

# Ten big things about GE/GMO crops and foods

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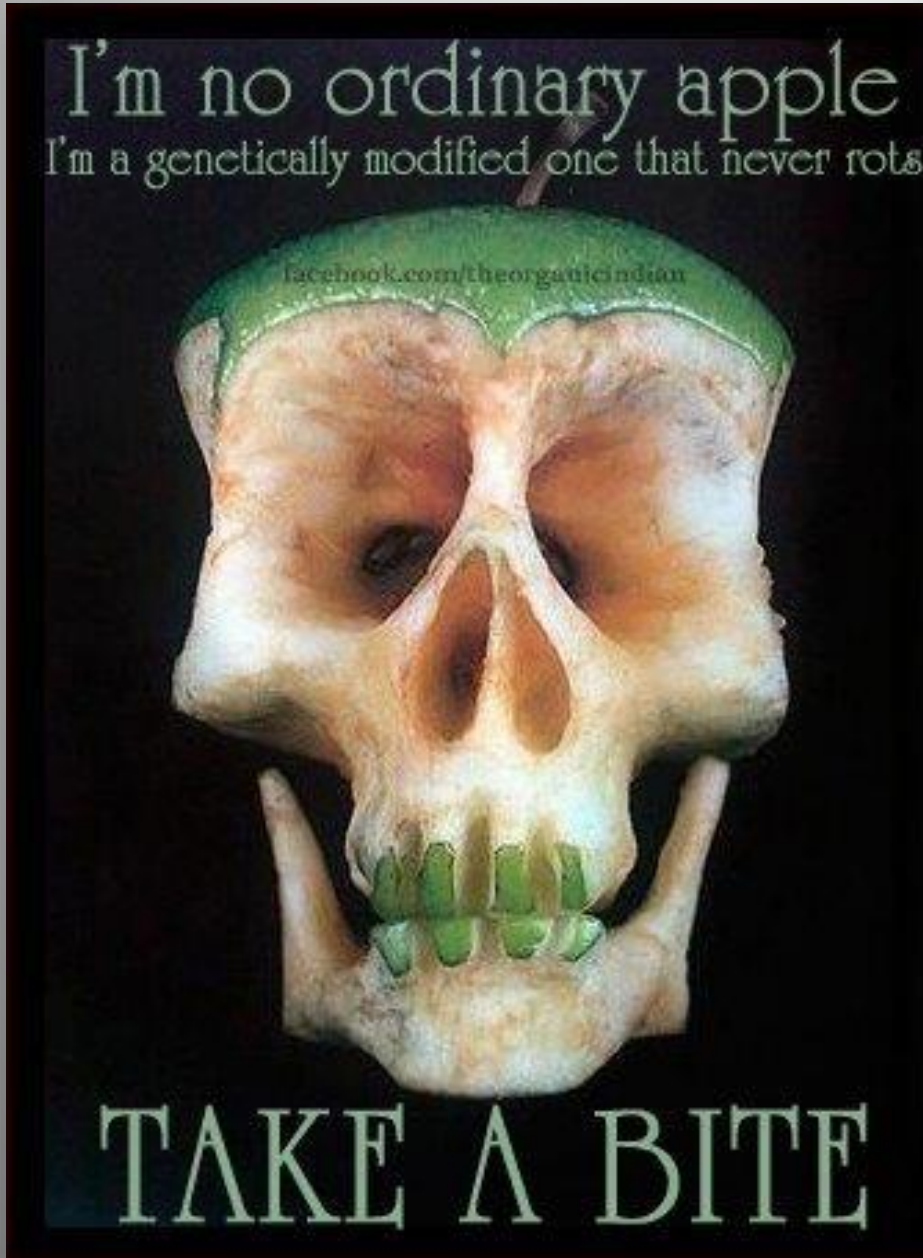
1. GE crop and food issues are messy  
and **extremely** controversial

# There are numerous myths that are rampant and recycled in media

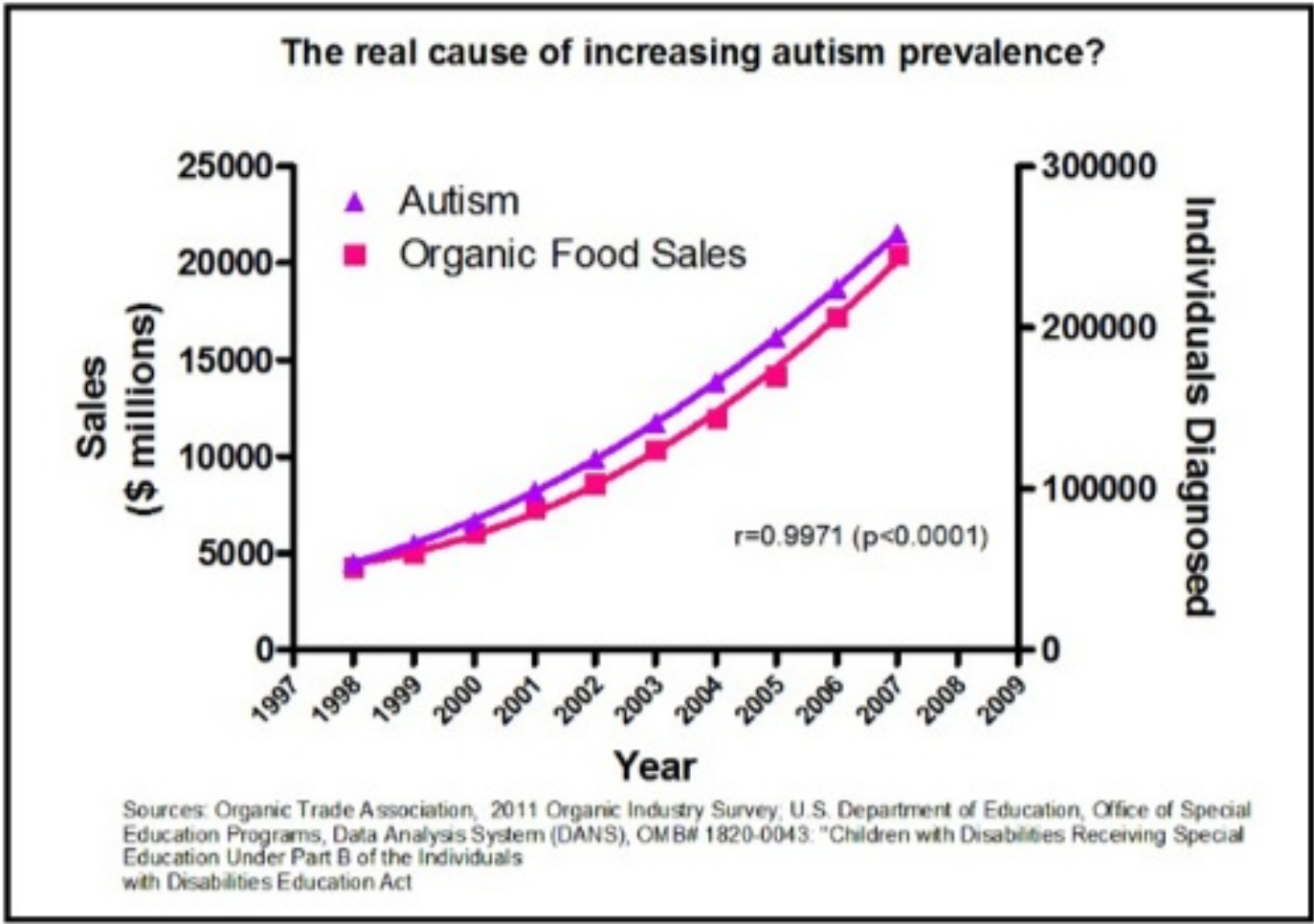


*Vandana Shiva accuses multinational corporations such as Monsanto of attempting to impose "food totalitarianism" on the world.*

And many more...



Much pseudo-science: “Half of all children will be Autistic by 2025 due to Roundup warns MIT scientist”



Food  
Evolution  
movie  
debunks  
the “data”  
of the  
extreme  
anti-GMO  
left

# FOOD|EVOLUTION

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Amongst all this conflict and confusion around food,  
how do we make the best decisions  
about how we feed ourselves?



