How Much Do You Pay for Your Food? Are They the Right Foods?

Peggy G. Lemaux
University of California, Berkeley
http:/ucbiotech.org
http://pmb.berkeley.edu/~lemauxlab

CHINA
$155.06

CANADA
$345.00

Each amount is the total for food for a family of 4 for a week.

INDIA
$39.27

MEXICO
$189.09

Concept by Peter Menzel, Hungry Planet, http://menzelphoto.com/

GERMANY
$500.07

HIGHEST

CHAD
$1.23

LOWEST

USA (California)
$159.18

Where Does California Rank?

Which means $5.68/day/ person

So, what if I told you, I would give you $30 for food for today, would you take it?

But, wait, actually it has to pay for a month of food

And everything else you need to live – shelter, transportation, clothing!!

A student from Sacramento State took me up on the challenge - What happened?

I actually made the $30 last for 3 weeks! I originally weighed 187.6 lbs; I currently weigh 173. I spent the money on bread, peanut butter, jelly and honey...bread to meet the carbs requirement and peanut butter and jelly to meet the protein, fiber, sodium and sugar requirements.

Ricky Lazaro Jr.



Ricky paid attention to what foods he bought – to get a good variety to meet his dietary needs.

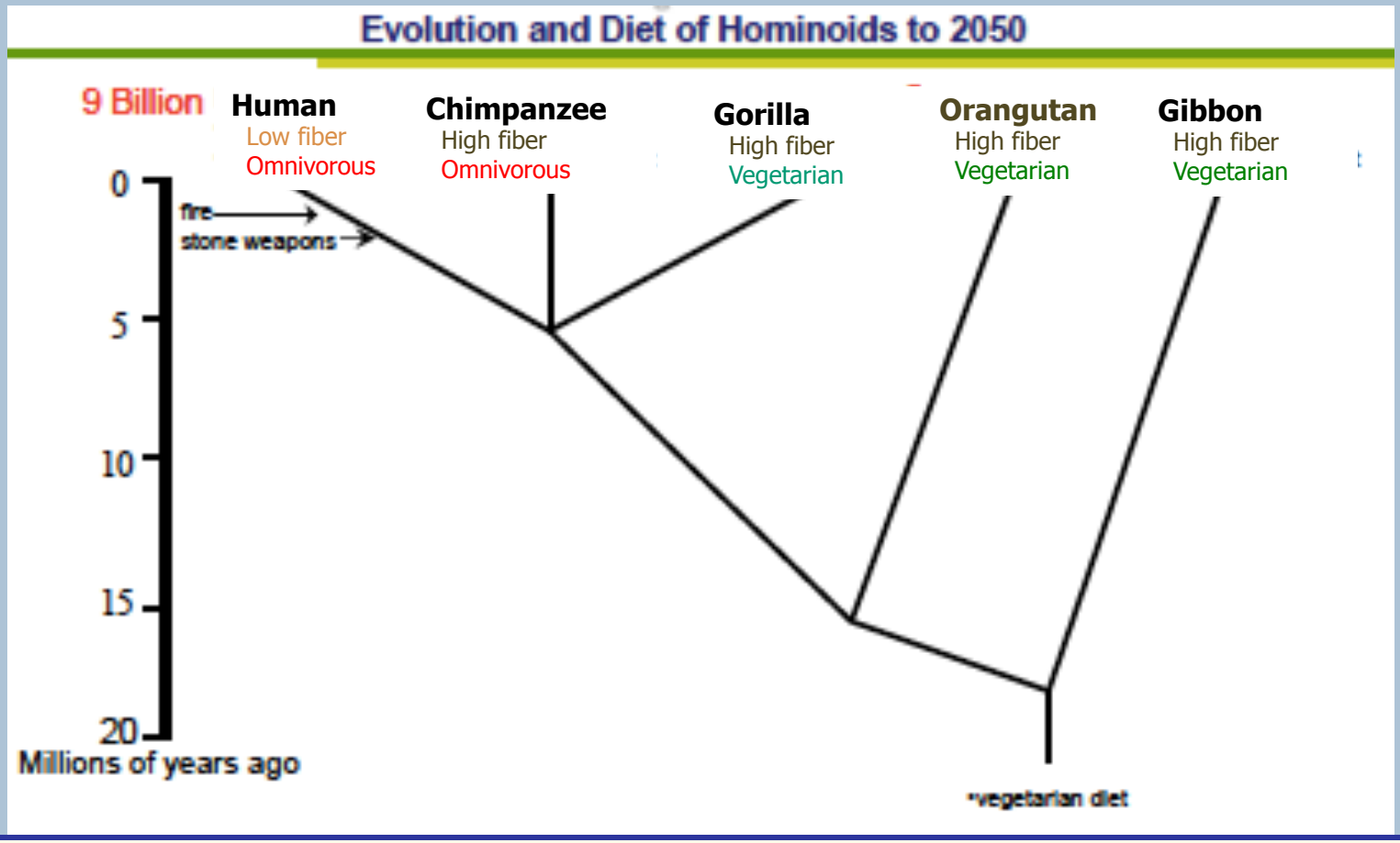
What about a 2012 PHS116 student?

Student's response to the challenge

I lasted 22 days, eating only Texas Toast and bologna…The bread and meat were high calorie, low cost. I did not get vegetables or fruits because they are comparatively expensive.

Did this person make appropriate dietary choices based on his body's health needs?

In general do Americans make appropriate choices? Let's look at the history of food consumption…



Human diets changed over millions of years from high-fiber vegetarian diets for primates to low-fiber omnivorous diets for humans

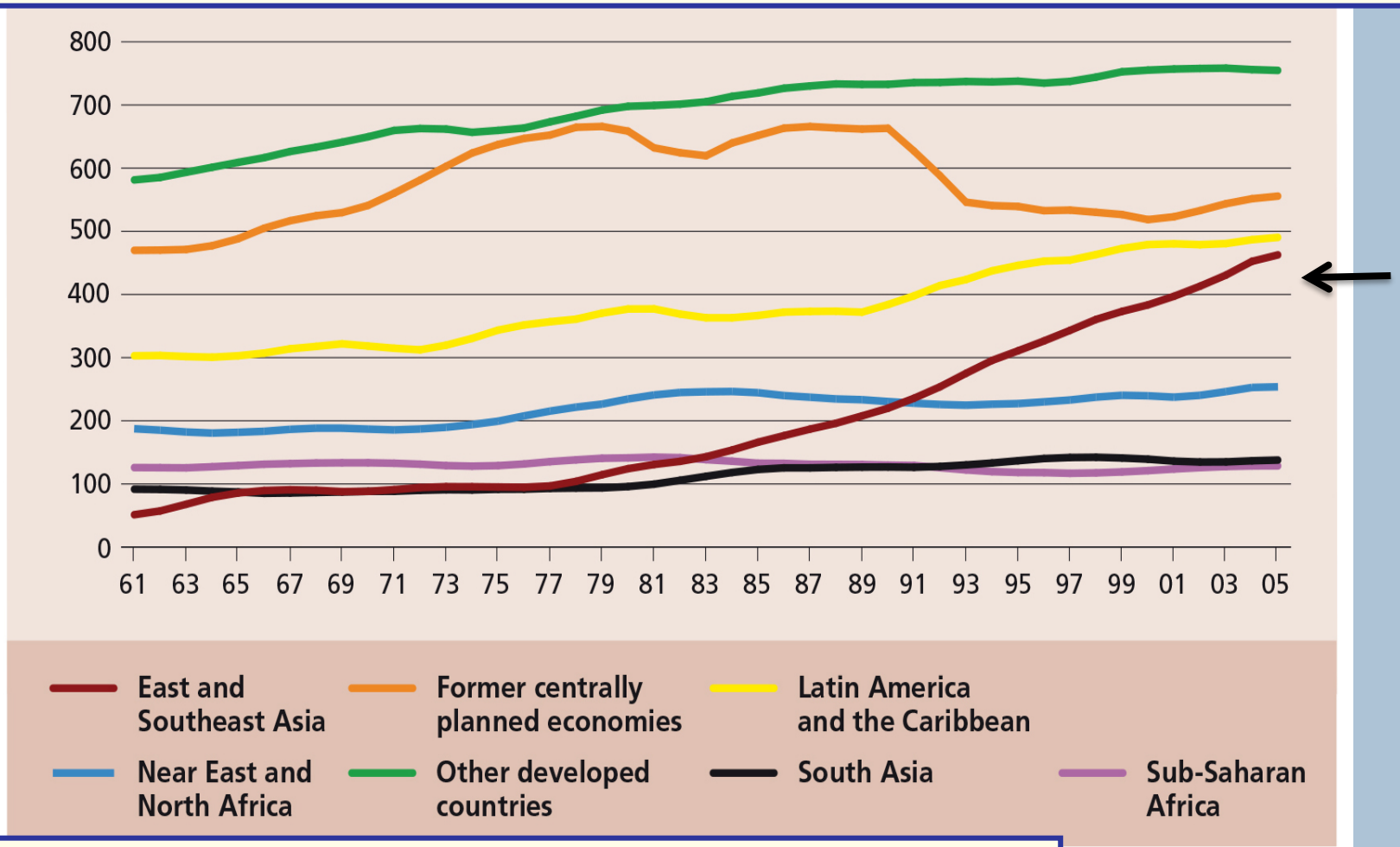
What impact does this have on human health and the environment?

Human Health Effects
Consuming a High-Fiber Diet of Fruits and Vegetables has Lipid-lowering Benefits

	Cholesterol-lowering (Reduced total, saturated fat, cholesterol)	High-Fiber Starch-Based Neolithic	High-Fiber Vegetable-Based Simian
Vegetable Protein (g/d)	28	64	93
Total Dietary Fiber (g/d)	26	46	143
Phytosterols (g/d) (Reduce cholesterol levels)	0.3	0.5	1.0
Nuts (almonds & hazelnuts) (g/d)	0	0	70

Positive health effects from high-fiber, vegetarian diets result in lower serum lipid levels

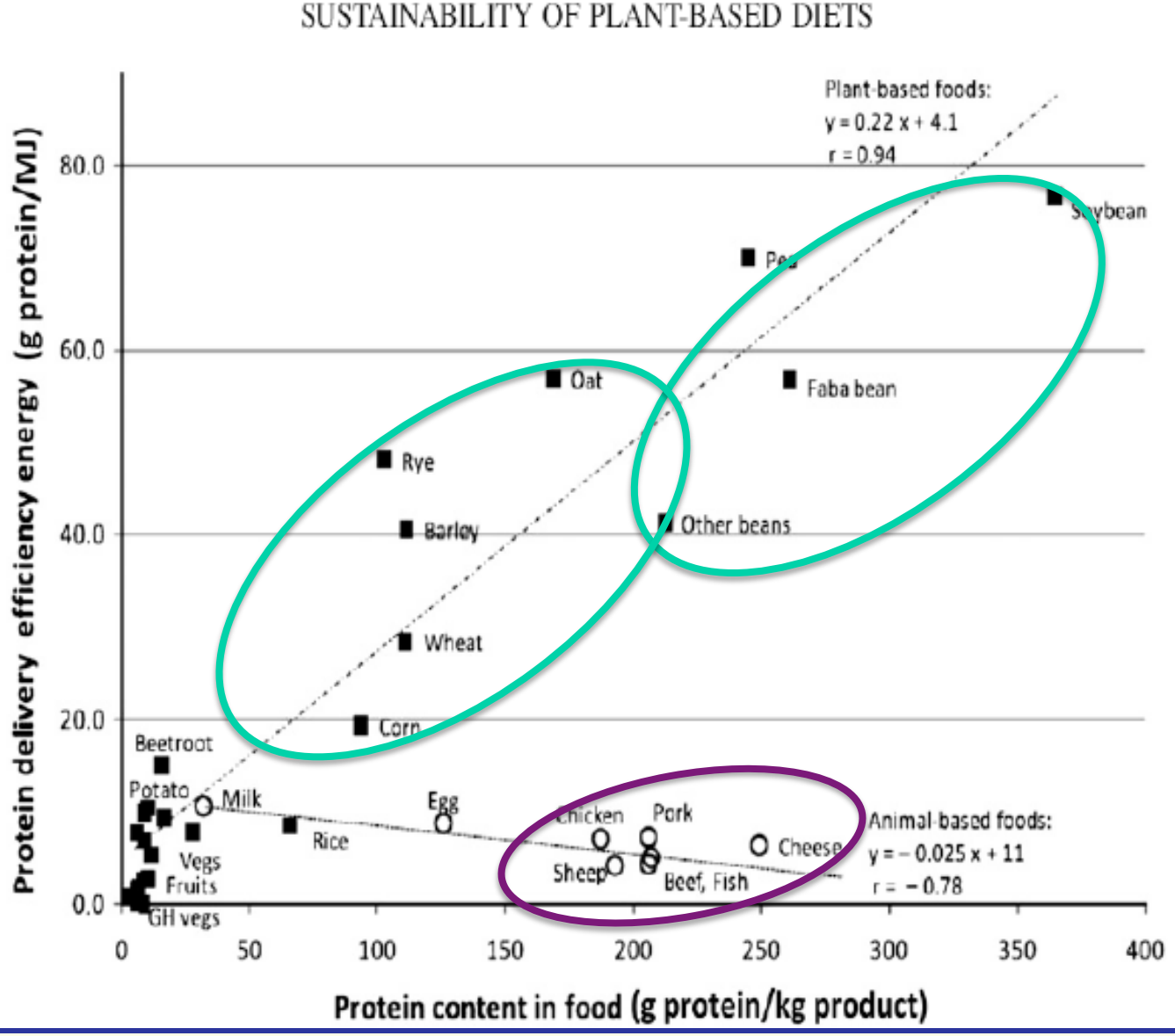
Environmental Effects
Switch from high-fiber, vegetarian diets causes massive increases in meat consumption



Source: FAO, 2009b.

