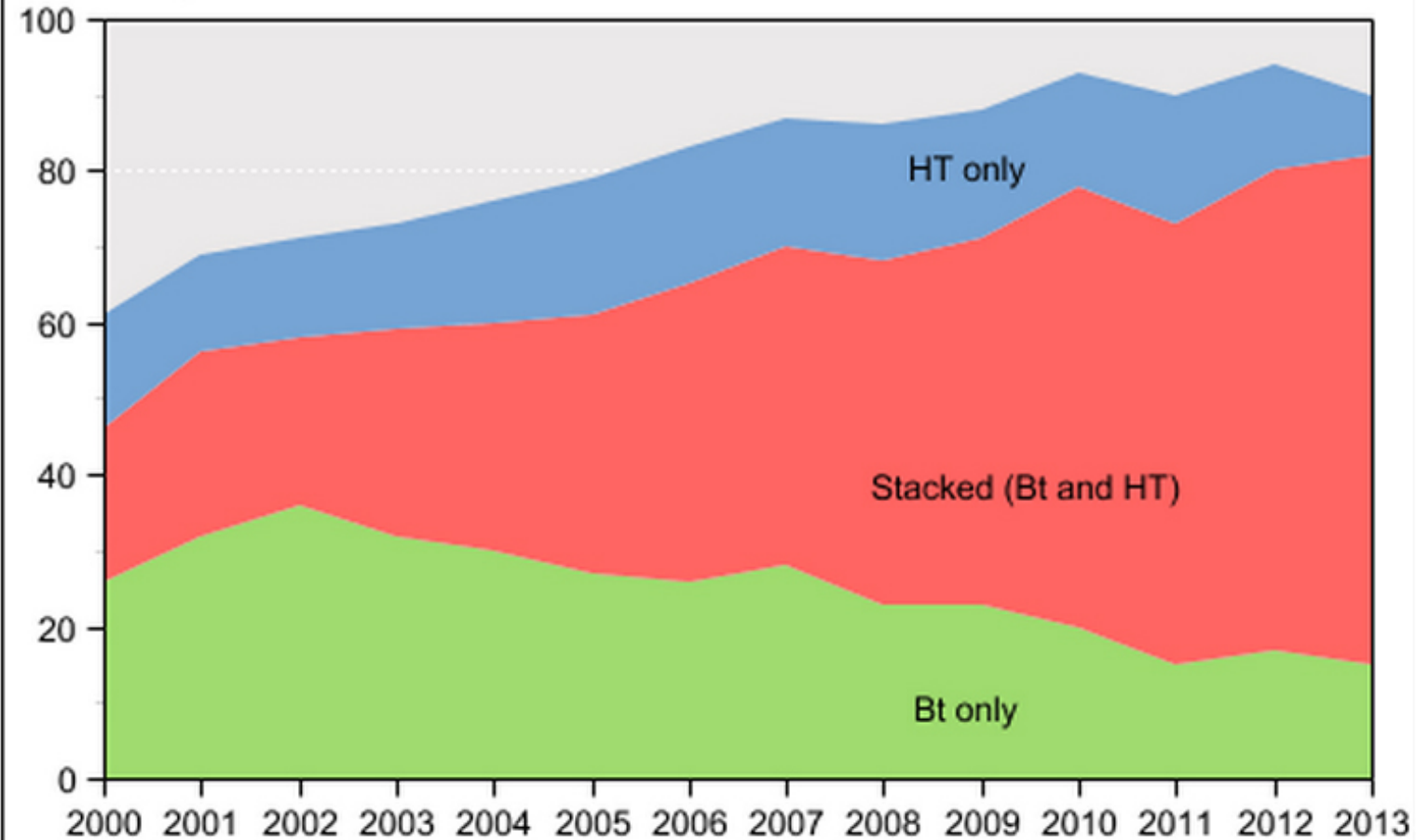
Percent of planted acres



Source: USDA, Economic Research Service using data from USDA, National Agricultural Statistics Service, June Agricultural Survey.

Adoption of genetically engineered cotton in the United States, by trait, 2000-13

Percent of planted acres

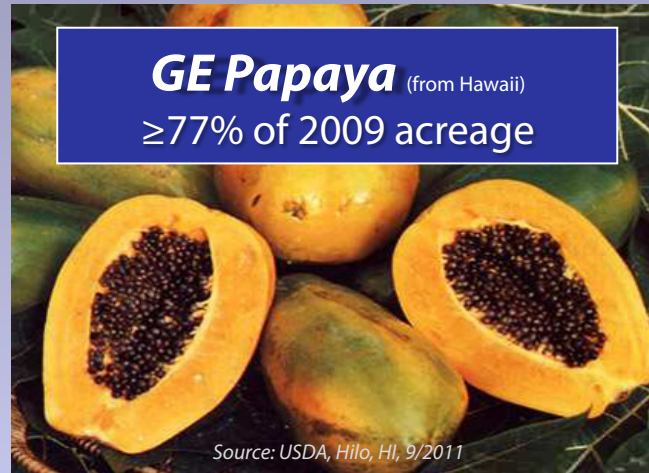


Source: USDA, Economic Research Service using data from USDA, National Agricultural Statistics Service, June Agricultural Survey.