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# Pew Survey on views of controversial science issues - 2015

PewResearchCenter

NUMBERS, FACTS AND TRENDS SHAPING THE WORLD

FOR RELEASE JANUARY 29, 2015

## Public and Scientists' Views on Science and Society

*Both the public and scientists value the contributions of science, but there are large differences in how each perceives science issues. Both groups agree that K-12 STEM education falls behind other nations.*

A PEW RESEARCH CENTER STUDY CONDUCTED IN COLLABORATION WITH THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (AAAS)

FOR FURTHER INFORMATION ON THIS REPORT:

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202.419.4372  
[www.pewresearch.org](http://www.pewresearch.org)

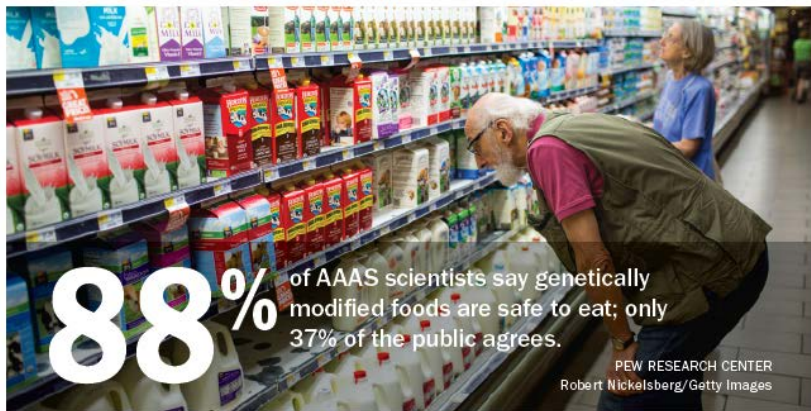
# Scientist views contrast with public on GMOs

JANUARY 28, 2015



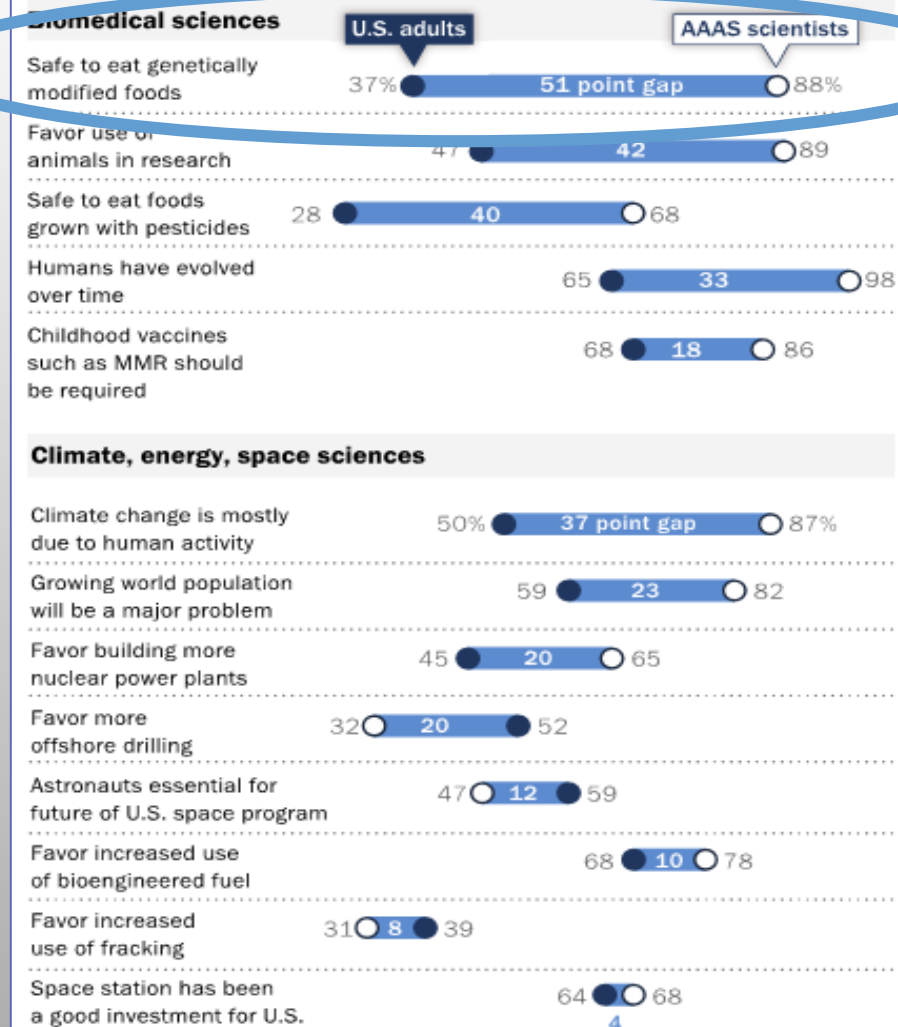
PUBLIC AND SCIENTISTS' VIEWS ON SCIENCE AND SOCIETY

## 88% of AAAS scientists say genetically modified foods are safe to eat; only 37% of the public agrees



### Opinion Differences Between Public and Scientists

% of U.S. adults and AAAS scientists saying each of the following



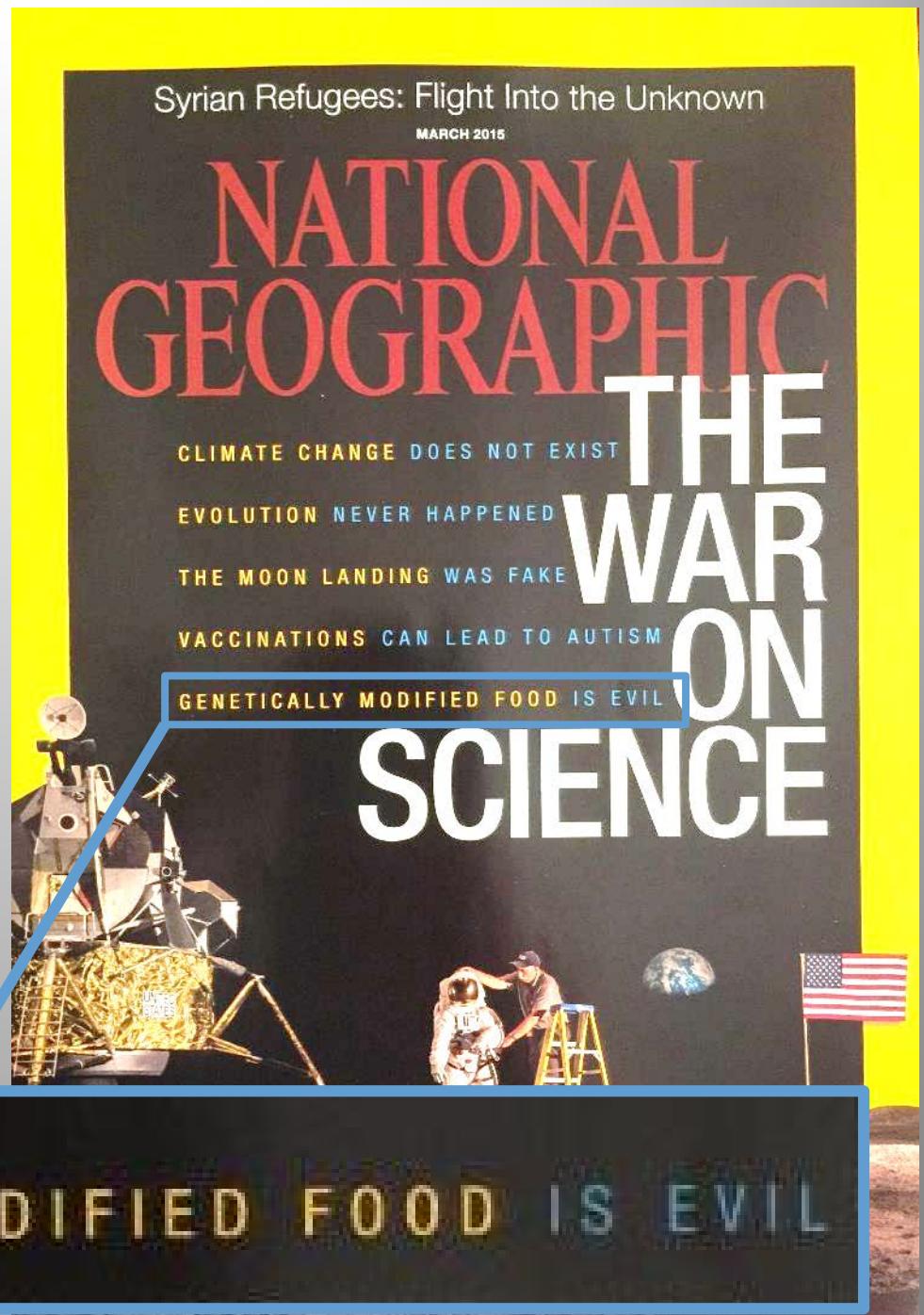
Survey of U.S. adults August 15-25, 2014. AAAS scientists survey Sept. 11-Oct. 13, 2014. Other responses and those saying don't know or giving no answer are not shown.