Consumption of Energy via Meat Per Capita Is Rising Rapidly in S.E. Asia

l and agriculture 2009: Livestock in 92-5-106215-9. http://www.fao.org/docrep/012/i0680e/i0680e00.htm



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Why is switching to meat diets an environmental issue? Protein delivery efficiency (energy in vs. energy out) is very different between plant-based foods and meat

So, failure to direct human food consumption to plant-based foods could have major human health and environmental consequences. Conclusion?

Plants ARE IMPORTANT!!

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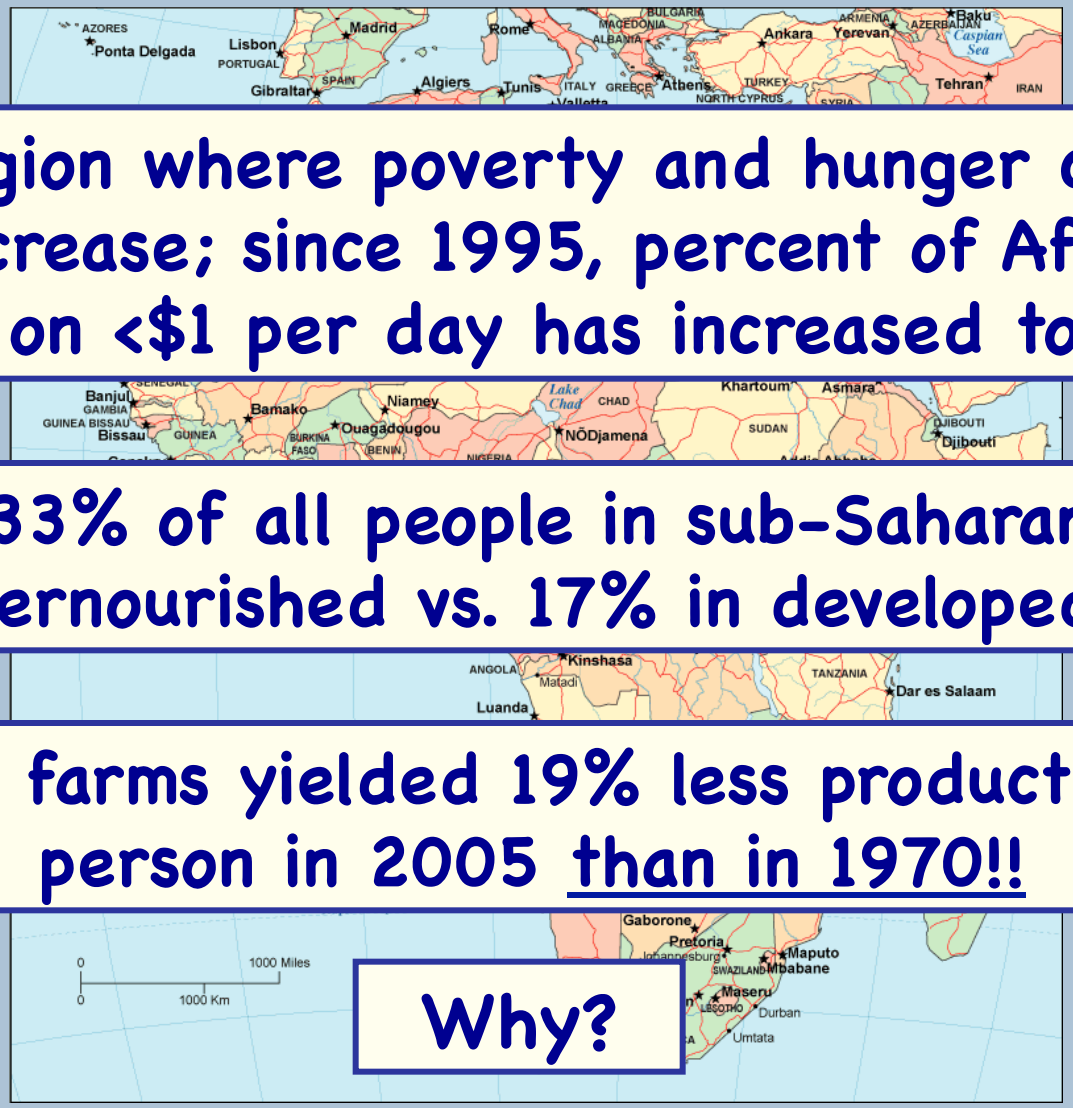
Have you ever thought how lucky you are to have the variety, quality and quantity of plant-based foods to eat?

Availability of such foods in less developed countries, like Africa, requires a different perspective. Why?



Only region where poverty and hunger continue to increase; since 1995, percent of Africans living on <$1 per day has increased to 50%

Almost 33% of all people in sub-Saharan Africa are undernourished vs. 17% in developed world

African farms yielded 19% less production per person in 2005 than in 1970!!

Why?

From "Starved for Science: How Biotechnology Is Being Kept out of Africa" by R. Parlberg 2008

Senegal

United States

Technologies used for agriculture in Africa and other developing countries are different from those in the developed world…

And crop yields are lower in the developing world

CROP	YIELD (kilograms per hectare)			
	Kenya	Ethiopia	India	Developed World
Maize	1,640	2,006	1,907	8,340
Sorghum	1,230	1,455	797	3,910
Rice	3,930	1,872	3,284	6,810
Wheat	2,310	1,469	2,601	3.110
Chickpea	314	1,026	814	7,980

5X

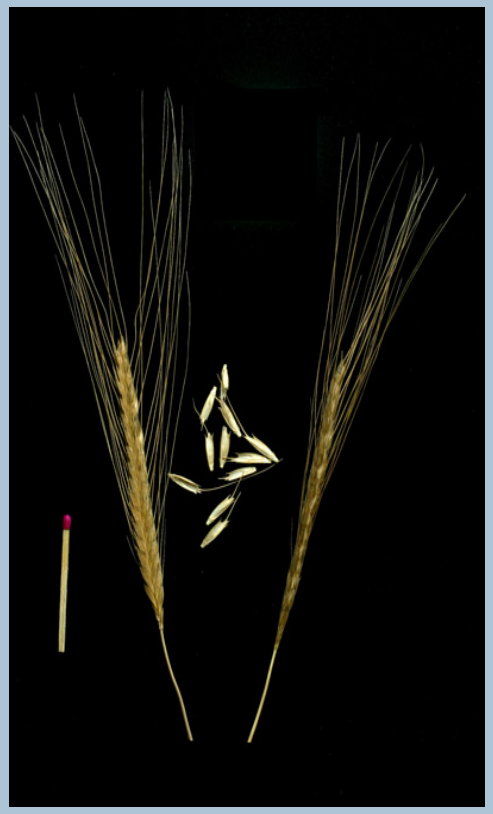
3X

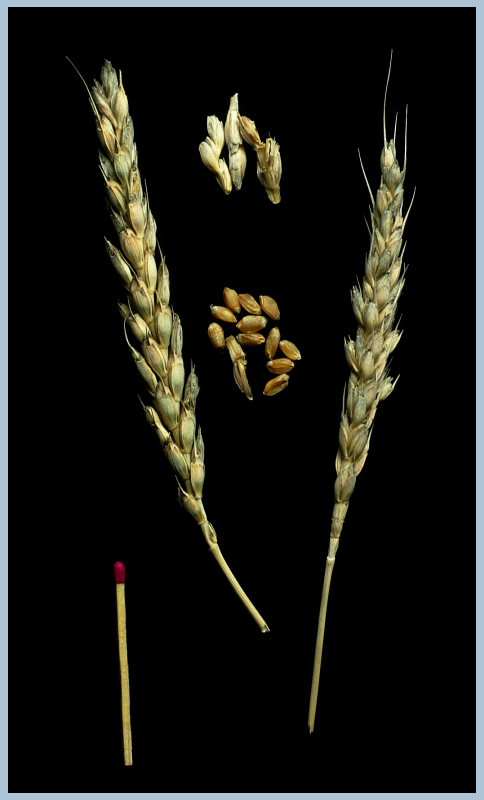
25X

WHY?

Many reasons…one is lack of genetic improvements to give higher yields under their growing conditions.

In the developed world how have genetic modifications been used to increase yields?





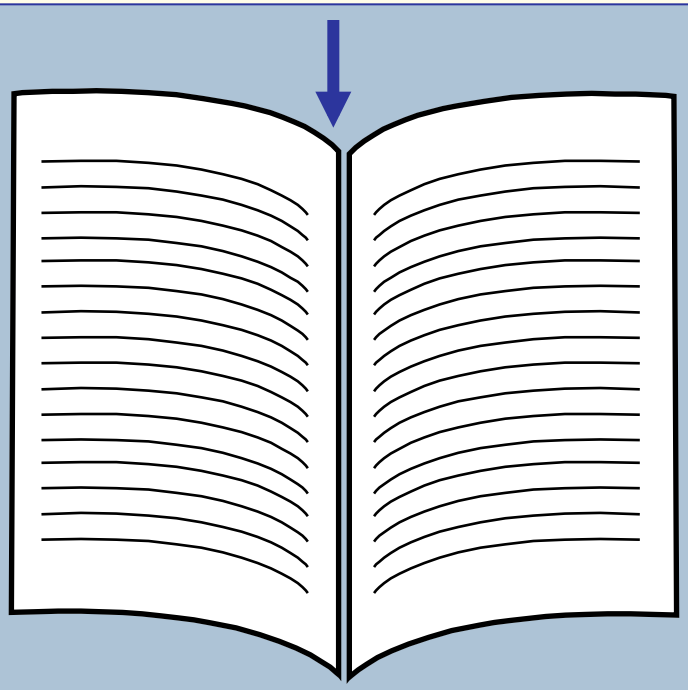
Triticum monococcum
Ancient variety

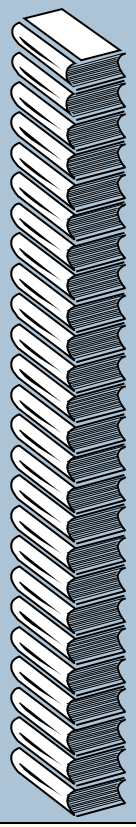
Triticum aestivum
Modern bread variety

Information in the wheat genome

Chemical units represented by alphabetic letters

...CTGACCTAATGCCGTA...