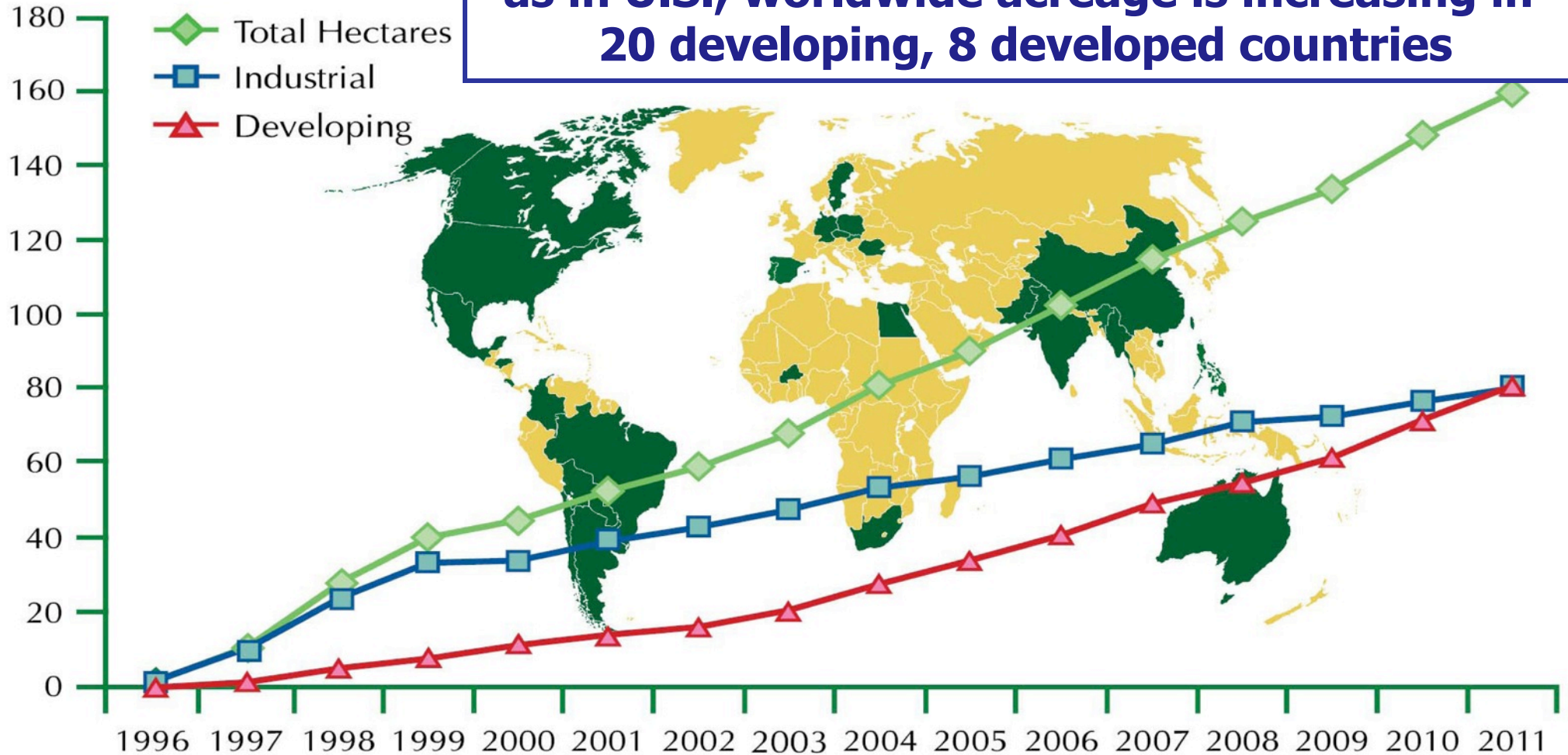


But These Types of GE Crops Lead To Estimates that 75% of Processed Foods in U.S. Have GE Ingredients

There are only a few genetically engineered, whole foods in the U.S market



Despite the same limited crop and trait types as in U.S., worldwide acreage is increasing in 20 developing, 8 developed countries



Total worldwide area cultivated = 420 M Acres = areas of Texas + California + Nevada = 345 M acres

WHAT'S IN THE PIPELINE?






*Field Trials Conducted in California with
Grape Root Stocks Engineered for
Resistance to Fanleaf Virus*

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



A close-up photograph of several green grapes. The grapes are covered in a fine, white, powdery substance, which is powdery mildew. The background is dark, making the green grapes and the white powder stand out.