PEW RESEARCH CENTER



GMOs one of the  
“fake news - fake  
science” issues

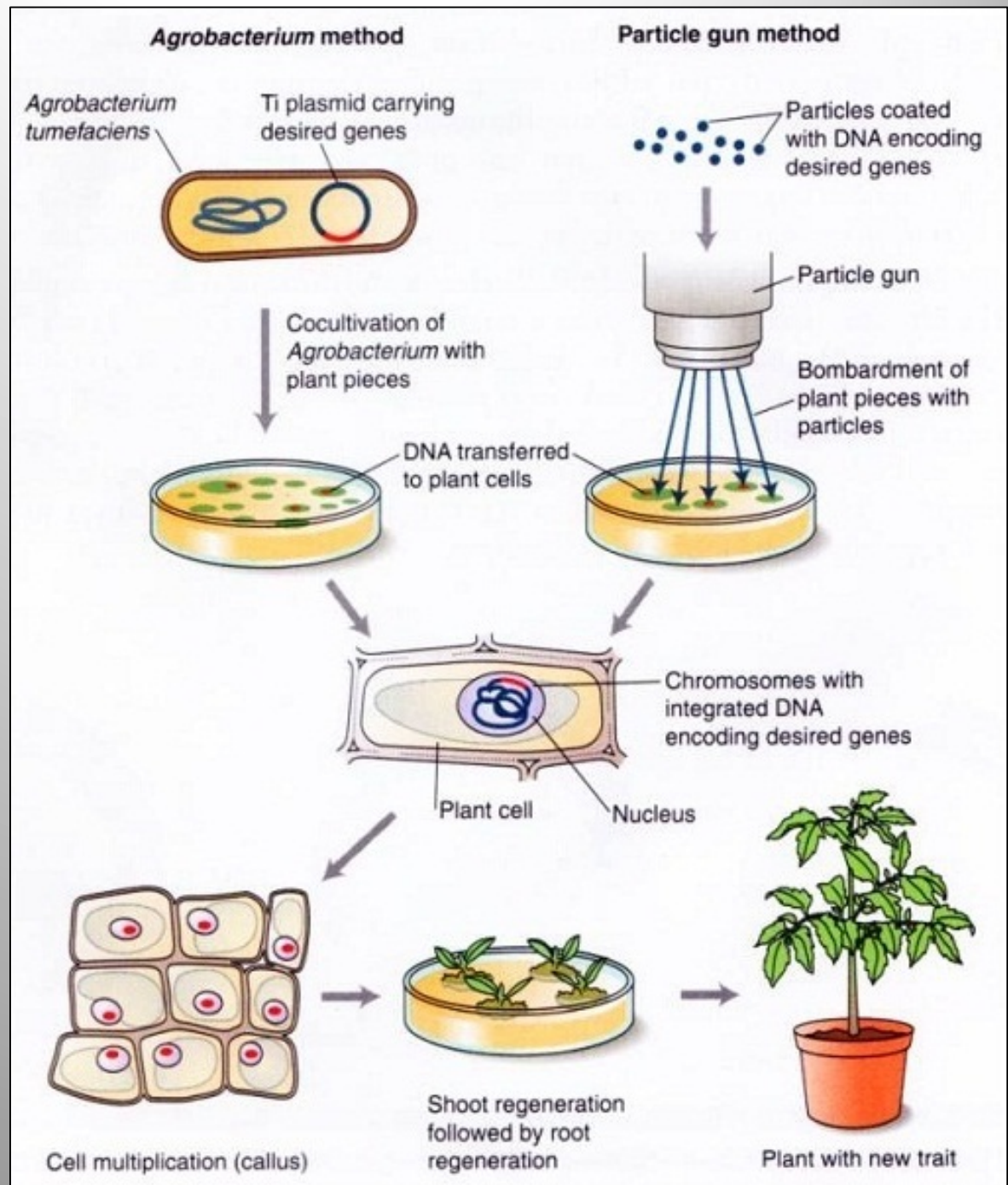
*It's hard to tell  
what science is  
saying amidst all  
the noise*



GENETICALLY MODIFIED FOOD IS EVIL

2. GE is a **diverse set of methods**,  
not a specific product or mode of use

# Steps to create a GE plant



# What is genetic engineering (GE)

- **Direct modification of DNA**
  - Vs. indirect modification in breeding
- Asexually modified, usually in somatic cells
  - Then regenerated into whole organisms, usually starting in Petri dishes



# Gene editing technology for diverse traits

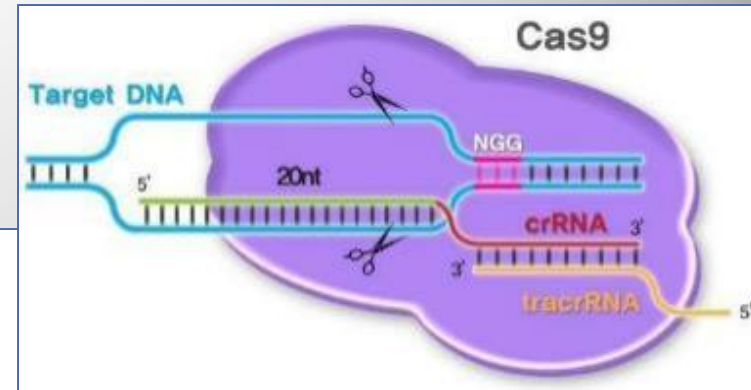
## Science magazine names CRISPR 'Breakthrough of the Year'

By Robert Sanders | DECEMBER 18, 2015



In its year-end issue, the journal *Science* chose the CRISPR genome-editing technology invented at UC Berkeley 2015's Breakthrough of the Year.

A runner-up in 2012 and 2013, the technology now revolutionizing genetic research and gene therapy "broke away from the pack, revealing its true power in a series of spectacular achievements," wrote *Science* correspondent John Travis in the Dec. 18 issue. These included "the creation of a long-sought 'gene drive' that



# nature

THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE

## Dawn of the gene-editing age

PAGE 155



# EVERYWHERE

### CONSERVATION

#### A WORLD OF TWO HALVES

*E. O. Wilson's vision for an  
Earth shared with nature*

PAGE 170

### PLANT BIOLOGY

#### FLOWER ARRANGEMENT

*An attractant / receptor pair  
driving pollen-tube growth*

PAGES 178, 241 & 245

### GROUP DYNAMICS

#### THE RIGHT SIZE FOR A LAB

*The skills mix and head  
count needed for success*

PAGE 263

[NATURE.COM/NATURE](http://NATURE.COM/NATURE)

10 March 2016 £10

UK €11.95

# Recombinetics creates hornless cattle – mimics a natural mutation

## *Open Season Is Seen in Gene Editing of Animals*

By AMY HARMON NOV. 26, 2015



A calf, left, approximately the same age as the first two genetically modified calves to have their DNA edited so that they do not grow horns, right. Jenn Ackerman for *The New York Times*

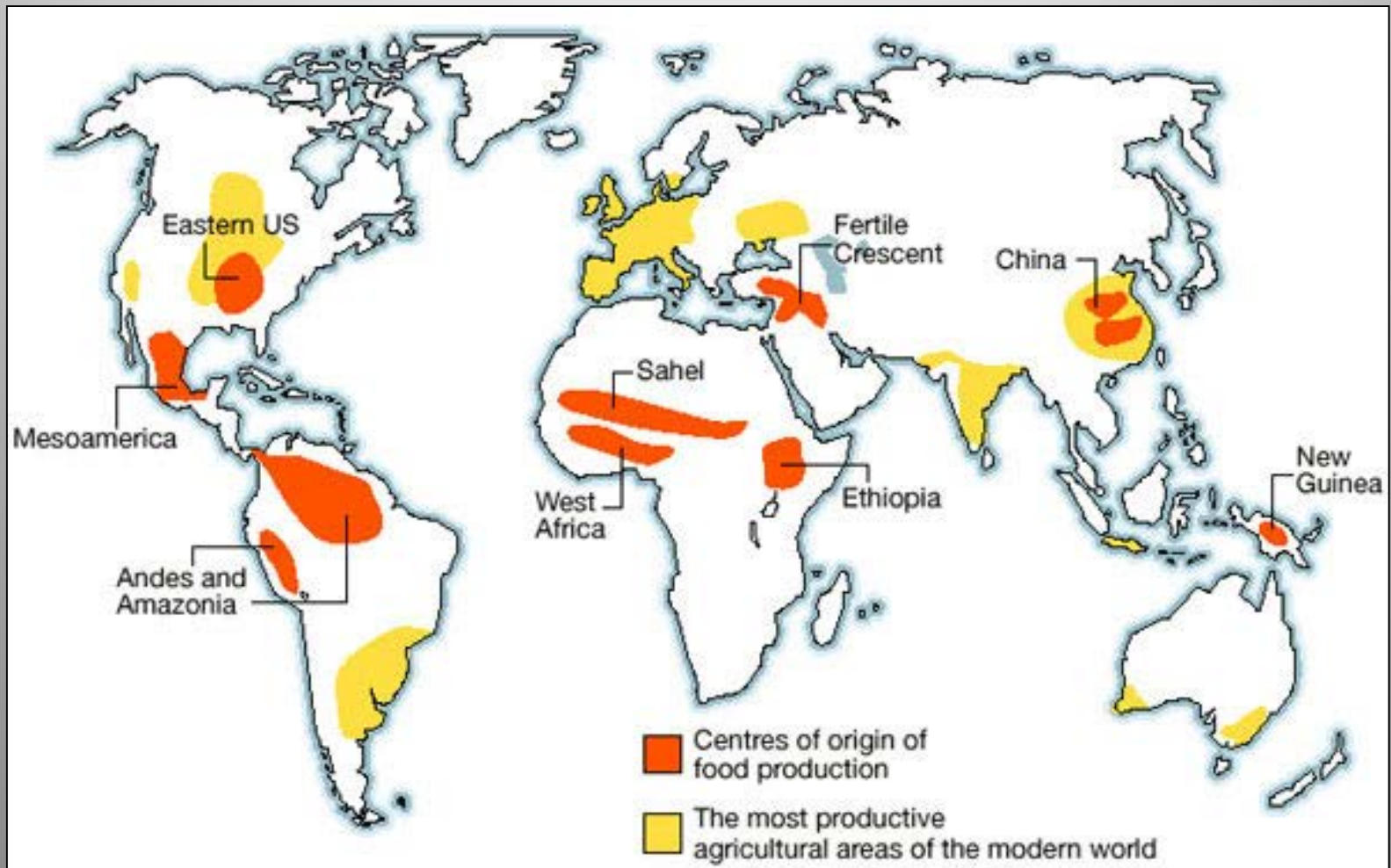
**The New York Times**

3. The most radically modified crops  
and foods are **not** GE



# Where did our crops come from?

Answer: All over the world



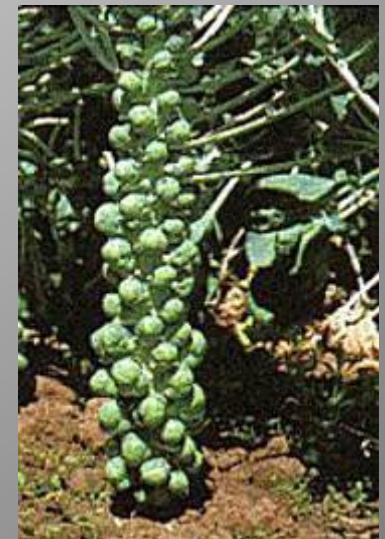
# Most crops intensively bred, prior to GMOs



# Mutants are some of our best friends: Domestication of wild cabbage



Ornamental kale  
Late 1900's



Breeding is continually changing varieties in response to markets, climate change, pests...