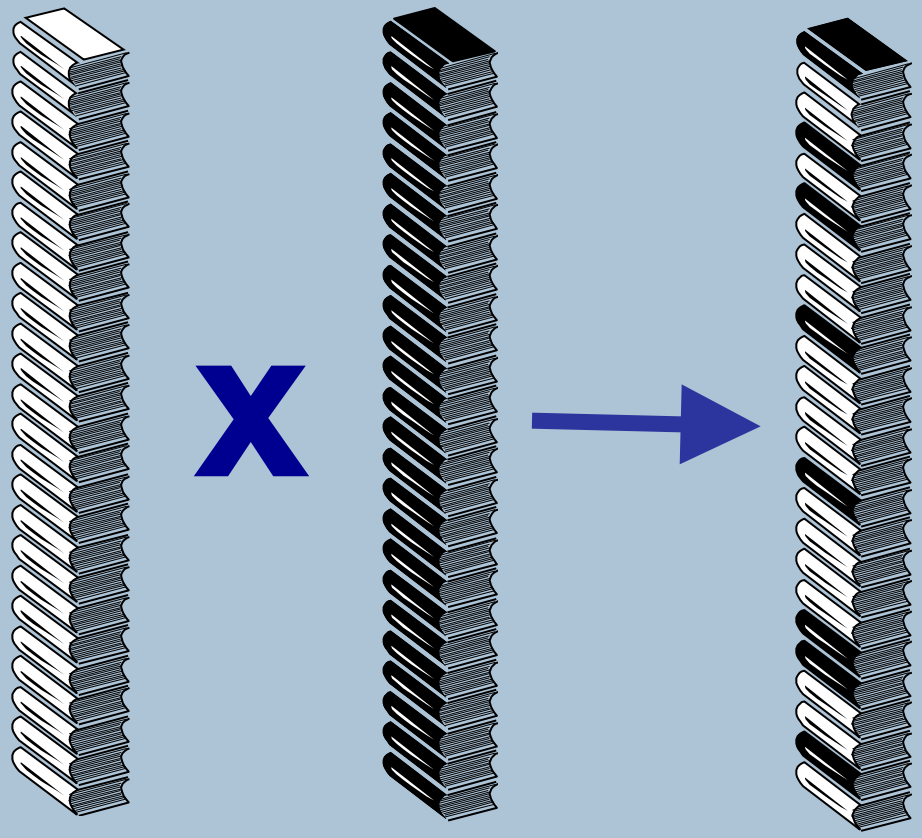


1700 books
1000 pages each

1700 books
(or 1.7 million pages)

Classical breeding

Two wheat varieties with some of the same and some different information in their books



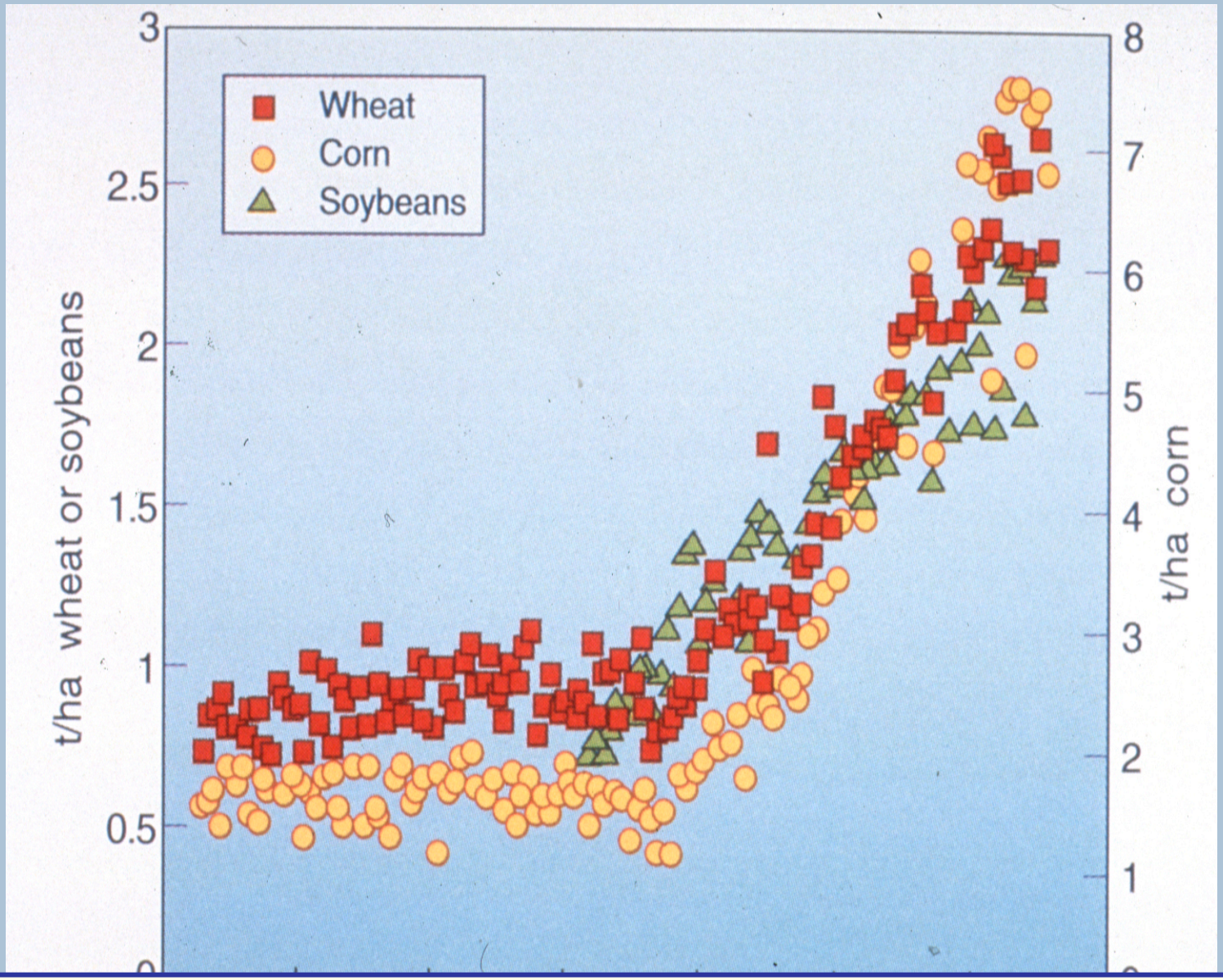
Random retention of information: ~50% from each parent

1700 books (or 1.7 million pages)

1700 books (1.7 million pages)

1700 books (1.7 million pages)

Genetic modification that <u>is not</u> GE or GMO



Since 1930's classical breeding, mechanization and inputs led to dramatic yield improvements


But there are other means to create new varieties through genetic modification
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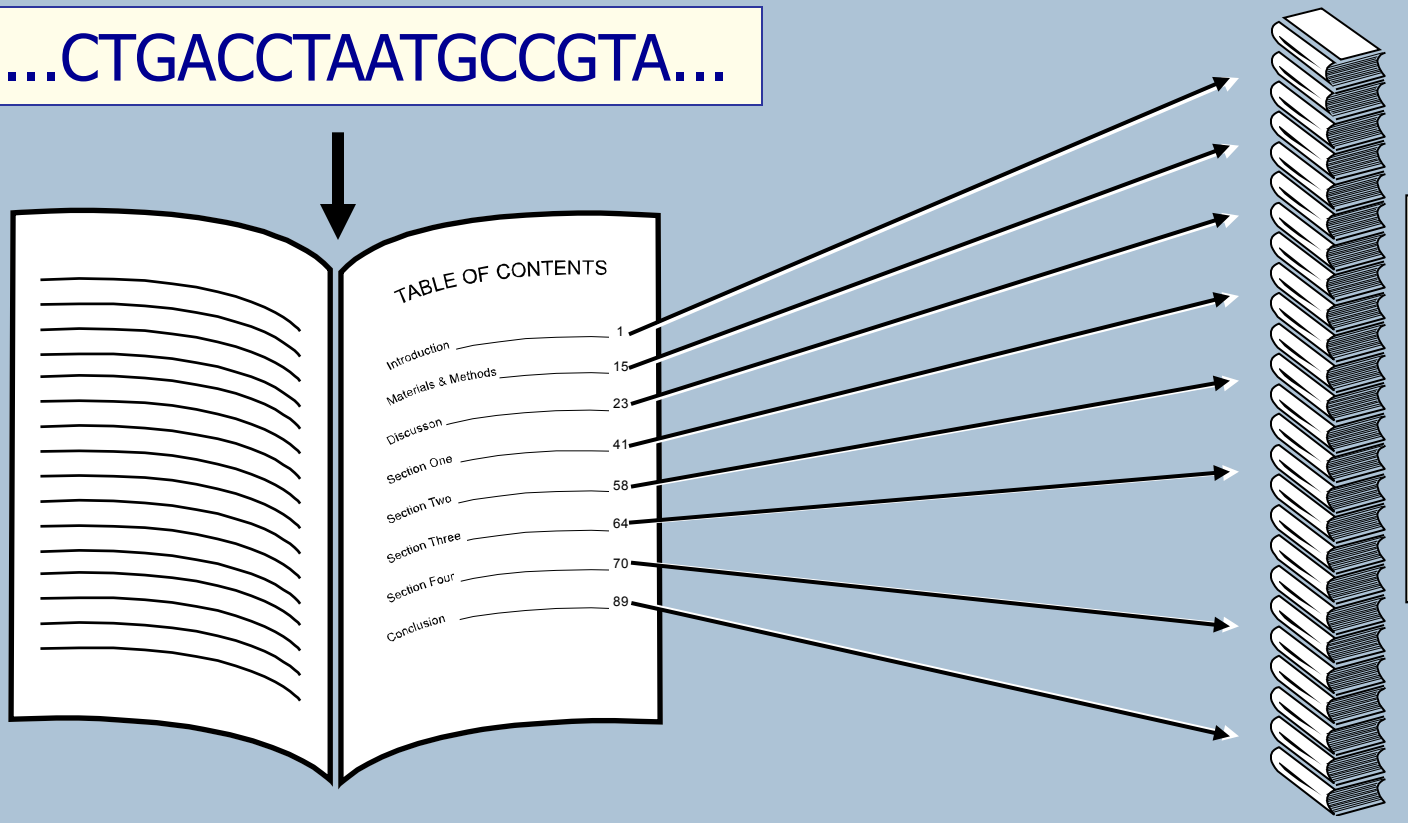
Marker-Assisted Breeding

...CTGACCTAATGCCGTA...



Uses a table of contents for wheat genes

Genomics

1700 books
(or 1.7 million pages)

Genetic modification <u>that is not</u> GE or GMO

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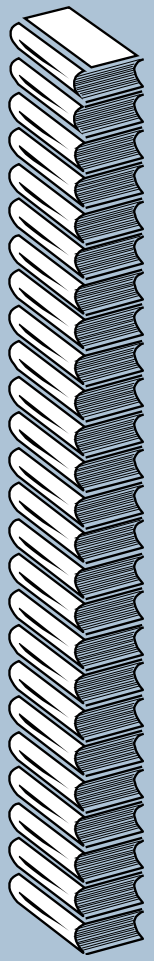
Marker-assisted breeding in rice to protect it against bacterial blight and blast disease

Limited to diversity in compatible relatives

How can these limitations be overcome?

