Finding Our Way Through the Controversy over Genetic Engineering in Agriculture

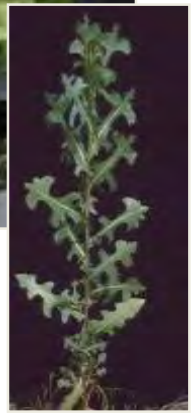
The good, the bad, and the righteous

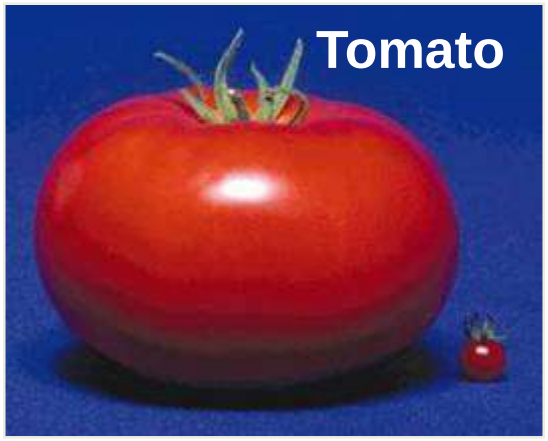
Steve Strauss, OSU

For more on these kinds of issues, consider this course

Campus or ecampus versions

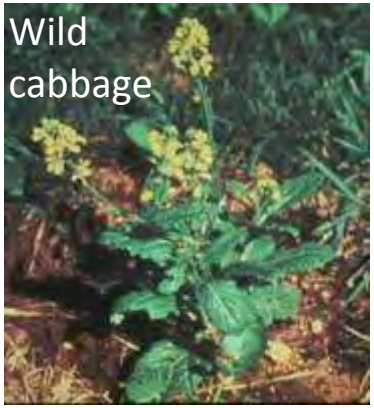
Aren’t most food crops already genetically engineered?





Mutants are some of our best friends:

Domestication of *Brassica oleracia*



Kohlrabi
Germany, 100 AD

Ornamental kale
Late 1900's

Kale, 500 BC

Brussel sprouts
Belgium, 1700's

Many plant varieties derived from induced mutations

Calrose 76 semi-dwarf rice

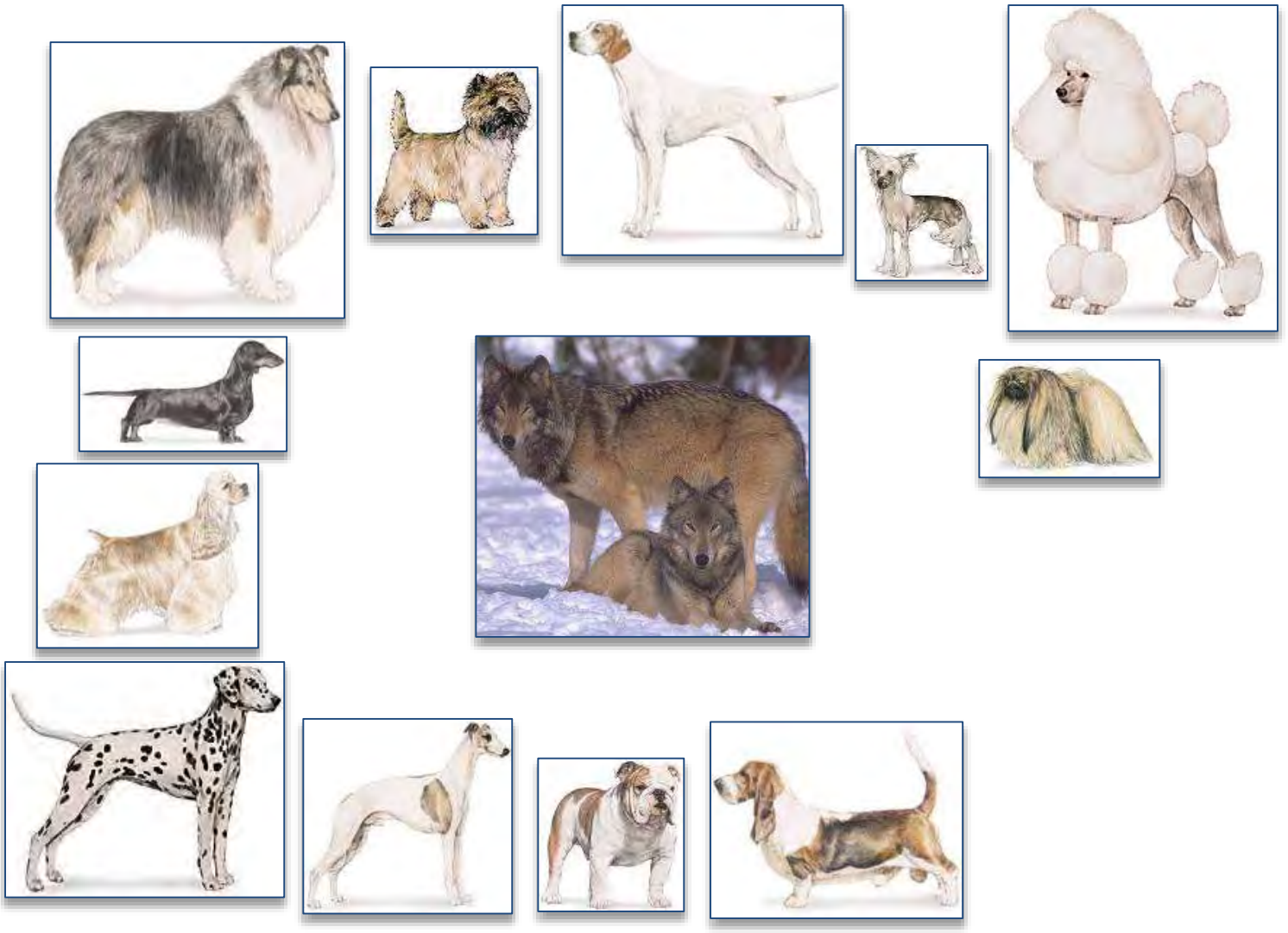
Over 2,000 crop varieties derived from mutagenesis have been commercialized.

High oleic sunflower

Rio Red grapefruit

Radical changes in domesticated animals:

All dogs derived from the wolf by breeding

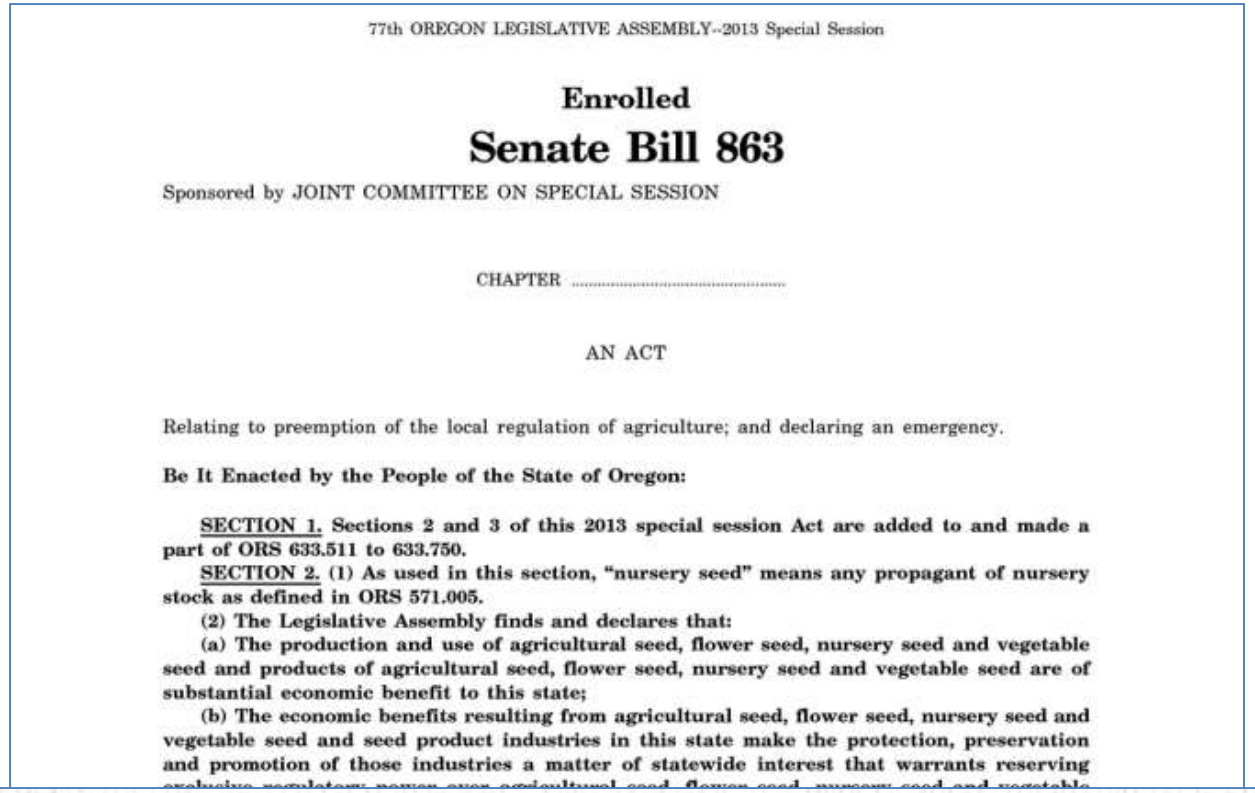


Looks like this, a common public perception of genetic engineering

Breeding continues and is accelerating in age of massive DNA sequencing

Yet GMOs, and only GMOs, have remained powerfully controversial for ~two decades

Recently passed Oregon bill motivated by anti-GMO activism at county level



77th OREGON LEGISLATIVE ASSEMBLY--2013 Special Session

Enrolled

Senate Bill 863

Sponsored by JOINT COMMITTEE ON SPECIAL SESSION

CHAPTER .....

AN ACT

Relating to preemption of the local regulation of agriculture; and declaring an emergency.

Be It Enacted by the People of the State of Oregon:

SECTION 1. Sections 2 and 3 of this 2013 special session Act are added to and made a part of ORS 633.511 to 633.750.

SECTION 2. (1) As used in this section, "nursery seed" means any propagant of nursery stock as defined in ORS 571.005.

(2) The Legislative Assembly finds and declares that:

(a) The production and use of agricultural seed, flower seed, nursery seed and vegetable seed and products of agricultural seed, flower seed, nursery seed and vegetable seed are of substantial economic benefit to this state;

(b) The economic benefits resulting from agricultural seed, flower seed, nursery seed and vegetable seed and seed product industries in this state make the protection, preservation and promotion of those industries a matter of statewide interest that warrants reserving

(c) The agricultural seed, flower seed, nursery seed and vegetable seed and seed product industries in this state will be adversely affected if those industries are subject to a patchwork of local regulations.

Views are polarized

FEATURE

US public opinion divided over biotechnology?

Although a majority of US citizens remain supportive, opposition to biotechnology is on the rise.

Susanna Hornig Priest

Conventional wisdom judges the people of the United States to have few concerns about biotechnology in comparison to people in other parts of the developed world. According to data from a new survey, this picture is at once both accurate and misleading. At least one other major comparative study using data from 1996–1997 published this year appeared to indicate generally more favorable attitudes in the US than in Europe[1]. But recent data reflect mixed opinions in the US consistent with other evidence suggesting moderate declines in US support. While the proportions may be different, the US increasingly resembles Europe in having significant amounts of opposition.

A changing climate

Several reports have suggested that the con-

greater than benefit rose from 20% in 1995 to 24% in 1997 to 29% in 1999[2]. Other indicators suggest US opinion has grown increasingly negative. According to figures released by the US Office of Technology Assessment, in 1986 only 22% of the US public thought genetic engineering would make "the quality of life" worse, and in 1982 only 16%[3].

In this context, the Public Policy Research Institute at Texas A&M University conducted a telephone survey for the author between April 10 and May 3 that explored current public attitudes to biotechnology. The nationwide survey was limited to US citizens aged 18 and over, and was based on standard random digit dialing procedures, resulting in 1002 completed interviews out of 3182 qualified contacts (a cooperation rate of 31.5%).

sure does not reach the levels of positive responses obtained in this survey for similar questions about other technologies ranging from computers and information technology (with 87.8% expecting improvement), to solar energy (87.7%), telecommunications (82.3%), the Internet (72.1%), and even space exploration (62.2%). Of the technologies included in this study, only nuclear energy (with just 43.0% expecting it to improve life) scored lower. And of all seven technologies, only nuclear energy (with 32.4% expecting it to "make things worse") was similar to genetic engineering in garnering close to one-third negative responses. In other words, despite different levels of overall support, the two technologies are very similar in the proportion of people who hold the more pessimistic view. The conventional wisdom that says that genetic engineering is non-controversial in the US is difficult to sustain in the light of these figures, as is the assumption that opposition is limited to the extremist "fringe."

Susanna Hornig Priest is associate professor in the Department of Journalism, Texas A&M University, College Station TX 77843-4111 (susanna@tamu.edu).

NATURE BIOTECHNOLOGY VOL 18 SEPTEMBER 2000

Genetic engineering looks like nuclear power

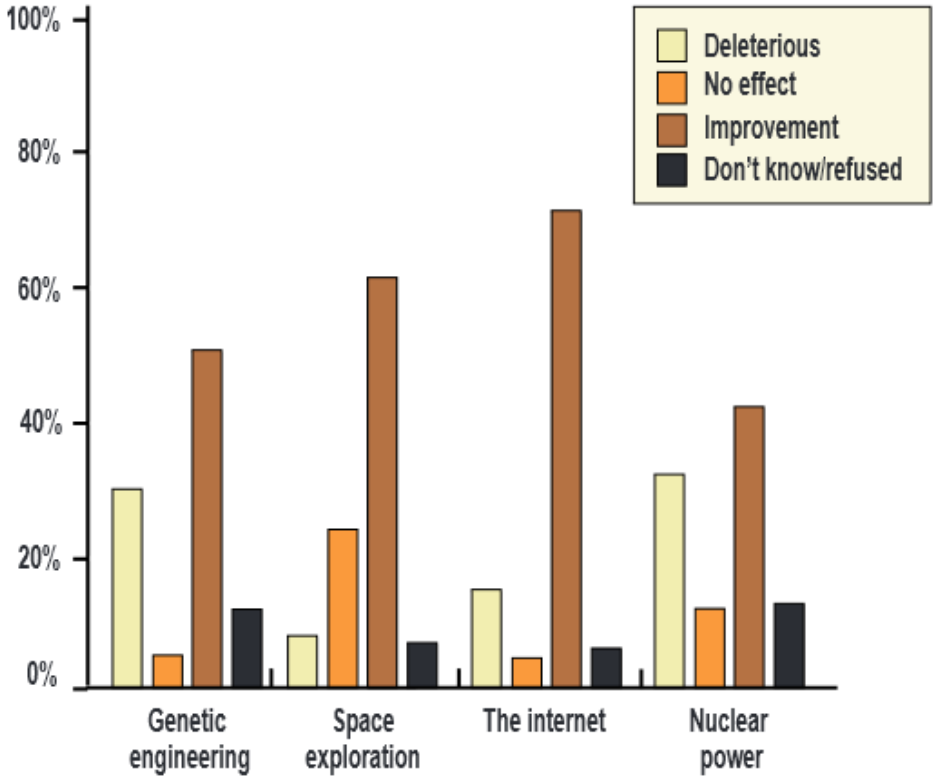


Figure 1. Percentages of respondents in this survey who believe that each of four technologies "will improve our way of life in the next 20 years, will have no effect, or will make things worse." Responses for solar energy and for "communications and information technology," which were very largely positive (see text), are not shown.