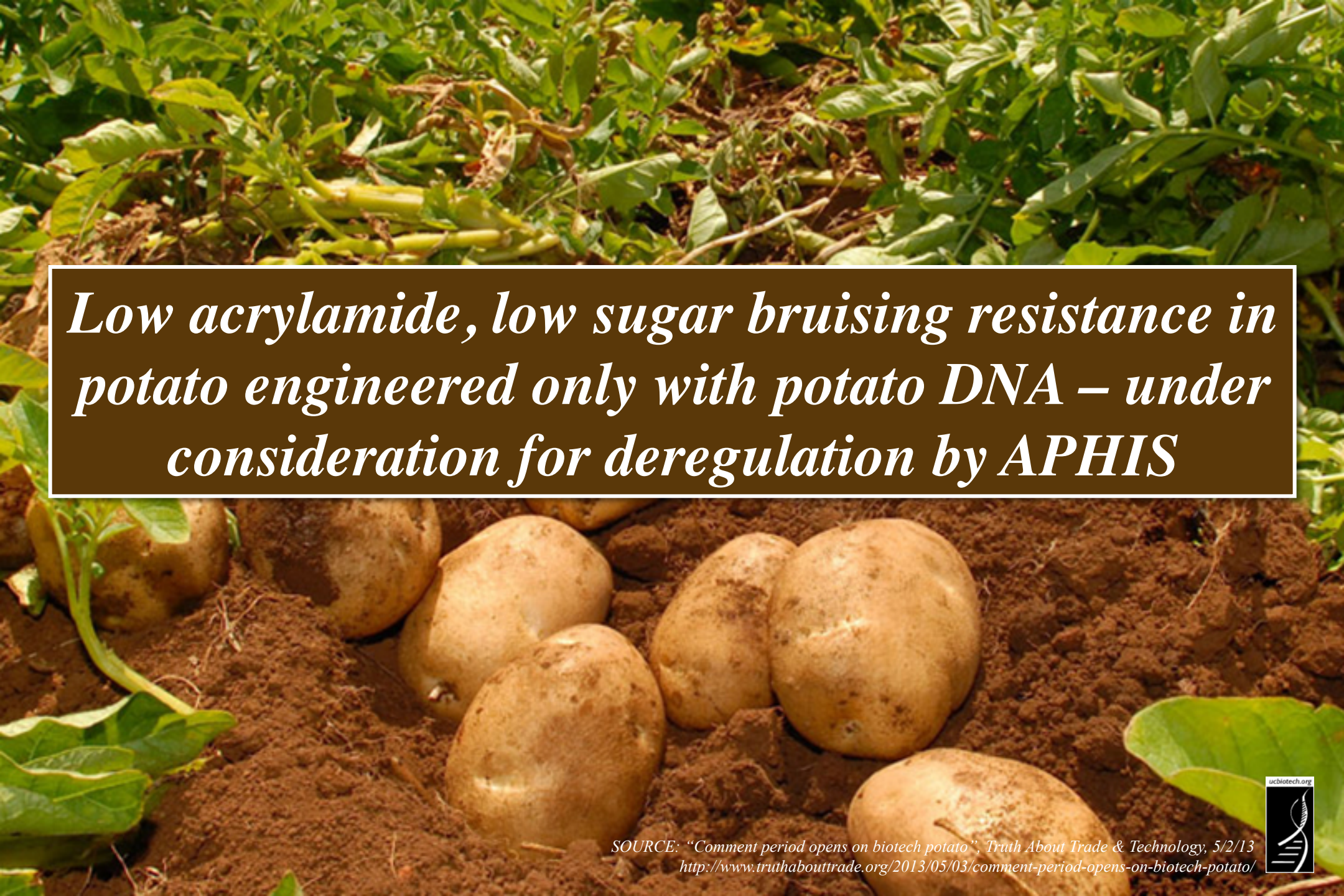
*Australian researchers identify
grape genes that provide resistance
to powdery mildew*



*Arcadia Biosciences develops canola that uses
50% less nitrogen fertilizer*

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





Low acrylamide, low sugar bruising resistance in potato engineered only with potato DNA – under consideration for deregulation by APHIS

SOURCE: "Comment period opens on biotech potato", Truth About Trade & Technology, 5/2/13
<http://www.truthabouttrade.org/2013/05/03/comment-period-opens-on-biotech-potato/>



About 80% of tomatoes under certain conditions suffer blossom end rot. Tomatoes engineered for high solids resist the disease



SOURCE: "Transgenic processing tomato also resists blossom end rot", *The Grower*, 5/24/12
<http://www.thegrower.com/e-newsletters/fresh-from-the-field/Transgenic-processing-tomato-also-resists-blossom-end-rot-152327065.html>

