

Farming in a

GMO World



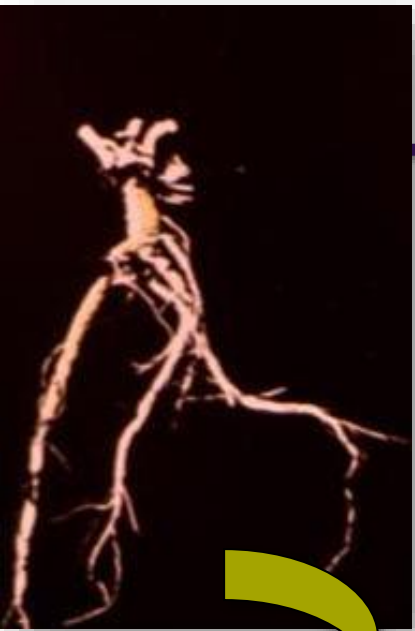
UNIVERSITY OF
GEORGIA

Wayne Parrott

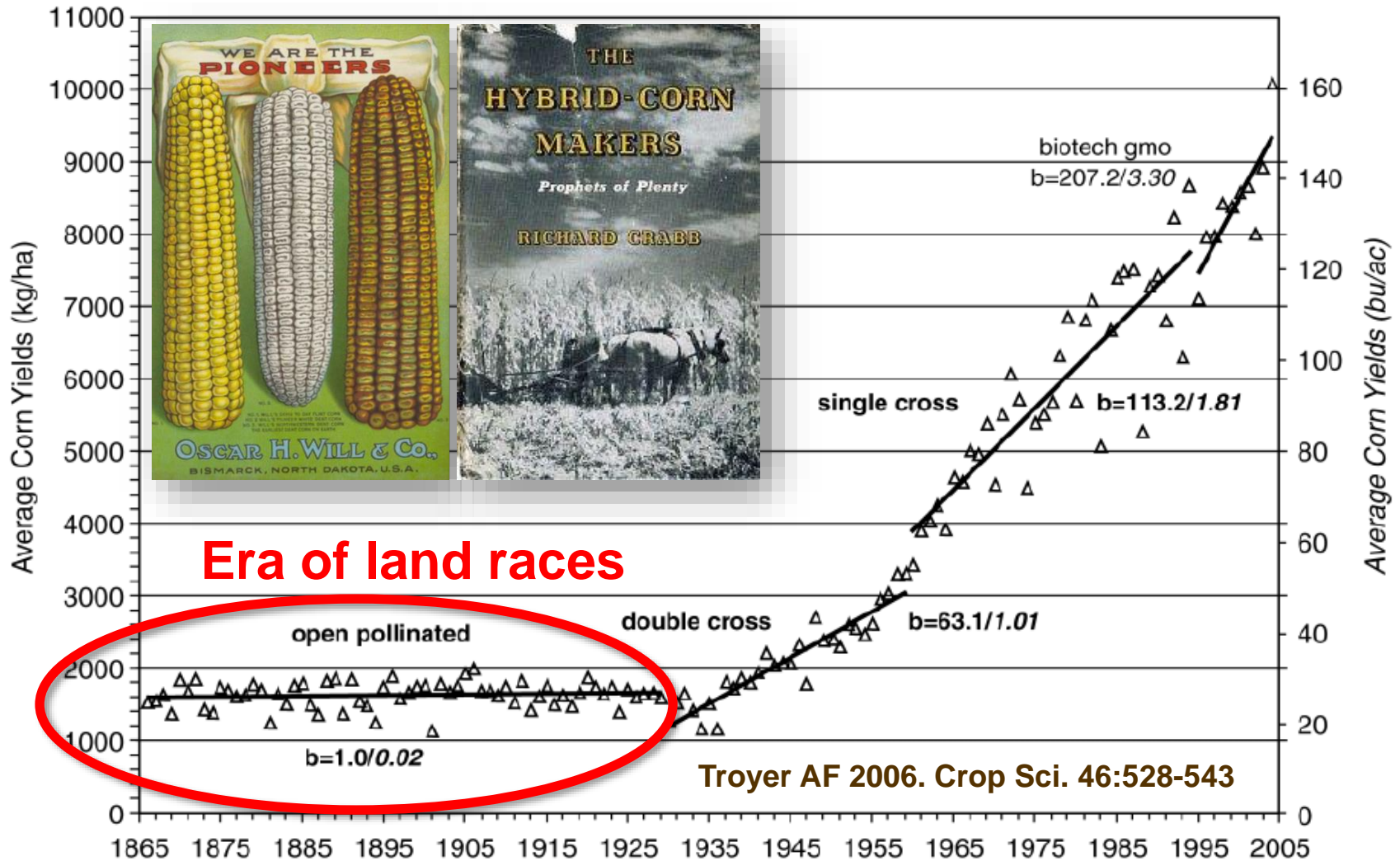
*Department of Crop and Soil Sciences
Institute for Plant Breeding, Genetics & Genomics*