Broad values predict acceptance-rejection

October 2013: Broad attitudes towards science, technology and nature influence consumer attitudes towards GM foods.

Pro-science and technology values are a strong predictor of support for GM foods.

Against

Segment 1 (20%) –concerned and disengaged: "the pace of technological change is too fast to keep up with"

Segment 2 (23%) –risk averse and informed: ..less positive towards the benefits of science and technology generally, and biotechnology specifically…least likely to agree that "not vaccinating children puts others at risk".

For

Segment 3 (28%) –cautiously keen: … high interest in science and agreement that "the benefits of science are greater than any harmful effects"

Segment 4 (23%) – the science fans: …"new technologies excite me more than they concern me"

My awakenings to the controversy

It goes far beyond science – I found that trusted environmentalist sources were not

Tree Biotechnology Conference at Oxford in 1999 - Vandalism against lignin modified trees to “welcome” conferees, Euro-press attacks

FRANKENSTEIN'S FOREST

The tree-top protesters, who confounded the Government's road-building programme by camping in the path of bulldozers, are now poised to target the very trees they might once have called home.

Whilst public attention has been focused on the threat of 'Frankenstein Foods', the same corporations who are forcing us to ingest genetically modified (GM) meals have been quietly perpetrating yet another crime against the environment.

The biotech industry has been understandably tight-lipped about its latest phase of the genetic revolution. But it is currently preparing to take over the world's forests – or what's

ment. Campaigners fear that GM trees will sap up water, nutrients and light, leaving indigenous trees to die out along with the host of insects, plants and fungi which rely upon them. In turn, birds and animals would lose many of their natural prey. Those surviving creatures would fall victim to herbicide weed-killer, liberally applied once the GM trees become resistant. The result, opponents fear, will be a sanitised, silent forest, cleansed of natural life.

This month, activists are targetting the Forest Biotechnology '99 conference, hosted by Oxford Forestry Institute from July 11 - 16. It will bring together some of the world's top

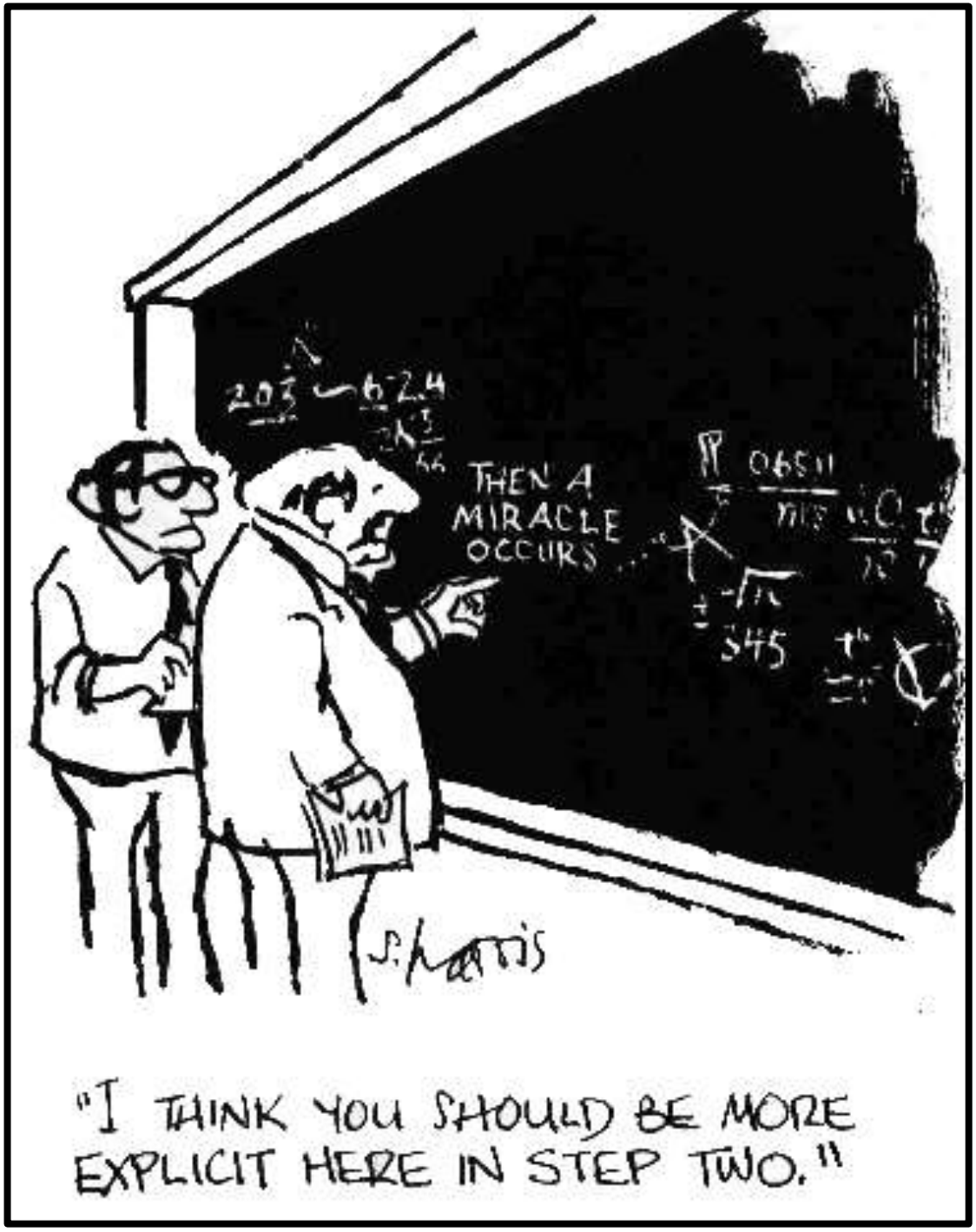
1997. The trees, engineered by the University of Derby, to be disease- and insect-resistant were destroyed by removing the bark. A growing spate of raids on food crops caused AstraZeneca to make a statement to the press before a GeneticX Snowball action earlier this year, fearing damage to their GM poplars.

In April, Monsanto teamed up with two of the world's biggest forest and paper corporations, International Paper and Westvaco. They also got New Zealand company, Fletcher Challenge, in on the deal as they own the all-important patents on newly developed genes which will give the consortium the monopoly on GM trees that they're after. Having sunk

vention, which governs global emissions of greenhouse gases, came into force after the 1997 Kyoto conference, industrialised countries have been forced to clean up. However, the corporations argue that by planting more trees, they should be awarded 'carbon credits', because trees absorb carbon dioxide.

Recently, naturally rich native forests have fallen to the chainsaw, only to be replaced by invasive foreign plantation species such as eucalyptus. To the undiscerning eye, one forest is indistinguishable from another, allowing corporations to boast about how well they are managing their operations. Look behind the greenwash and companies such as Shell are

Whilst public attention has been focused on the threat of 'Frankenstein Foods', the same corporations who are forcing us to ingest genetically modified (GM) meals have been quietly perpetrating yet another crime against the environment.



"I THINK YOU SHOULD BE MORE EXPLICIT HERE IN STEP TWO."

Roadmap for talk

- Orientation
  - The context, definition of GE
- The good, bad, and the righteous
  - Good: Status in world, a few examples, humanitarian promise
  - Bad: Mismanagement, regulation, food toxicology, risk perception
  - Righteous: A la Jonathan Haidt – “Moral certainty” that polarize and impede collaborative solutions

See also his TED talks

A sense of scale

Libertarian: Free market, unfettered technology, anything goes

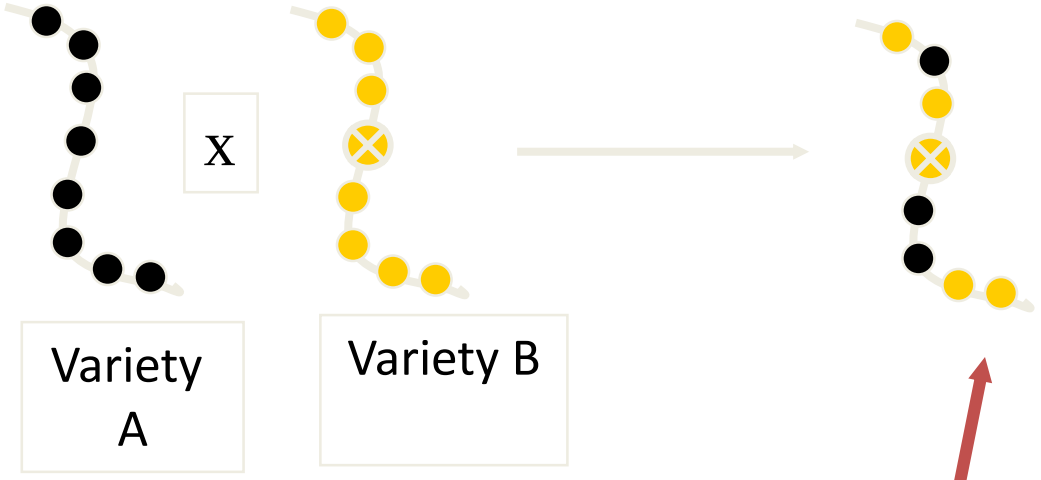
The messy middle – complex tradeoffs, science not political regulations, case-by-case consideration, GMOs a valued tool among many others

But where much of the world is today

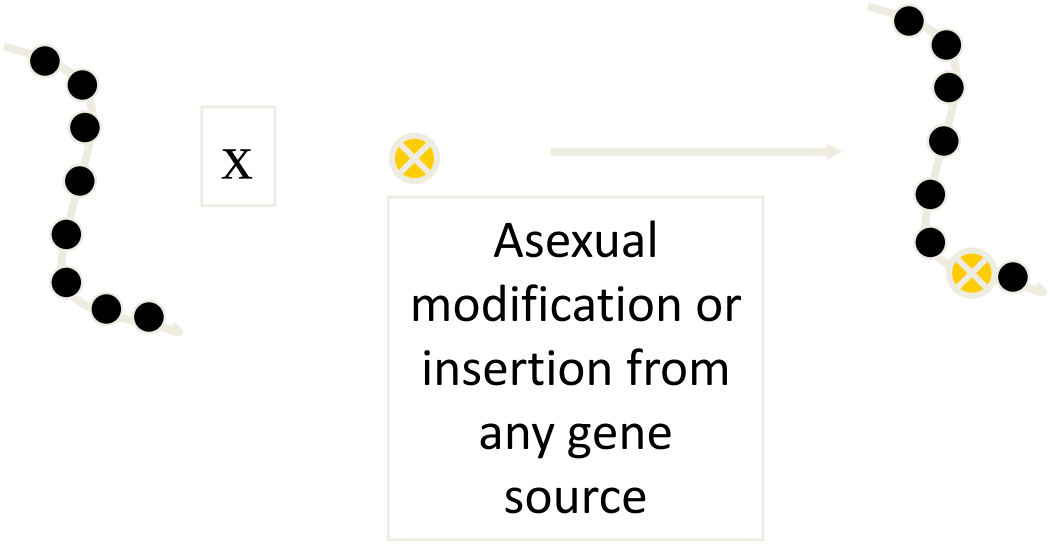
There is never enough regulation, biotech is opening a Pandora's Box, go back to "nature," all industrial scale farming is bad, patents are wrong, all GMOs are dangerous

Genetic engineering defined

Traditional plant breeding



Genetic engineering



The GMO acronyms

- **GE (genetic engineering) = GM (genetic modification) = transgenic = asexual modification and/or insertion of DNA**

  GMO = genetically modified organism

  GEO = genetically engineered organism

  The terms "biotechnology" or "modern biotechnology" often equated with GE or GM methods in public media

Regeneration of transgenic plants

Then propagated normally (seeds, cuttings) and tested for health and new qualities, incorporated into breeding programs

Propagation of poplars in tissue culture

Growth in the field

GMOs = Conscious, directed, science based *tinkering* for those cases when natural or random variation will not suffice