Genetic Engineering (GE) or GM



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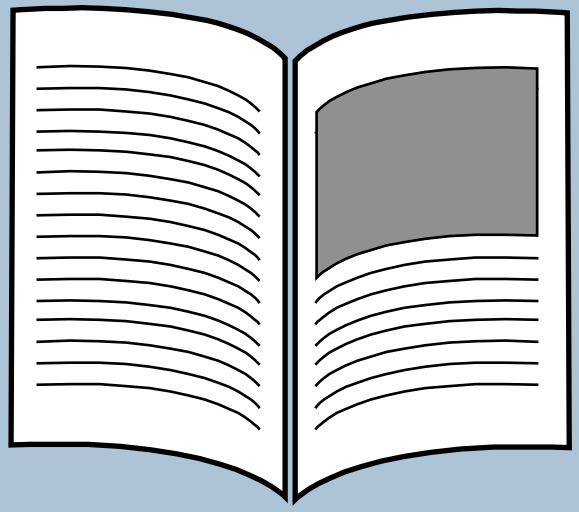
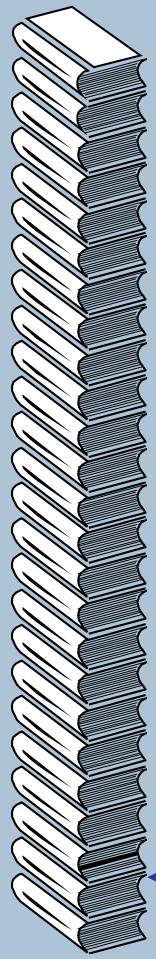


One-half page
equivalent to a gene



Inserts
randomly
in genome

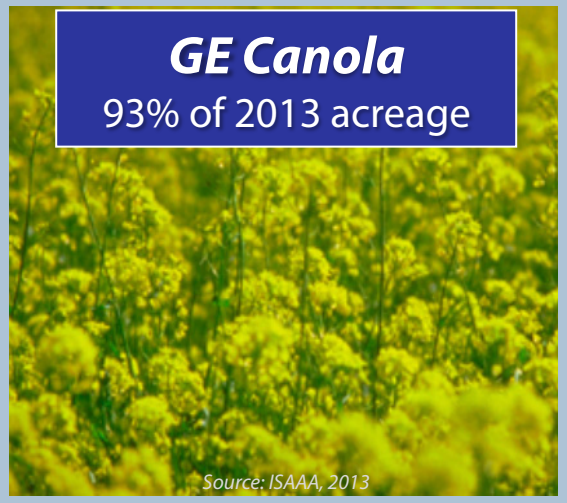
Inserted
gene(s)

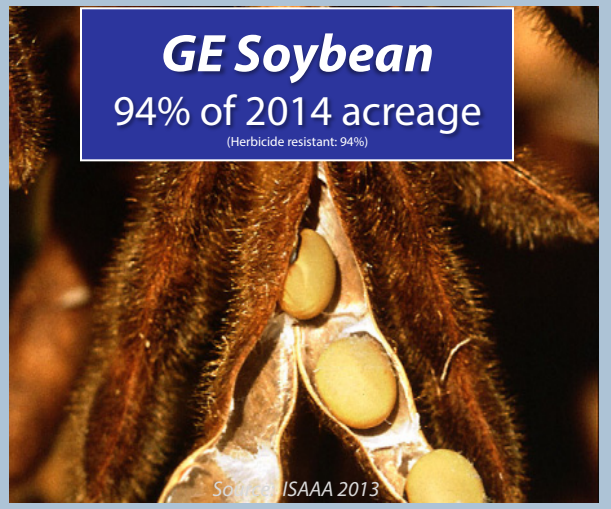
1700 books
(1.7 million pages)

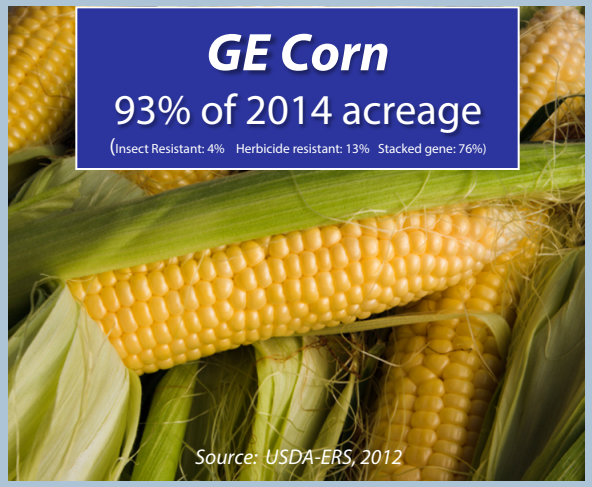
Genetic modification
that is GE and GMO

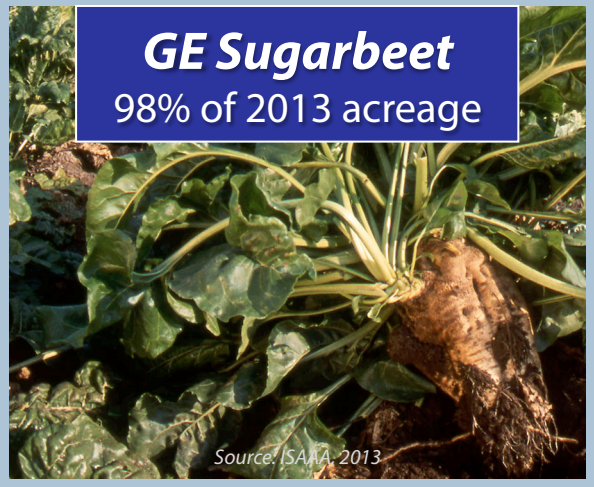
1700 books
(1.7 million pages)

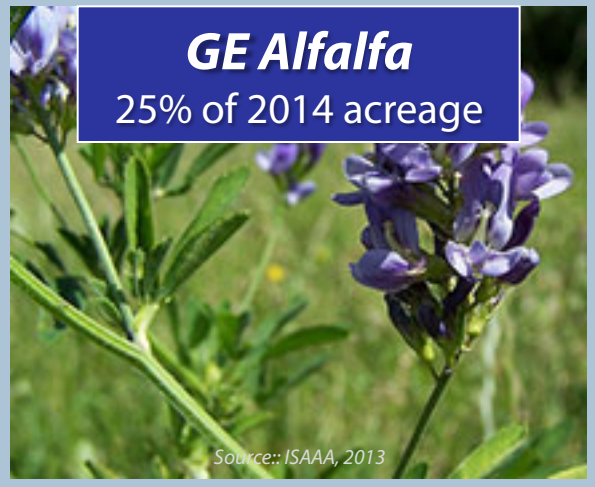
U.S. has these GE varieties in commercial fields











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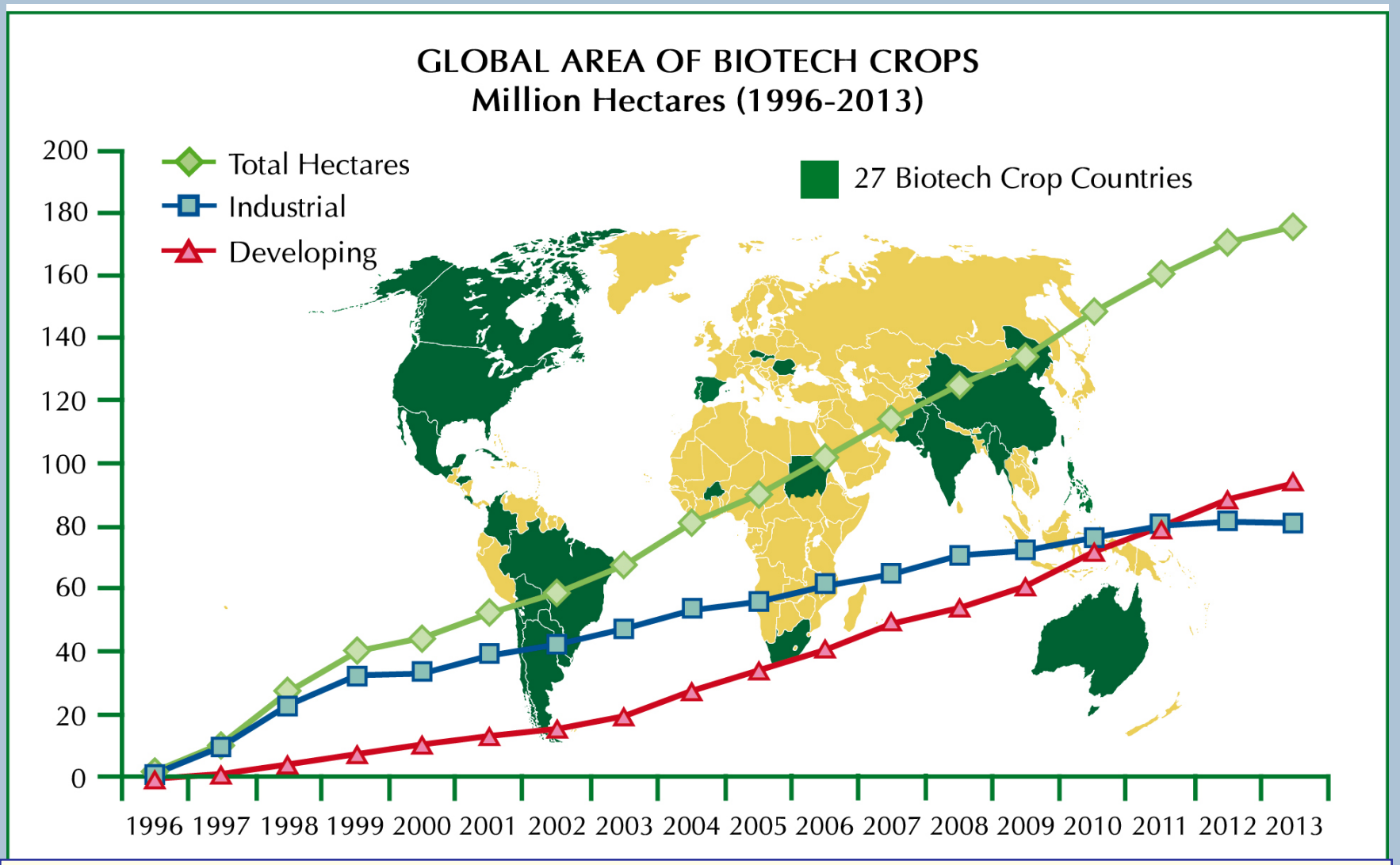
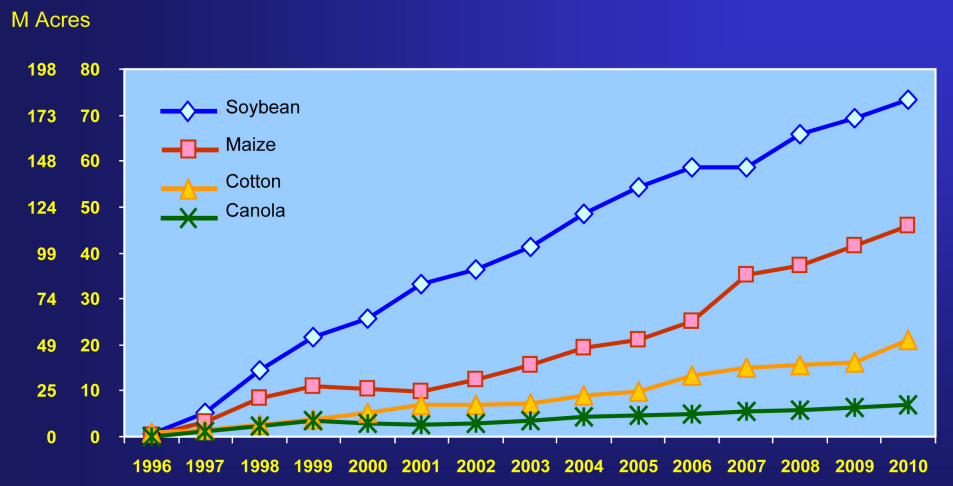


Some crops also grown in developing countries. 2013 figures indicate 15.4 million farmers in 27 countries planted an area >3X size of California; >90% small acreage farmers

But only three African countries grow GE crops now – mostly insect-resistant maize

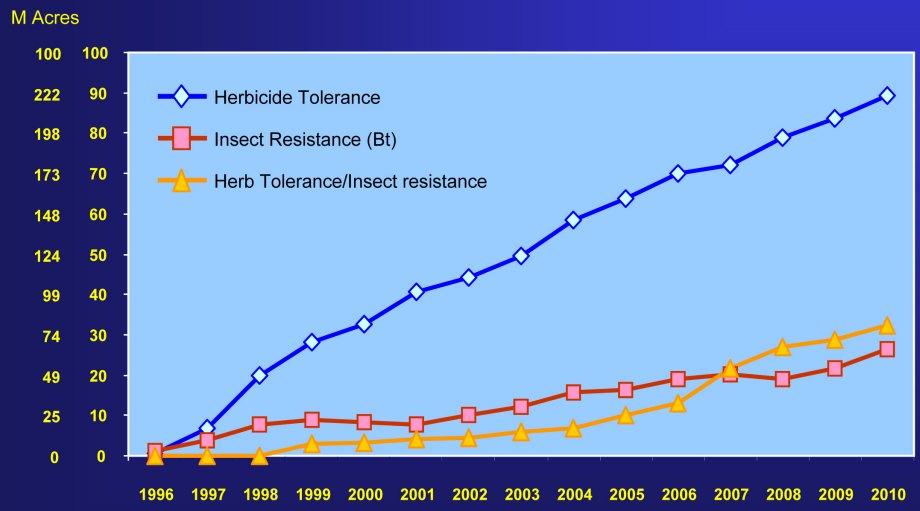
Advances for African farmers only in limited crops – not necessarily those of most value and…

Global Area of Biotech Crops, 1996 to 2010: By Crop (Million Hectares, Million Acres)



Source: Clive James, 2010

Global Area of Biotech Crops, 1996 to 2010: By Trait (Million Hectares, Million Acres)



Source: Clive James, 2010

…the number of traits is also limited – herbicide and insect resistance.