Top: Peggy Lemaux, John Meade, Raúl Coronado
Bottom: Corbis



Corn yields



Land needed to grow 1 bushel of corn



- 6 lbs of beef, 13 lbs of pork, 20 pounds of chicken, or 28 lbs of catfish

2030 145 ft²

2009 264 ft²

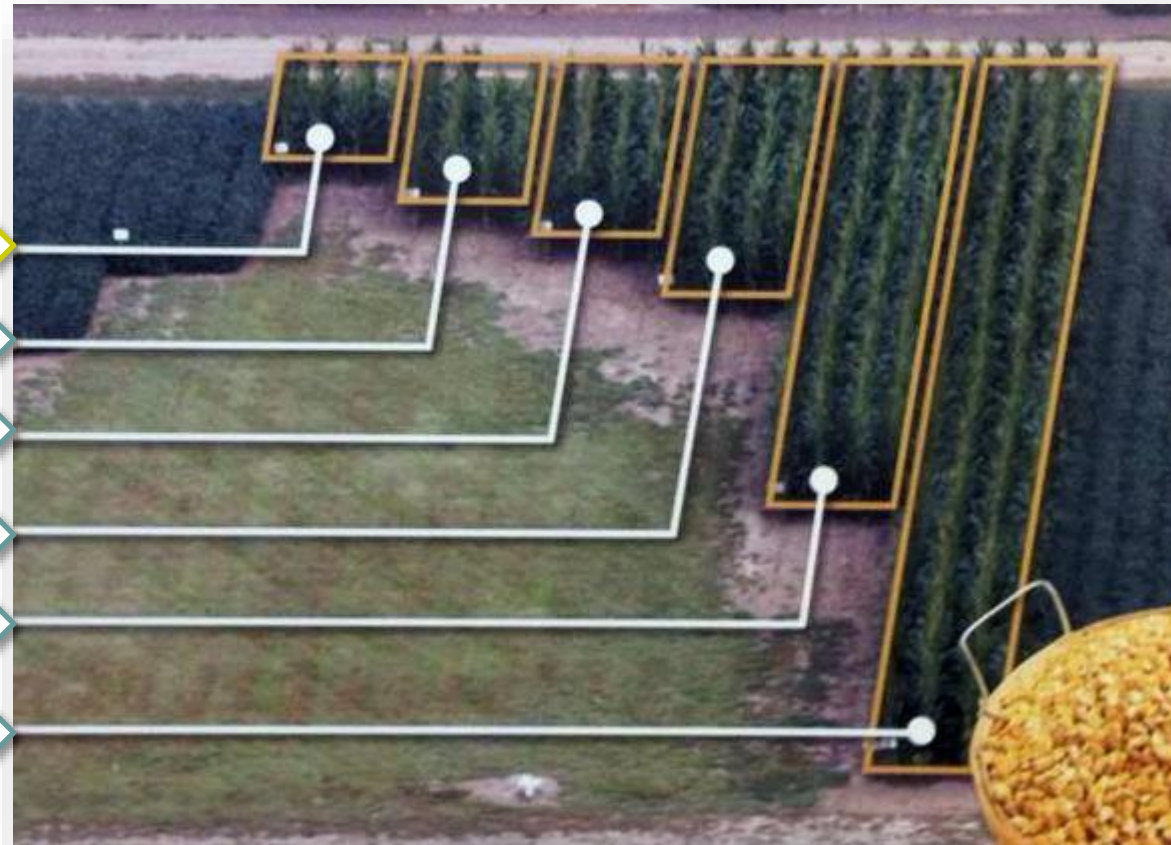
1997 340 ft²

1970s 484 ft²

1950s 968 ft²

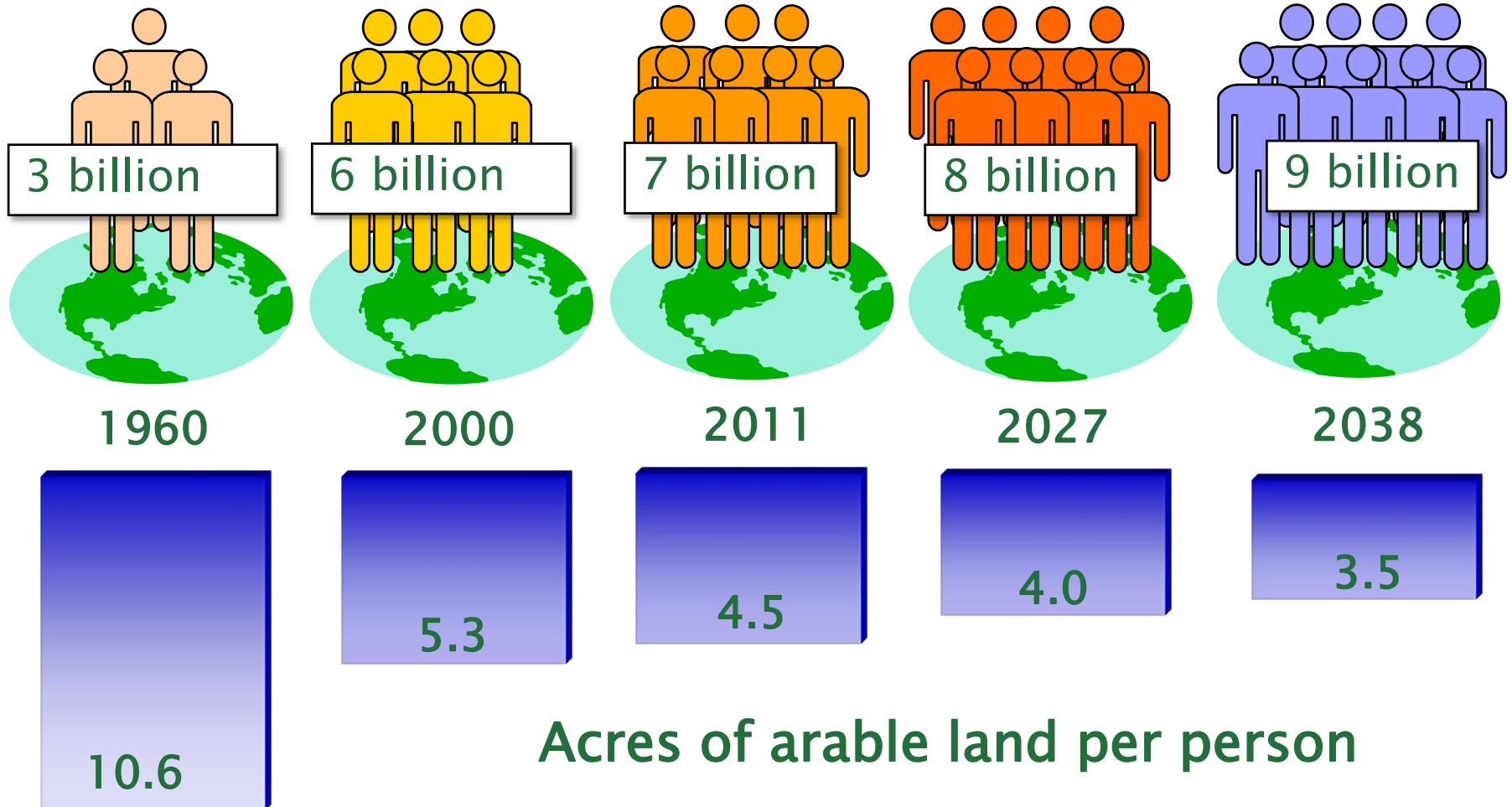
1866-1920

1742 – 1452 ft²

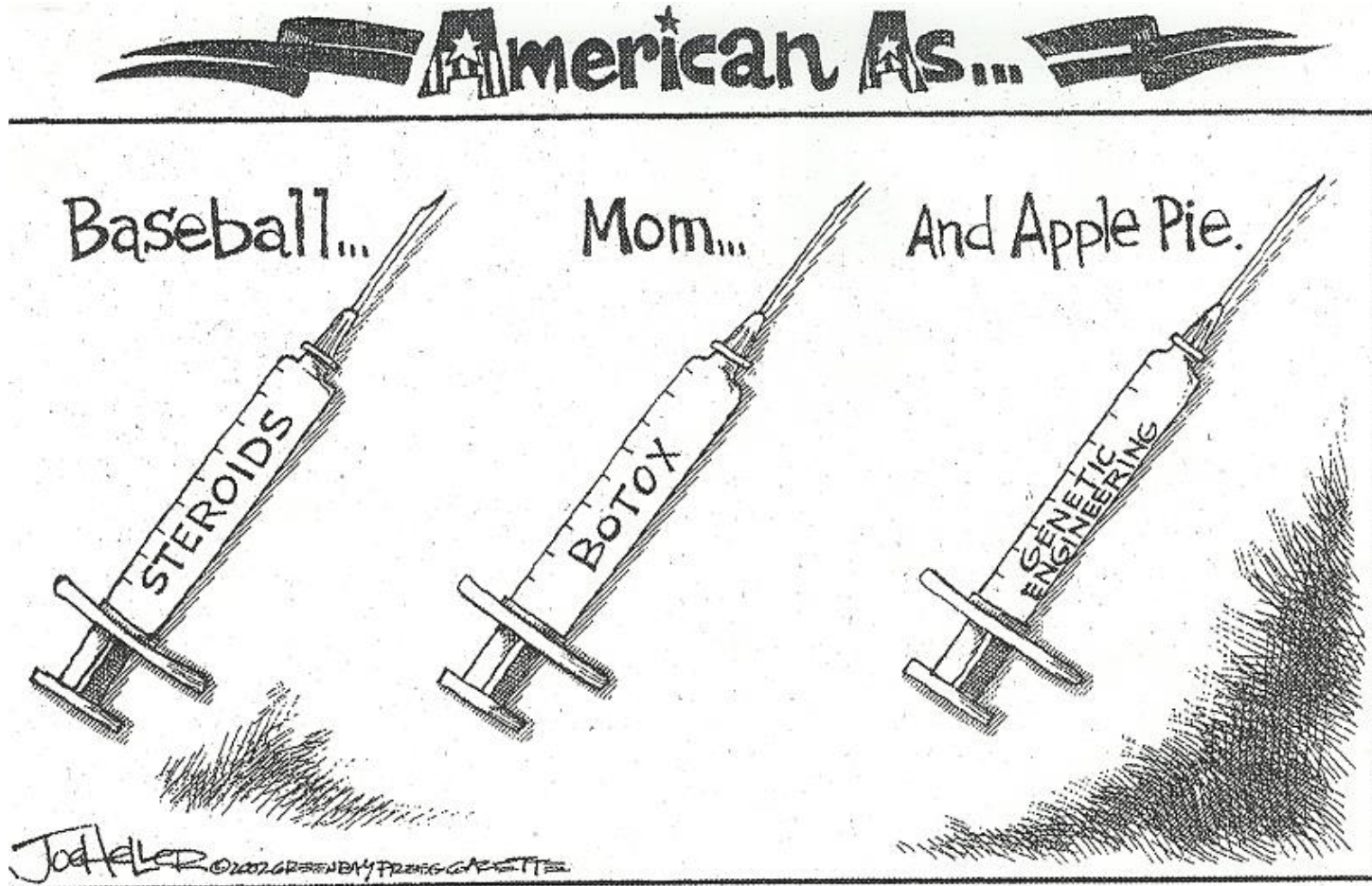


There is no more land for agriculture

Must use same amount of land for more food production



Modification vis Genetic Engineering



By Joe Heller, Green Bay (Wis.) Press-Gazette

Transgenics occur in nature



FOOD & CULTURE

Natural GMO? Sweet Potato Genetically Modified 8,000 Years Ago

Updated May 5, 2015 · 2:51 PM ET

MICHAELEEN DOUCLEFF



SHARE



Now that's a big root: Sweet potatoes aren't tubers, or thickened stems, like potatoes. Sweet potatoes are roots — swollen and packed with starch.

U-ichiro Murakami/Flickr.com

PNAS

The genome of cultivated sweet potato contains *Agrobacterium* T-DNAs with expressed genes: An example of a naturally transgenic food crop

Tina Kyndt¹, Dora Quispe^{2,3,4}, Hong Zhai⁵, Robert Jarret⁶, Marc Ghislain⁷, Qingchang Liu⁸, Godelieve Gheysen⁹, and Jan F. Kreuze^{2,3}

¹Department of Molecular Biotechnology, Ghent University, 9000 Ghent, Belgium; ²International Potato Center, Lima 12, Peru; ³Beijing Key Laboratory of Crop Genetic Improvement/Laboratory of Crop Heterosis and Utilization, Ministry of Education, China Agricultural University, Beijing, China, 100193; and ⁴Plant Genetic Resources Unit, US Department of Agriculture, Agricultural Research Service, Griffin, GA 30223

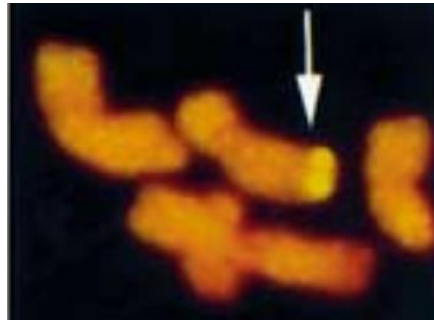
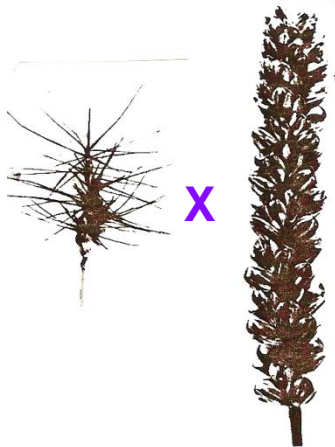
Proc. Natl. Acad. Sci. USA 112:5844-5849

<http://www.npr.org/sections/goatsandsoda/2015/05/05/404198552/natural-gmo-sweet-potato-genetically-modified-8-000-years-ago>

Terminology



Cross directly:

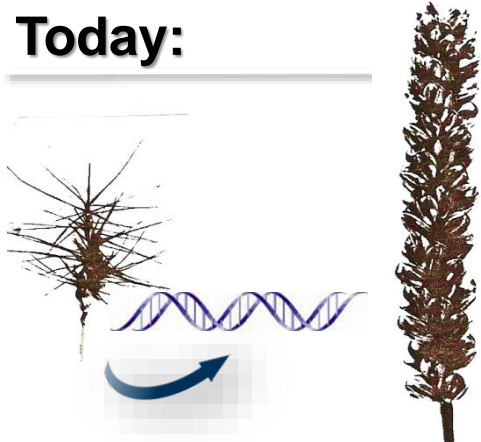


Wheat



Move a chunk of chromosome with hundreds of unknown genes

Today:



Isolate & move 1 known gene
= **Genetic engineering**

GMO

Vocabulary

2016 Version



GMO

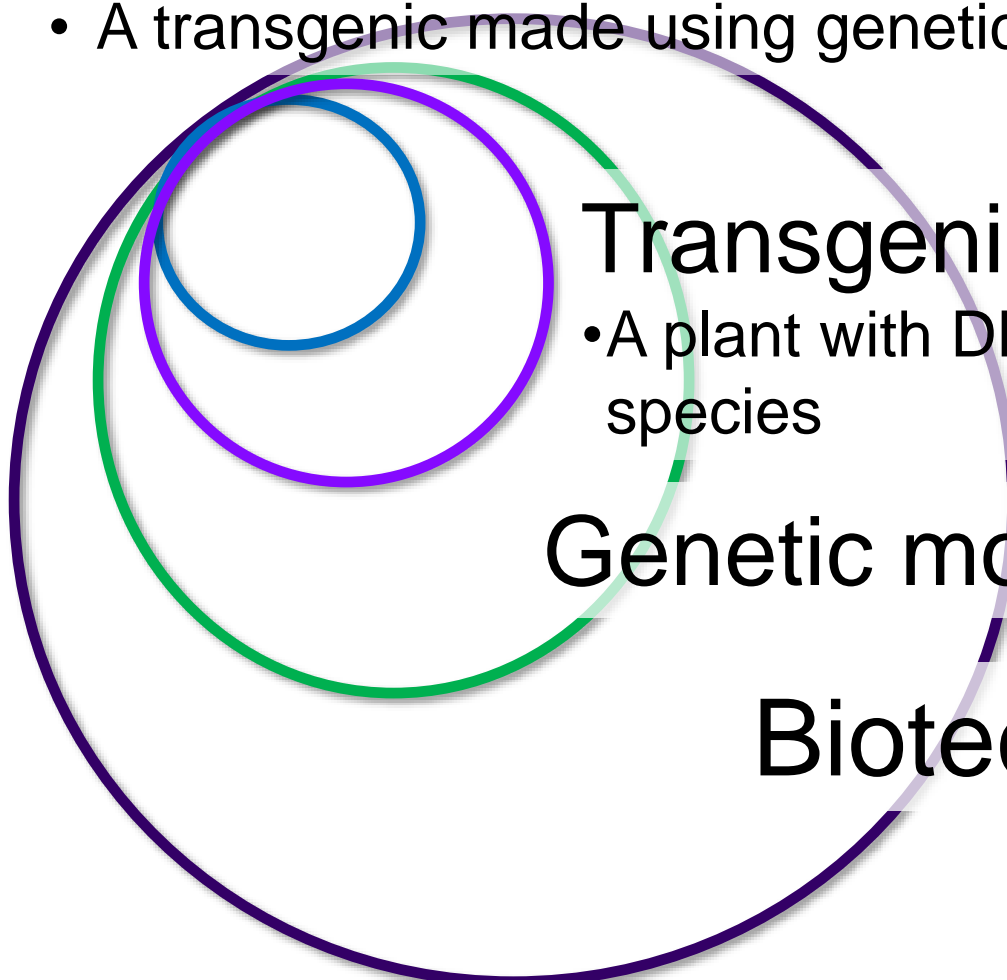
- A transgenic made using genetic engineering

Transgenics

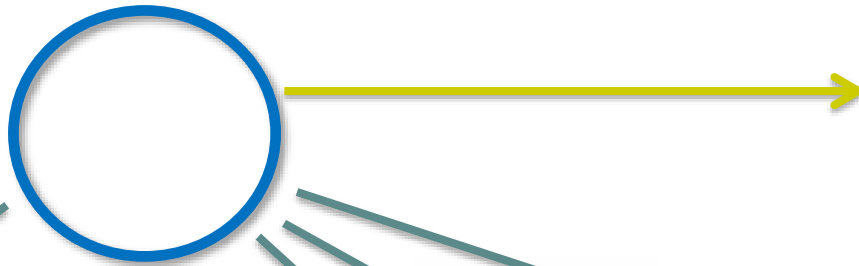
- A plant with DNA from another species

Genetic modification

Biotechnology

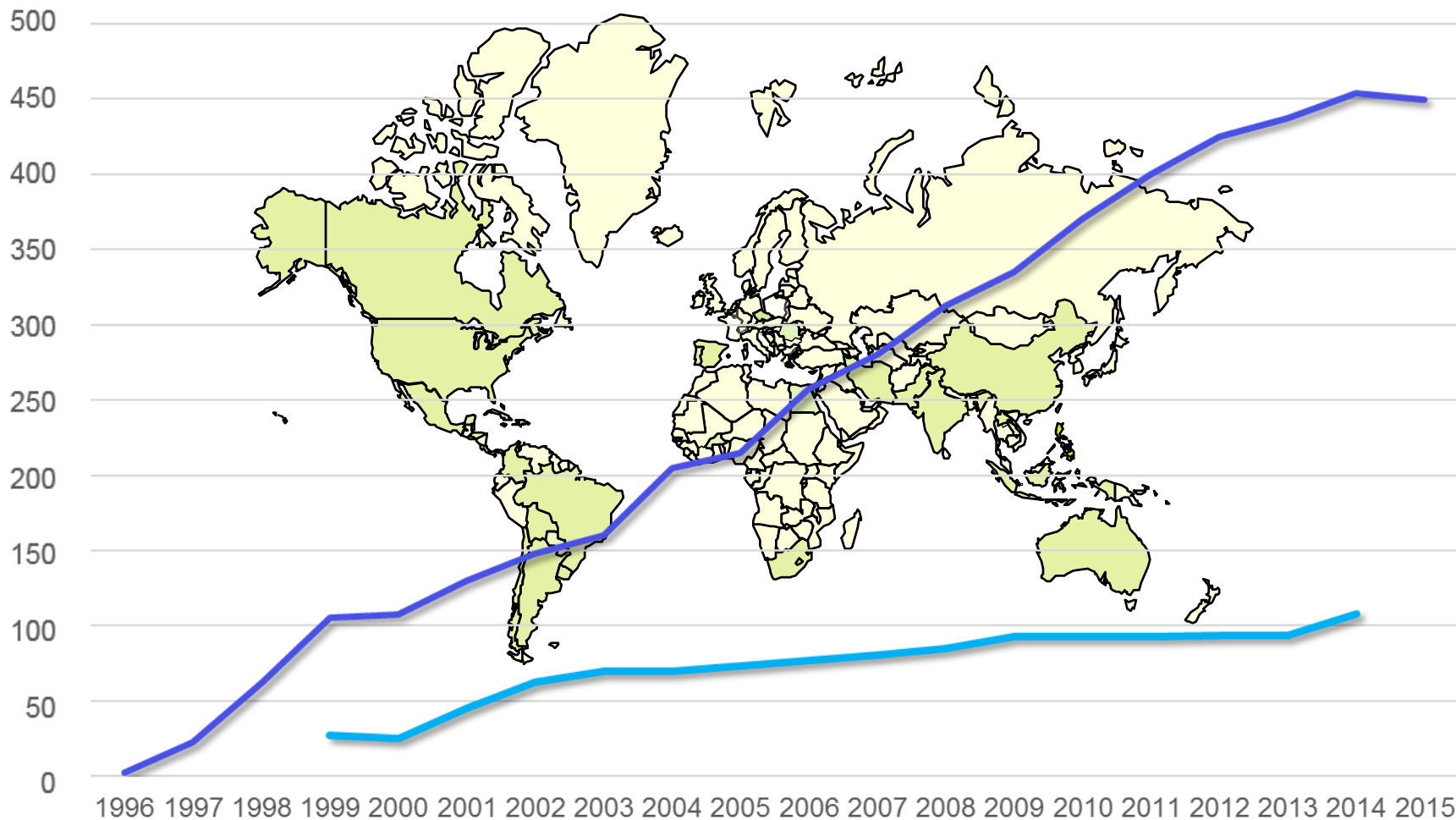


GMOs



Use of GM crops

(millions of acres) 18 million farmers in ~28 countries

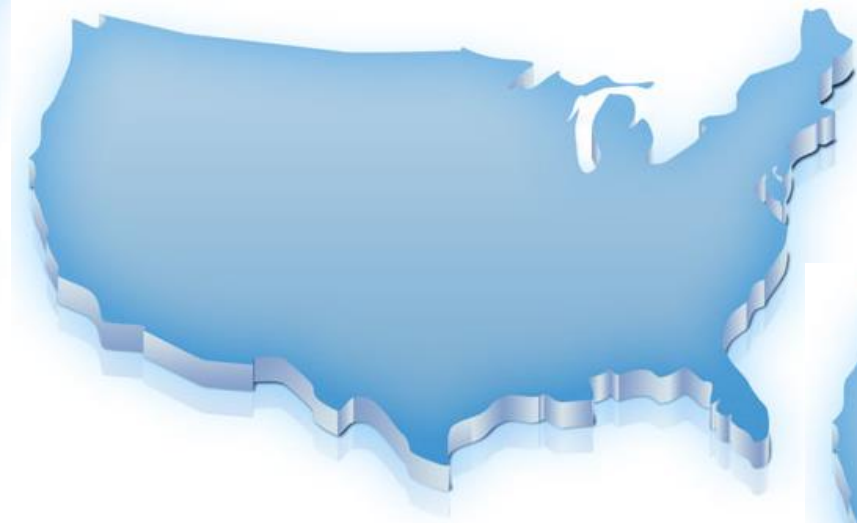


Area planted since 1994

18 million farmers in 2015 in 28 countries



- 6.890 million sq mi
 - = 2.2x the size of continental US



GM crop overview



Remember when they said “Genetically Engineered potatoes, what can possibly go wrong?”