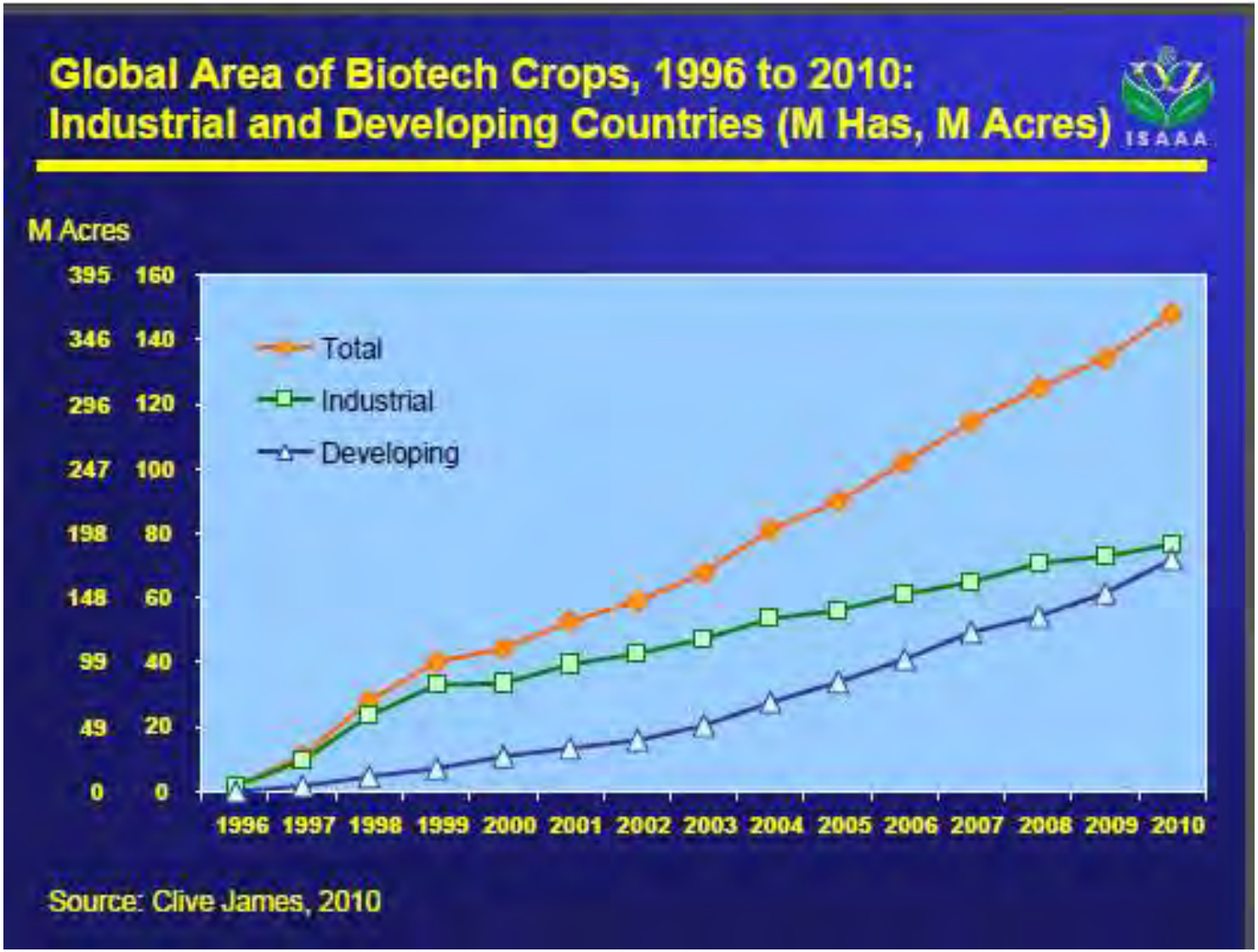
* Key limiting factors to productivity

* Novel opportunities

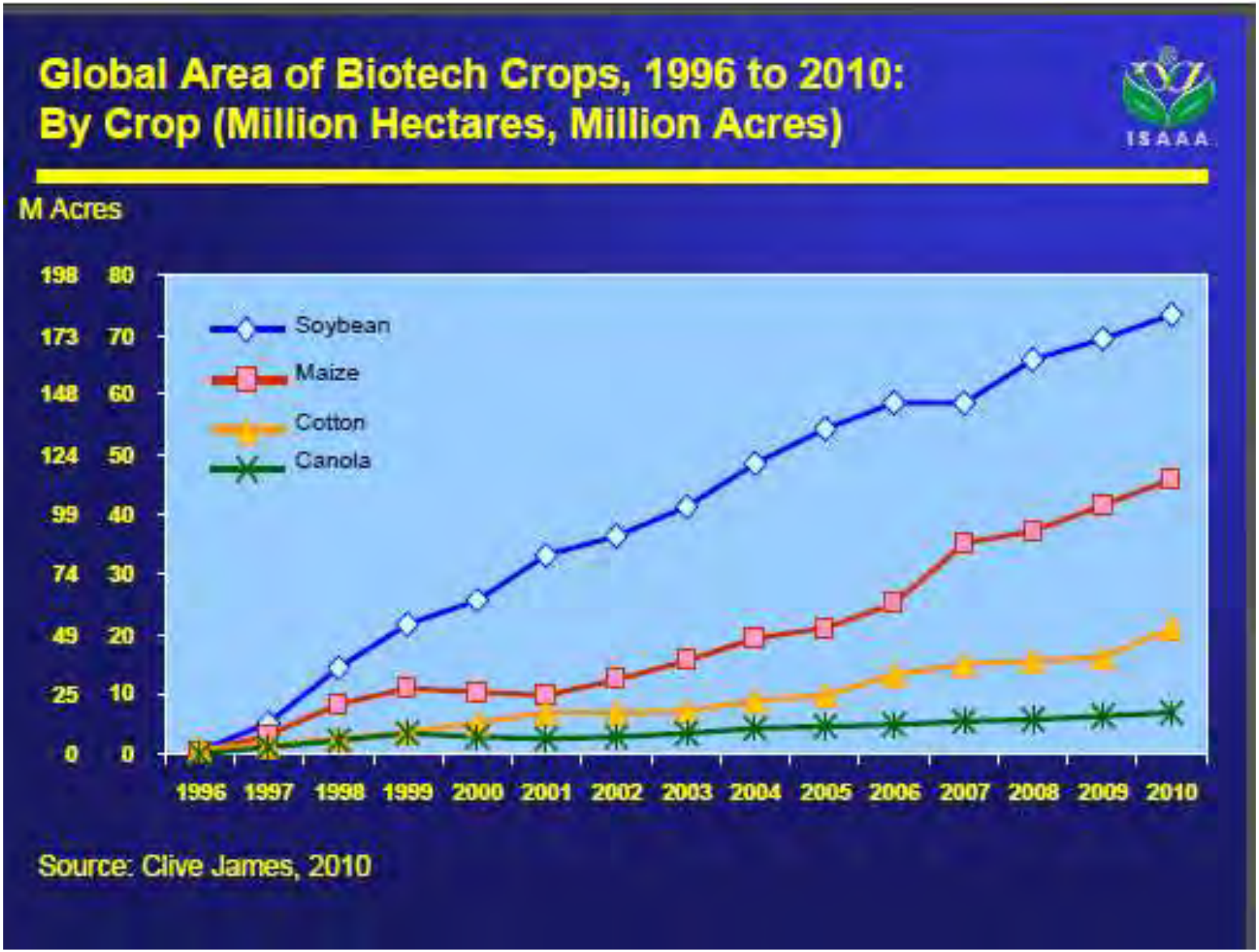
The good

Meteoric rise of GMO crops in world –

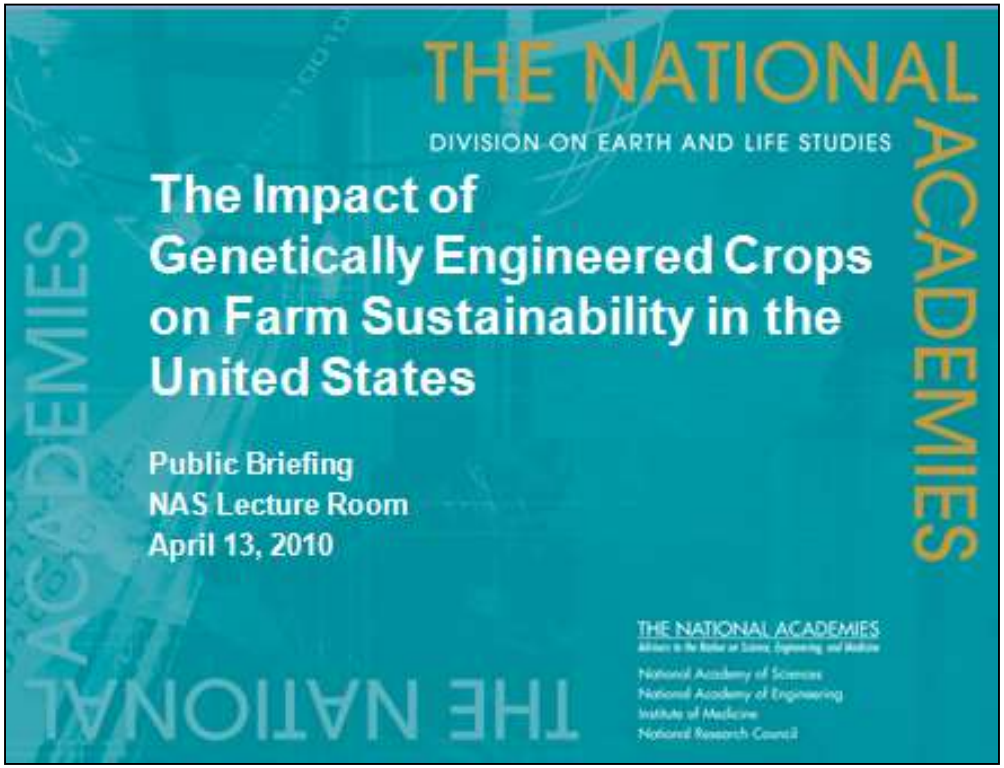
Most rapidly adopted innovation in history of agriculture, grown on >10% arable land on planet



Four crops, and two types of traits dominate (insect and herbicide resistance)



Major reports on GMO crops show very large positive impacts on economics, sustainability, in USA and worldwide



Herbicide tolerant plants promote conservation tillage – With its many environmental benefits thereof

Conservation Technology Information Center

- In 2002
  - Used 306 million gallons less fuel
  - $3.5B savings in sedimentation costs
- Lowers greenhouse gas emissions
- Improved soil organic matter
- Reduces erosion and fertilizer runoff into water
- Often provides better wildlife habitat

~$70 billion in global value to 2010

The large majority to consumers, not farmers or seed companies

Review in Advance first posted online on August 14, 2013. (Changes may still occur before final publication online and in print.)

Agricultural Biotechnology: Economics, Environment, Ethics, and the Future

Alan B. Bennett,[1,2] Cecilia Chi-Ham,[2] Geoffrey Barrows,[3] Steven Sexton,[4] and David Zilberman[3]

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[3]Department of Agricultural and Resource Economics, University of California, Berkeley, California 94720; email: gmb103@berkeley.edu, zilber11@berkeley.edu

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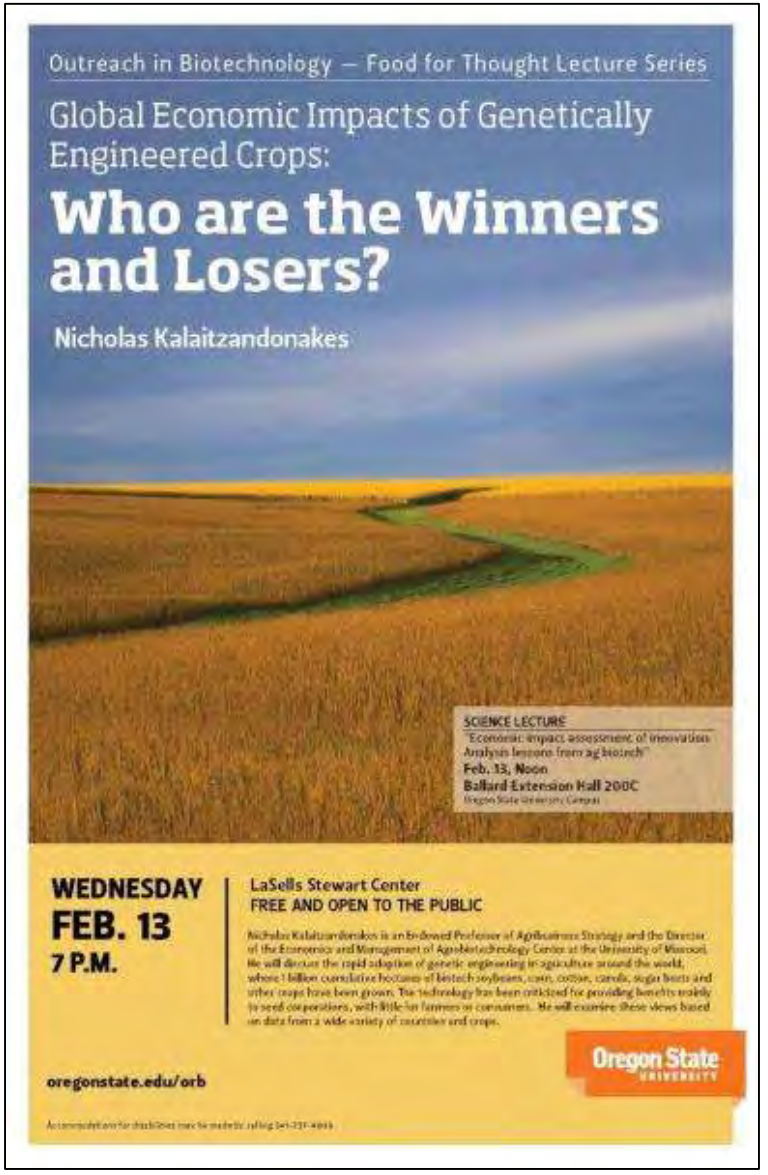
Keywords

genetic modification, genetic engineering, GMO, GM crops, food security

Abstract

Agricultural biotechnology and, specifically, the development of genetically modified (GM) crops have been controversial for several reasons.

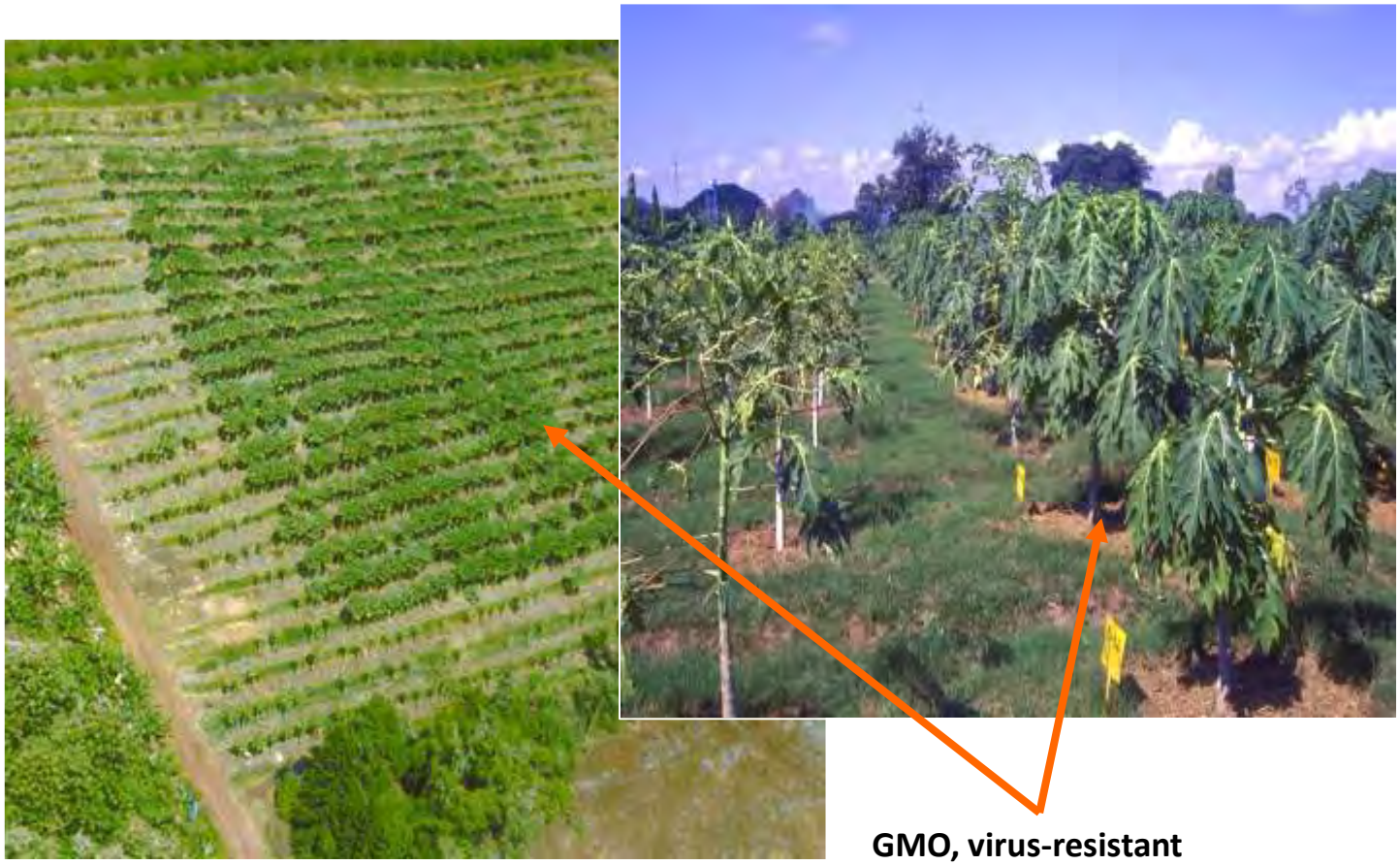


Its not all mega-crops

Virus-resistant papaya saved the Hawaiian industry in the mid-1990s / ~70% of papaya today