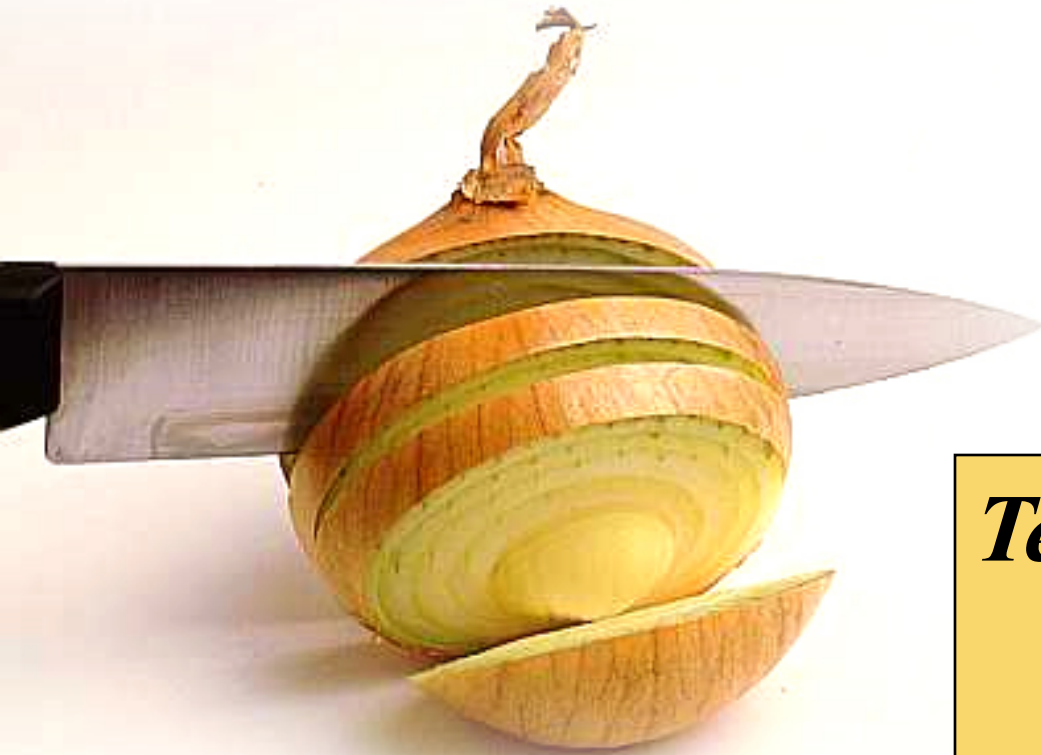


A photograph of a whole green apple at the top center, with two slices of the same apple below it, one on the left and one on the right. The apple slices are cut horizontally, showing the core and seeds. The background is a light-colored, marbled surface.

*Non-browning GE apple to be labeled
and marketed in U.S.*

SOURCE: "Stop Genetically Engineered Apples!", Organic Consumers Association, 3/24/11.
<http://www.organicconsumers.org/bytes/ob269.htm#SEC3>





***Tear-free onion developed
by turning off tear-
inducing enzyme***

SOURCE: "Scientists create 'no tears' onions", Herald and Weekly Times, 2/1/08
http://www.checkbiotech.org/green_News_Genetics.aspx?Name=genetics&infoId=16834



*Japanese scientists create blue rose
with blue pigments from pansies*

SOURCE: <http://www.japantimes.co.jp/cgi-bin/getarticle.pl5?nn20040701a2.htm>

*Slow-Mow grass addresses watering,
maintenance and weed problems*



*SOURCE: "Engineering a mow-less lawn", New York Times, 4/22/06
http://www.nytimes.com/2006/04/22/business/22offline.html?_r=1&oref=slogin*



*What is the U.S. regulatory process
that governs these engineered
plants?*

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?

APHIS Determines Nonregulated Status – 86 granted

(8-11-2012)

**Once nonregulated, organism
no longer requires APHIS review
for movement or release in U.S.**

- ✓ Alfalfa – HT –removed, reinstated
- ✓ Corn - HT, IR, AP
- ✓ Cotton - HT, IR
- ✓ Soybean - HT, PQ
- ❖ Potato - IR, VR
- ❖ Tomato - PQ
- ❖ Squash - VR
- ✓ Canola – HT
- Papaya - VR
- ❖ Rice - HT
- Rapeseed - HT, AP, PQ
- ✓ Sugar beet - HT
- ❖ Flax - HT
- Chicorium - AP
- Tobacco – PQ
- Rose - PQ

- ✓ Large-scale production
- ❖ Not on market

(http://www.aphis.usda.gov/brs/not_reg.html)





Once deregulated, U.S. Circuit Court denies revival of lawsuit aimed at preventing growers from planting GE sugar beets

What Are Some of the Issues?



What are some food safety issues?

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

What are some environmental issues?

- **Transfer of engineered genes to non-GMO/organic crops?**
- **Development of herbicide-tolerant weeds or pesticide-resistant insects**
- **Spread of pharmaceutical genes into commercial crops?**
- **Loss of genetic diversity?**
- **Property rights (gene patents)?**

What are some food safety issues?