Herbicide tolerance



- Facilitates no-till
 - Protects soils from erosion
 - Saves fuel



Corbis



Transgenic corn in Honduras



Soil erosion

Greatest threat to sustainability



<http://thelensnola.org/2013/05/08/studys-key-question-is-ole-muddy-muddy-enough-to-rebuild-the-coast/>

Scale-neutral technology



<http://david.farmnet.com.au/2010/02/05/31-combines-ha>

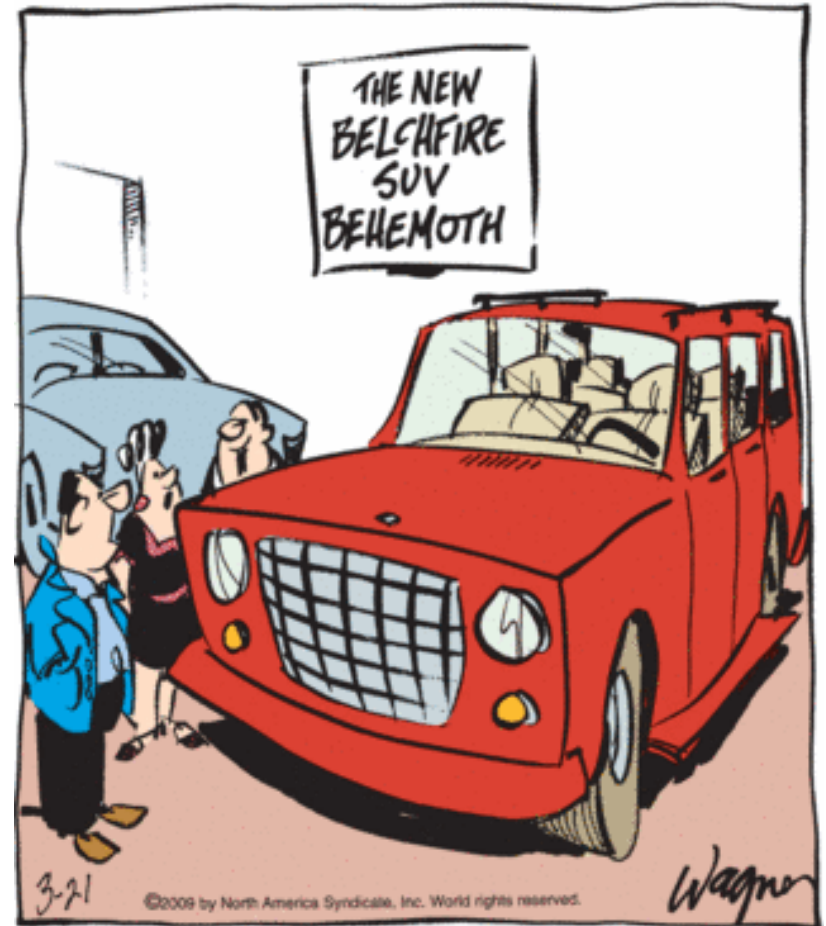


Photo: INBIO, Paraguay: no-till seed drill

Car equivalents – 2012



- Plowing is fuel-intensive
- Carbon savings from no-till GM crops
 - = to parking 11 Million family cars for 1 year



“We had to modify the grille. ... It was sucking hybrids into the engine.”

Glyphosate tolerant sugar beet



Hershey Dumps Sugar Beets Because of GMO Concerns



'This is really just a matter of listening to and being responsive to what consumers want us to put into their products'

-Hershey's



organicconsumers.org

Superweeds



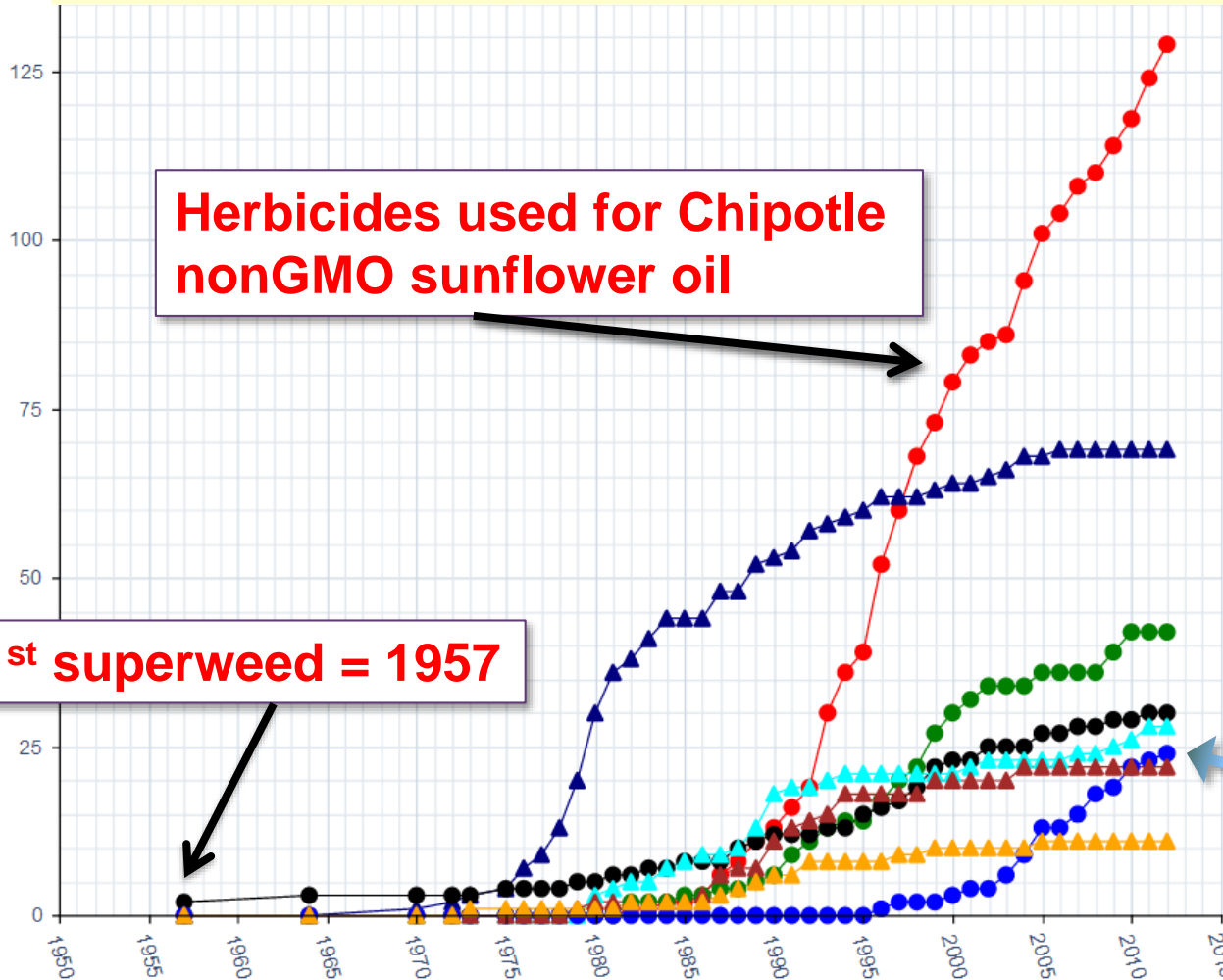
<http://www.usnews.com/news/articles/2012/10/19/herbicide-resistant-super-weeds-increasingly-plaguing-farmers>

Stanley Culpepper, University of Georgia

Number of resistant weeds



■ ALS Inhibitors ■ Triazines ■ ACCase Inhibitors ■ Synthetic Auxins ■ Bipyridiliums ■ Glycines ■ Ureas, Amides
■ Dinitroanilines