* Nobel prize winning RNAi - “Immunization” via by implanting a viral gene in the papaya genome

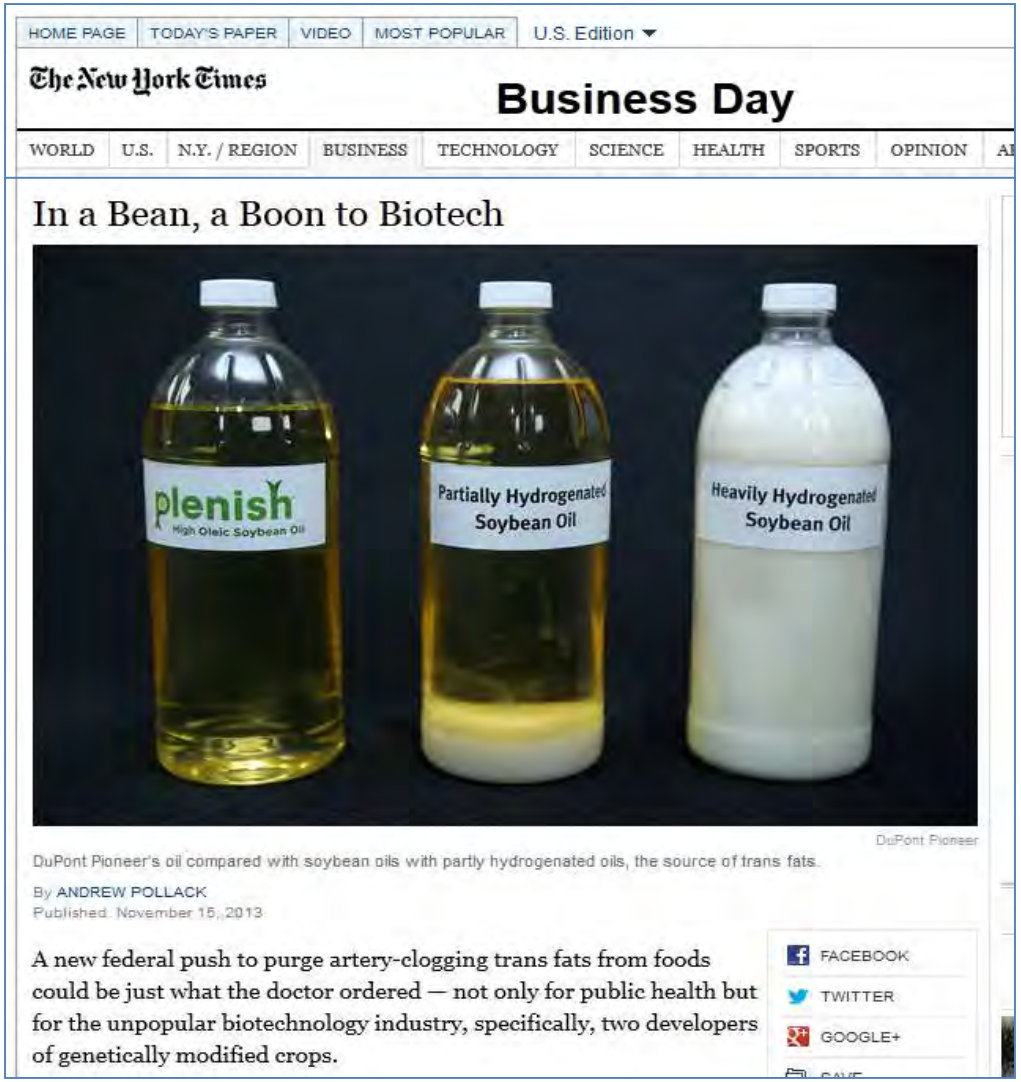
* Great humanitarian potential, but controversy has put on hold in developing world



Courtesy of Denis Gonsalves, formerly of Cornell University

GMO, virus-resistant trees

Consumer nutrition applications will help to promote biotech acceptance?



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In a Bean, a Boon to Biotech

DuPont Pioneer

DuPont Pioneer's oil compared with soybean oils with partly hydrogenated oils, the source of trans fats.

By ANDREW POLLACK
Published: November 15, 2013

A new federal push to purge artery-clogging trans fats from foods could be just what the doctor ordered — not only for public health but for the unpopular biotechnology industry, specifically, two developers of genetically modified crops.

FACEBOOK
TWITTER
GOOGLE+

The developers, Monsanto and DuPont Pioneer, have manipulated the genes of the soybean to radically alter the composition of its oil to make it longer-lasting, potentially healthier and free of trans fats.

Biofortified plants are improving nutrition for many, and can do much more

HarvestPlus
Breeding Crops for Better Nutrition

The non-profit organization HarvestPlus focuses on the development of biofortified crops for the developing world, including a provitamin A enriched sweet potato that is **currently** being grown by half a million families. Other biofortification projects are underway to increase levels of protein, iron, zinc, antioxidants, and other beneficial components in food.

Sources: HarvestPlus; CIMMYT

Why use breeding and biotechnology for β-carotene (pro-vitamin A) enrichment?

Deficiency is widespread, impacts severe, and decades of supplements are unable to overcome

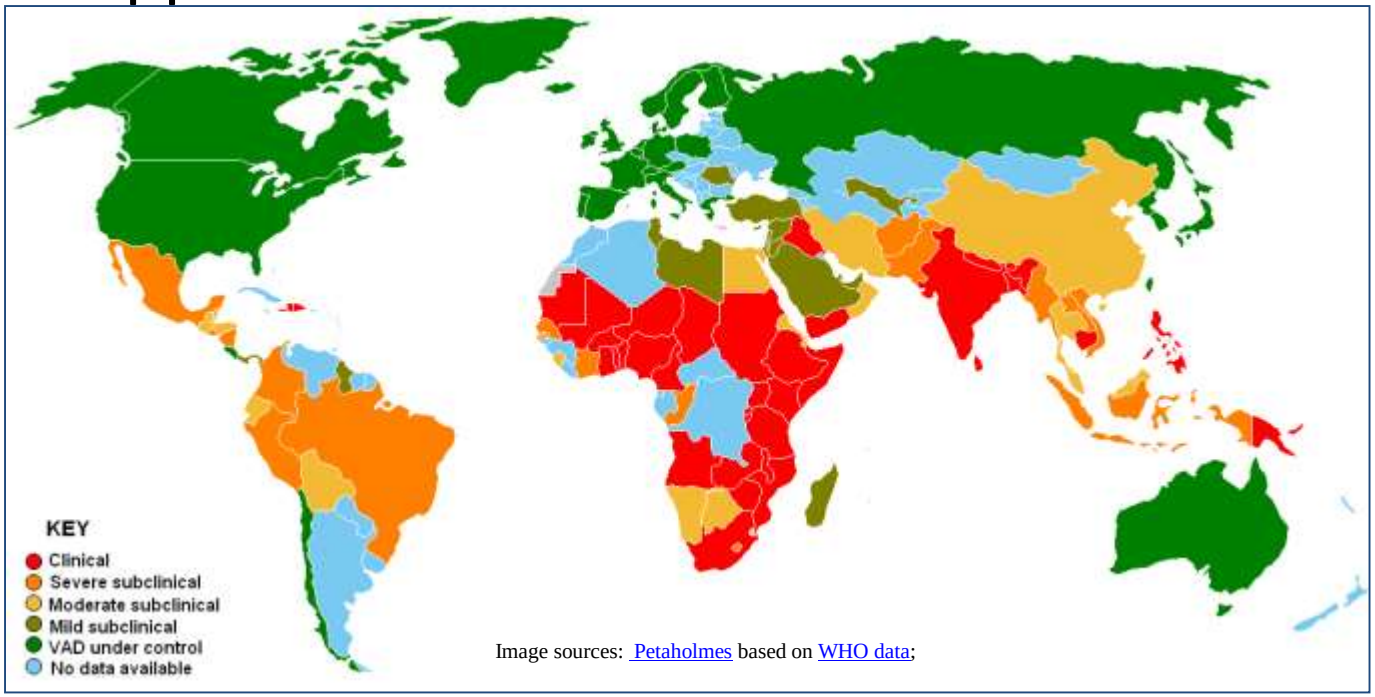


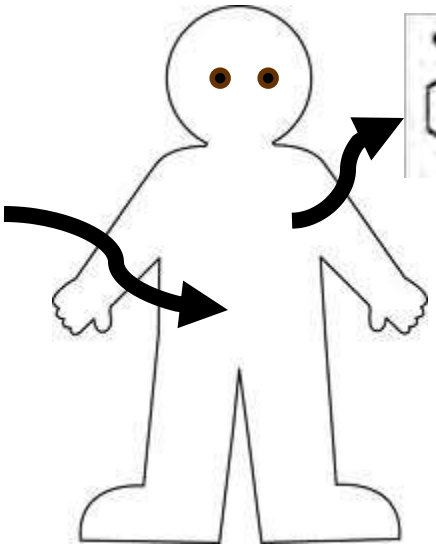
Image sources: Petaholmes based on WHO data;

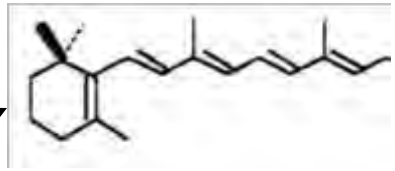
Young women suffering blindness due to Vit A deficiency

Vitamin A deficiency is estimated to affect approximately one third of children under the age of five around the world. It is estimated to claim the lives of 670,000 children under five annually. Approximately 250,000-500,000 children in developing countries become blind each year owing to vitamin A deficiency…. night blindness due to vitamin A deficiency is also high among pregnant women in many developing countries.

Breeding and GMO methods can enhance plant nutritional quality

β-carotene



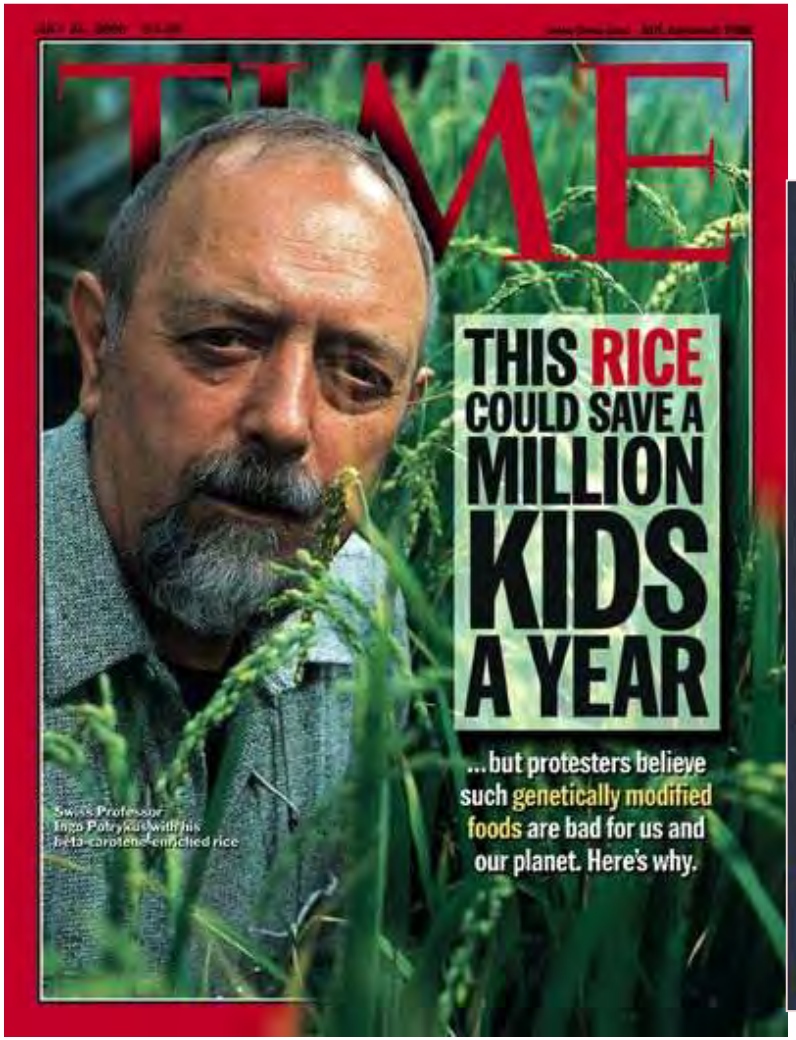


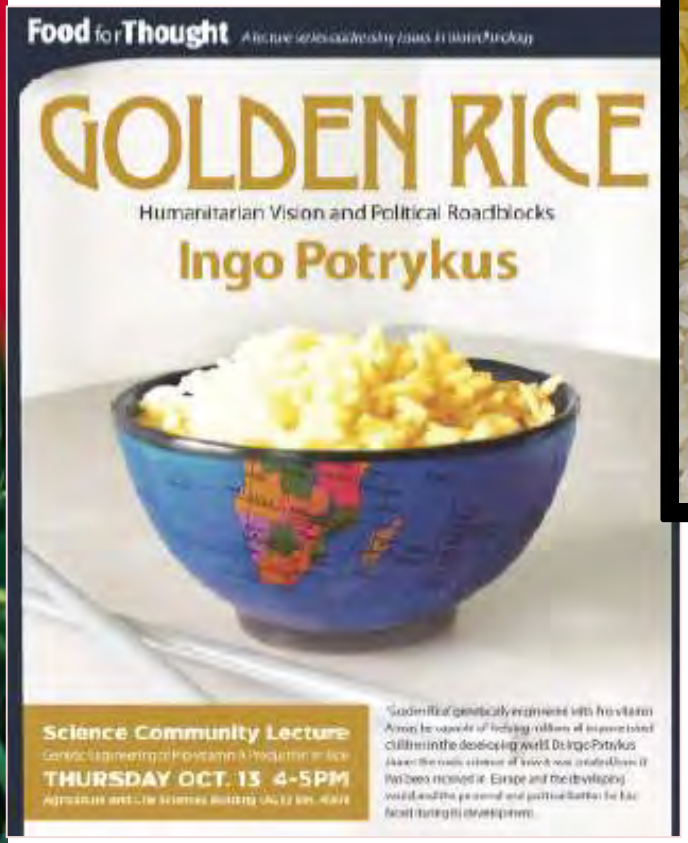
Vitamin A

The β-carotene enriched foods shown here have been produced using GM and non-GM approaches