Why?

More of world's crops are genetically engineered

By Elizabeth Weise, USA TODAY

Lemaux: "Because of expenses involved, creating engineered crops for developing countries requires humanitarian contributions by philanthropists, like Gates and Rockefeller Foundations, or perhaps by companies who see value in such endeavors."

Although academic scientists want to play a meaningful role, they have limited resources to do so.

farmland, up from nothing just 15 years ago.

SOURCE: "More of world's crops are genetically engineered", USA Today, February 23, 2011.
http://www.usatoday.com/tech/news/biotech/2011-02-22-biotech-crops_N.htm

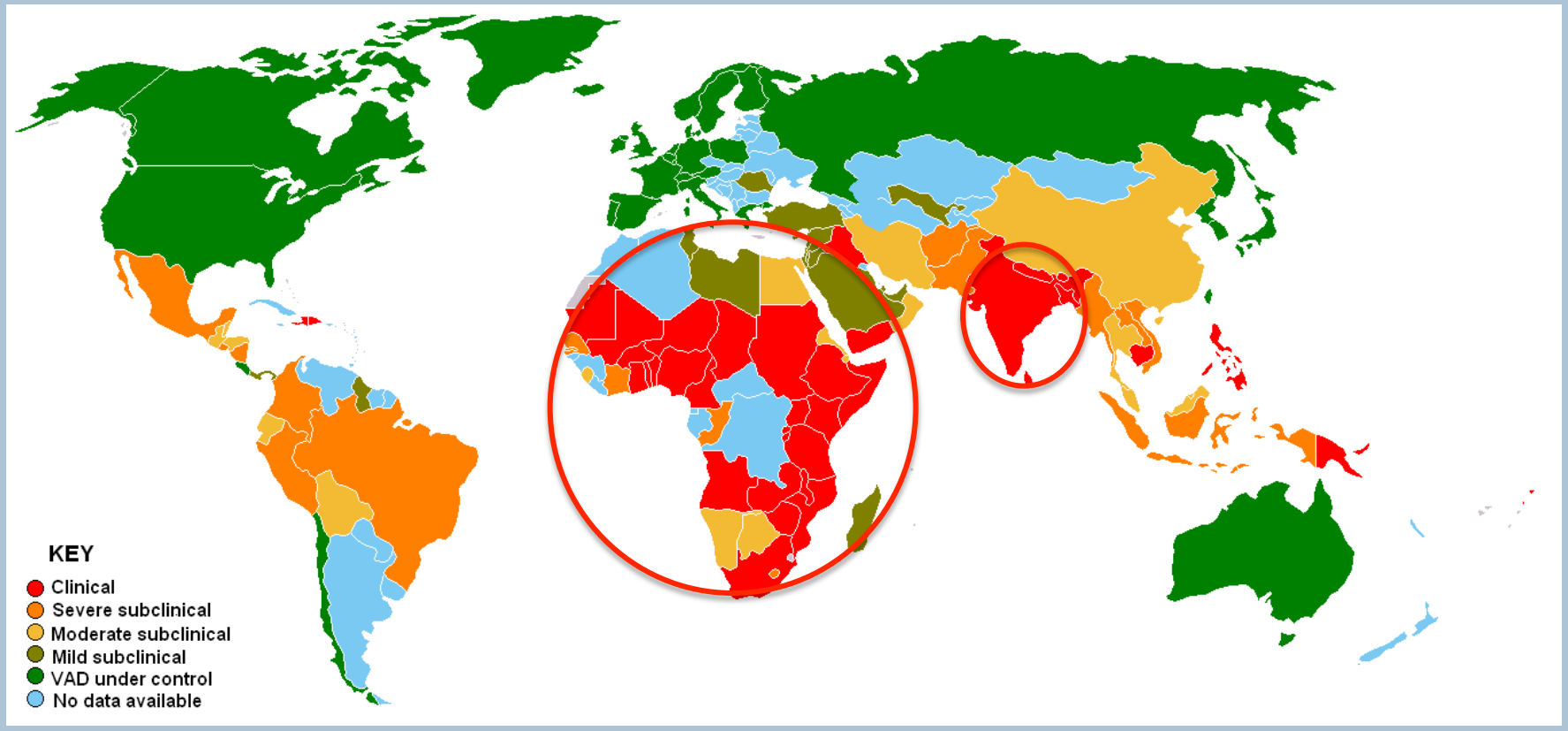
So, can such groups use genetic engineering to modify crops to benefit developing countries?

Two public sector efforts to genetically engineer crops for developing countries

Vitamin A-enriched Golden Rice

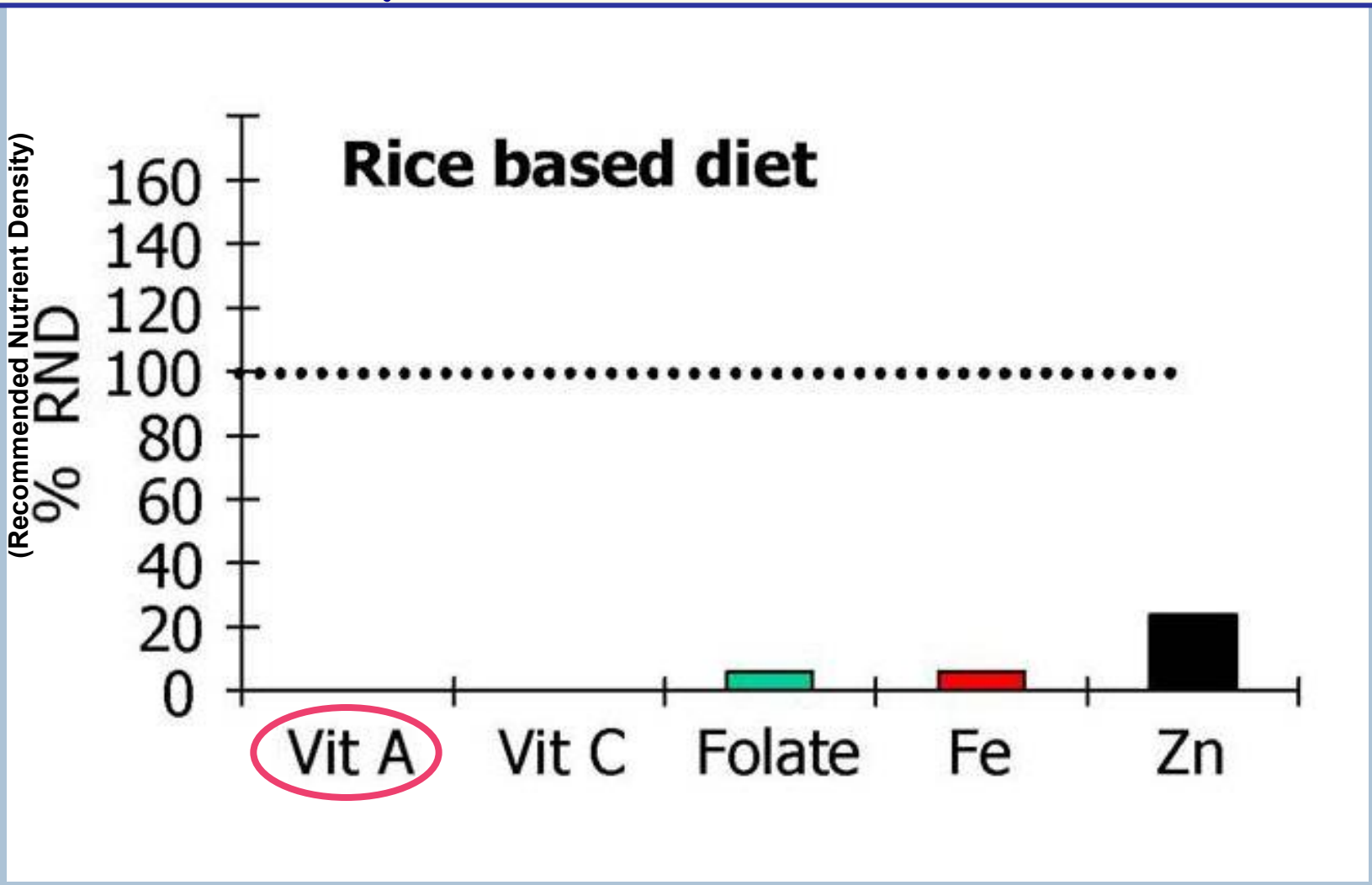
Nutritionally Enhanced Banana

Vitamin A deficiency (VAD): Severity of health impact



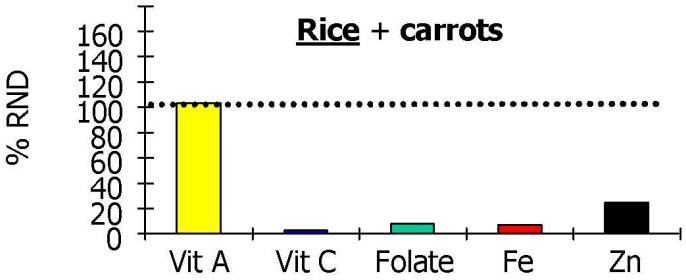
VAD causes: mortality, blindness, night blindness, impaired immunity system, impaired brain development
Consuming too much: toxic, birth defects

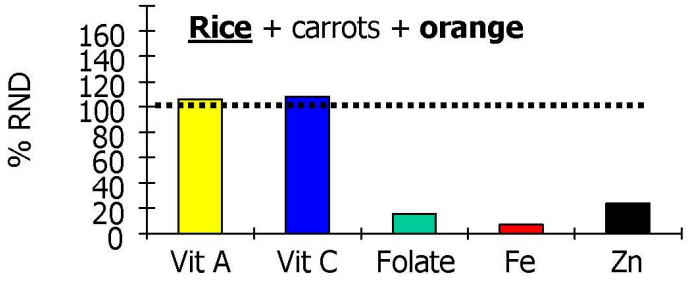
Rice: predominant diet in many developing countries but poor source of vitamins, minerals

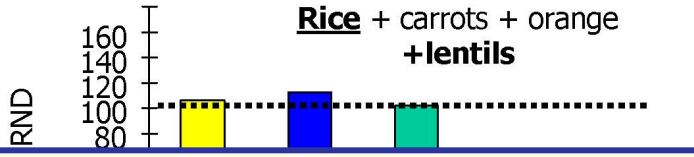


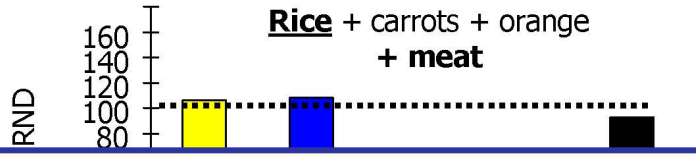
From: "Nutrition: A Cornerstone for Human Health and Productivity", Richard J. Deckelbaum. Seminar, Earth Institute of Columbia University, April 14, 2005

Modified from G. Barry, IRRI

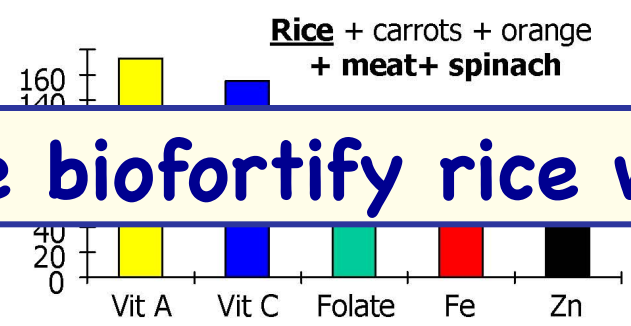


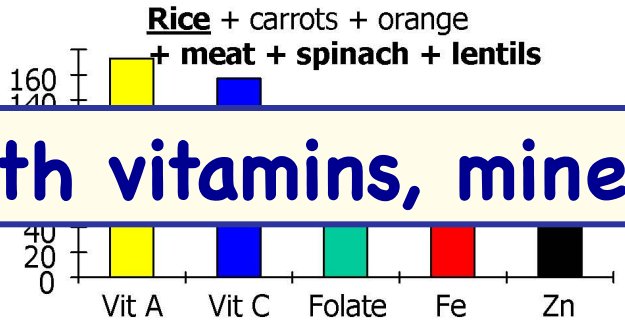






…but not everyone has that luxury!!