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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

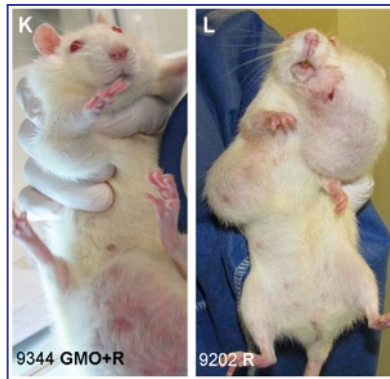
**But
intermittently
studies are
published
casting doubts
on the safety
of available
GE foods, like
this one
published by
French
researcher in
Sept. 2012 –**

**Subsequently
reviewed by
European
Food Safety
Authority and
found to have
no merit.**

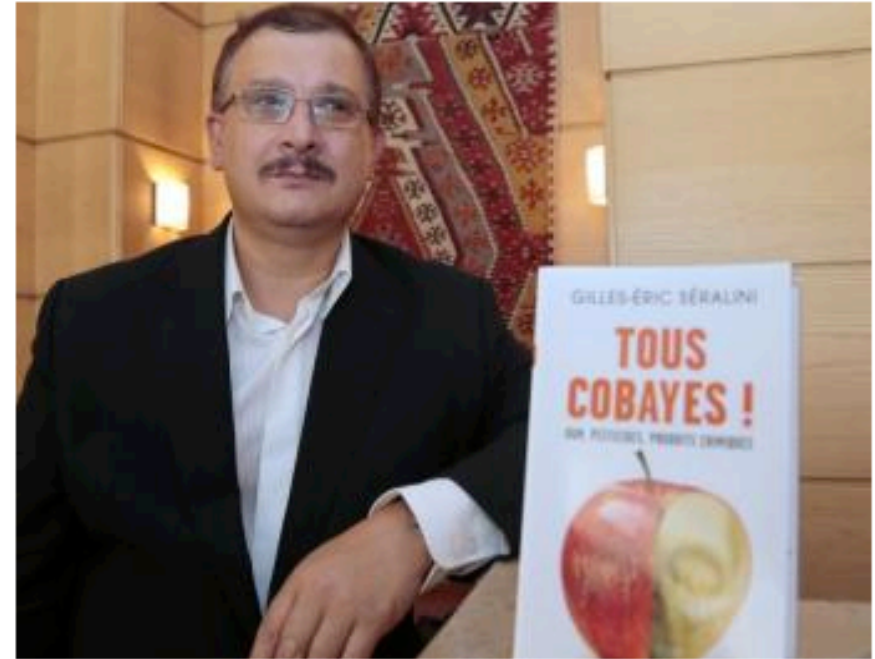
French academies trash GM corn cancer study

By RFI

A controversial study that linked genetically modified maize to cancer in lab rats is a "scientific non-event", six French scientific academies said in a rare joint statement Friday.



Claim that
Monsanto's
RR corn
causes
tumors in
rats



The report's author, Gilles-Eric Seralini, with his book *All Guinea Pigs*
AFP / Jacques Demarthon

"This work does not enable any reliable conclusion to be drawn," they say, adding that the publicity surrounding the publication has "spread fear among the public."

The joint statement - an extremely rare event in French science - is unsigned and issued in the names of the national academies of agriculture, medicine, pharmacy, science, technology and veterinary studies.

**Metaanalysis review also from France,
published earlier in same journal**

**Twelve long-term (>90d to 2yr) and twelve multigenerational (2 to 5
generation) feeding trials of GE feed in animals**

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



maize

potato



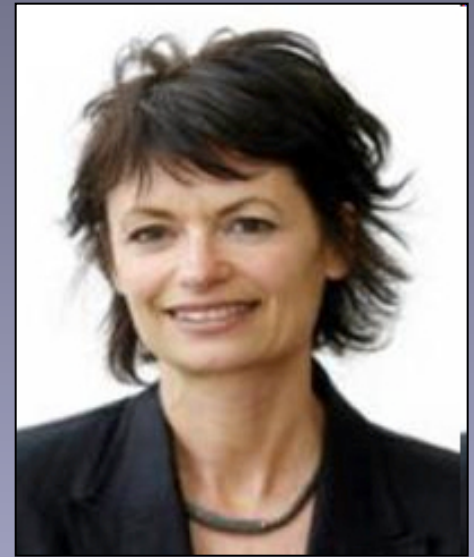
soy

rice



triticale

Anne Glover, the first European chief scientific adviser, appears to look at science and technology in a different light than many Europeans.



“If we look at evidence from [more than] 15 years of growing and consuming GMO foods globally, then there is no substantiated case of any adverse impact on human health, animal health or environmental health, so that’s pretty robust evidence, and I would be confident in saying that there is no more risk in eating GMO food than eating conventionally farmed food...it has nothing to do with genetic engineering... I would argue that we use every technical possibility – not just GMOs – it requires every tool in our toolkit to deliver.”

What are some food safety issues?

- Lack of peer-reviewed food safety tests
- Creation of allergens or activation of toxins
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- Labeling
- Gene flow from food to intestinal bacteria increasing antibiotic resistance

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

Actually it does...

Foods produced through biotechnology are subject to same labeling laws as all other foods and food ingredients

Govt-mandated label information relates to composition or food attributes not agricultural or manufacturing practices

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

GM food must be labeled if:

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

Other nations have specific, 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 a Proposition to require mandatory labeling of foods with GE ingredients and restrictions on the use of the term “natural” on food labels.

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%

appeared pleased.