Herbicides used for Chipotle nonGMO sunflower oil

1st superweed = 1957

Due to conventional agriculture

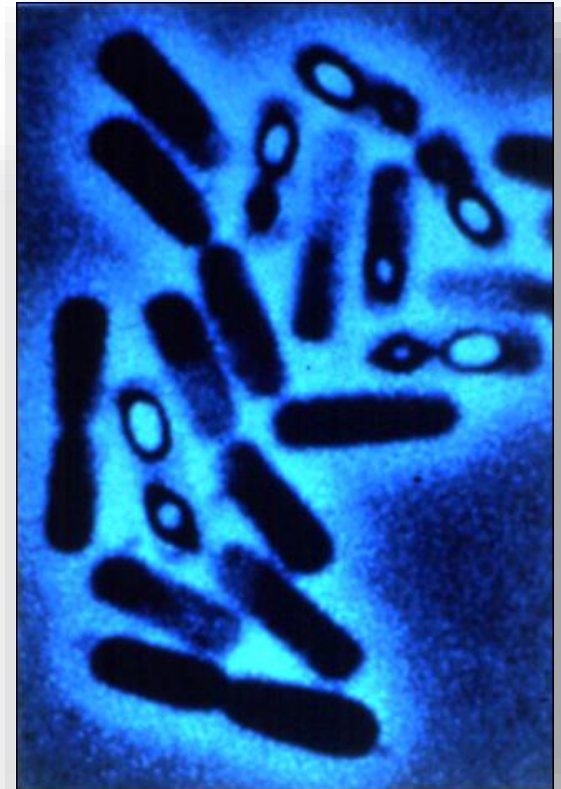
Due to transgenic agriculture

Resistance against insects

Bt crops



Bacillus thuringiensis



Bt cotton



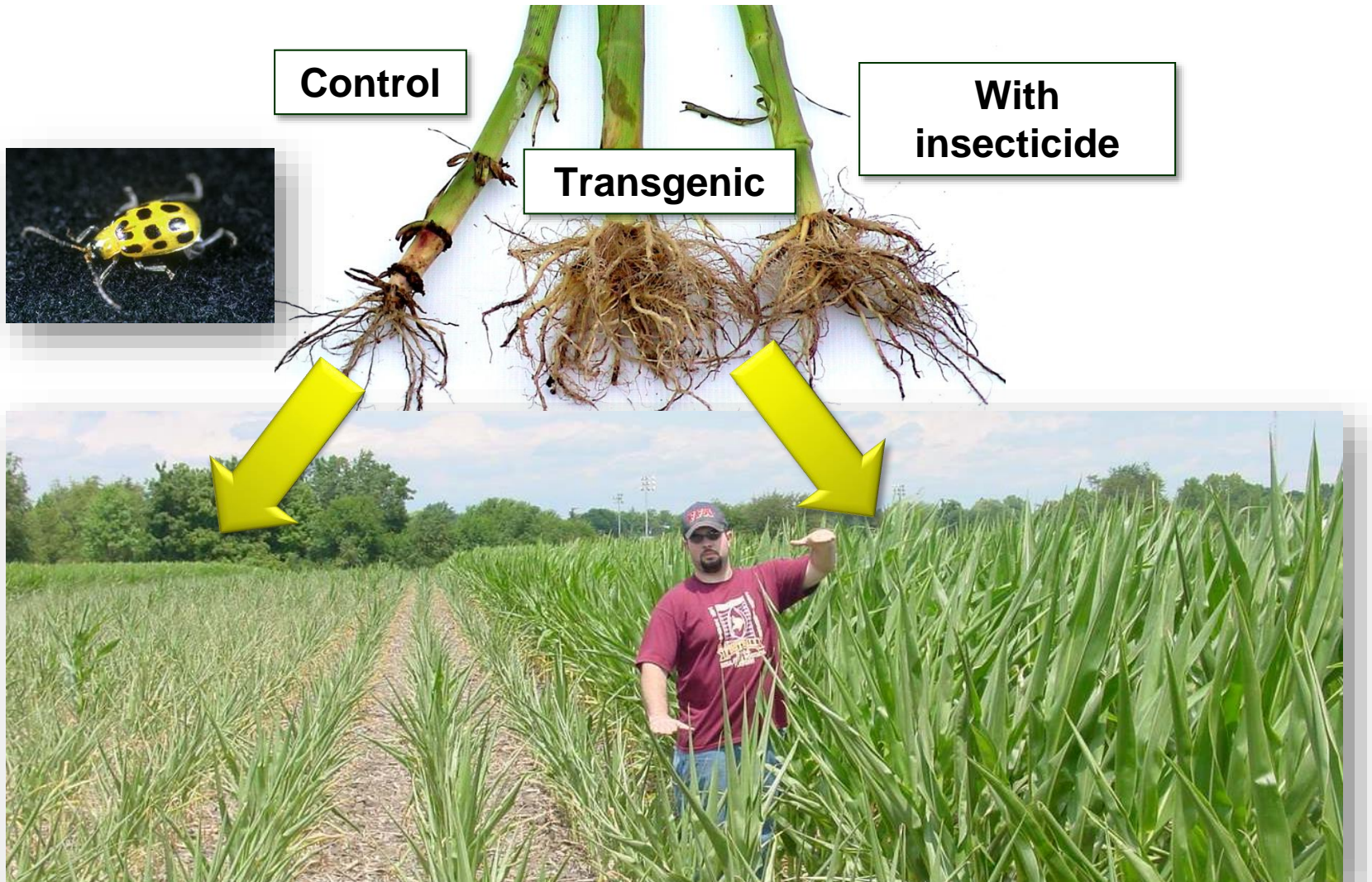
Cotton bollworm



Bt crops - corn



Rootworm-resistant corn



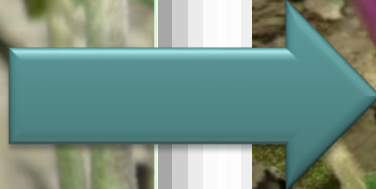
Corn Earworm



Photos: Zamorano, Honduras by María Mercedes Roca; NPR

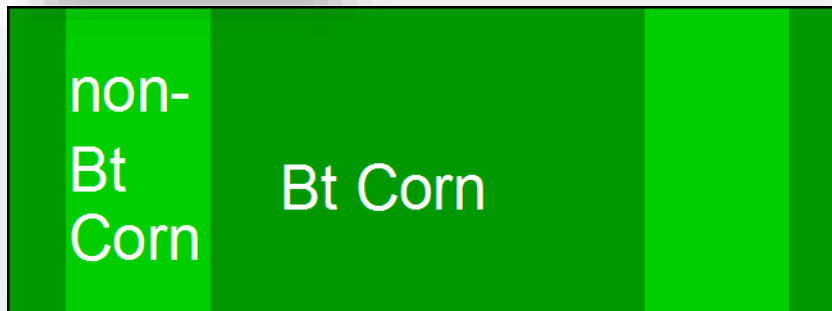
Fruit borer-resistant brinjal

Bangladesh



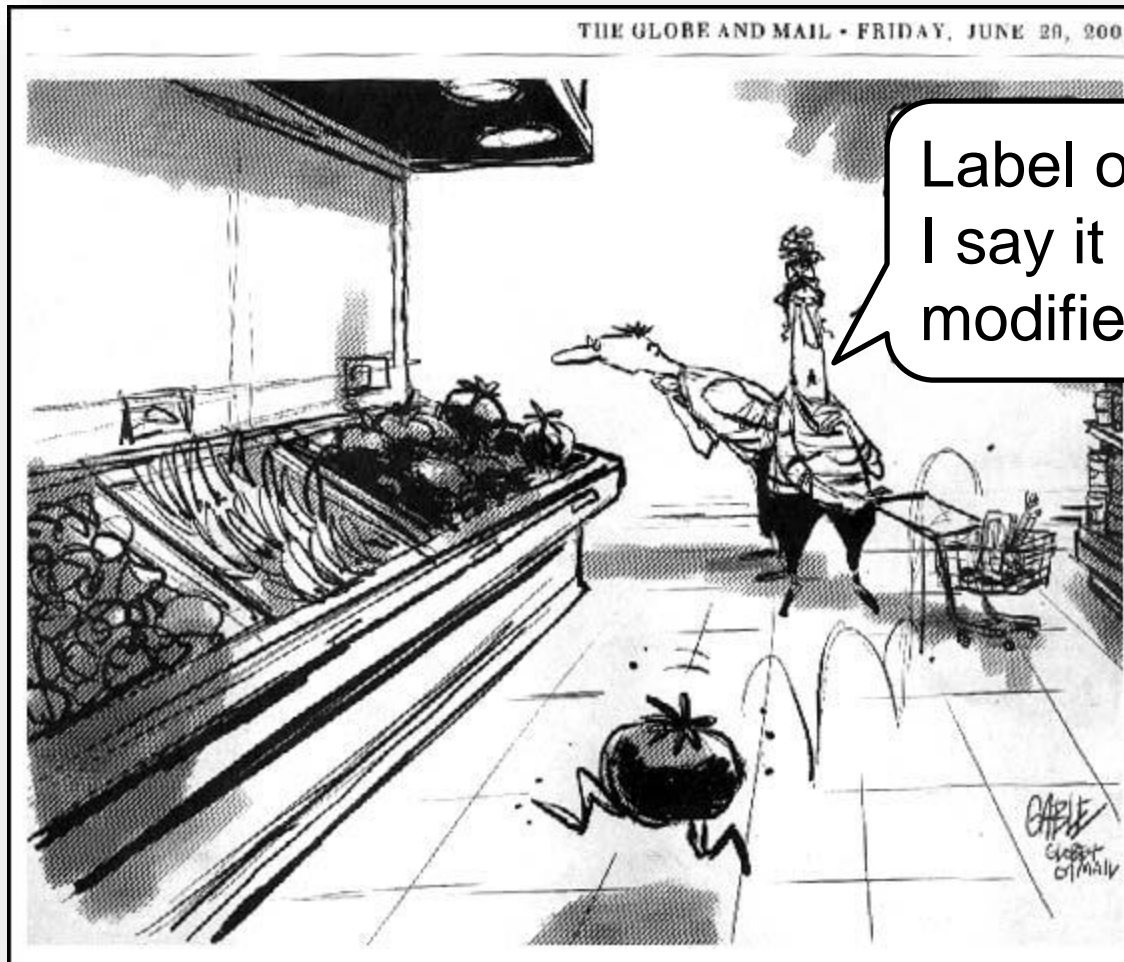


Insect Resistance Management



- Computer models predicted that Bt would work for ~8 years with proper management
- Has worked for more than 12 years
 - Sporadic outbreaks in Arizona, India, South Africa
 - Failure in Puerto Rico
 - Midwest on watch for possible failure