OSU wheat variety trials



University of Kentucky wheat variety trials

# Oregon wheat traits of interest

- Grain yield
  - Yield stability
  - Broad adaptation
- Grain quality
  - Test weight
  - Kernel size, weight
  - Hardness
- Stress tolerance
  - Optimal maturity
  - Winter-hardiness
  - Straw strength
  - Drought tolerance
  - Heat tolerance
- Disease resistance
  - Stripe rust
  - Leaf and stem rust
  - Strawbreaker footrot
  - Cephalosporium stripe
  - Fusarium crown rot
  - Dryland footrots
  - Septoria tritici
  - Septoria nodorum
  - Mildew
- Insect resistance
  - Hessian fly



# Sources of genes include mutation breeding

- 3,217 registered varieties developed from mutation breeding
  - FAO/IAEA database (<http://www-infocris.iaea.org/MVD/>)
- DNA changes include deletions, insertions, inversions



**Institute of Radiation Breeding  
Ibaraki-ken, JAPAN  
[www.irb.affrc.go.jp/](http://www.irb.affrc.go.jp/)**



# Radical changes in domesticated animals

All dogs derived from the wolf by breeding

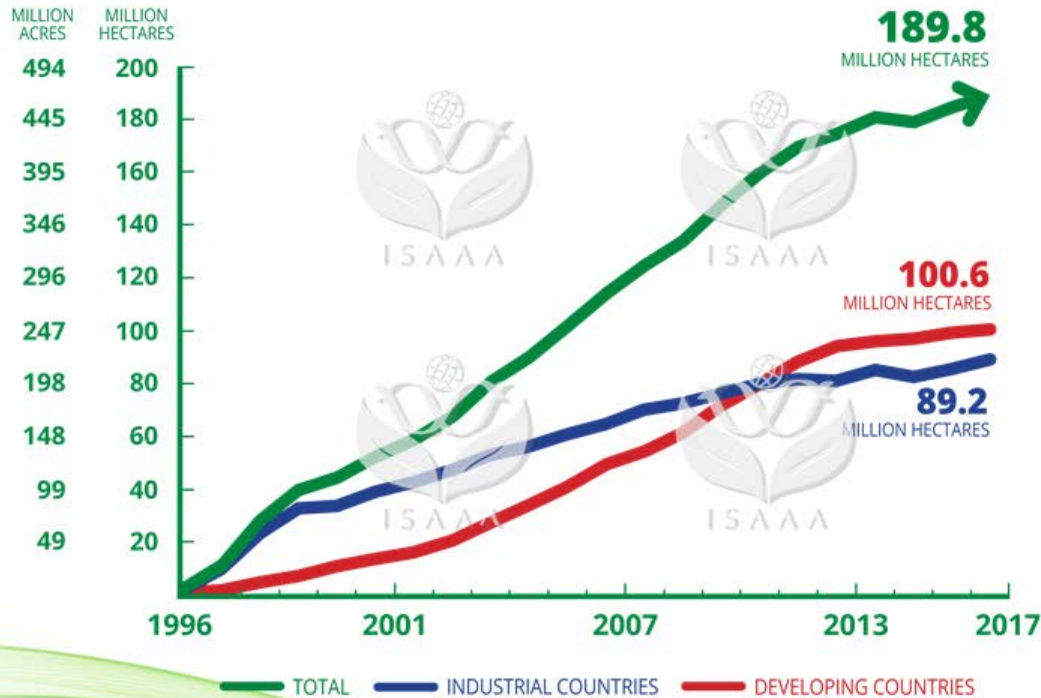


4. GE crops have provided great **value** to farmers and environment, and have been taken up at an extraordinary rate (where allowed)



First generation herbicide and insect resistant crops were rapidly adopted by farmers, both in the developed and developing world

### Global Area of Biotech Crops, 1996 to 2017: Industrial and Developing Countries (Million Hectares, Million Acres)

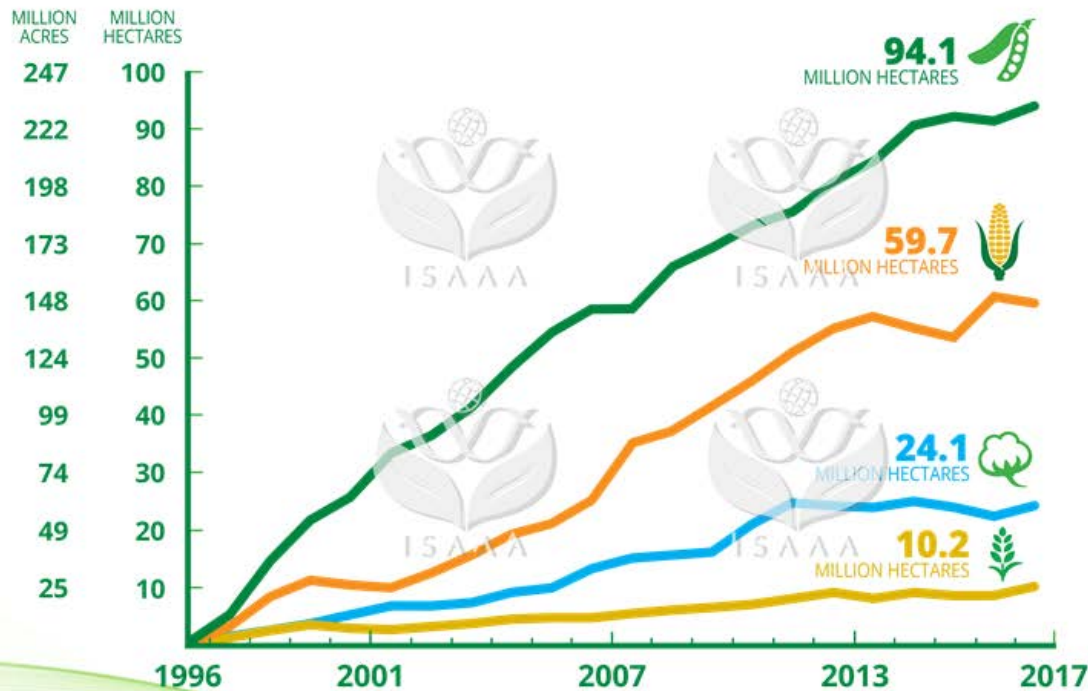


ISAAA, 2017

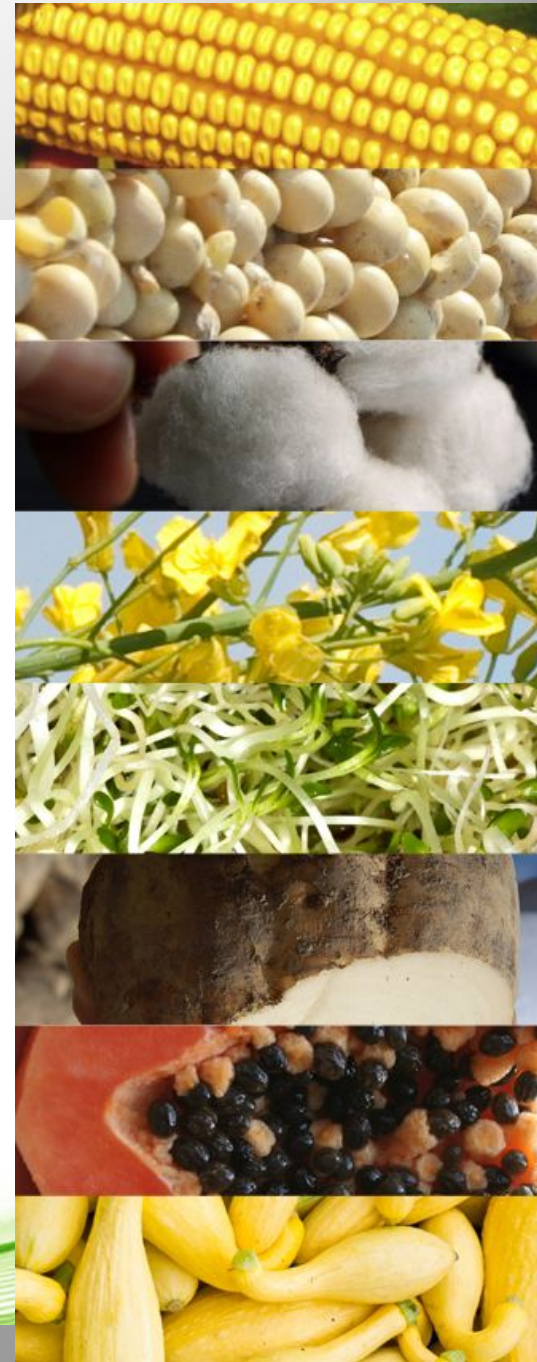


# Four crops dominate, 8+ in USA

Global Area of Biotech Crops, 1996 to 2017: By Crop  
(Million Hectares, Million Acres)



ISAAA, 2017



# Global “meta-analysis” of early impacts

The screenshot shows the PLOS ONE website interface. At the top left is the PLOS ONE logo. To the right are navigation links for 'Subject Areas', 'For Authors', and 'About Us'. A search bar is located on the right side with a magnifying glass icon and a link to 'advanced search'. Below the navigation is a section for article status: 'OPEN ACCESS' and 'PEER-REVIEWED'. The article title is 'A Meta-Analysis of the Impacts of Genetically Modified Crops' by Wilhelm Klümper and Matin Qaim. The publication date is November 3, 2014, and the DOI is 10.1371/journal.pone.0111629. On the right side, there is a statistics table showing 2 Saves, 0 Citations, 79,064 Views, and 948 Shares.