"We've said from the beginning of this campaign that the more voters learned about Prop 37, the less they'd like it.

al government, which does not require such labels because bioengineered foods are not significantly different in taste, texture and nutrition.

has long harvested corn, cotton, soybean and other plants in which the DNA has been tinkered with in the laboratory to resist pesticides and ward off

into food ingredients found in many cereals, baked goods and sodas.

Despite scientific consensus that genetically modified foods

sumers remain leery and efforts have been mounted to force special labels. Mandatory labeling exists elsewhere, including the European Union.

ing bills, but all failed. A citizen's petition to mark genetically engineered foods nationwide 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

End of Story?

ESSAY OF THE WEEK

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 likely in California, nor a number of other states, like Washington, Oregon, Vermont...

And, outside government, others are addressing the issue of labeling.

All Natural!

 **Capital Press**
Agriculture Newspaper

FDA asked to clarify 'natural'

Judge stays lawsuit until agency decides labeling rule for GMO foods

though they contain genetically engineered corn.

The plaintiff, Elizabeth Cox, seeks class action status for the case, which would allow other consumers to join the litigation, as well as at least \$5

refer the question of "natural" labeling of genetically engineered ingredients to the FDA.

While the agency has issued guidance that doesn't require manufacturers to label genetically engineered foods,

And there might be restrictions on not only labeling with regard to genetically engineered ingredients but also with regard to using the term "natural".

that accuses the company of falsely labeling its Mission tortilla chips as "natural" even

Gonzalez Rogers in Oakland, Calif., has decided to stay the litigation for six months and

the product, Gonzalez Rogers said.

"Under these circumstances,

SOURCE: "Judge asks FDA if GMO foods can be 'natural'", Capital Press, July 17, 2013
<http://www.capitalpress.com/content/mp-GMO-natural-label-071713>





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.

A variety of companies are becoming involved in different ways in GMO labeling.

grown in the United States, for example, have been genetically modified. The alterations make soybeans resistant to a herbicide used in weed control, and causes the corn to produce its own insecticide. Efforts are under way to produce a genetically altered apple that will spoil less quickly,

'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



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.

apple by
expens
ments r
browni
apples i
services
all apple

"As a company, labeling genetically modified, we want we're not for mandatory label-

Biotech foods have been place, Chris Schlect, horticulturist, deregulated, he said.

SOURCE: "Biotech apples inflame debate", Capital Press, December 20, 2012

<http://www.capitalpress.com/orewash/djw-GMOapples-w-art-121912>

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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

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.

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though it was not

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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

- ***Prop 65 originally passed to protect citizens of CA from toxic substances***
- ***Often well-meaning and effective, it resulted in frivolous lawsuits. Example: lawsuit against banks for not posting Prop 65 warnings on ATM machines as users might smoke nearby and "contaminate" people using ATM***
- ***Prop 65 warning signs so prevalent that signage has become meaningless***
- ***Could be similar with signage for GE foods: label indicating "may contain genetically engineered ingredient" would become so common it could become meaningless and ignored***



Might another solution be...

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

Now to some environmental issues?

- **Transfer of engineered genes to non-GMO/organic crops?**
- **Development of herbicide-tolerant weeds or pesticide-resistant insects**
- **Spread of pharmaceutical genes into commercial crops?**
- **Loss of genetic diversity?**
- **Property rights (gene patents)?**

What are some environmental issues?

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Can Organic Agriculture Coexist with GE Crops?

What is Co-existence

- ***Development of best management practices to minimize adventitious presence of unwanted material***
- ***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***

One of the most divisive issues regarding coexistence is idea 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 discussion is impossible. Dualism (right versus wrong) – jeopardizes compromise

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



This is not the first time coexistence between conventional and organic agriculture has been an issue.

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.



Specialty



Organic



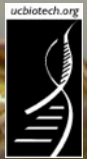
Naked Juice
NUTRITIOUS

Naked Juice
Nutritious - Pure - Delicious

How might a GE crop be a co-existence issue for an organic farmer?

Certificate of Approval
Town & Country Market
An Association of Distributors & Retailers

HEALTHY TOMATOES



**...What Genetic Modification Input
Methods Are PERMITTED?
(§ 205.2 National Organic Program)**

- they “...include the use of traditional breeding, conjugation, fermentation, hybridization, in vitro fertilization, or tissue culture.”



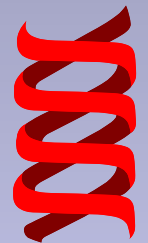
...And What Genetic Modification Input Methods Are PROHIBITED?

(§ 205.2 National Organic Program)

- **“A variety of methods...are not considered compatible with organic production. Such**

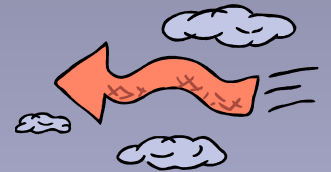
Are There Tolerances for GE in Organic Products?

positions of genes when achieved by recombinant DNA technology).”