Miscellaneous traits



Label or no label....
I say it is genetically
modified

Drought tolerance

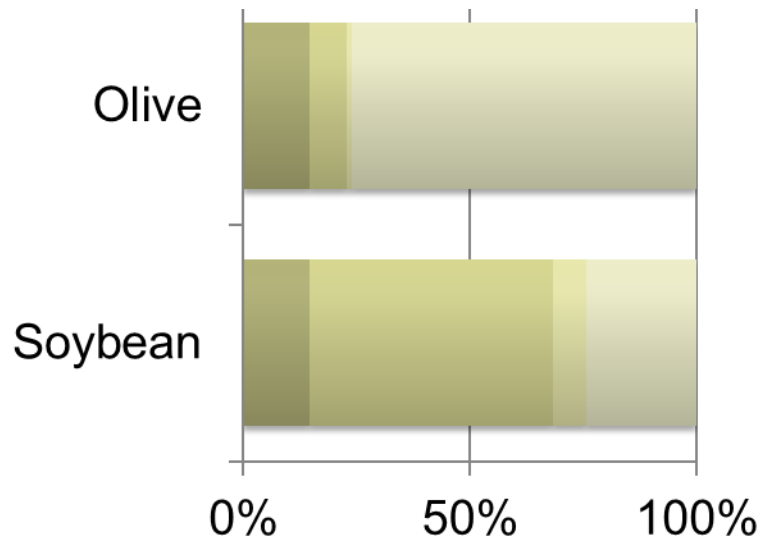


High oleic oil

Eliminates transfats



- Stearic
- Linoleic
- Linolenic
- Oleic



Prevent food spoilage

Non-browning potato & apple



JR Simplot &
Okanagan Specialty Fruits

Is browning trivial?



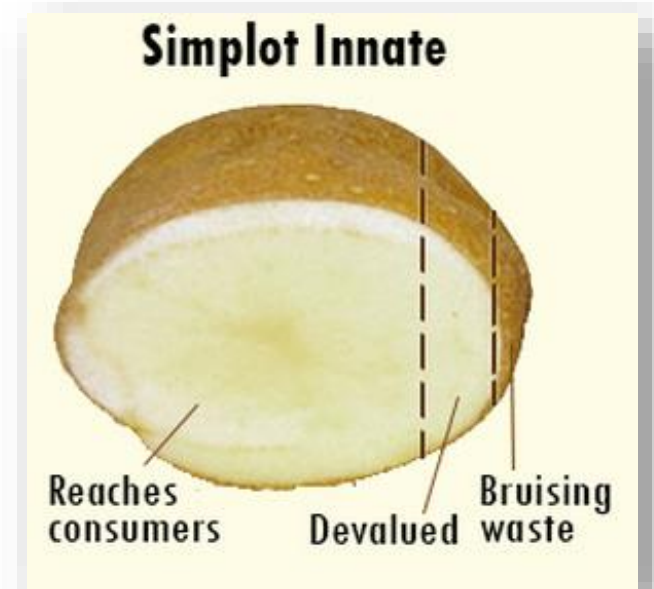
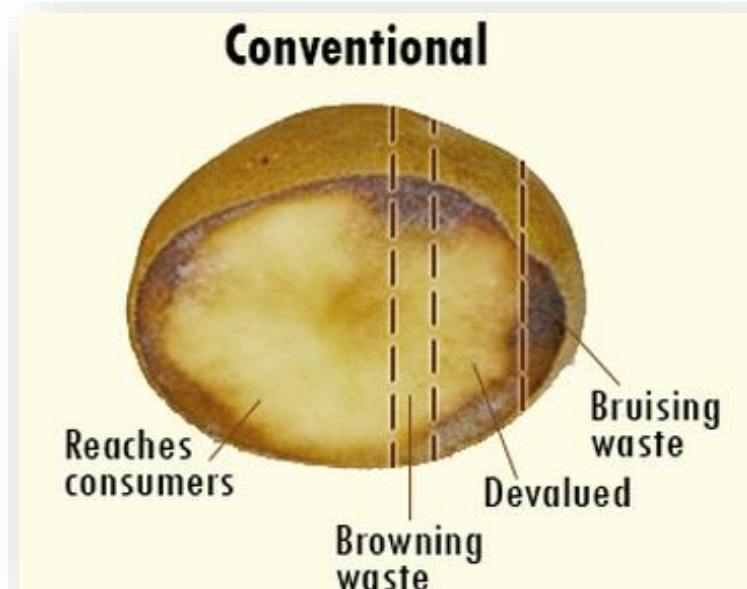
- 400 million lbs of wasted potato
 - \$90 million in producer costs
 - 60 million lbs of CO2 emissions
 - 6.7 billion gallons of water
 - 170,000 acres planted and sprayed

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 Halterman¹ · Joe Guenther² · Susan Collage³ · Nathaniel Butler⁴ · David Douches⁵



Blight-resistant potato



JR Simplot Company

Brazilian bean



Photos: Franciso Aragão, EMBRAPA

Papaya



Corbis



Dennis Gonsalves

Virus resistance: Squash



Justice III



Conqueror III



Liberator III

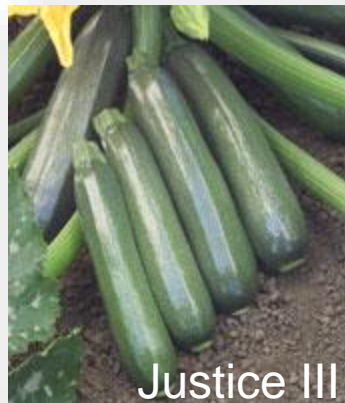


Judgment III

Liabilities



- Fresh produce only
 - Less likely to be imported
- Cannot leave the US
 - Cruise ships
 - Caribbean resorts that buy US produce



GMOs & agrichemical use



THE TESTS INDIKATE YOU'RE BEING POISONED
BY AGRICULTURAL HERBICIDES IN YOUR TAP WATER.
THE GOOD NEWS IS THAT YOU'RE WEED-FREE.