Photo credit: Golden rice humanitarian board

Golden Rice is the most prominent GMO biofortification product under development





β-carotene makes the rice look golden

The bad

Poor weed management has led to rapid development of herbicide tolerant weeds

nature biotechnology

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NATURE BIOTECHNOLOGY | NEWS

Glyphosate resistance threatens Roundup hegemony

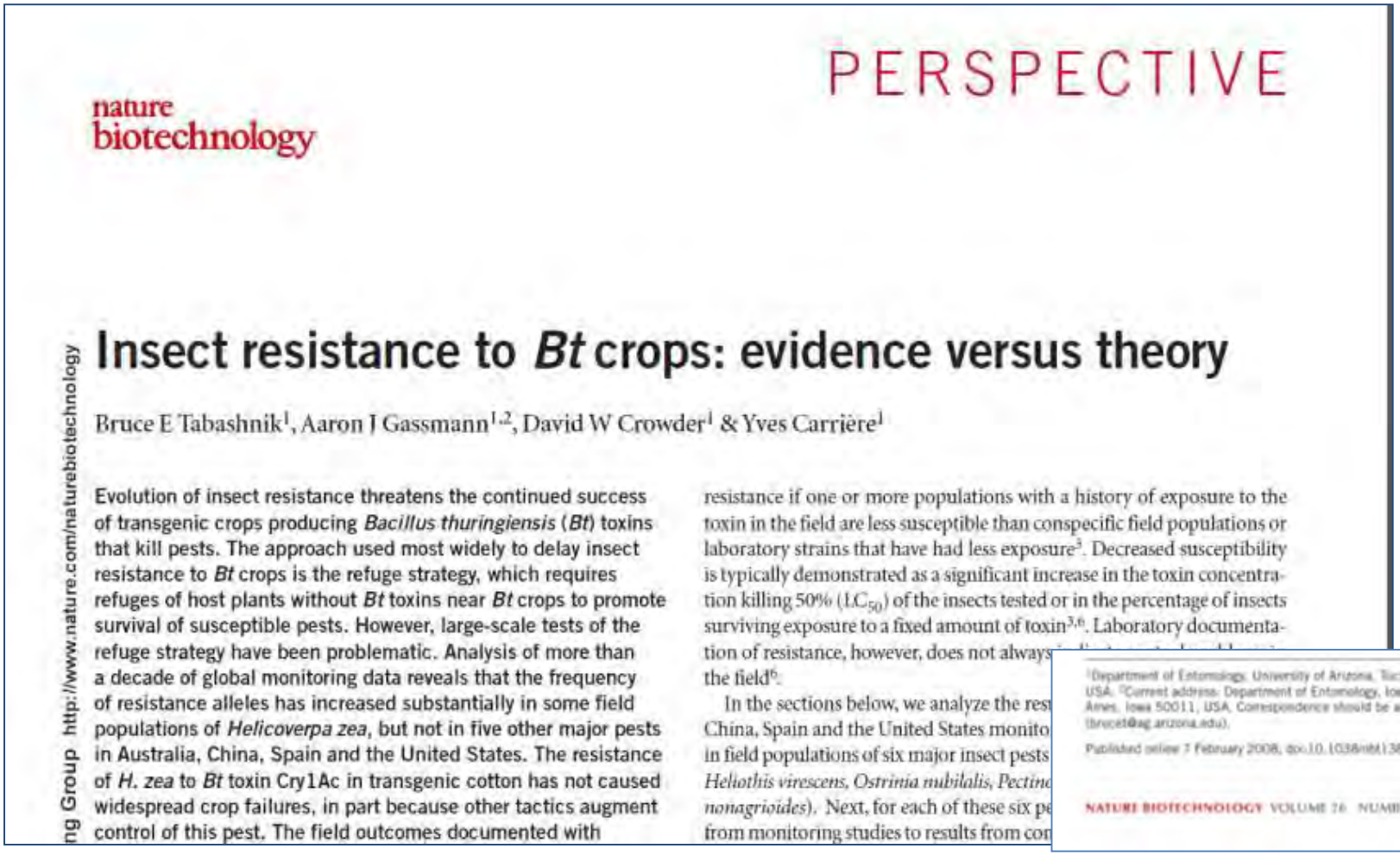
Emily Waltz

Nature Biotechnology **28**, 537–538 (2010) | doi:10.1038/nbt0610-537
Corrected online: **13 October 2010**
Corrigendum (October, 2010)

Weeds are becoming increasingly resistant to glyphosate, a report from the US National Academy of Sciences (NAS) released in April has found. The driving force, according to the report, is farmers' dependence on the weed killer accompanied by the widespread adoption of genetically modified (GM) herbicide-tolerant crops. Seed makers are hoping to forestall the problem by developing GM crops with 'stacked' traits that tolerate multiple herbicides. But weed scientists warn that if farmers manage these new crops in the same way as they managed their glyphosate-tolerant predecessors, weeds will simply become resistant to the new technologies.

"The number of weed species evolving resistance to glyphosate

Insect resistance is developing, but has been better managed



nature biotechnology

PERSPECTIVE

Insect resistance to *Bt* crops: evidence versus theory

Bruce E Tabashnik[1], Aaron J Gassmann[1,2], David W Crowder[1] & Yves Carrière[1]

Evolution of insect resistance threatens the continued success of transgenic crops producing *Bacillus thuringiensis* (*Bt*) toxins that kill pests. The approach used most widely to delay insect resistance to *Bt* crops is the refuge strategy, which requires refuges of host plants without *Bt* toxins near *Bt* crops to promote survival of susceptible pests. However, large-scale tests of the refuge strategy have been problematic. Analysis of more than a decade of global monitoring data reveals that the frequency of resistance alleles has increased substantially in some field populations of *Helicoverpa zea*, but not in five other major pests in Australia, China, Spain and the United States. The resistance of *H. zea* to *Bt* toxin Cry1Ac in transgenic cotton has not caused widespread crop failures, in part because other tactics augment control of this pest. The field outcomes documented with

resistance if one or more populations with a history of exposure to the toxin in the field are less susceptible than conspecific field populations or laboratory strains that have had less exposure[5]. Decreased susceptibility is typically demonstrated as a significant increase in the toxin concentration killing 50% (LC_{50}) of the insects tested or in the percentage of insects surviving exposure to a fixed amount of toxin[3,6]. Laboratory documentation of resistance, however, does not always

the field[6].

In the sections below, we analyze the rest

China, Spain and the United States monito

in field populations of six major insect pests

Heliothis virescens, *Ostrinia nubilalis*, *Pectine*

nonagrioides). Next, for each of these six pe

from monitoring studies to results from cor

[1]Department of Entomology, University of Arizona, Tucson, Arizona 85721, USA. [2]Current address: Department of Entomology, Iowa State University, Ames, Iowa 50011, USA. Correspondence should be addressed to B.E.T. (brucet@ag.arizona.edu).

Published online 7 February 2008; doi:10.1038/nbt1382

Analogous to antibiotics in medicine, continued benefits require careful management, and inputs of new genes/traits

Are declines in monarch butterflies--associated with reduced milkweed populations--due to improved weed control from herbicide tolerant crops?

environment360
Opinion, Analysis, Reporting & Debate

01 APR 2013: INTERVIEW

Tracking the Causes of Sharp Decline of the Monarch Butterfly

A new census found this winter's population of North American monarch butterflies in Mexico was at the lowest level ever measured. Insect ecologist Orley Taylor talks to Yale Environment 360 about how the planting of genetically modified crops and the resulting use of herbicides has contributed to the monarchs' decline.

BY RICHARD CONNIFF

University of Kansas insect ecologist Orley R. "Chip" Taylor has been observing the fragile populations of monarch butterflies for decades, but he says he has never been more concerned about their future.

Monarchs are beloved for their spectacular migration across Canada and the United States to overwintering sites in central Mexico — and back again. But a new census taken at the monarchs' wintering grounds found their population had declined 59 percent over the previous year and was at the lowest level ever measured.

In an interview with *Yale Environment 360* contributor Richard Conniff, Taylor — founder and director of Monarch Watch, a conservation and outreach program — talked about the factors that have led to the sharp drop in the monarch population. Among them, Taylor said, is the increased planting of genetically modified corn in the U.S. Midwest, which has led to greater use of herbicides, which in turn kills the milkweed that is a prime food source for the butterflies.

Orley Taylor

ABOUT THE AUTHOR

Richard Conniff, who conducted this interview for *Yale Environment 360*, is a National Magazine Award-winning writer whose articles have appeared in *Time*, *Smithsonian*, *The Atlantic*, *National Geographic*, and other publications. He is the author of several books, including *The Species Seekers: Heroes, Fools, and the Mad Pursuit of Life on Earth*. In previous articles for *Yale Environment 360*, he has written about the pricing of ecosystem services and about new advances that could help produce food crops that can thrive as the climate shifts.

MORE BY THIS AUTHOR

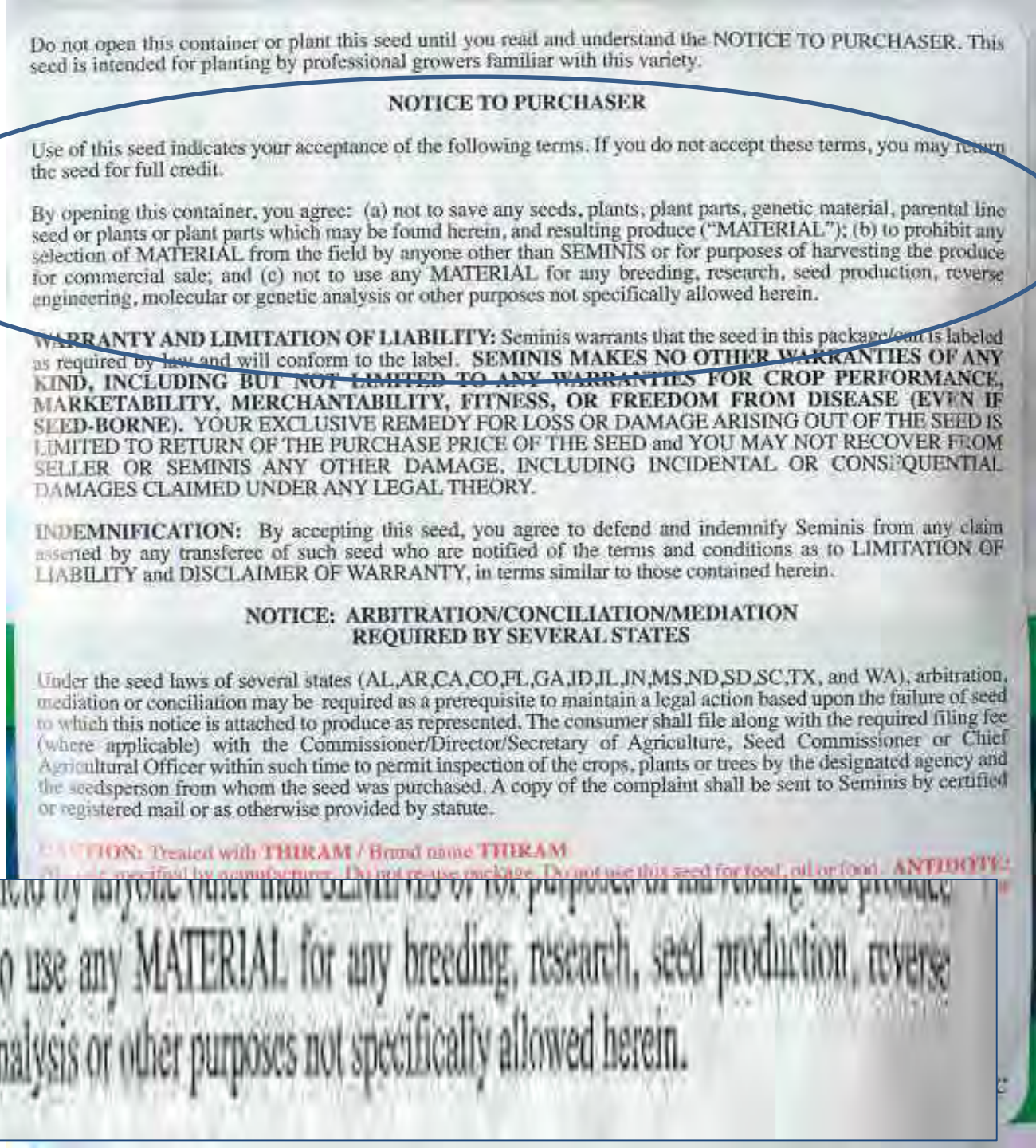
RELATED ARTICLES

Into the Heart of Ecuador's Yasuni

Few places on earth harbor as much biodiversity as Ecuador's Yasuni Biosphere Reserve, which sits atop vast deposits of oil and now faces intense development pressure. In a Yale Environment 360 video, filmmaker Ryan Killackey travels to the heart of Yasuni with scientists inventorying its stunning wildlife and plants. The researchers hope their work will bolster initiatives to preserve this threatened land.

READ MORE

Contracts rent seed -- but they also ban research: "Shrink wrap" agreements



Do not open this container or plant this seed until you read and understand the NOTICE TO PURCHASER. This seed is intended for planting by professional growers familiar with this variety.

NOTICE TO PURCHASER

Use of this seed indicates your acceptance of the following terms. If you do not accept these terms, you may return the seed for full credit.