There are tolerances for pesticides but not for GM content

☞ Pesticides: “When residue testing detects prohibited substances at levels that are greater than 5% of the EPA’s tolerance for the specific pesticide residue detected...the agricultural product must not be sold or labeled, or represented as organically produced.”



☞ GMOs: At the present time there are no specified tolerances for GMOs in organic products. Organic products are not ‘guaranteed’ GMO-free, although some organic farmers sign contracts guaranteeing GMO-free

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Investigative report

Monsanto's practices weed out competition

*Licensing pacts, science
propel seed company
to dominate position*



Companies have taken the lead in creating today's commercial GE crops and control most of the key intellectual property, making it difficult for small companies or the academic sector to play a meaningful role in addressing agricultural challenges with genetic engineering.

of an corn grown in the U.S., the company also is using its wide reach to control the ability of new biotech firms to get wide distribution for their products, according to a review of several Monsanto licensing

A farmer holds Monsanto's Roundup Ready soybean seeds. Confidential contracts detailing Monsanto Co.'s business practices reveal how the world's biggest seed developer protects its dominance over the multibillion-dollar market for genetically altered crops, an Associated Press investigation has found.

Dan Gill/Associated Press

SOURCE: Capital Press, December 18, 2009



US regulators examine competition in agriculture

By **CHRISTOPHER LEONARD**
Associated Press

ANKENY, Iowa — Federal officials concerned about how much control a few corporations have over the nation's food supply pledged March 12 to begin a new era of antitrust enforcement, seeking to balance agricultural power between companies, farmers and



Related story

See story package —
"Antitrust action looms" —
on Page 1.

brewing sense of powerless and frustration in small towns that was on display March 11 at a farmer's rally. More than 200 people packed a small ball-

But, among companies there is a lot of competition with just a few companies jockeying for a position. This may or may not be good for agriculture.

side to open the hearing, called the workshop an unprecedented act of cooperation between their agencies.

"I think you will see an historic era of enforcement that will almost inevitably grow from the partnership that we have established," Holder said.

Some Obama administration officials have made clear

ty production.

Those in the audience at the hearing paid keen attention, trying to discern just how aggressive the Obama administration will be.

For farmers, it is an effort to constrain corporations like Monsanto Co., Archer Daniels Midland Co. and Tyson Foods Inc., which producers say wield

cession and stifle innovation and investment.

Holder and Vilsack said it's not clear yet what actions will ultimately result from the five hearings, which will examine competition in the dairy, seed, meatpacking and crop production.

But they said it won't just be a series of lawsuits. They're


sumers.

"This is not just about farmers and ranchers," Vilsack said. "It's really about the survival of rural America. We've seen a significant decline in the number of farmers and ranchers and that translates into a significant decline in the number of people living in rural America."

The hearings play to a long-

Chuck Grassley, R-Iowa, Iowa Attorney General Tom Miller and others outlined their concerns about consolidation in the farm sector.

"Bigger isn't per se bad," Grassley said. "But it can lead to predatory business practices and behaviors and that's what we've got to be concerned about."



Recent U.S. Supreme Court had an important impact on how patents will play out in the U.S. Justices rendered unanimous decision indicating that patent exhaustion does not permit a farmer to reproduce patented seeds through planting and harvesting without patent holder's permission

If this decision had gone the other way, the patent landscape would have changed dramatically.

*SOURCE: "Supreme Court Supports Monsanto in Seed-Replication Case", New York Times, 5/13/13
<http://www.nytimes.com/2013/05/14/business/monsanto-victorious-in-genetic-seed-case.html>*