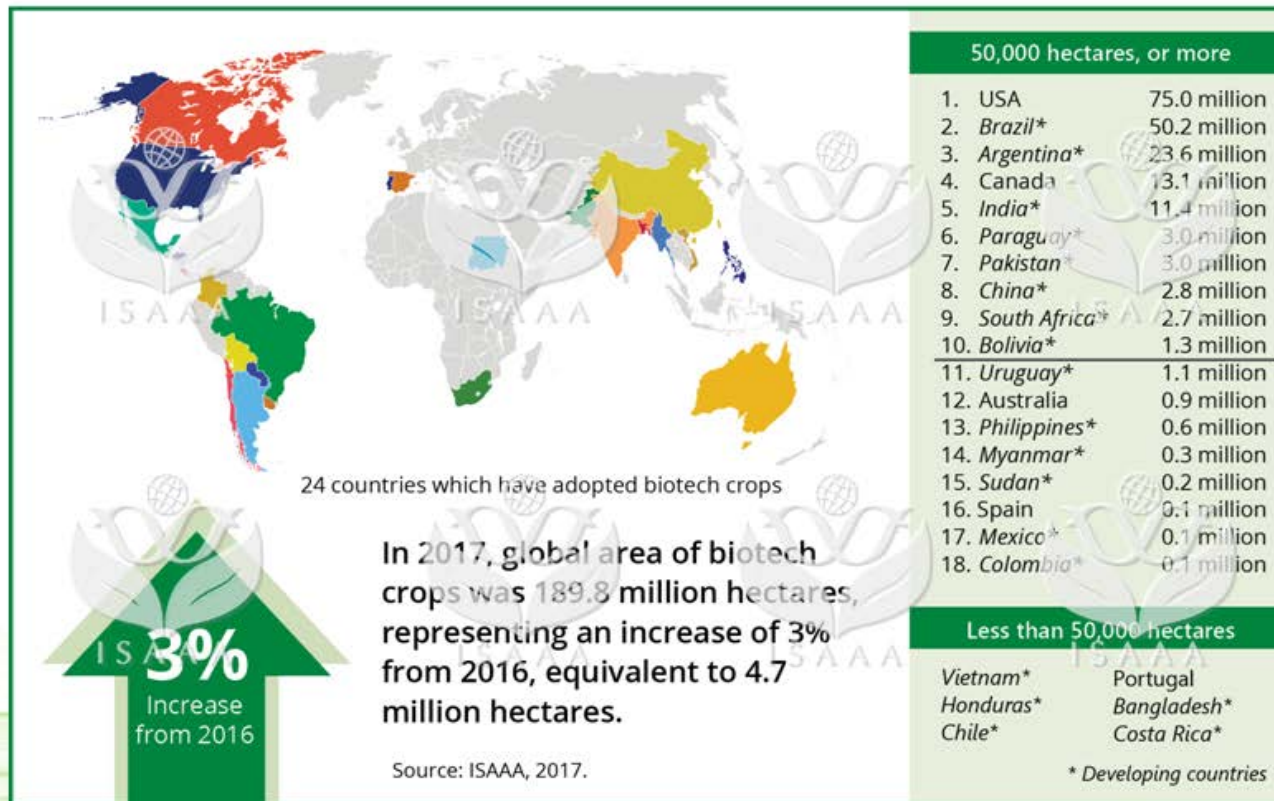
2 Saves	0 Citations
79,064 Views	948 Shares

“147 original studies were included.”

“On average, GM technology adoption has reduced chemical pesticide use by 37%, increased crop yields by 22%, and increased farmer profits by 68%.”

# Adoption rates highly variable

## Global Area of Biotech Crops, 2017: By Country (Million Hectares)



5. Some GE crops and management practices are **not** a good idea, and very tough to manage

# It is possible to transfer allergens with GE methods

2009 NEJM



The NEW ENGLAND  
JOURNAL of MEDICINE

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ORIGINAL ARTICLE

## Identification of a Brazil-Nut Allergen in Transgenic Soybeans

Julie A. Nordlee, M.S., Steve L. Taylor, Ph.D., Jeffrey A. Townsend, B.S., Laurie A. Thomas, B.S., and Robert K. Bush, M.D.  
N Engl J Med 1996; 334:688-692 | March 14, 1996

Abstract Article References Citing Articles (201)

### BACKGROUND

The nutritional quality of soybeans (*Glycine max*) is compromised by a relative deficiency of methionine in the protein fraction of the seeds. To improve the nutritional quality, methionine-rich 2S albumin from the Brazil nut (*Bertholletia excelsa*) has been introduced into transgenic soybeans. Since the Brazil nut is a known allergenic food, we assessed the allergenicity of the 2S albumin.

[Full Text of Background...](#)

### MEDIA IN THIS ARTICLE

#### FIGURE 3



Reactivity on Skin-Prick Testing to Extracts of Transgenic Soybeans

Thus caution warranted

This product never developed for commercial use or marketed

# Roundup tolerant bentgrass escape in Oregon

483

## GMO grass that 'escaped' defies eradication, divides grass seed industry



8.1k  
shares



# Roundup tolerant bentgrass permitted

## Feds deregulate controversial GMO grass seed



Linn County bills itself as the grass seed capital of the world. But the thriving grass business has been divided by a controversial genetically modified grass developed by Scotts Miracle-Gro. *(Jeff Manning/The Oregonian)*



By **Jeff Manning** | [The Oregonian/OregonLive](#)

[Email the author](#) | [Follow on Twitter](#)

on January 18, 2017 at 10:00 AM, updated January 18, 2017 at 10:18 AM

The U.S. Department of Agriculture on Tuesday deregulated a genetically modified grass that some Oregon farmers and dealers say threatens the state's grass seed business.



# Poor weed management has led to rapid development of herbicide-resistant weeds

## And motivated development of new kinds of herbicide tolerant crops

nature  
biotechnology

nature.com > journal home > archive > issue > news > full text

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)

PDF Citation Reprints Rights & permissions Article metrics

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

BILL BARNESDALE / AGSTOCKUSA /



# Damage from growing use of dicamba resistant crops – due to chemical's volatility

 **the salt** WHAT'S ON YOUR PLATE

 2:16

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[Transcript](#)

**FOOD FOR THOUGHT**

## Damage From Wayward Weedkiller Keeps Growing

July 6, 2017 - 5:01 AM ET  
Heard on Morning Edition

 **DAN CHARLES** 



# Insect resistance development

REVIEW

nature  
biotechnology

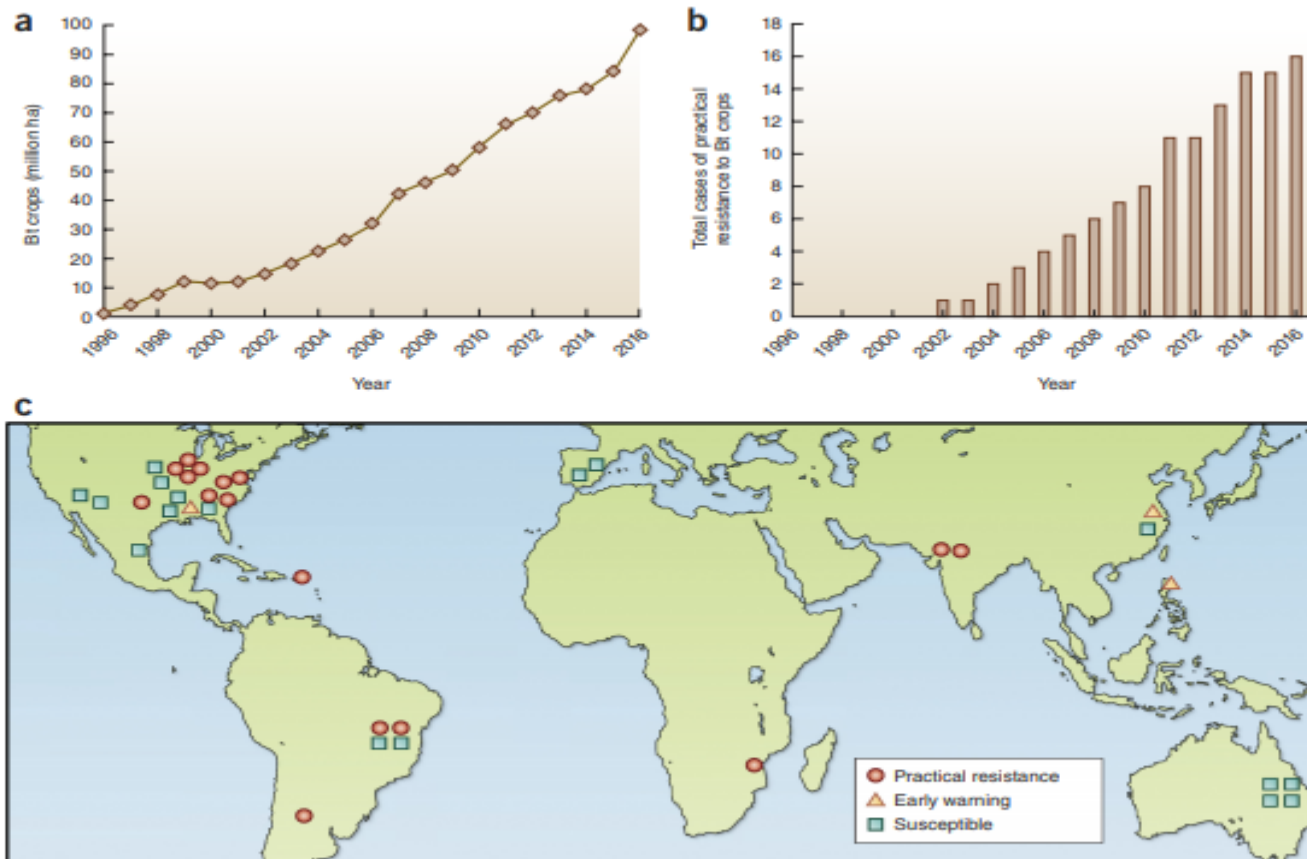
## Surge in insect resistance to transgenic crops and prospects for sustainability