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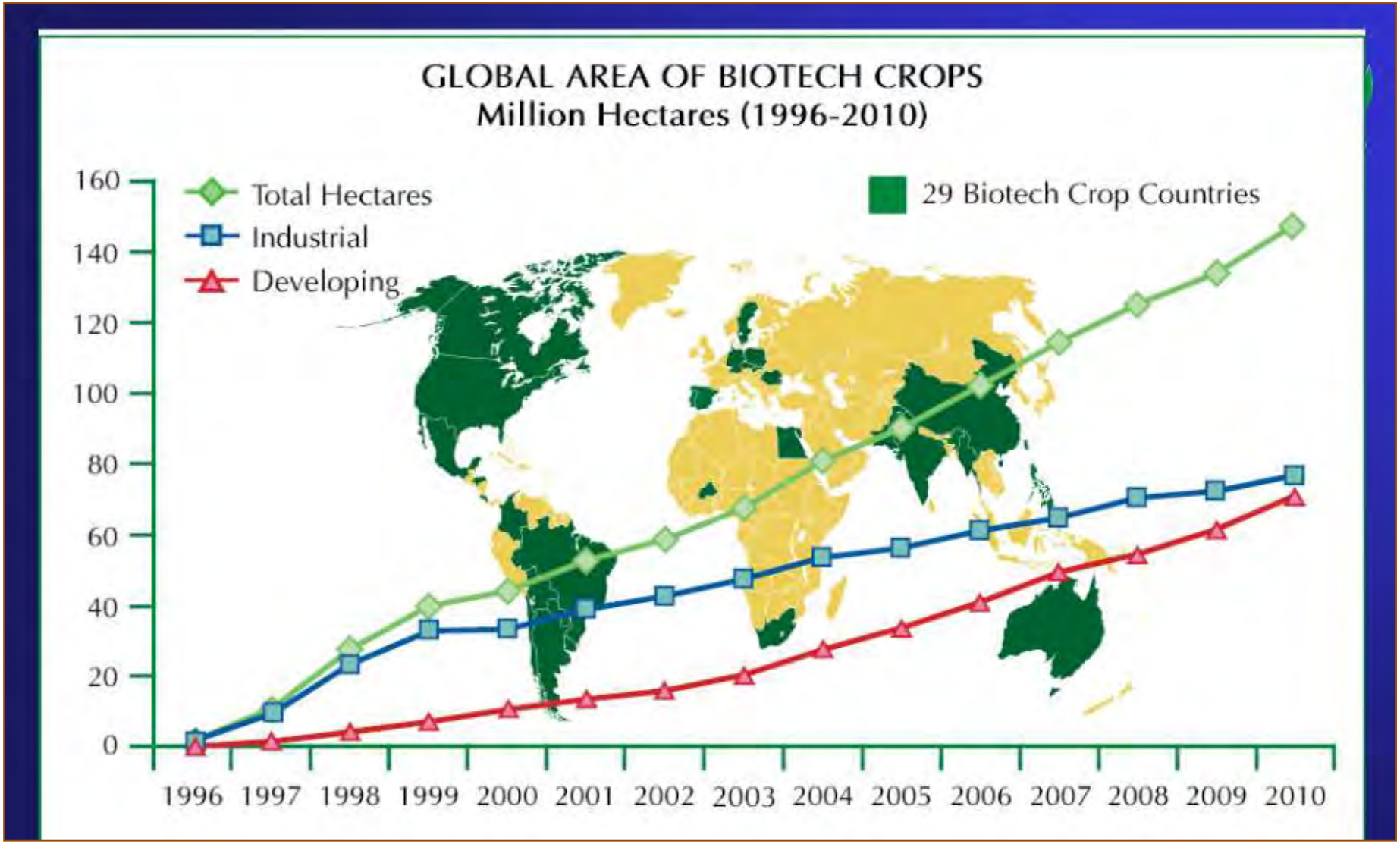
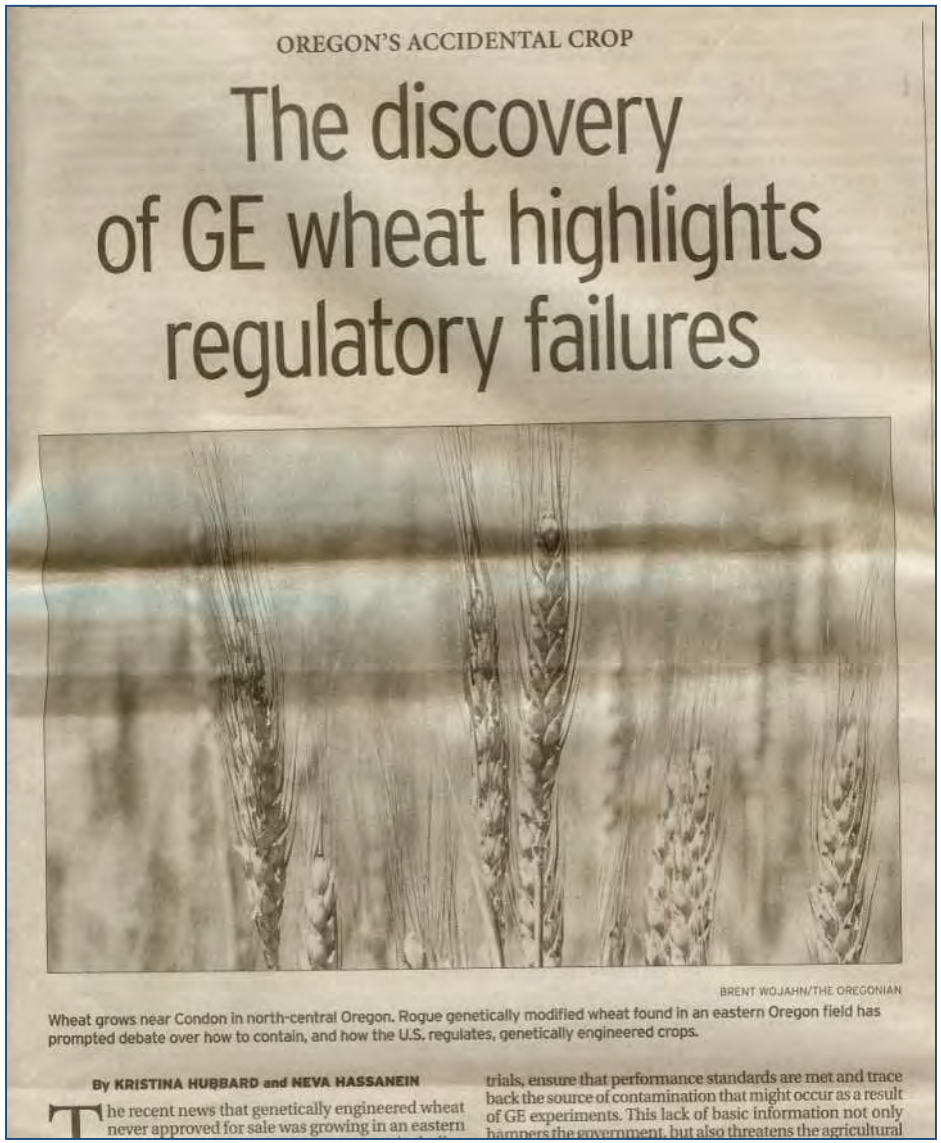
for commercial sale; and (c) not to use any MATERIAL for any breeding, research, seed production, reverse engineering, molecular or genetic analysis or other purposes not specifically allowed herein.

Widely differing regulations and uptake of GMOs create serious trade barriers



Regulatory presumption of hazard, trade barriers, stifle research and development



OREGON'S ACCIDENTAL CROP

The discovery of GE wheat highlights regulatory failures

BRENT WOJAHN/THE OREGONIAN

Wheat grows near Condon in north-central Oregon. Rogue genetically modified wheat found in an eastern Oregon field has prompted debate over how to contain, and how the U.S. regulates, genetically engineered crops.

By KRISTINA HUBBARD and NEVA HASSANEIN

The recent news that genetically engineered wheat never approved for sale was growing in an eastern

trials, ensure that performance standards are met and trace back the source of contamination that might occur as a result of GE experiments. This lack of basic information not only hampers the government, but also threatens the agricultural

An agreed safe, well studied, extremely rare GMO contaminant nearly crippled Pacific Northwest trade in wheat

How to conduct field research given this risk?

There must be a better way

Op-Ed in Oregonian
June 16, 2013

Continued worry over safety of approved GMO food for human health

FEATURE

How safe does transgenic food need to be?

Laura DeFrancesco

Disputes over how to assess a foodstuff's safety continue to play into public fears about transgenic crops.

Transgenic crops are the most highly regulated foods in the world. In recent years, there have been calls in the United States to relax some of the rules for their oversight. And yet controversies over the safety of transgenic food products continue to rumble, particularly in Europe, Africa and now further afield in the Far East. Despite the fact that numerous national and international scientific panels have concluded that food derived through transgenic approaches is as safe as food produced in other ways and that food-borne pathogens pose a much greater threat to human health[1], scare stories continue to

any finished food placed on the market meets the safety levels implicit in the definition of adulterated foods. FDA is authorized to seek sanctions against foods that do not adhere to these standards through seizure, injunction or criminal prosecution," writes Emily Marden of the University of British Columbia's Faculty of Law in Vancouver[3]. This holds for all new foods, whether transgenic or not.

Notwithstanding the absence of legal underpinnings, a *de facto* regulatory process (called a consultation) exists at the FDA, whereby companies submit information on new genetically modified foods destined for the market

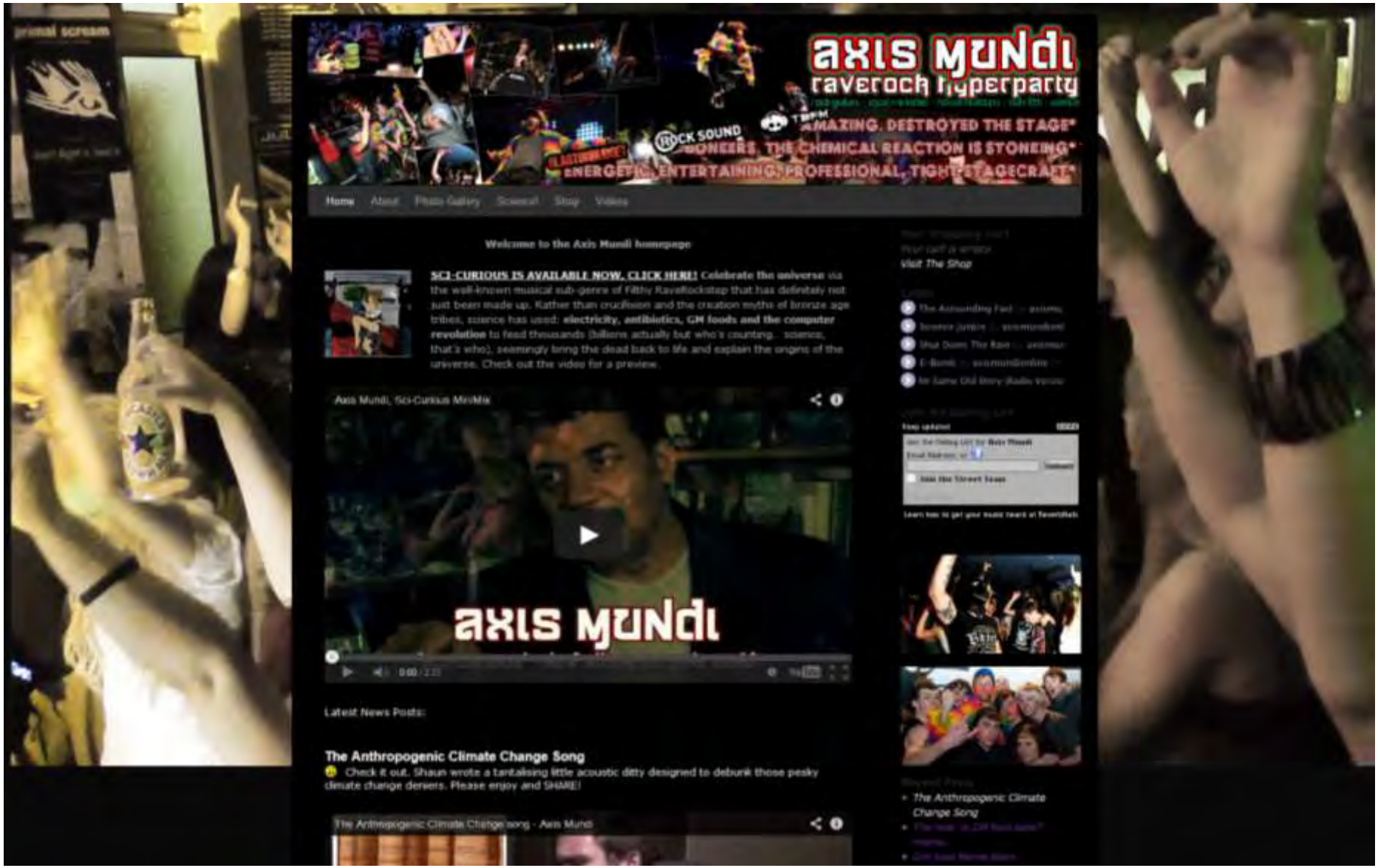
Laura DeFrancesco is Senior Editor at Nature Biotechnology.

Regulation of Biotechnology was laid out (51 Fed. Reg. 23302, June 26, 1986)[5]. Depending on the exact nature of the change made to

Nutrition that is responsible for oversight of the safety of food derived from transgenic crops destined for human consumption.

http://www.axismundionline.com/blog/the-new-is-gm-food-safe-meme/

Our full album of science based memes are in our facebook page album HERE. Our manifesto on MemeWars is HERE
Let's not allow moronic groups like Greenpeace to dominate the meme world with lies on important issues.



<u>On "About" page</u>: Axis Mundi are a Rave-Rockstep ultra-party. Described as "a cross between **System of a Down** and the **Prodigy**"… just add "**Brian Cox**" and you're about there. New album "**Sci-curious**" (released June 2013)

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The Biofortified Blog

20 points of broad scientific consensus on GE crops

by Pamela Ronald on 5 October 2013

By Pamela Ronald and Karl Haro von Mogel

Just as many on the political right discount the broad scientific consensus that human activities contribute to global warming, many progressive advocacy groups disregard, reject, or ignore the decades of scientific studies demonstrating the safety and wide-reaching benefits of GE crops. Is political identity more important than science and the environment?

Review your knowledge of food, farming and plant genetics by reviewing this list. It represents specific points of broad scientific consensus: that is, the conclusions of the scientific community based on analysis of thousands of experimental results over the past 10-20 years. For each point, we have provided links to appropriate references. Please let us know which ones we missed.

1. **GE crops currently on the market are safe to eat.** (See the European Commission Joint Research Centre, European Food Safety Authority, The American Medical Association, the National Academy of Sciences, and the World Health Organization)
2. **The processes of genetic engineering and conventional genetic modification pose similar risks of unintended consequences.**
3. **The risks and benefits of new traits in crops depend upon the traits themselves and not the means of their introduction, whether through GE or conventional means.**
4. **The planting of Bt cotton has reduced the use of sprayed insecticides.**
5. **The planting of Bt corn in the US has benefited growers of non-GE corn.**
6. **Planting of Bt cotton has enhanced yields in China and India.**
7. **Planting of Bt cotton has reduced insecticide poisonings of farmers and their families.**
8. Adoption of Bt cotton enhances insect biodiversity.
9. **If not properly managed,** overuse of Bt spray or Bt crops **will lead to** Bt resistant insects.
10. Farmers need to deploy a crop diversity strategy and crop rotation to reduce the evolution of insect resistance.
11. **US farmers that plant BT crops are required to deploy a "refuge strategy": creating refuges of crop plants that do not make Bt toxins. This promotes survival of susceptible insects and has helped to delay evolution of pest resistance to Bt crops.**
12. Global pest-monitoring data suggest that Bt crops have remained effective against most pests for more than a decade.
13. Failure to provide adequate refuges appears to have hastened resistance of pink bollworm in India and western corn rootworm in the US to Bt.
14. Effective methods for slowing the spread of insect resistance include crop rotation, **intercropping and planting refuges of non-BT cotton and non-crop species.**
15. **Planting of herbicide tolerant (HT) crops has reduced the environmental impact of herbicide use. This is because the** reduced tillage **associated with planting of HT crops has led to reduced soil erosion and** reduced greenhouse gas emissions.
16. **The liberal use of glyphosate without proper management has spurred the evolution of** weeds resistant to that herbicide.
17. The evolution of herbicide resistant weeds is a problem for farmers who rely on a single herbicide.
18. GE crops are just one of the many tools that can be used to enhance the sustainability of farms.
19. **Papaya genetically engineered for resistance to papaya ringspot virus has protected yields against significant losses from the virus and** saved the Hawaiian papaya industry.
20. **Consumption of** Golden Rice **within the normal diet of rice-dependent poor populations could provide**

http://www.biofortified.org/2013/10/20-points-of-broad-scientific-consensus-on-ge-crops/

Continued worry over safety of approved GMO food for human health

FEATURE

How safe does transgenic food need to be?

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Nutrition that is responsible for oversight of the safety of food derived from transgenic crops destined for human consumption.

From DeFrancesco 2013 –Nature Biotechnology

- "Critics and proponents of genetically modified organisms (GMOs) alike agree that genetically modified foods have failed to produce any untoward health effects, and that the risk to human health from foods contaminated with pathogens is far greater than from GMOs.
  - The US Centers for Disease Control (CDC; Atlanta) reports that in 2012, there were 128,000 cases of food-borne illnesses leading to hospitalizations, with 3,000 deaths (http://www.cdc.gov/foodborneburden/index.html).
- Contrast that with none reported for transgenic foods in their decades-long history in the food supply."