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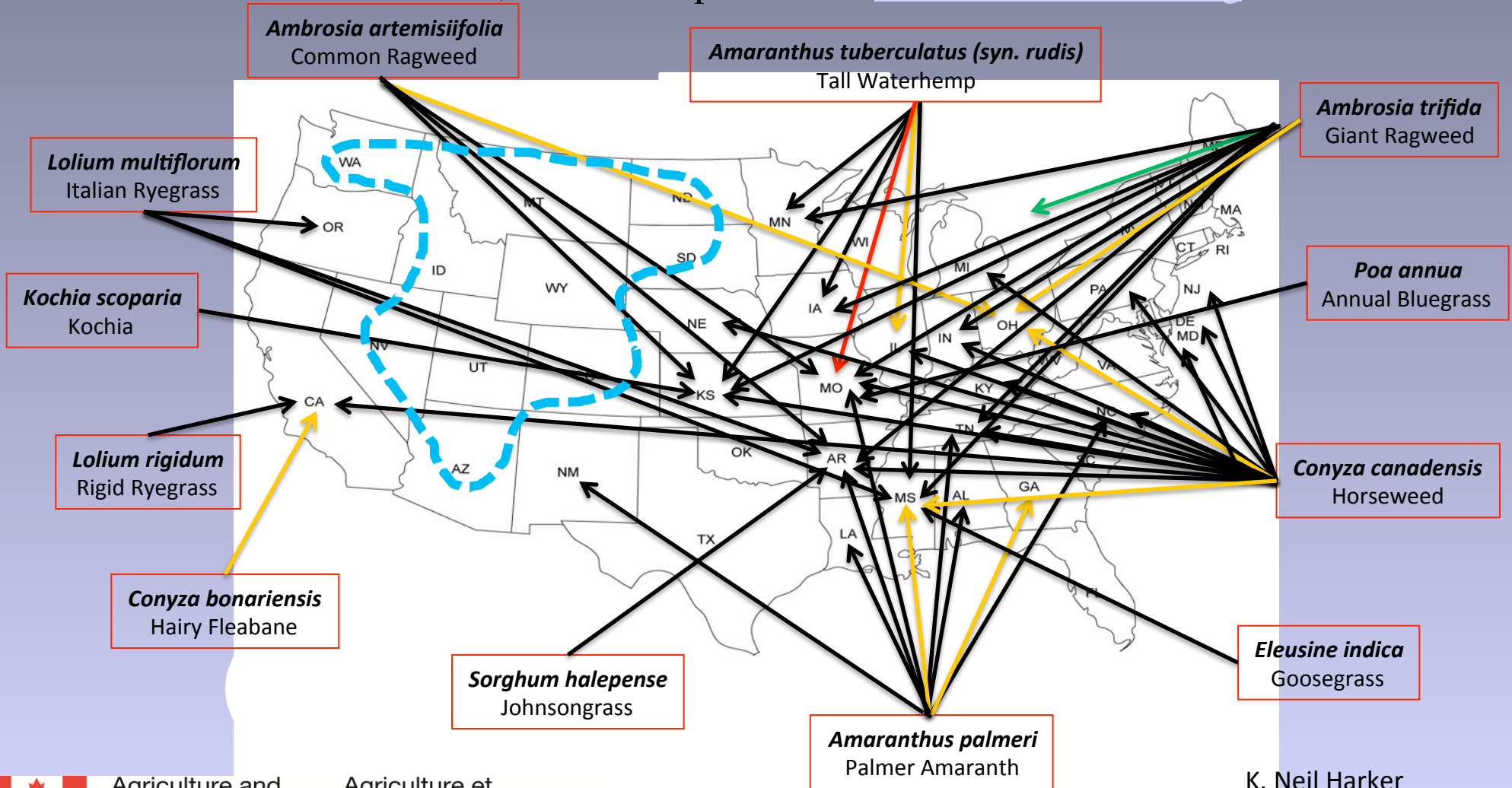
“When any single herbicide mechanism of action is used repeatedly without alternative management tactics, however, selection pressure becomes intense for plants that are tolerant or resistant to that herbicide.”

“There is now a large and growing threat to soil conservation gains because of the dire need... to manage these resistant weeds...”

SOURCE: Council for Agricultural Science and Technology (CAST). 2012. *Herbicide-resistant Weeds Threaten Soil Conservation Gains: Finding a Balance for Soil and Farm Sustainability*. Issue Paper 49. CAST, Ames, Iowa. <http://bit.ly/wc1A5Qq>

Glyphosate- Resistant Weeds – USA

December 13, 2010 – adapted from: www.weedscience.org



Where to get more information on the issues?



ucbiotech.org

SCIENCE-BASED INFORMATION & RESOURCES ON AGRICULTURE, FOOD & TECHNOLOGY

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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 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.





Genetically Engineered Plants and Foods: A Scientist's Analysis of the Issues (Part I)

Peggy G. Lemaux

Department of Plant and Microbial Biology, University of California, Berkeley, California 94720; email: lemauxpg@nature.berkeley.edu

Genetically Engineered Plants and Foods: A Scientist's Analysis of the Issues (Part II)

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Key Words

benefits, biotechnology, crops, food safety, genetic engineering, risks

Abstract

Through the use of the new tools of genetic engineering, genes can be introduced into the same plant or animal species or into plants and animals that are not sexually compatible—the latter is a discipline with classical breeding. This technology has led to the commercial production of genetically engineered (GE) crops on approximately 250 million acres worldwide. These crops generally are herbicide and pest tolerant, but other GE crops in the pipeline focus on traits for improved nutrition, enhanced shelf life, and improved drought tolerance. For some farmers and consumers, planting and eating GE crops are acceptable; for others they raise issues about safety and the environment. In Part I of this

Annu. Rev. Plant Biol. 2009. 60:511-59

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Abstract

Genetic engineering provides a means to introduce genes into plants via mechanisms that are different in some respects from classical breeding. A number of commercialized, genetically engineered (GE) varieties, most notably canola, cotton, maize and soybean, were created using this technology, and at present the traits introduced are herbicide and/or pest tolerance. In 2007 these GE crops were planted in developed and developing countries on more than 280 million acres (113 million hectares) worldwide, representing nearly 10% of rainfed cropland. Although the United States leads the world in acres planted with GE crops, the majority of this planting is on large acreage farms. In developing countries, adopters are mostly small and resource-poor farmers. For farmers and many consumers worldwide, planting GE crops and eating

Also in peer-reviewed articles:
Lemaux P.G. *Annual Review of Plant Biology* 2008
and 2009 and ANR Fact Sheets 2006