Bruce E Tabashnik<sup>1</sup> & Yves Carrière

Transgenic crops have revolutionized insect pest control, but their effectiveness has been reduced by evolution of resistance in pests. We analyzed global monitoring data reported during the first two decades of transgenic crops, with each case representing the responses of one pest species in one country to one insecticidal protein from *Bacillus thuringiensis* (Bt). The cases of pest resistance to Bt crystalline (Cry) proteins produced by transgenic crops increased from 3 in 2005 to 16 in 2016. By contrast, in 17 other cases there was no decrease in pest susceptibility to Bt crops, including the recently introduced transgenic corn that produces a Bt vegetative insecticidal protein (Vip). Recessive inheritance of pest resistance has favored sustained susceptibility, but even when inheritance is not recessive, abundant refuges of non-Bt host plants have substantially delayed resistance. These insights may inform resistance management strategies to increase the durability of current and future transgenic crops.

Nature. All rights reserved.

# Insect resistance has risen in parallel with crop use



**Figure 1** Global status of pest resistance to Bt crops. (a) Hectares planted to Bt crops each year. (b) Cumulative cases of field-evolved practical resistance to Bt crops. (c) Each symbol represents 1 of 36 cases indicating responses of one pest species in one country to one toxin in Bt corn, cotton, or soy (Tables 1 and 2).

6. **Simple** answers to ag and food problems should set off alarm bells

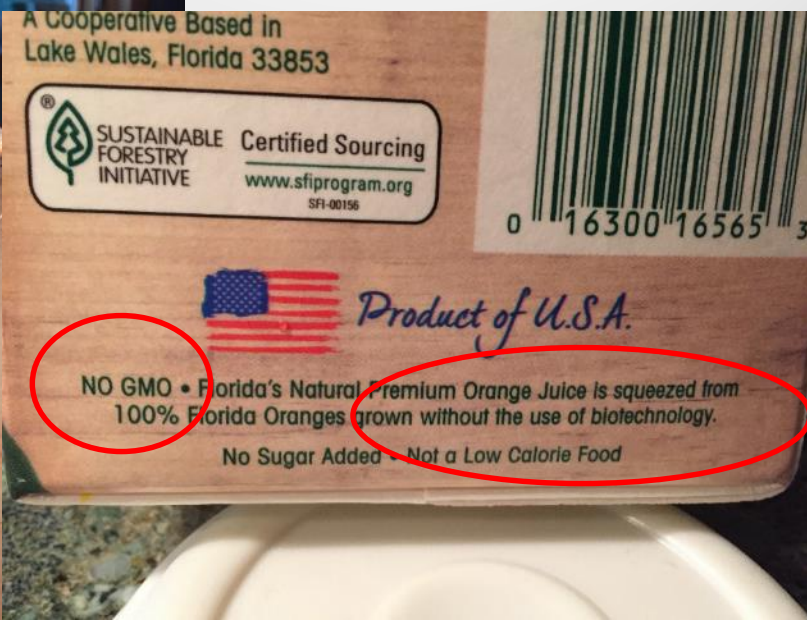
# Non-GMO labels have proliferated



# GMO-free labels a major feature of “clean label” movement



# Non-GMO claims on orange juice



BUSINESS DAY

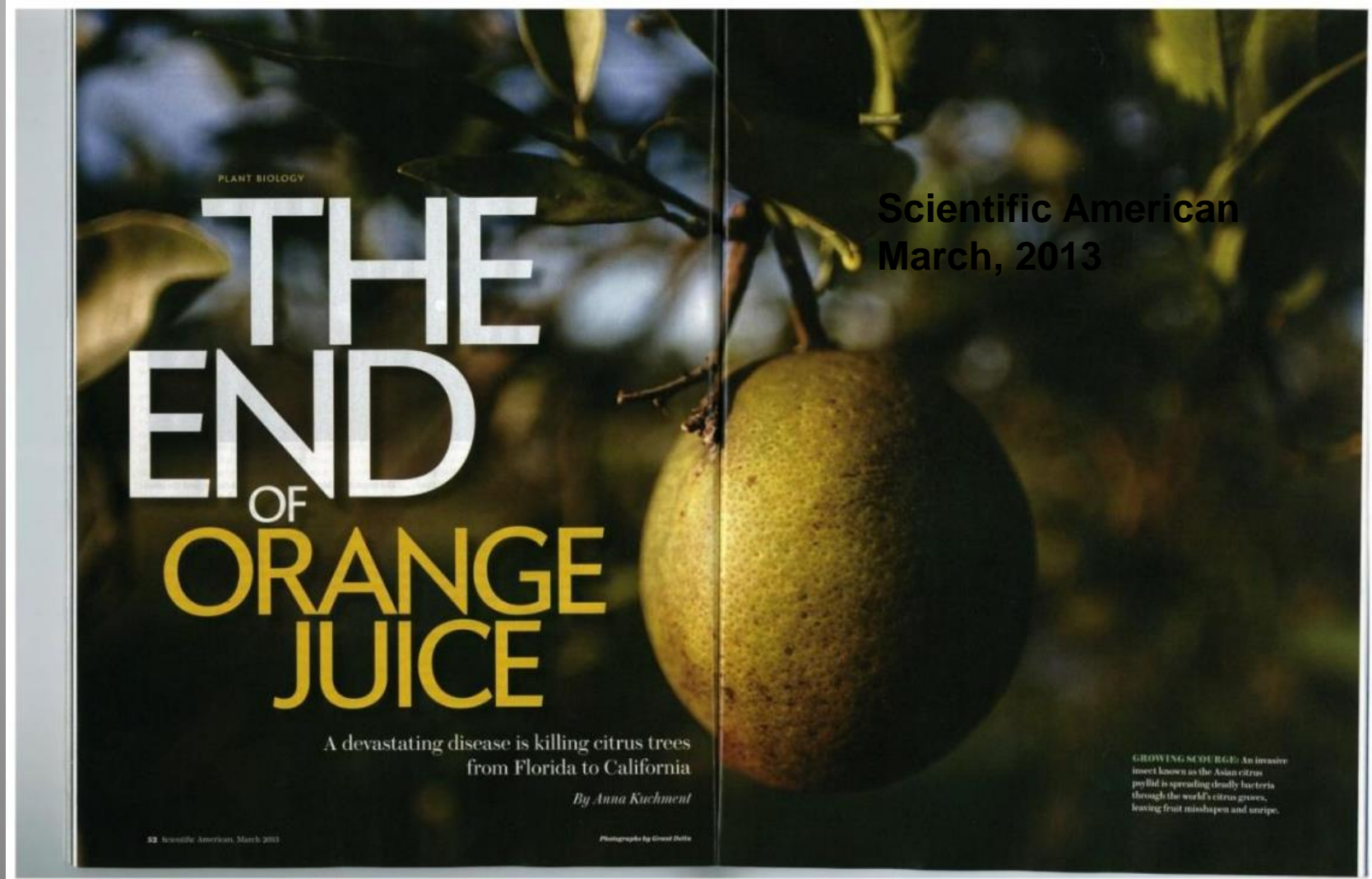
*Some Tropicana and Other PepsiCo Products to Carry Non-GMO Project Seal*

The New York Times

By STEPHANIE STROM DEC. 10, 2015



# In spite of GE solutions to devastating 'citrus greening' threatening the industry



Scientific American  
March, 2013

PLANT BIOLOGY

# THE END OF ORANGE JUICE

A devastating disease is killing citrus trees  
from Florida to California

*By Anna Kuchment*

32 Scientific American, March 2013

Photographs by Girard Dulis

**GROWING SCOURGE:** An invasive insect known as the Asian citrus psyllid is spreading deadly bacteria through the world's citrus groves, leaving fruit misshapen and stunted.