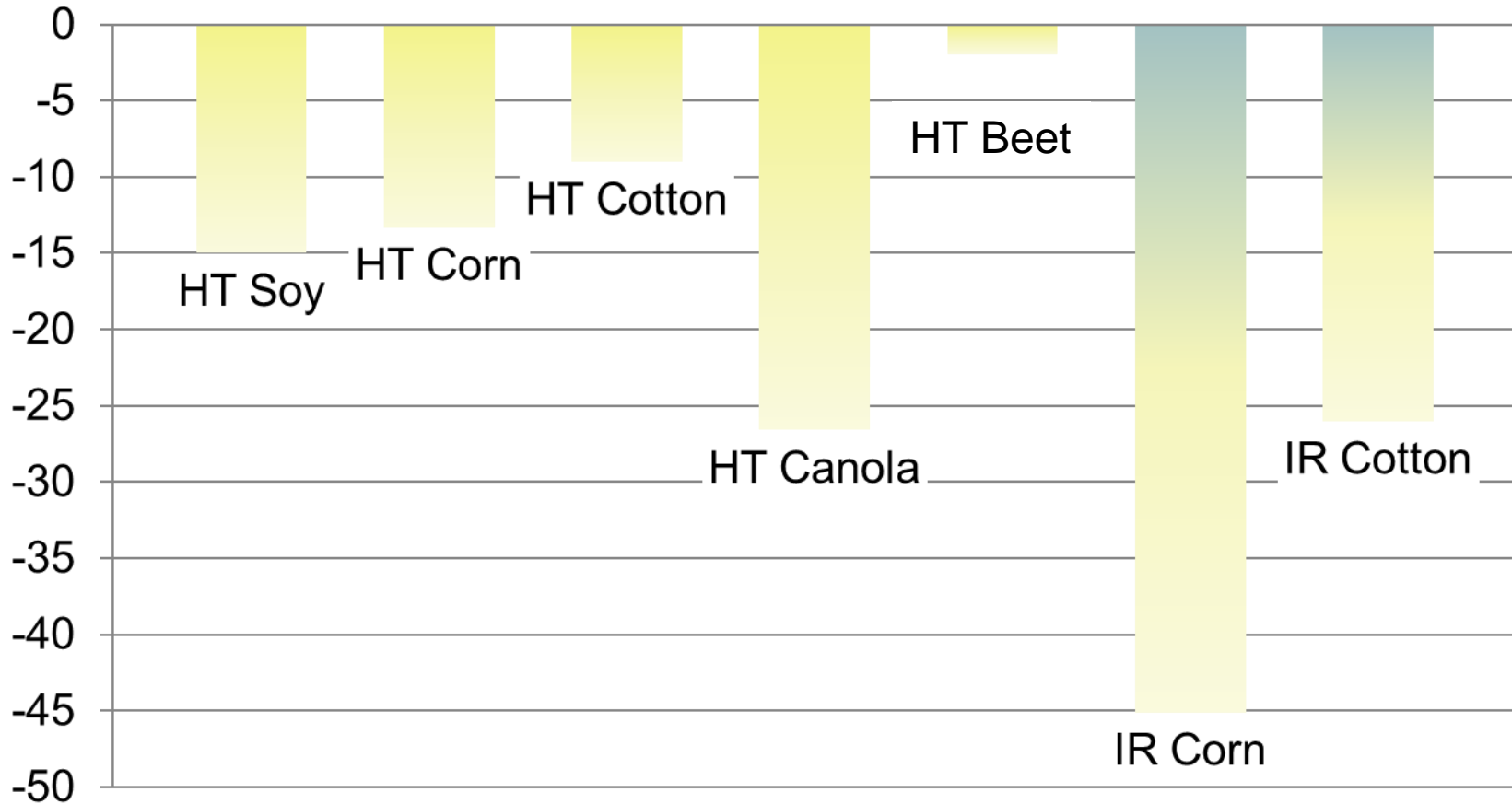


©1995 FORT WORTH STAR-TELEGRAM
ETTA HULME

Use of GM Leads to Lower Environmental Impact Quotient, 1996-2012



Percent reduction in environmental damage



Health



© 2007 Tom Swick
WIKON



The criterion



- *Foods produced from genetic engineering must be at least as safe as their conventional counterparts*
 - *No allergies*
 - *No new toxins*
 - *Same nutrition*
- *Conventional food = GRAS*
 - *Generally Regarded As Safe*

Prior to commercialization

Must ensure there are no unintended effects



Lead Event



International market

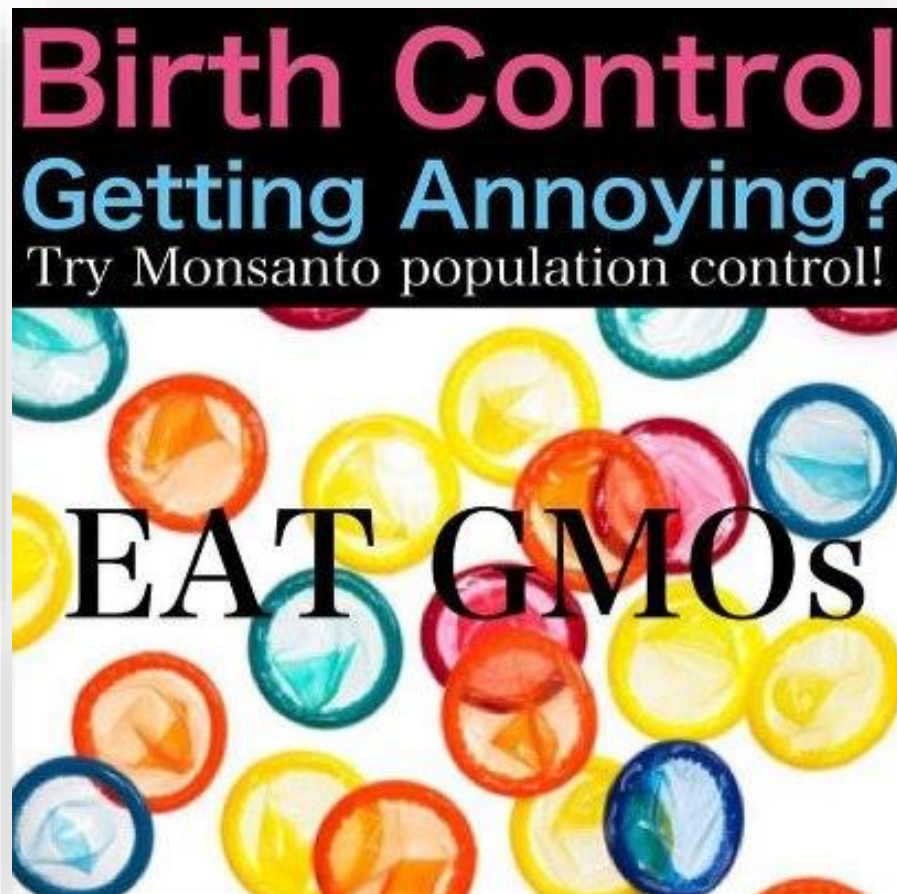
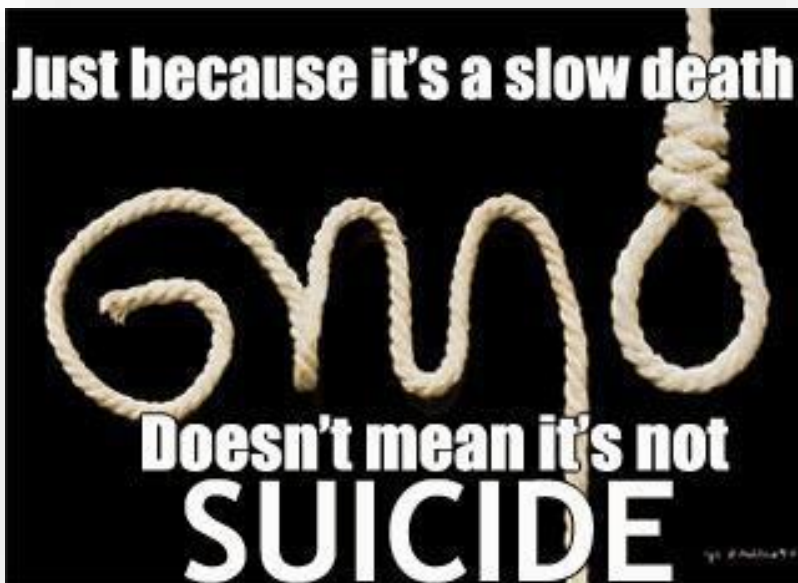


How about the adverse reports?



Male Testosterone and Sperm Counts Plummet Leading to Lack of Sexual Desire Due to GMOs