How GMO food is tested for safety

- Is the *new component*, such as a new protein, likely to be toxic or allergenic?
  - High dose toxicology studies, rate of digestion in simulated stomach fluids, structural similarity
- Is the *overall biochemistry*, and natural toxins and allergens, changed beyond the normal range of variation among varieties, environments, stresses?
- Has their *specific use* in agriculture caused the levels of toxins and pesticide residues to be above safe levels?

Why whole-food toxicology studies are not required – from DeFrancesco 2013

- "Most of the transgenic food that we currently eat (Roundup Ready soy, for example) is embedded in a variety of processed foods (at very low concentrations).
  - [And the transgenic components are also at very low levels, and known to not have acute or even moderate toxic effects from high dose studies, and coexist with numerous natural toxins with much stronger known toxic or allergenic effects]
- …measuring the effects of a complex foodstuff, in which a transgenic ingredient may be one of many components, in the milieu of a typical diet, is [thus] extremely challenging. **Such effects are likely to be vanishingly small and obscured by numerous confounding variables.**
- [But trust in agribusiness is very low, elevating the perception of risk…]
  - It does not help that Monsanto leads the agribusiness sector in lobbying spending, according to OpenSecrets.com."

Risk perception

- The controversy itself is complex, and creates confusion, and thus fear and discomfort
- Why accept any *perceived* risk if there are not large, direct benefits?
  - Frankenpills vs. Frankenfood


PERSPECTIVES

SCIENCE AND SOCIETY

Opposition to transgenic technologies: ideology, interests and collective action frames

- People accept large but familiar risks, and shun unknown, complex, imposed, and invisible risks
  - GMO technology is complex, imposed, and invisible
  - If something bad is put into food supply, it may cause long term or intergenerational harm, thus a “dread risk”

The righteous

Corporate hyperbole?

MONSANTO BEYOND THE ROWS

FROM THE FARM · NEWS AND VIEWS · AT MONSANTO · INNOVATION

MONSANTO ANNOUNCES CLINTON GLOBAL INITIATIVE COMMITMENT ON HONEY BEE HEALTH

By Jerry Hayes
Beeologics

11 Like 10

My goal in life and work is continuous improvement. And, it has here since coming to Monsanto with lots of help from like-minde have really engaged and seen the vision of what Monsanto can d bee health.

Monsanto Announces Clinton Global Initiative Commitment on Honey Bee Health

Investment Launches Coalition to Research the Challenges Facing Honey Bees

Thursday October 10, 2013

ST. LOUIS-(BUSINESS WIRE)-Monsanto recently announced its commitment to honey bee health at the 2013 Clinton Global Initiative Annual Meeting with support from the Keystone Center, American Honey Producers Association, American Beekeeping Federation, World Wildlife Fund, Project Apis m. (PAm), and commodity groups. The multi-stakeholder coalition will include individuals involved in honey bee health as well as new stakeholders, which include agriculture commodity groups, industry groups, government agencies, environmental NGOs, and agriculture companies, all focused on improving honey bee health.

The coalition will have four priority areas of focus: 1) improving honey bee nutrition; 2) providing research investment in novel technology for varroa and

Left vs. right senses of justice, role for corporations, a major reason for outrage

The *Haidtian elephant* that *drives* the presentation of biased science by lefty-green NGOs

- Profit vs. public good
- Socialist vs. capitalist
- Multinational vs. local
- Monsanto vs. small farmers
- Patents vs. open source
- Major reason for US vs. EU schism

Does organically certified crops have a special right to “purity”

Gene flow is ubiquitous in agriculture – with or without GMOs

"Genetic drift" (i.e., seed and pollen movement) does not entitle Monsanto to take over your farm – nor do they try to!

Goals of organic system laudable, but is the righteousness warranted?

UNIVERSITY OF OXFORD

04 SEP

Organic farms not necessarily better for environment

Science

04 Sep 12

Organic cereals generate higher greenhouse gas emissions per unit of product than their conventionally farmed counterparts, the researchers found.

Organic farming is generally good for wildlife but does not necessarily have lower overall environmental impacts than conventional farming, a new analysis led by Oxford University scientists has shown.

GENETIC LITERACY PROJECT

WHERE SCIENCE TRUMPS IDEOLOGY

The organic hepatitis outbreak: We need organic field testing

Mischa Popoff | June 17, 2013 | Genetic Literacy Project

Today's organic consumer is well informed. They have made the connection between quality of life and their own personal responsibility as for how it's going to play out for

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Mischa Popoff

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SEPT. 5, 2012

Little evidence of health benefits from organic foods, Stanford study finds

BY MICHELLE BRANDT

You're in the supermarket eyeing a basket of sweet, juicy plums. You reach for the conventionally grown stone fruit, then decide to spring the extra $1/pound for its organic cousin. You figure you've just made the healthier decision by choosing the organic product — but new findings from Stanford University cast some doubt on your thinking.

"There isn't much difference between organic and conventional foods, if you're an adult and making a decision based solely on your health," said Dena Bravata, MD, MS, the senior author of a paper comparing the nutrition of organic and non-organic foods, published in the Sept. 4 issue of *Annals of Internal Medicine*.

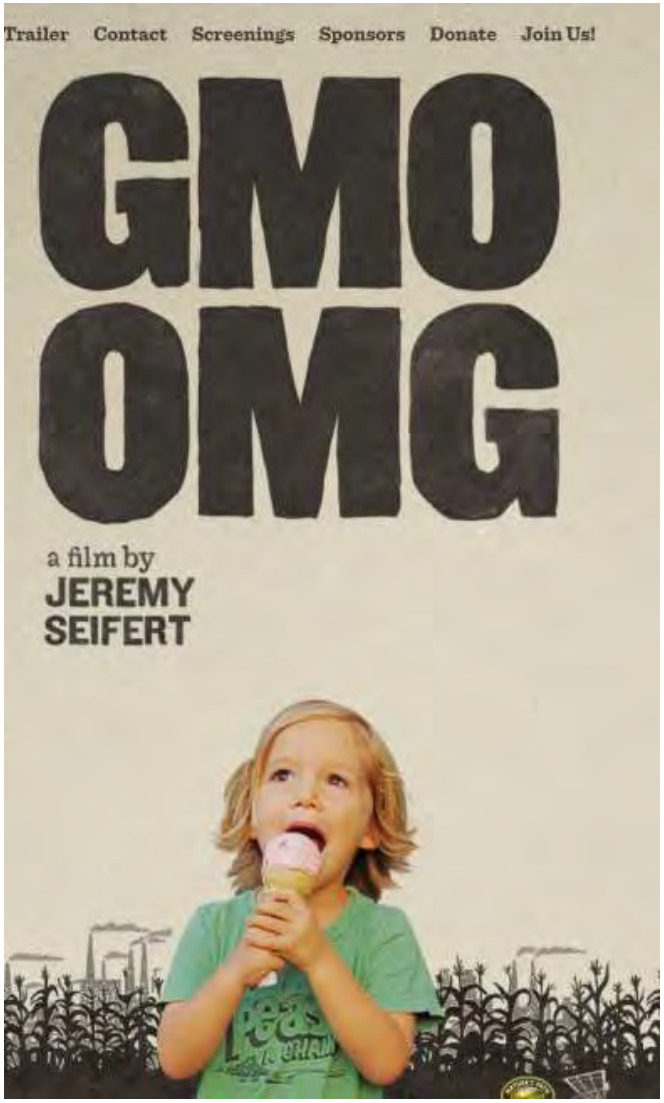
A team led by Bravata, a senior affiliate with Stanford's Center for Health Policy, and Crystal Smith Spangler, MD, MS, an instructor in the school's Division of General Medical Disciplines and a physician-investigator at VA Palo Alto Health Care System, did the most comprehensive meta-analysis to date of

Natanel von der Groeben

Crystal Smith-Spangler and her colleagues reviewed many of the studies comparing organic and conventionally grown food, and found little evidence that organic foods are more nutritious.

Or that from the alternative remedy industry?

Or from popular books, movies or “documentaries?”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GMO OMG
a film by
JEREMY SEIFERT


Who controls the future of your food?

"…genetically engineered crops—which are, in his view, such barely concealed poisons that he actually dressed his children in full hazmat gear before letting them enter a field of genetically modified corn...

…As Ferris Jabr pointed out in extremely thoughtful review in *Scientific American*, Seifert's intellectual laziness is profound. "Instead of using his children like marionettes for ludicrous theatrics, Seifert could have, I don't know, done some actual research,"…

…Seifert's message of fear and illiteracy has now been placed before millions of television viewers….

…By themselves, genetically engineered crops will not end hunger or improve health or bolster the economies of struggling countries. They won't save the sight of millions or fortify their bones. But they will certainly help. First, though, we have to adopt reality as our principal narrative. For people like Jeremy Seifert, that may be too much to ask."

Is labeling GMO food the right(eous) thing to do?

For labeling proponents, it is clearly a means to limit, stigmatize, or remove GMOs from the marketplace

IS LABELING REALLY ABOUT OUR "RIGHT TO KNOW"?

"We are going to force them to label this food. If we have it labeled, then we can organize people not to buy it."

—*Andrew Kimbrell, Executive Director, Center for Food Safety*

"Personally, I believe GM foods must be banned entirely, but labeling is the most efficient way to achieve this. Since 85% of the public will refuse to buy foods they know to be genetically modified, this will effectively eliminate them from the market just the way it was done in Europe."

—*Dr. Joseph Mercola, Mercola.com*

"By avoiding GMOs, you contribute to the tipping point of consumer rejection, forcing them out of our food supply."

—*Jeffrey Smith, Founder, Institute for Responsible Technology*

"With labeling it (GMOs) will become 0%… For you the label issues is vital, if you get labeling then GMOs are dead-end."

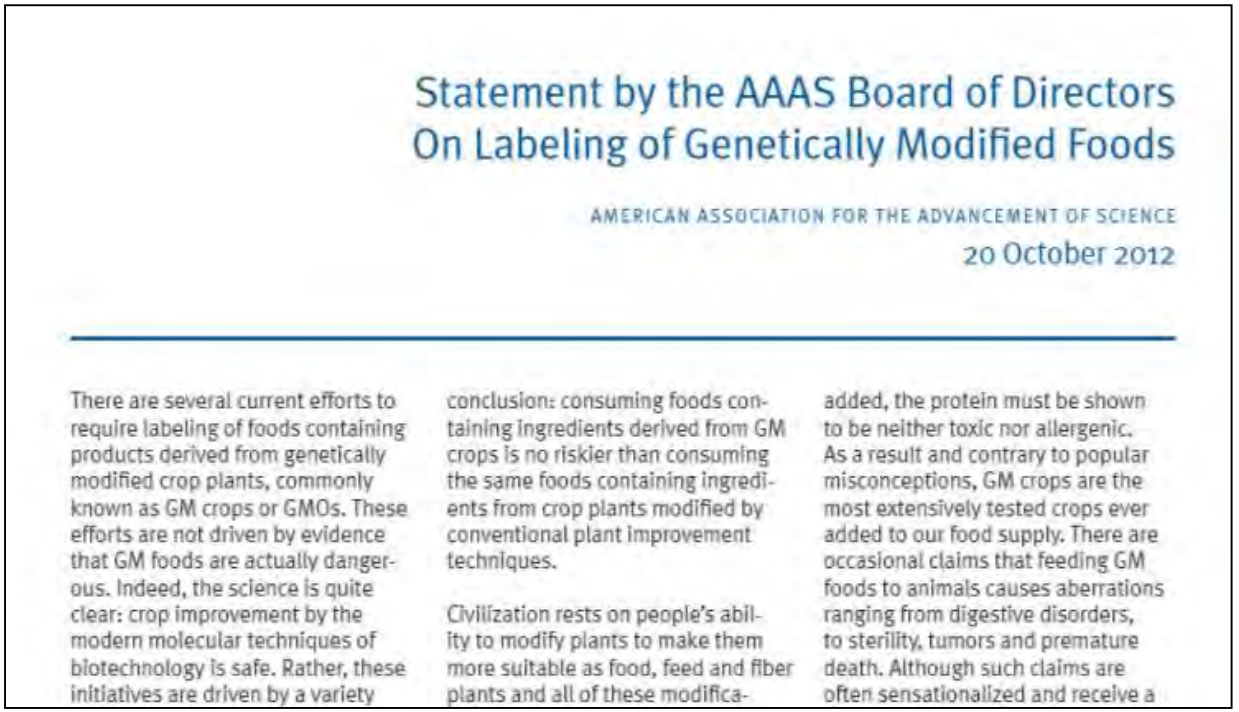
—*Vandana Shiva, environmental activist*

"The burning question for us all then becomes how—and how quickly—can we move healthy, organic products from a 4.2% market niche, to the dominant force in American food and farming? The first step is to change our labeling laws."

—*Ronnie Cummins, Director, Organic Consumers Association*

Once examined seriously, labeling does not look so appealing – issues include cost, choice, science & ethics

"Legally mandating such a label can only serve to mislead and falsely alarm consumers"



Statement by the AAAS Board of Directors On Labeling of Genetically Modified Foods

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

20 October 2012

There are several current efforts to require labeling of foods containing products derived from genetically modified crop plants, commonly known as GM crops or GMOs. These efforts are not driven by evidence that GM foods are actually dangerous. Indeed, the science is quite clear: crop improvement by the modern molecular techniques of biotechnology is safe. Rather, these initiatives are driven by a variety

conclusion: consuming foods containing ingredients derived from GM crops is no riskier than consuming the same foods containing ingredients from crop plants modified by conventional plant improvement techniques.

Civilization rests on people's ability to modify plants to make them more suitable as food, feed and fiber plants and all of these modifica-

added, the protein must be shown to be neither toxic nor allergenic. As a result and contrary to popular misconceptions, GM crops are the most extensively tested crops ever added to our food supply. There are occasional claims that feeding GM foods to animals causes aberrations ranging from digestive disorders, to sterility, tumors and premature death. Although such claims are often sensationalized and receive a

Approved by the AAAS Board of Directors on 20 October 2012

AAAS

Major newspapers agree

Tuesday, October 8, 2013

The Seattle Times
Winner of Nine Pulitzer Prizes

Editorials

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IN THE NEWS: Boarding' mentally ill | Hazing expulsions | Government shutdown | Ocean acidification | Seahawks

Editorial: Vote No on Initiative 522, the GMO labeling initiative

Efforts to label foods with GMOs have failed in Oregon and California. Shoppers want useful information not scare tactics. Vote No on I-522.