# CRISPR-modified grapefruit resistant to citrus canker

Plant Biotechnology  
Journal

aab  
Association of Applied Biologists

SEB  
Society for  
Experimental Biology

*Plant Biotechnology Journal* (2016), pp. 1–7

doi: 10.1111/pbi.12677

## Genome editing of the disease susceptibility gene *CsLOB1* in citrus confers resistance to citrus canker

Hongge Jia<sup>1</sup>, Yunzeng Zhang<sup>1</sup>, Vladimir Orbović<sup>2</sup>, Jin Xu<sup>1</sup>, Frank F. White<sup>3</sup>, Jeffrey B. Jones<sup>3</sup> and Nian Wang<sup>1,\*</sup>



**American chestnut was  
an iconic, widespread  
keystone forest tree in  
the USA**

**It was extirpated as a  
forest tree by Chestnut  
Blight**



# 1912 photo of blight in NY



Complete destruction of chestnut trees in mixed stands. Note healthy condition of trees of other species. Views along Long Island Railroad, near Richmond Hill, New York.—*Photograph by Prof. Collins.*

# Breeding has not worked despite nearly 100 years of effort – give genetic engineering a chance?



The screenshot shows the top portion of a Scientific American article. At the top right, there are links for 'Sign In | Register' and a shopping cart icon with '0' items. Below this is a search bar with the placeholder text 'Search ScientificAmerican.com'. A navigation bar contains a red 'Subscribe' button and several menu items: 'News & Features', 'Topics', 'Blogs', 'Videos & Podcasts', 'Education', and 'C'. Below the navigation bar, the breadcrumb trail reads 'Energy & Sustainability » Scientific American Volume 310, Issue 3'. To the right of the breadcrumb are icons for page number '2', 'Email', and 'Print'. The main article title is 'The American Chestnut's Genetic Rebirth' in a large, bold, black serif font. To the left of the title is a small thumbnail image of a brain with the text 'The New Century of the Brain See Inside'. Below the title is a sub-headline: 'A foreign fungus nearly wiped out North America's once vast chestnut forests. Genetic engineering can revive them'. The author's name, 'By William Powell', is centered below the sub-headline. The main text of the article begins with 'In 1876 Samuel B. Parsons received a shipment of chestnut seeds from Japan and decided to grow and sell the trees to orchards. Unbeknownst to him, his shipment likely harbored a stowaway that caused one of the greatest ecological disasters ever to befall eastern North America. The trees probably concealed spores of a pathogenic fungus, *Cryphonectria parasitica*, to which Asian chestnut trees—but not their American cousins—had evolved resistance. *C. parasitica* effectively strangles'. To the right of the main text is a box titled 'More In This Article' containing a small image of a chestnut tree and the text 'A New Generation of American Chestnut Trees May Redefine America's Forests'.

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 SCIENTIFIC AMERICAN  
The New Century of the Brain  
See Inside

## The American Chestnut's Genetic Rebirth

A foreign fungus nearly wiped out North America's once vast chestnut forests. Genetic engineering can revive them

By William Powell

In 1876 Samuel B. Parsons received a shipment of chestnut seeds from Japan and decided to grow and sell the trees to orchards. Unbeknownst to him, his shipment likely harbored a stowaway that caused one of the greatest ecological disasters ever to befall eastern North America. The trees probably concealed spores of a pathogenic fungus, *Cryphonectria parasitica*, to which Asian chestnut trees—but not their American cousins—had evolved resistance. *C. parasitica* effectively strangles

More In This Article

 A New Generation of American Chestnut Trees May Redefine America's Forests

# “Green” certification of forests create severe barriers to field research, markets

## Plantation Certification & Genetic Engineering

### FSC's Ban on Research Is Counterproductive

Steven H. Strauss, Malcolm M. Campbell, Simon N. Pryor,  
Peter Coventry, and Jeff Burley

ABSTRACT

Genetic engineering, also called genetic modification (GM), is the isolation, recombinant modification, and asexual transfer of genes. It has been banned in forest plantations certified by the Forest Stewardship Council (FSC) regardless of the source of genes, traits imparted, or whether for research or commercial use. We review the methods and goals of tree genetic engineering research and argue that FSC's ban on research is counterproductive because it makes it difficult for certified companies to participate in the field research needed to assess the value and biosafety of GM trees. Genetic modification could be important for translating new discoveries about tree genomes into improved growth, quality, sustainability, and pest resistance.

**Keywords:** biotechnology; entomology and pathology; ethics; genetics; silviculture

Genetic engineering, commonly called genetic modification (GM) in much of the world, is the use of recombinant DNA and asexual gene transfer methods to breed more productive or pest-resistant crops. It has been the subject of considerable controversy, with concerns raised from biological, socioeconomic, political, and ethical perspectives. Some of the issues are similar to those raised by the use of molecular biology and genetic engineering in medicine, which we see in the news headlines daily. However, genetic modification in agriculture and forestry raises environmental issues as well.

GM crops, mainly herbicide- and pest-resistant varieties of soybeans, maize, or cotton, have been vigorously adopted by farmers in North America because they are easy to manage and they improve yields, reduce costs, or reduce pesticide ecotoxicity (Carpenter

and Gianessi 2001). However, the controversy, primarily embodied in regulatory barriers to trade of GM crops with Europe and Japan, has slowed their adoption considerably in recent years.

If GM trees are used in forestry in the near future, they are likely to occur primarily in intensively managed environments, such as urban forests or plantations. In urban forestry, genetic modification is expected to help trees adapt to the stresses and special demands of human-dominated systems. Examples would be trees that are more tolerant of heavy metals or other pollutants, resist urban pests or diseases, grow slower, or do not produce fruits when these create hazards in street environments (Brunner et al. 1998).

Plantations, although very different from natural forests in structure and function, are considered part of the spectrum of methods in sustainable forest management (Romm 1994).

Plantations can relieve pressure on natural forests for exploitation and can be of great social value by supplying community and industrial wood needs and fueling economic development. The environmental role of plantations is recognized by the Forest Stewardship Council (FSC), an international body for certification of sustainably managed forests. FSC Principle 10 states that plantations should “complement the management of, reduce pressures on, and promote the restoration and conservation of natural forests” (FSC 2001).

FSC has certified some of the most intensively managed plantations in the world, including poplar plantations and the intensive pine and eucalypt plantations of the Southern Hemisphere. Although many environmental mitigations are built into these certified plantation systems, within the areas dedicated to wood production they function as tree farms. Such intensive plantation systems often use highly bred genotypes, possibly including exotic species, hybrids, and clones, as well as many other forms of intensive silvicultural management. It is in the context of these biointensive systems that the additional expense of GM trees is likely to be worthwhile.

However, FSC currently prohibits all uses of GM trees, and is the only certification system to have done so



## Forest Stewardship Council

*“...genetically modified trees are prohibited...”*



Kevin Folta

Land-grant scientist exploring ways to make better food with less input, also learning and teaching how to effectively communicate science to the public.

Feb 15 · 4 min read

## The Deeply Offensive Marketing Ploy of “Clean Food”

When the commercial says that I should select *clean food* it makes my blood boil

Open in app



19



2



Tweet link

7. There is a **vast variety** of GE products shown in research, but only two kinds have dominated due to economic and regulatory/market obstacles

And with rare exceptions, as a result only **big ag** can play



# Virus-resistant GM papaya

Saved the Hawaiian industry in the mid-1990s, ~80% of crop today

Like a vaccine  
—  
“RNAi immunization”  
via implanting  
a viral gene in  
the papaya  
genome



**GMO, virus-resistant trees**

# “Innate” potato – native DNA, non-browning and other traits

One hour after cutting – Control vs. Innate



Two days after cutting –  
Control vs. Innate

# “Innate 2.0” potato – late blight resistant, and reduced sprouting and browning (↓ waste, ↑ safety, ↓ pesticide, ↑ yield)

Midwest - Sept 4<sup>th</sup> 2013



Zebra Chip

Control



Innate™ 2.0



Am. J. Potato Res.  
DOI 10.1007/s12230-015-9485-1



INVITED REVIEW

## Biotech Potatoes in the 21st Century: 20 Years Since the First Biotech Potato

Dennis Halterman<sup>1</sup> · Joe Guenther<sup>2</sup> · Susan Collinge<sup>3</sup> · Nathaniel Butler<sup>4</sup> · David Douches<sup>4</sup>

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**Abstract** Potato is the world's most important vegetable crop, with nearly 400 million tons produced worldwide every year, lending to stability in food supply and socioeconomic impact. In general, potato is an intensively managed crop, requiring irrigation, fertilization, and frequent pesticide applications in order to obtain the highest yields possible. Important traits are

and the potential effects that biotech potato could have on the industry.