Can we biofortify rice with vitamins, minerals?

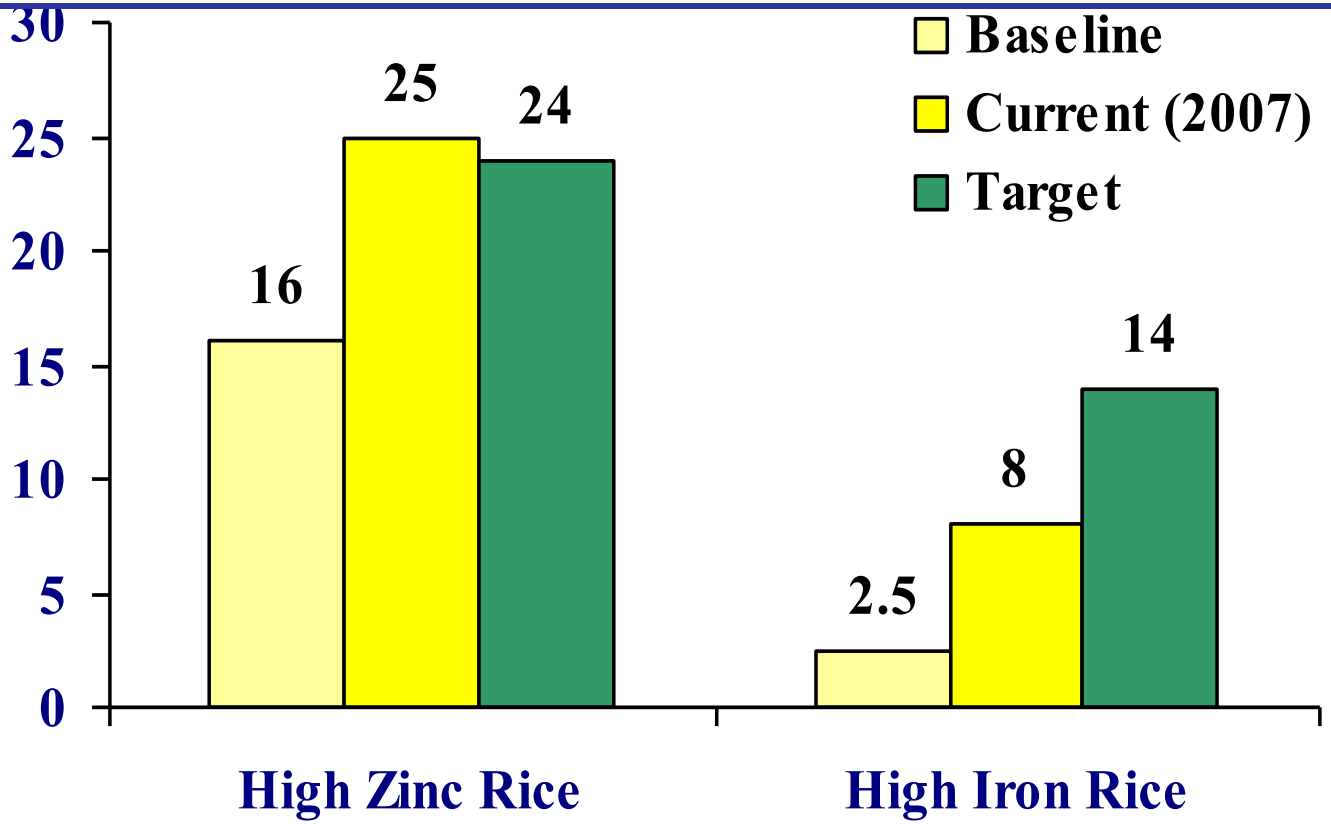
Rice diets can be supplemented with fruits, vegetables and meat to get needed nutrients…

Modified from G. Barry, IRRI

: "Nutrition: A Cornerstone for Human Health and Productivity", Richard J. Deckelbaum. Seminar at The Earth Institute of Columbia University, April 14, 2005

Rice with increased iron and zinc made by classical breeding using other rice varieties with these traits…

But increasing vitamin A not possible as there are no compatible varieties with high vitamin A levels.



E. Boncodin, Fedl Budget Secy Manila Philippines

Rice engineered with plant and bacterial genes to make provitamin A, converted to vitamin A in body

But could it help?

Half of child's Vitamin A needs provided with normal portion of Golden Rice 2

NO MAGIC BULLET

NEW YORK TIMES

SUNDAY, AUBUST 25, 2013

NEWS ANALYSIS

Golden Rice: Lifesaver?

By AMY HARMON

Published: August 24, 2013 408 Comments

STEVE CARELL
TONI COLLETTE

ONE bright morning this month, 400 protesters smashed down the high fences surrounding a field in the Bicol region of the Philippines and uprooted the genetically modified rice plants growing inside.

Enlarge This Image

Jes Aznar for The New York Times

Genetically engineered Golden Rice grown in a facility in Los Baños, Laguna Province, in the Philippines.

Despite potential positive health effects, activists in 2013 destroyed field trial of Golden Rice in the Philippines

Why?
What was said:
"GMOs, like Golden Rice, threaten continuation of life on our planet – far worse than nuclear war"

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Nutritionally Enhanced Banana

Bananas are the world's most important fruit crop - the staple food of Uganda

But there are major micronutrient deficiencies in Uganda:

Vitamin A deficiency (VAD)

Iron deficiency anemia (IDA)

Enhancing vitamin A in banana using Golden Rice strategy

(accomplished by Australian and African scientists)

Control
1.25 ug/g dwt βCE

Exp1>APsy2a
9.96 ug/g dwt βCE

Ubi>APsy2a
16.10 ug/g dwt βCE

ucbiotech.org

13-fold increase in Vit. A levels

But engineered bananas, developed specifically for the poor are stuck in field trials because governments are reluctant to approve GE crops due to lobbying by opponents.

http://www.chathamhouse.org/expert/comment/15204]

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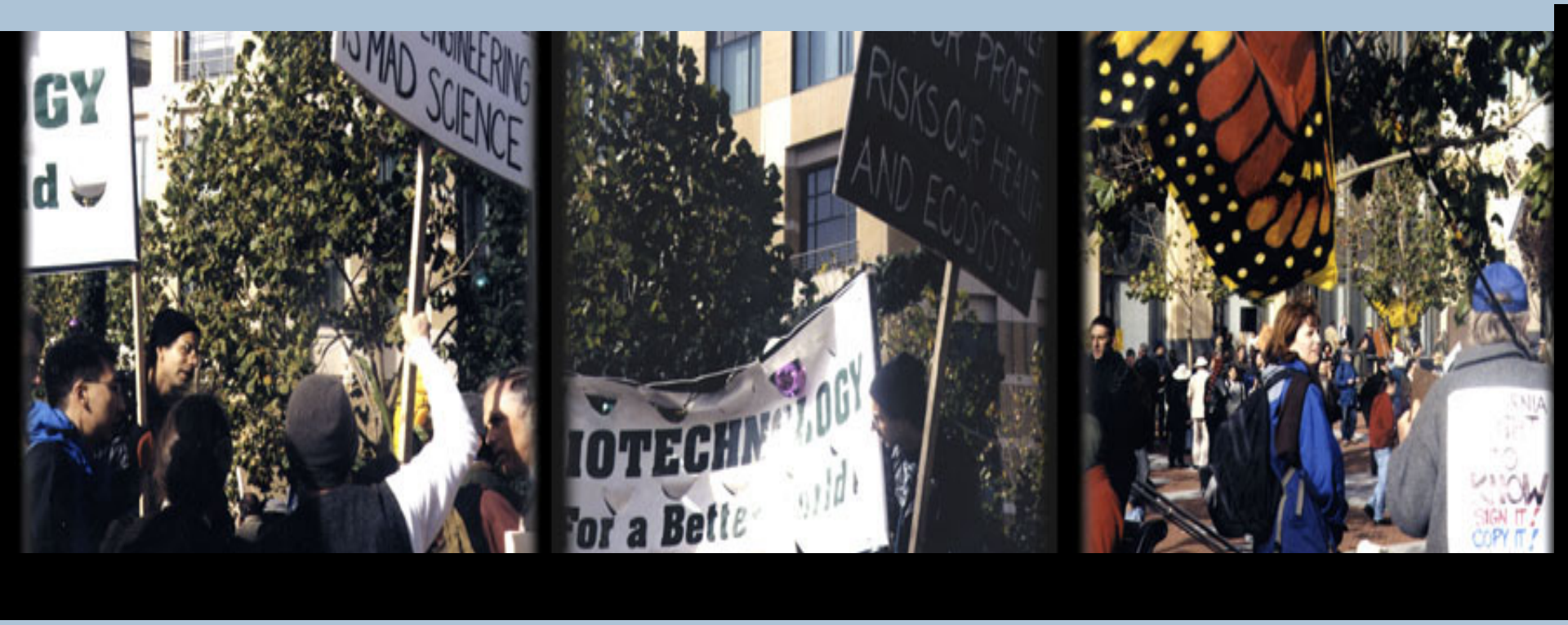
What Are Some Issues with GE Crops?



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Food safety issues?

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

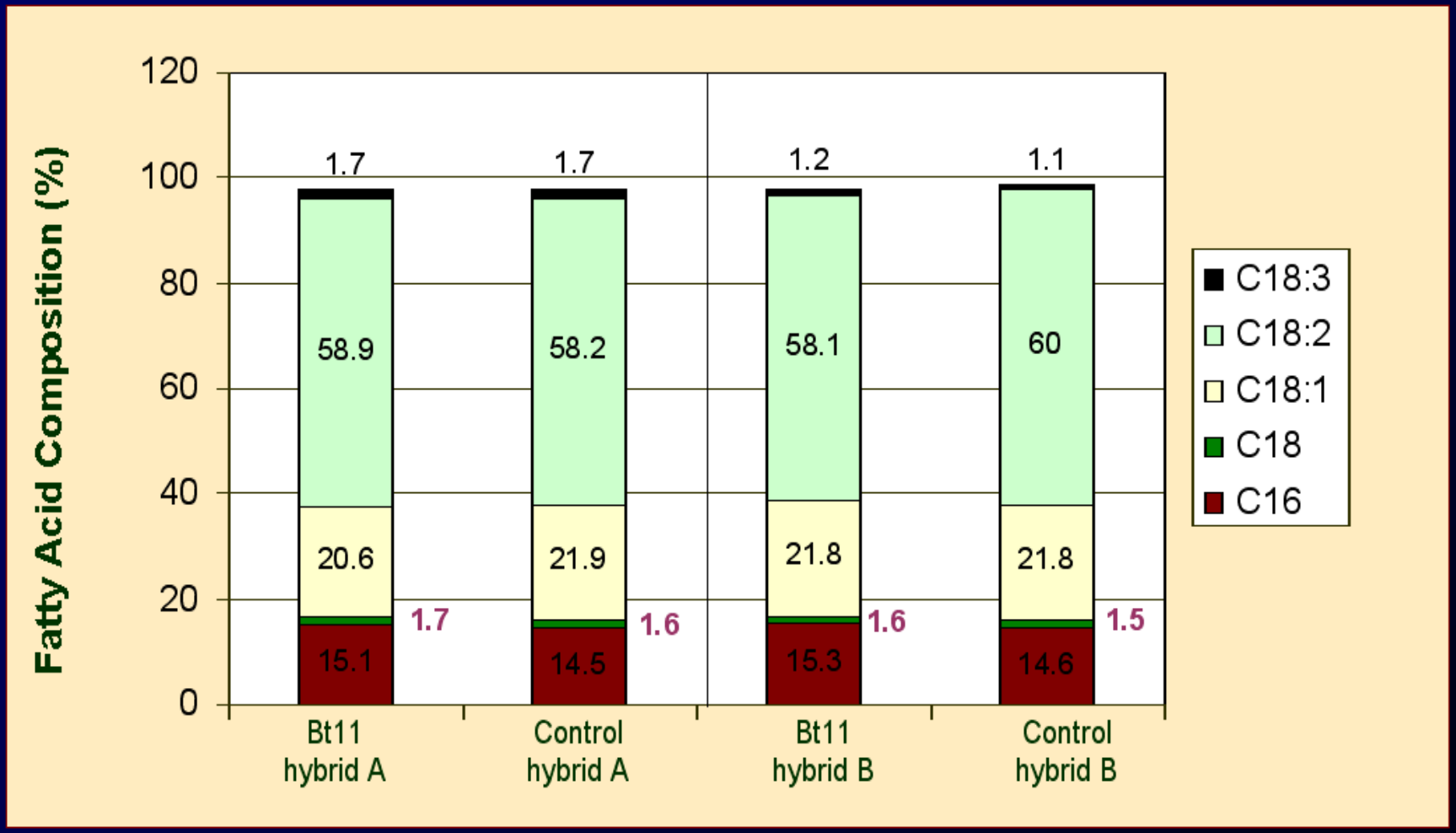
FDA uses the concept of substantial equivalence for regulatory approval

Modified food has essentially all characteristics of nonmodified food except for introduced genetic material and products made from it.