Seattle Times Editorial

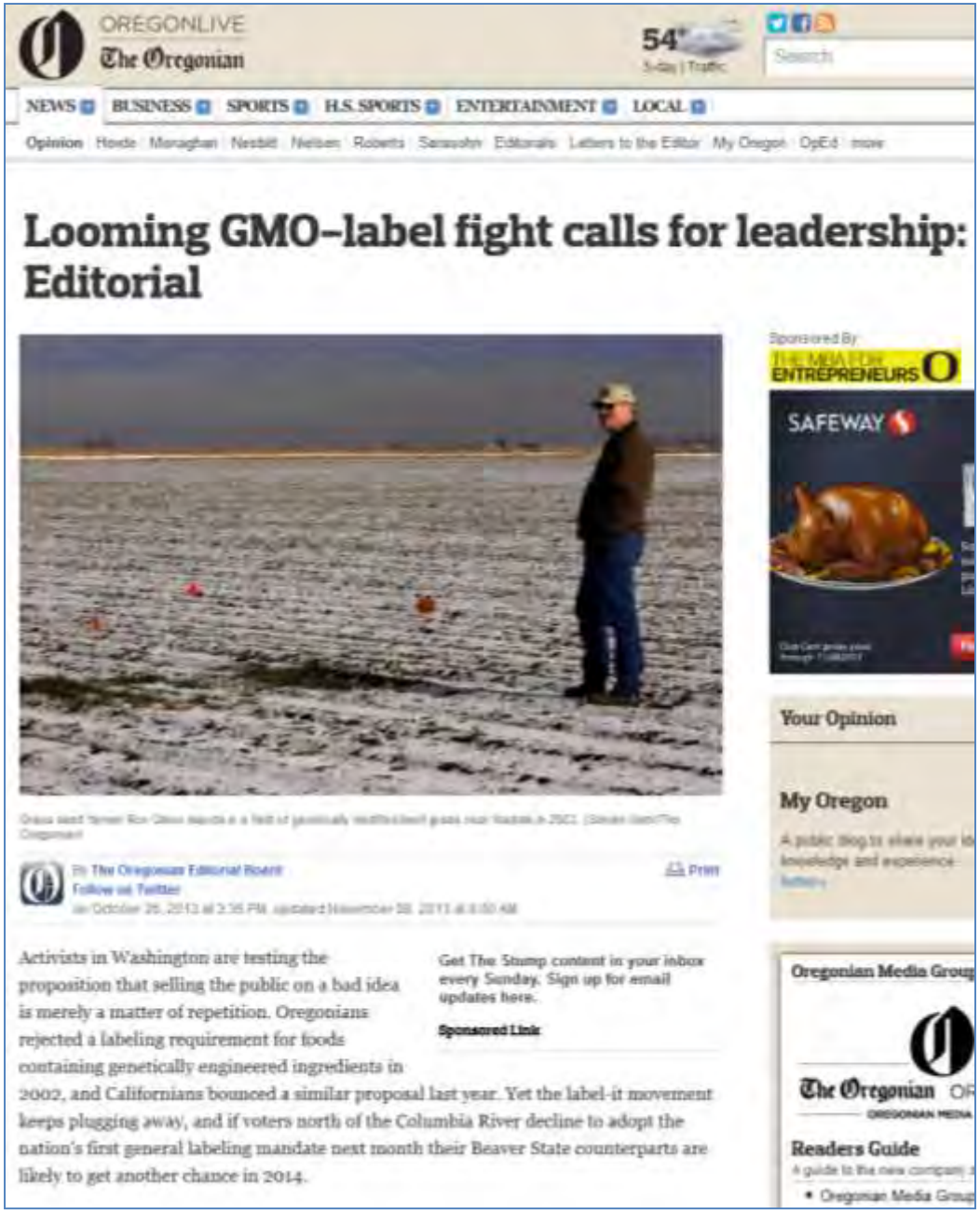
INITIATIVE 522 is a clumsy, emotion-based campaign to require labeling of selective food products containing genetically modified organisms.

The issue for proponents of I-522 seems to be less about outcomes — the products themselves — but rather finding the modern processes offensive.

Farmers and science have nurtured and bred hybrid versions of plants and animals for selective characteristics for centuries. But the efforts of the last few decades have stirred critics whose alarmist concerns are not supported by the mainstream scientific community.

Multistate efforts to require labeling of products as containing genetically modified organisms are ostensibly about a bold warning on packaging. The intent is more pointed, if a bit more subtle.

Labeling is one part of an effort to make the use of GMOs more expensive, arduous and complicated for farmers, processors, shippers, inspectors and regulators.



OREGONLIVE
The Oregonian

54°

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Looming GMO-label fight calls for leadership: Editorial

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SAFEWAY

Your Opinion

My Oregon

By The Oregonian Editorial Board
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Print

Activists in Washington are testing the proposition that selling the public on a bad idea is merely a matter of repetition. Oregonians rejected a labeling requirement for foods containing genetically engineered ingredients in 2002, and Californians bounced a similar proposal last year. Yet the label-it movement keeps plugging away, and if voters north of the Columbia River decline to adopt the nation's first general labeling mandate next month their Beaver State counterparts are likely to get another chance in 2014.

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Oregonian Media Group

The Oregonian

Readers Guide

"Activists in Washington are testing the proposition that selling the public on a bad idea is merely a matter of repetition…….

they'll do the state's farmers little good by either supporting or tolerating an irrational labeling policy. "

Vote in Washington largely broke down along urban-rural divide

Initiative to the Legislature 522 Concerns labeling of genetically-engineered foods - County Results

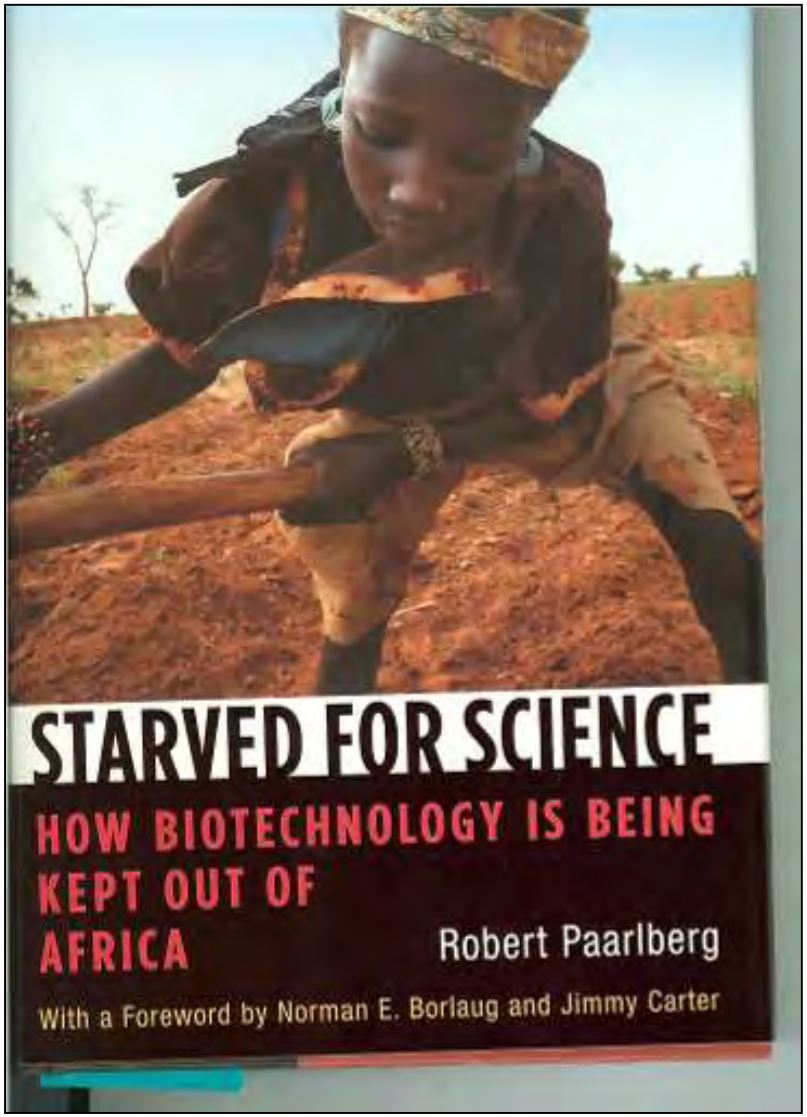
Find candidates and races

Last updated on 11/18/2013 4:12 PM

Total

No	51.11%
892,003	
Yes	48.89%
853,280	

Is it righteous to protect the developing world from GMO crops?



Golden rice and the Philippines

Vitamin A deficiency is a serious problem among the poor there. Field trials are underway to test, develop, and provide access to it for poor farmers

Intl Rice Research Inst: In the Philippines, vitamin A deficiency affects approximately 1.7 million children (15.2%) aged 6 months to 5 years.

Subclinical vitamin A deficiency affects one out of every ten pregnant women.

With funding and organization from European NGOs, field trials were vandalized in August 2013

The New York Times

August 24, 2013

Golden Rice: Lifesaver?

By AMY HARMON

ONE bright morning this month, 400 protesters smashed

EDITORIAL

Standing Up for GMOs

ON 8 AUGUST 2013, VANDALS DESTROYED A PHILIPPINE "GOLDEN RICE" FIELD TRIAL. OFFICIALS AND staff of the Philippine Department of Agriculture that conduct rice tests for the International Rice Research Institute (IRRI) and the Philippine Rice Research Institute (PhilRice) had gathered for a peaceful dialogue. They were taken by surprise when protesters invaded the compound, overwhelmed police and village security, and trampled the rice. Billed as an uprising of farmers, the destruction was actually carried out by protesters trucked in overnight in a dozen jeepneys.

The global scientific community has condemned the wanton destruction of these field trials, gathering thousands of supporting signatures in a matter of days.* If ever there was a clear-cut cause for outrage, it is the concerted campaign by Greenpeace and other nongovernmental organizations, as well as by individuals, against Golden Rice. Golden Rice is a strain that is genetically modified by molecular techniques (and therefore labeled a genetically modified organism or GMO) to produce β-carotene, a precursor of vitamin A. Vitamin A is an essential component of the light-absorbing molecule rhodopsin in the eye. Severe vitamin A deficiency results in blindness, and half of the roughly half-million children who are blinded by it die within a year. Vitamin A deficiency also compromises immune system function, exacerbating many kinds of illnesses. It is a disease of poverty and poor diet, responsible for 1.9 to 2.8 million preventable deaths annually, mostly of children under 5 years old and women.†

Rice is the major dietary staple for almost half of humanity, but white rice grains lack vitamin A. Research scientists Ingo Potrykus and Peter

India; and a former scientist at ETH-Zurich, Switzerland, and at IRRI, Philippines.

Nina Fedoroff is a National Medal of Science laureate; a Distinguished Professor at the

newsblog

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Swedish scientists decry government links to anti-GMO 'vandals'

13 Nov 2013 | 12:31 GMT | Posted by Davide Castelvecchi | Category: Biology & Biotechnology, Earth, environment & ecology, Policy

Posted on behalf of Marta Paterlini.

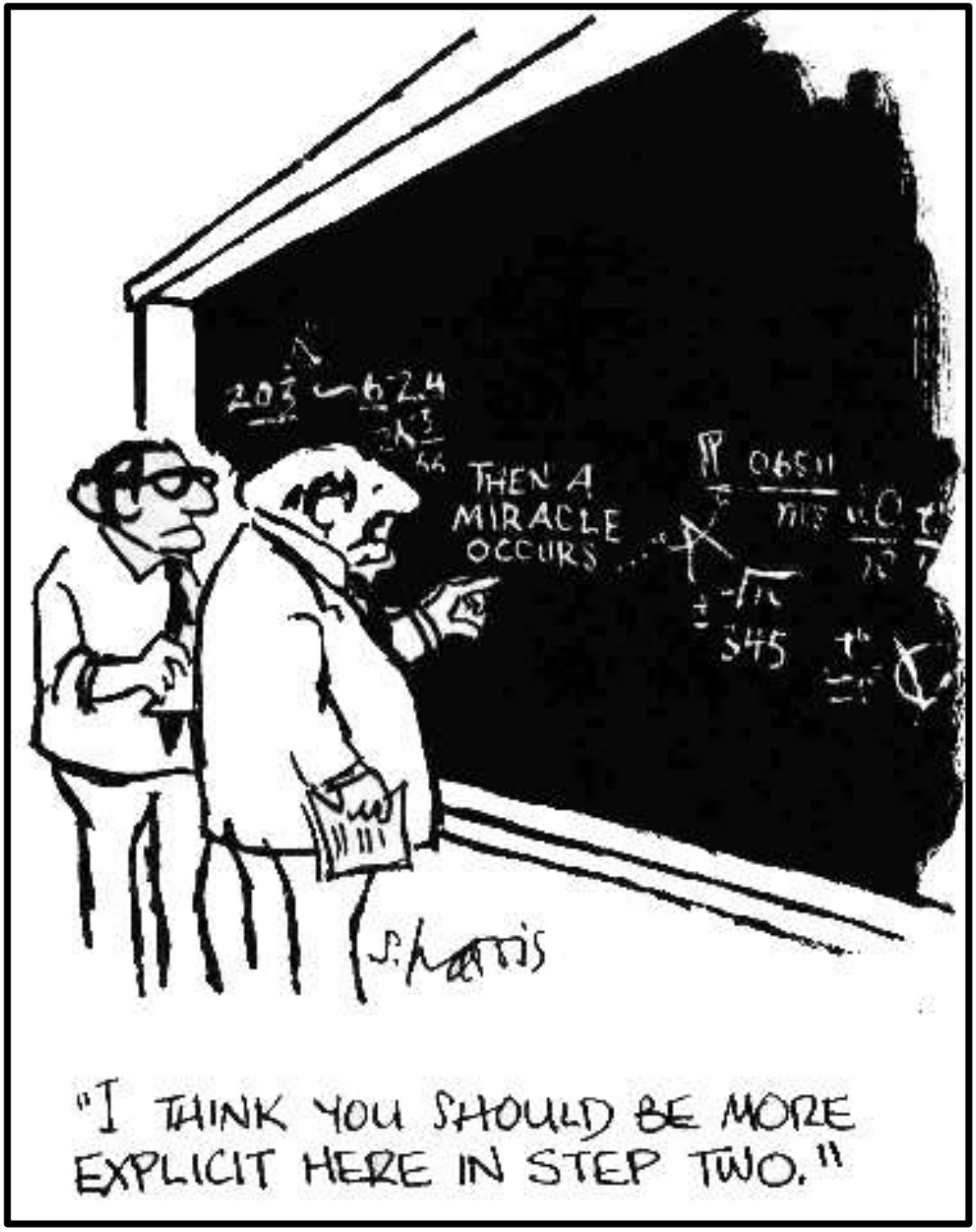
A group of Swedish scientists challenged their government in an open letter on 22 October in which they alleged that Swedish foreign aid has supported vandalism in the Philippines against research plots of genetically modified crops.

You Tube of vandalism – from Philippines news

You Tube of vandalism: http://www.youtube.com/watch?feature=player_embedded&v=8DAoh1Xe6mI

Statement from the International Rice Research Institute about the vandalism

Video from IRRI on field trial vandalism: http://www.youtube.com/watch?v=uxa76CHDH5Y&feature=youtu.be



"I THINK YOU SHOULD BE MORE EXPLICIT HERE IN STEP TWO."

The New York Times

July 27, 2013

A Race to Save the Orange by Altering Its DNA

By AMY HARMON

CLEWISTON, Fla. — The call Ricke Kress and every other citrus grower in Florida dreaded came while he was driving.

Face the “wall of opposition” ?

Two big choices

- Unethical, irreversible, and unpredictable impacts on food safety and environment
  - Stop it or regulate it to where it does not matter
- Studied and regulated smartly, it is an essential tool
  - For helping people in dire need right now, and for managing a very scary future on this planet