**Resumen** La papa es el cultivo hortícola más importante en el mundo, con cerca de 400 millones de toneladas producidas a nivel mundial anualmente, acreditando la estabilidad en el



Diverse pipeline of biofortification products  
= enhancement of critical vitamins or  
nutrients

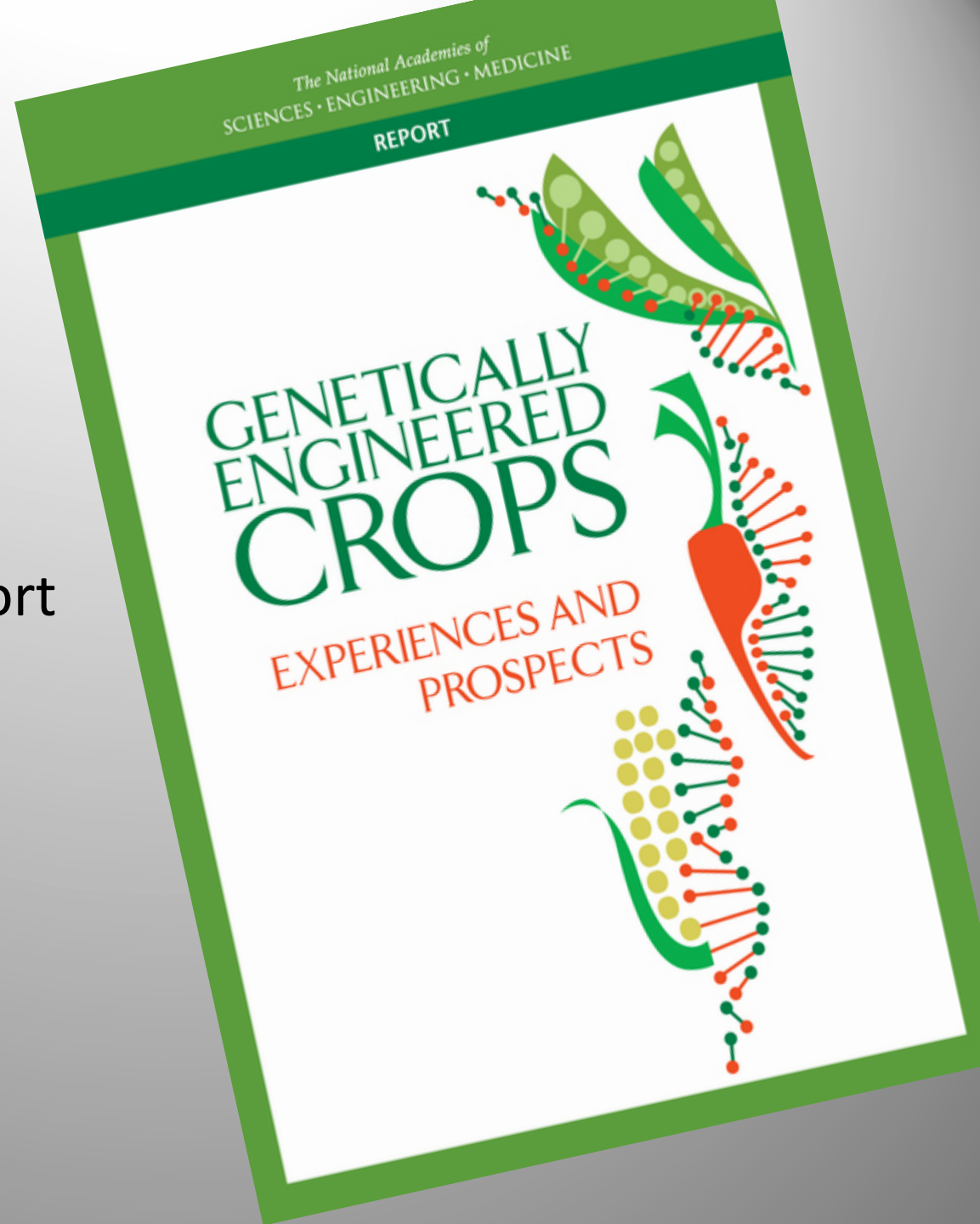


Golden  
Rice  
creator  
Ingo  
Potrykus

8. There is no credible scientific evidence GE foods **have had any harms** to humans or animals

# National Research Council Report 2016

- No evidence to support food/feed safety concerns
- Confirmed large insecticide reduction with Bt crops



# Is GM food safe?

if an overwhelming majority of experts say something is true, then any sensible non-expert should assume that they are probably right



The American Association for the Advancement of Science (AAAS) is the premier scientific body in the United States. It is the largest non-profit organization in the world with over 1 million members.



The American Medical Association (AMA) is the premier body of physicians in the United States. It is the largest non-profit organization in the world with over 200,000 members.



The World Health Organization (WHO) is the directing and coordinating authority for health within the United Nations system. It is the largest non-profit organization in the world with over 190 member states.



The National Academy of Sciences is an independent organization in the United States that provides advice to the federal government on matters of science and technology.



The European Commission is the executive body of the European Union. It is responsible for proposing and enforcing legislation, implementing policies, and managing the day-to-day business of the EU.



The American Council on Science and Health (YACSH) is a non-profit organization that provides independent scientific analysis and advice to the public and the government.



The Royal Society is the world's oldest independent scientific academy, based in London. It is the national academy of science for the United Kingdom.



The American Society for Cell Biology (ASCB) is a professional scientific organization for cell biologists. It is the largest non-profit organization in the world with over 10,000 members.



The American Society for Microbiology (ASM) is a professional scientific organization for microbiologists. It is the largest non-profit organization in the world with over 15,000 members.



The Crop Science Society of America (CSSA) is a professional scientific organization for crop scientists. It is the largest non-profit organization in the world with over 10,000 members.



The International Seed Federation (ISF) is a professional scientific organization for seed scientists. It is the largest non-profit organization in the world with over 100 members.



The Center for Science and the Environment (CAST) is a non-profit organization that provides independent scientific analysis and advice to the public and the government.



The Crop Science Society of America (CSSA) is a professional scientific organization for crop scientists. It is the largest non-profit organization in the world with over 10,000 members.



The International Society of African Biologists (ISAB) is a professional scientific organization for African biologists. It is the largest non-profit organization in the world with over 100 members.



The Federation of Animal Science Societies (FAS) is a professional scientific organization for animal scientists. It is the largest non-profit organization in the world with over 100 members.



The Society of Toxicology (SOT) is a professional scientific organization for toxicologists. It is the largest non-profit organization in the world with over 100 members.



The Consensus Statement on GMOs is a document that outlines the scientific consensus on the safety of genetically modified organisms.



The Society of Toxicology (SOT) is a professional scientific organization for toxicologists. It is the largest non-profit organization in the world with over 100 members.



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The Union is a professional scientific organization for scientists. It is the largest non-profit organization in the world with over 100 members.



The International Council for Science (ICSU) is a professional scientific organization for scientists. It is the largest non-profit organization in the world with over 100 members.



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# Is GM food safe?

if an overwhelming majority of experts say something is true, then any sensible non-expert should assume that they are probably right



The American Association for the Advancement of Science is an international non-profit organization. AAAS serves some 261 affiliated societies and academies of science.

"The science is quite clear: crop improvement by the modern molecular techniques of biotechnology is safe."



The premier body of physicians in the United States

"There is no scientific justification for special labeling of genetically modified foods."

Bioengineered foods have been consumed for close to 20 years, and during that time, no overt consequences on human health have been reported and/or substantiated in the peer-reviewed literature."



The World Health Organization (WHO) is the directing and coordinating authority for health within the United Nations system.

"No effects on human health have been shown as a result of the consumption of GM foods by the general population in the countries where they have been approved."



The National Academy of Sciences is a non-profit organization in the United States. It is the premier scientific body in the United States

"To date more than 98 million acres of genetically modified crops have been grown worldwide. No evidence of human health problems associated with the ingestion of these crops or resulting food products have been identified"



England's top medical society, the Royal Society of Medicine is an independent educational organisation for doctors, dentists, scientists and others involved in medicine and health care

"Foods derived from GM crops have been consumed by hundreds of millions of people across the world for more than 15 years, with no reported health problems."



The European Commission (EC) is the executive body of the European Union

"The main conclusion to be drawn from the efforts of more than 130 research projects, covering a period of more than 25 years of research, and involving more than 500 independent research groups, is that biotechnology, and in particular GMOs, are no more risky than e.g. conventional plant breeding technologies."

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

The scientific consensus around the safety of genetically modified foods is as strong as the scientific consensus around climate change. These foods are subjected to more testing than any other, and everything tells us that they're safe.

9. If you ask **bad questions** you will get  
bad answers



Are GE/GMO foods safe? Are they good for the environment?



# GE/GMO a technology with diverse outcomes, including many.....

- Genes/traits - Types of crops - Places
- Societies - Crop/Eco-systems
- Means of regulation & management
  
- **A general technology:** More like a wheel or computer than a specific medicine or saxophone
  
- **“Product not process,” “case by case,”** is global consensus for science assessments

10. Vilification of GE is a tool for unscrupulous or uncompetitive companies, countries, and NGOs

# Non-GMO labels have proliferated



# Very well funded activism against GMOs and related issues

- Agbiotech Info Net
- Agribusiness Examiner
- ACGA
- American Pasturage
- APHA
- Animal Protection Institute
- Beyond Pesticides
- NCRLC
- **Center for Food Safety**
- Center for Informed Food Choices
- Center for Media & Democracy
- CSPI
- Chef's Collaborative
- Children's Health Env Coalition
- Farm Animal Reform Movement
- Farm Aid
- Farm Sanctuary
- **Friends of the Earth**
- GRACE
- Government Accountability Project
- Green Guide Institute
- Green Party USA
- **Greenpeace**
- Humane Farm Association
- Humane Society US
- IATP



**More than 500 activist organizations in North America are spending in excess of \$2 billion annually engaging in food-related campaigns targeting biotech and many other elements**

- Earth Spirit
- Earth First
- Environmental Defense
- Environmental Media Services
- FAIR
- Family Farm Defenders
- PETA
- PCRM
- PIRG
- Public Citizen
- Purdey Fund
- Sierra Club
- SEAC
- Water Keeper Alliance

# Leading scientists attack Greenpeace over anti-GMO activism

Speaking of Science

## 107 Nobel laureates sign letter blasting Greenpeace over GMOs

By **Joel Achenbach** June 30, 2016 

**The Washington Post**  
*Democracy Dies in Darkness*

What you need to know about GMOs

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# Some lessons

- GE a general technology – many uses
- Newer methods more precise, very powerful (RNAi, CRISPR)
- No credible evidence for human safety harms
- Extensive uptake, large benefits, also significant problems in management
- Regulatory and market restrictions greatly limit GE crop use and benefit for society, both in USA and around the globe – despite stresses from climate change, pest proliferation, and growing human need