These products are tested and analyzed separately for specificity and mode of action of protein, source of protein, stability during digestion and processing, toxicity

SOURCE: Safety of Genetically Engineered Foods: Aproaches to Assessing Unintended Health Effects 2004. Natl Acad Press

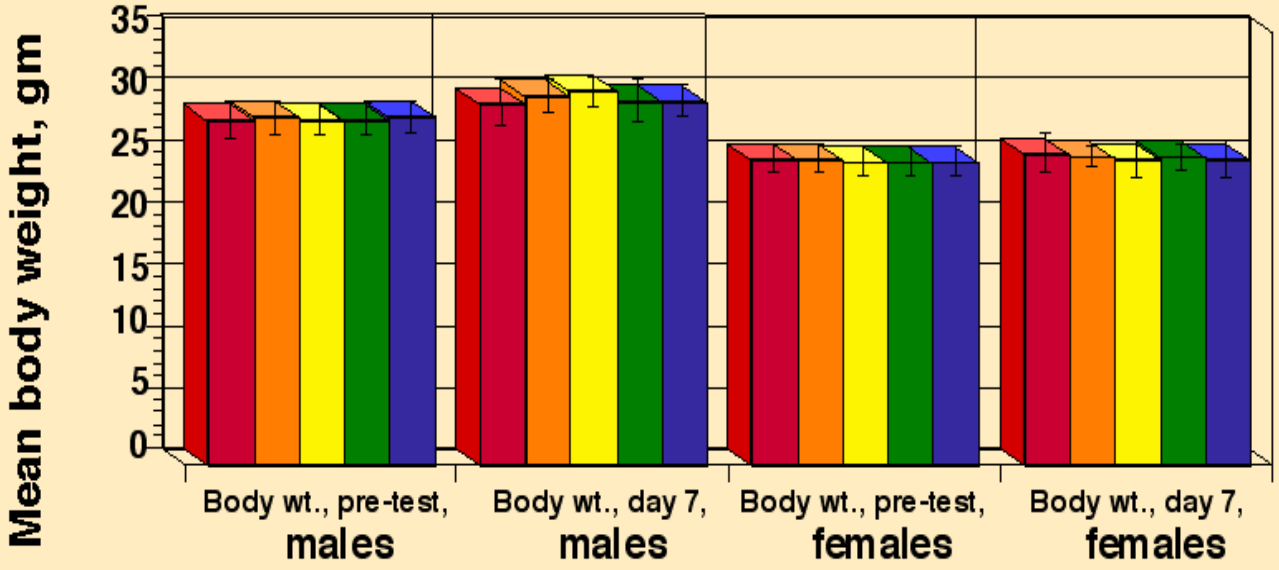
Substantial Equivalence: Fatty Acids



These results have been generated on Event Bt 11. Data showing similar fatty 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)



But on occasion there are widely cited studies casting doubts on GE food safety, like one in Sept. 2012 by French researcher

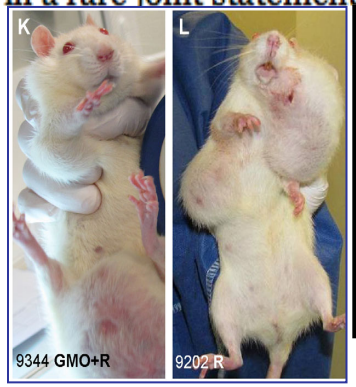
Later reviewed by European Food Safety Authority who found study had no merit – but did anyone notice that?

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.

eport's author, Gilles-Eric Séralini, with his book All eapigs
Jacques Demarthon



Claim that Monsanto's RR corn causes tumors in rats

"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.

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Metaanalysis, also from France, published earlier in same journal

12 long-term (>90d to 2yr) and 12 multigenerational (2 to 5 generation) animal feeding trials of GE feed concluded GE foods are nutritionally equivalent to non GE foods and can be safely consumed in food and feed.

maize

potato

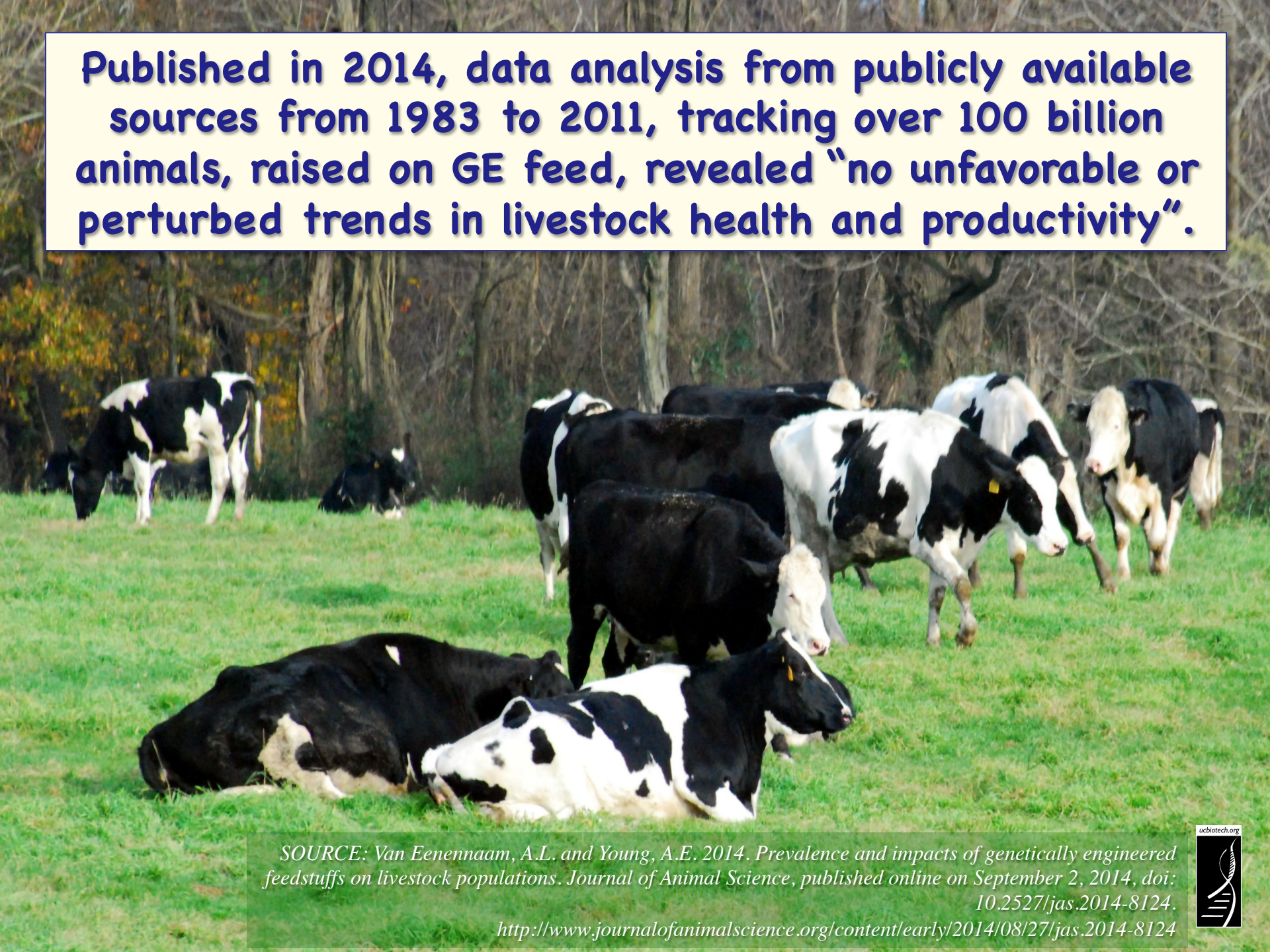
soy

rice

triticale

SOURCE: Snell C, Bernheim A, Berge J-P, Kuntz M, Pascal G, Paris A, Ricroch AE. 2012. Assessment of the health impact of GM plant diets in long-term and multigenerational animal feeding trials: A literature review. Food and Chemical Toxicology 50: 1134-1148.

Published in 2014, data analysis from publicly available sources from 1983 to 2011, tracking over 100 billion animals, raised on GE feed, revealed "no unfavorable or perturbed trends in livestock health and productivity".



SOURCE: Van Eenennaam, A.L. and Young, A.E. 2014. Prevalence and impacts of genetically engineered feedstuffs on livestock populations. Journal of Animal Science, published online on September 2, 2014, doi: 10.2527/jas.2014-8124.
http://www.journalofanimalscience.org/content/early/2014/08/27/jas.2014-8124

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Some environmental issues?

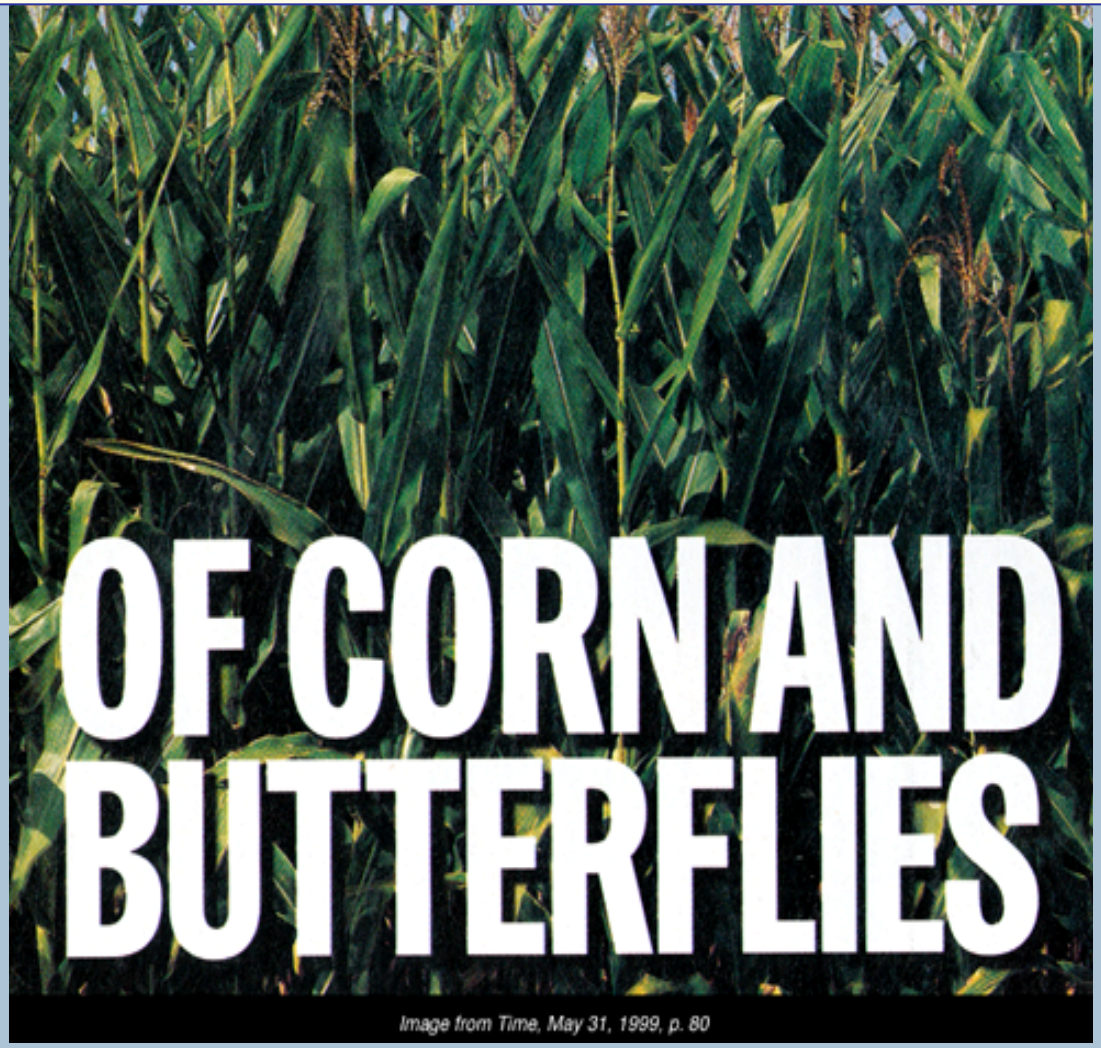
- Loss of efficacy of engineered trait?
- What are some regulatory issues?
- Property rights (gene patents)?
- Transfer of engineered genes to non-GMO/ organic crops?
- Spread of pharmaceutical genes into crops?
- Loss of genetic diversity?

Insect Resistance

B.t. cotton and corn engineered for insect resistance with gene(s) from naturally occurring bacterium.

To date minimal insect resistance has occurred

In late 90's negative impact of Bt corn pollen on monarchs surfaced. After much research, effects were found to be minimal, but...



Capital Press
Agriculture Newspaper

Groups seek glyphosate limits to protect butterflies

By MATEUSZ PERKOWSKI
Capital Press

Environmental groups seeking federal protection for monarch butterflies blame the use of genetically modified crops for the insect's steep decline.

Petitioners claim that while there were as many as 1 billion monarchs as recently as the 1990s, their numbers have dropped to around 33 million.

If the U.S. Fish and Wildlife Service agrees to list the species as threatened or endangered, protecting the insect may involve pesticide restrictions that affect biotech crops.

The alleged link between transgenic crops and the drop in monarch butterfly populations is milkweed, a plant that monarch larvae feed upon exclusively.

"A primary threat to the monarch is the drastic loss of milkweed caused by increased and later-season use of the herbicide glyphosate in conjunction with widespread planting of genetically engineered corn and soybeans in the Corn Belt region of the United States and to planting of genetically engineered cotton in California," the environmentalist petition said.

In the past, many herbicides had trouble killing milkweed because it's a perennial that regenerates from its roots, said Bill Freese, science policy analyst for the Center for Food Safety, a non-profit involved in the petition.

Glyphosate, on the other hand, is absorbed by the plant's roots and destroys it completely, he said.

After glyphosate-resistant biotech crops became common in the 1990s, farmers began spraying much more of the herbicide, Freese said.

They also applied it after crops had begun growing, rather than killing weeds before the crops emerged — the effect was that milkweed was already sprouting and susceptible to the chemical, he said.

"Timing is also a factor," Freese said.

While several types of aggressive weeds have developed resistance to glyphosate due to frequent spraying, hundreds have not, including milkweed, he said. "Each weed is really different."

If the federal government extends Endangered Species Act protection to the monarch butterfly, the listing could result in restrictions on how often glyphosate and other herbicides can be used on crops, Freese said.

As a consequence, farmers may plant fewer acres of genetically engineered crops, since they wouldn't be able to spray the chemicals over the top of crops in certain fields, he said.

The Biotechnology Industry Organization, which represents biotech companies, would not comment on the petition or the effect of transgenic crops on milkweed and monarchs.

Farmers can play a key role in the recovery of the species, said Sarina Jepsen, endangered species program director for the Xerces Society, an environmental group involved in the petition.

"We've seen real leadership from the agricultural sector in restoring habitat for the monarch butterfly," Jepsen said.

If the insect is listed as threatened, the Fish and Wildlife Service could enact 4(d) Special Rules that would allow routine farming practices to continue as long as they don't contribute to the insect's extinction, she said.

Jepsen said she didn't want to speculate about impacts to agriculture at this point, but she said 4(d) rules have been proposed for another butterfly species, the Dakota skipper, which the agency has proposed listing as threatened.

Under those rules, grazing would be disallowed in certain counties in Minnesota and North Dakota and farmers would face restrictions on when they can cut grass for hay.

…Impact of RoundUp on monarchs resurfaces due to impact on milkweed – an exclusive feedstock for butterfly larvae

http://www.capitalpress.com/Nation_World/Nation/20140903/groups-seek-glyphosate-limits-to-protect-butterflies

Herbicide Tolerance

Environmental impact associated with herbicide and insecticide use, as measured by the Environmental Impact Quotient, fell by 17.1%

But was there a consequence?

SOURCE: Brookes, G. 2012. Genetically Engineered Crops: Environmental Impacts 1996-2009. ISB Report, January 2012, pp. 1-5

Brookes, G. and Barfoot, P. 2011. Global impact of biotech crops: Environmental effects 1996-2009. GM Crops 2: 34-49

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CAST® Issue Paper
Number 49
February 2012

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

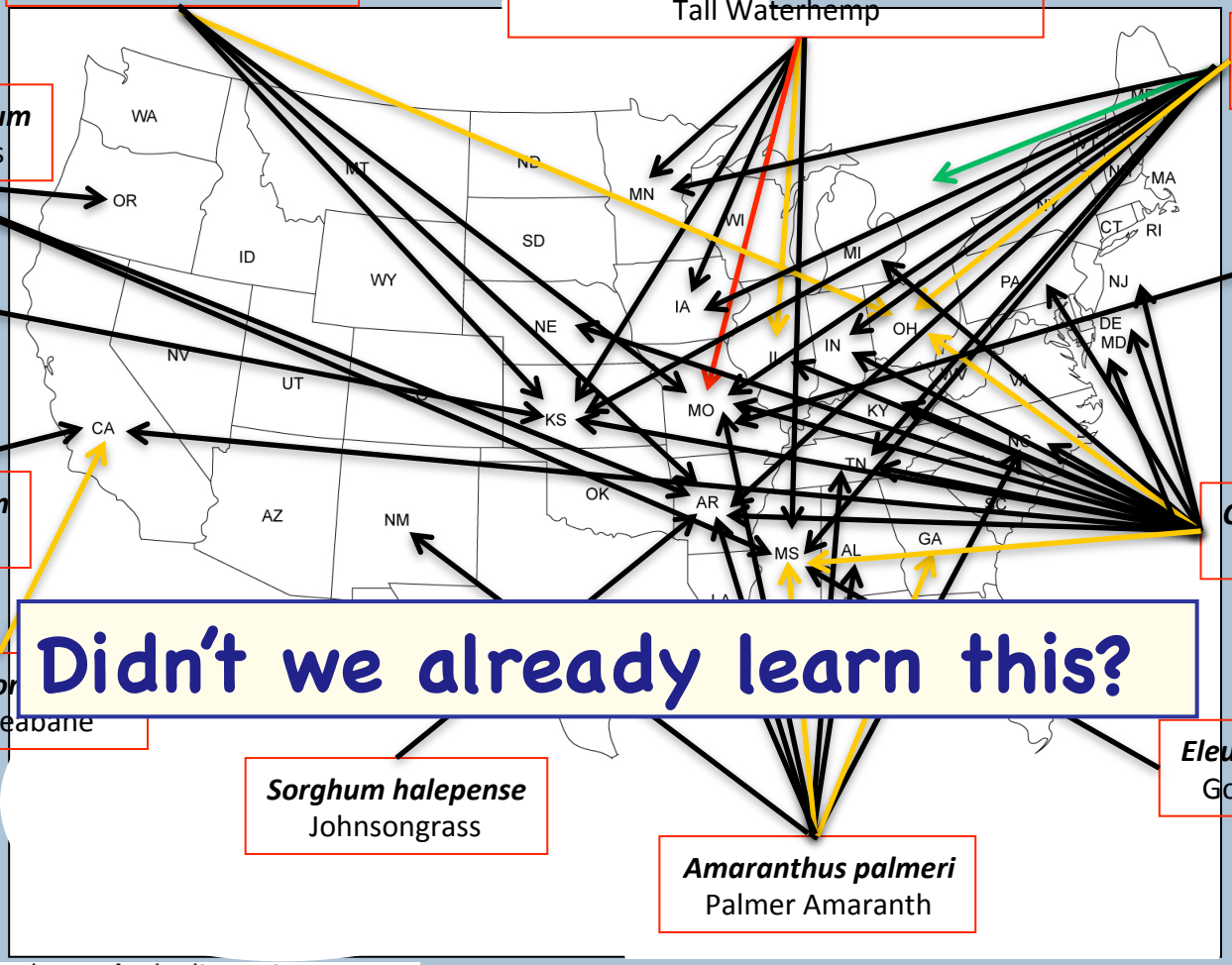
"There is now a large and growing threat to soil conservation gains because of the dire need…to manage resistant weeds…"

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/wtBMQq

Glyphosate-resistant weeds due to mutation, gene flow, weed shift – exacerbated when same herbicide is used repeatedly

Glyphosate- Resistant Weeds – USA

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



Ambrosia artemisiifolia
Common Ragweed

Amaranthus tuberculatus (syn. rudis)
Tall Waterhemp

Ambrosia trifida
Giant Ragweed

Lolium multiflorum
Italian Ryegrass

Poa annua
Annual Bluegrass

Kochia scoparia
Kochia

Lolium rigidum
Rigid Ryegrass

Conyza canadensis
Horseweed

Didn't we already learn this?

Conyza bor
Hairy Fleabane

Sorghum halepense
Johnsongrass

Eleusine indica
Goosegrass

Amaranthus palmeri
Palmer Amaranth

K. Neil Harker
AAFC - Lacombe, AB

Take-Home Messages

- Today's diets differ from diets of our primate ancestors
- Their high-fiber, vegetarian diets could play a positive role in human health today
- Shift to meat-based diets has negative impacts on the environment due to low energy efficiency conversion
- Food availability in developing countries has negative health impacts
- Increased food yields have lagged in those countries due to lack of genetic improvements from breeding and new genetic technologies
- Advances in nutritional improvement, like Golden Rice and Vitamin A banana, might be useful if allowed to reach consumers
- Metanalyses of GE food safety data in animals reveals they are nutritionally equivalent and can be safely consumed
- Environmental data indicates that there is reduced environmental impact of pesticide use with GE crops
- Overuse of specific herbicides has led to increased incidences of tolerant weed species

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SCIENCE-BASED INFORMATION & RESOURCES ON AGRICULTURAL BIOTECHNOLOGY

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know GMOS

This website, developed for the University of California Division of Agricultural and Natural Resources Statewide Biotechnology Workgroup, 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.

DISPLAY CARDS NOW IN SPANISH!

We now have Spanish cards available to distribute with both educational displays. Click here for more details!

BIOTECHNOLOGY INFORMATION

ANNUAL REVIEWS

Review articles: Focused on food, environmental and socioeconomic issues of GE crops and foods.

RESOURCES FOR OUTREACH & EXTENSION, RESEARCHERS & TEACHERS

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

Available on loan:

Educational displays: "Genetics and Foods" and Genetic Diversity and

and vegetables.

Tic Tac Grow: Educational game to teach what foods come from what crops.

HELPFUL SITES

Seed Biotechnology Center: Mobilizes research, education & outreach efforts in partnership with seed & biotechnology industries.

Provides education on use of animal genomics & biotechnology in livestock production.

SEARCH • CONTACT • SITE MAP

Want more information: See http://ucbiotech.org

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