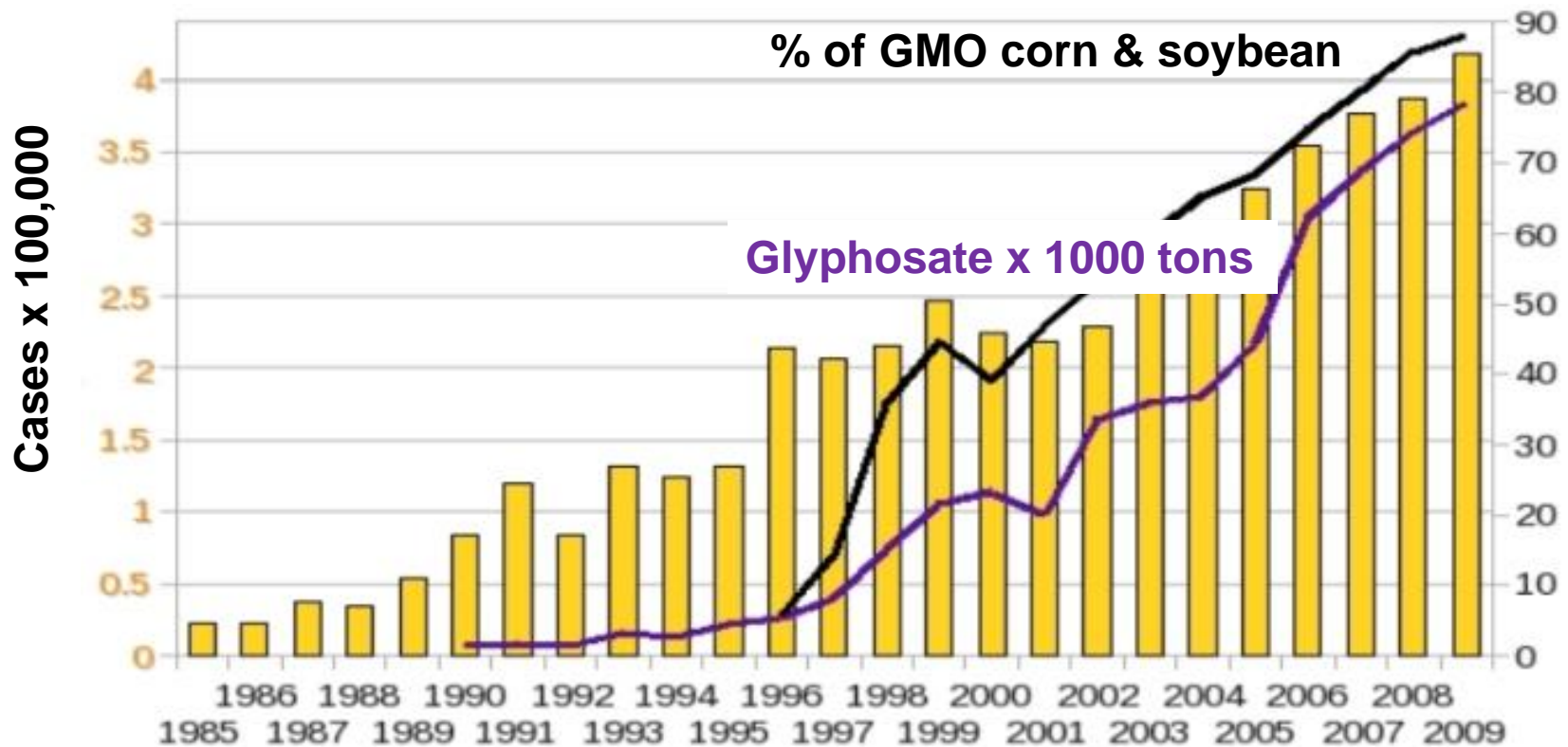




Misuse of statistics



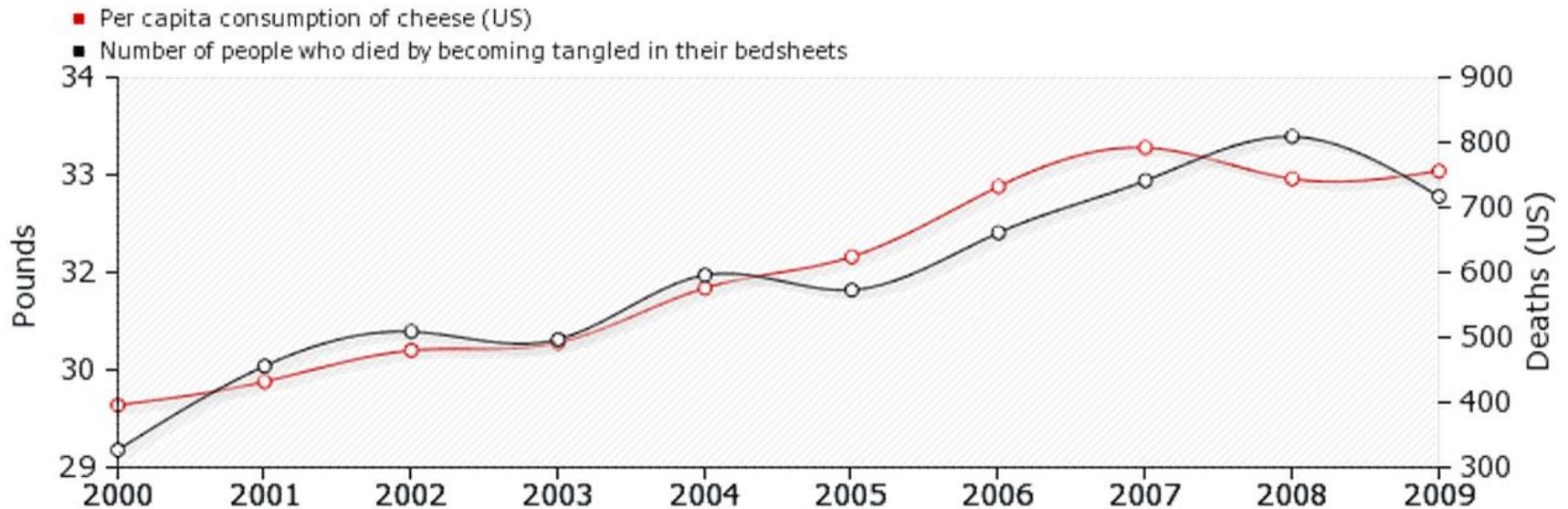
E.g., Relationship between transgenics, glyphosate and liver cancer
= >99.9999%



Misuse of statistics



Per capita consumption of cheese
correlates with
Number of people who died by becoming
tangled in their bedsheets



Experiments designed for the purpose



M

Where's the control treatment?

Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize

Gilles-Eric Séralini^{a,*}, Emilie Clair^a, Robin Mesnage^a, Steeve Gress^a, Nicolas Defarge^a, Manuela Malatesta^b, Didier Hennequin^c, Joël Spiroux de Vendômois^a

Experiments designed for the purpose



- Use Sprague-Dawley rats that normally get tumors by the time they are 2 years old
- A group of 10 compared to a group of 90
 - Odds are that the first death will occur in a group of 90 than in the group of 10
- Don't release the data and the experimental details
- Have a movie crew in the lab filming the "experiment"
 - *We Are all Guinea Pigs*





WARNING: MAY CONTAIN GMO DNA

**STUDIES HAVE DETECTED
TRANSGENIC DNA IN THE MILK AND MEAT
OF GMO FED ANIMALS**



MYTH

THESE FOODS ARE GMOs

TRUTH

**THESE FOODS MAY CONTAIN
TRANSGENIC DNA FROM GMO FEED**





Natural News

America's truth news bureau, read by 7+ million and growing



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[What are the world's most powerful anti-cancer foods?](#) | [Natural News eliminates all ad networks for](#)



SCIENCE WARNING: Genetically modified soybeans cause stunted growth of animal offspring

Thursday, November 05, 2015 by: David Gutierrez, staff writer

Tags: [genetically modified soybeans](#), [stunted growth](#), [breast milk deficiency](#)

Source: Infascelli Lab



Animal Science 2006, **82**: 193–199
© 2006 British Society of Animal Science

ISSN 1357-7298
DOI: 10.1079/ASC200530

Genetically modified soya bean in rabbit feeding: detection of DNA fragments and evaluation of metabolic effects by enzymatic analysis

R. Tudisco¹, P. Lombardi², F. Bovera¹, D. d'Angelo², M. I. Cutrignelli¹, V. Mastellone², V. Terzi³, L. Avallone² and F. Infascelli^{1†}

Food and Nutrition Sciences, 2013, **4**, 50–54

<http://dx.doi.org/10.4236/fns.2013.46A006> Published Online June 2013 (<http://www.scirp.org/journal/fns>)



Gamma-Glutamyl Transferase Activity in Kids Born from Goats Fed Genetically Modified Soybean

Vincenzo Mastellone, Raffaella Tudisco^{*}, Giovanni Monastra, Maria Elena Pero, Serena Calabrò, Pietro Lombardi, Micaela Grossi, Monica Isabella Cutrignelli, Luigi Avallone, Federico Infascelli



Animal, page 1 of 10 © The Animal Consortium 2010
doi:10.1017/S1751731110000728

Fate of transgenic DNA and evaluation of metabolic effects in goats fed genetically modified soybean and in their offsprings

R. Tudisco¹, V. Mastellone², M. I. Cutrignelli¹, P. Lombardi^{3†}, F. Bovera¹, N. Mirabella³, G. Piccolo¹, S. Calabrò¹, L. Avallone³ and F. Infascelli¹

Small Ruminant Research xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Small Ruminant Research

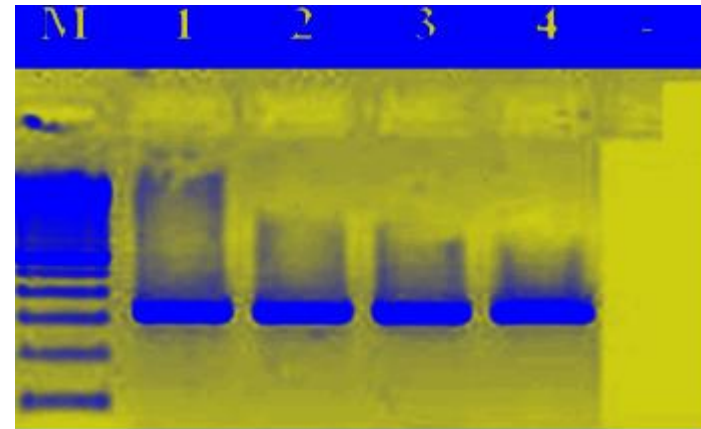
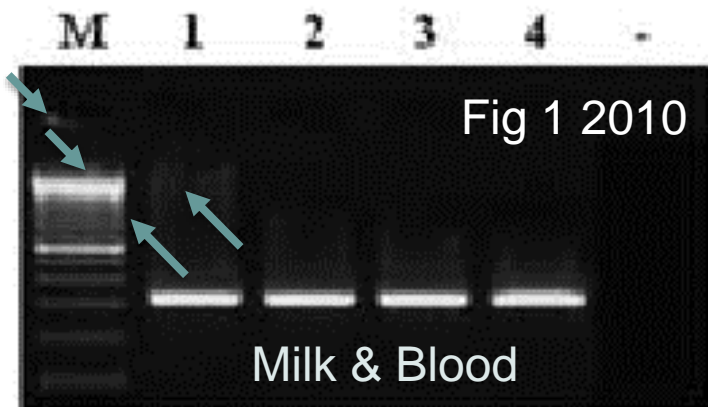
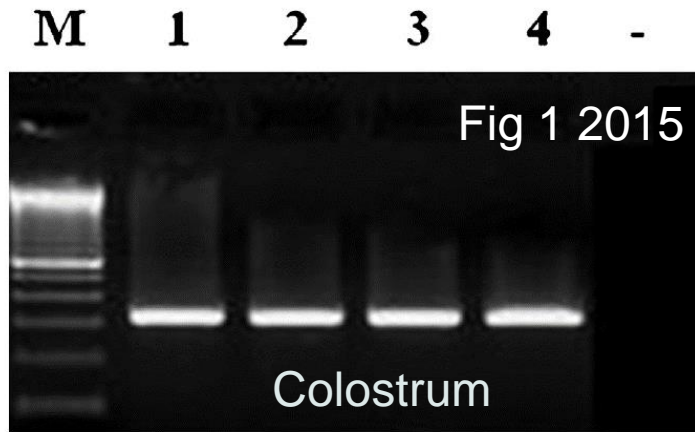
journal homepage: www.elsevier.com/locate/smallrumres



Genetically modified soybean in a goat diet: Influence on kid performance

R. Tudisco^a, S. Calabrò^a, M.I. Cutrignelli^a, G. Moniello^b, M. Grossi^a, V. Mastellone^a, P. Lombardi^{a,*}, M.E. Pero^a, F. Infascelli^a

Looking at the 'data'



Looking at the data



Fig 2 2010

Kidney muscle
spleen heart blood

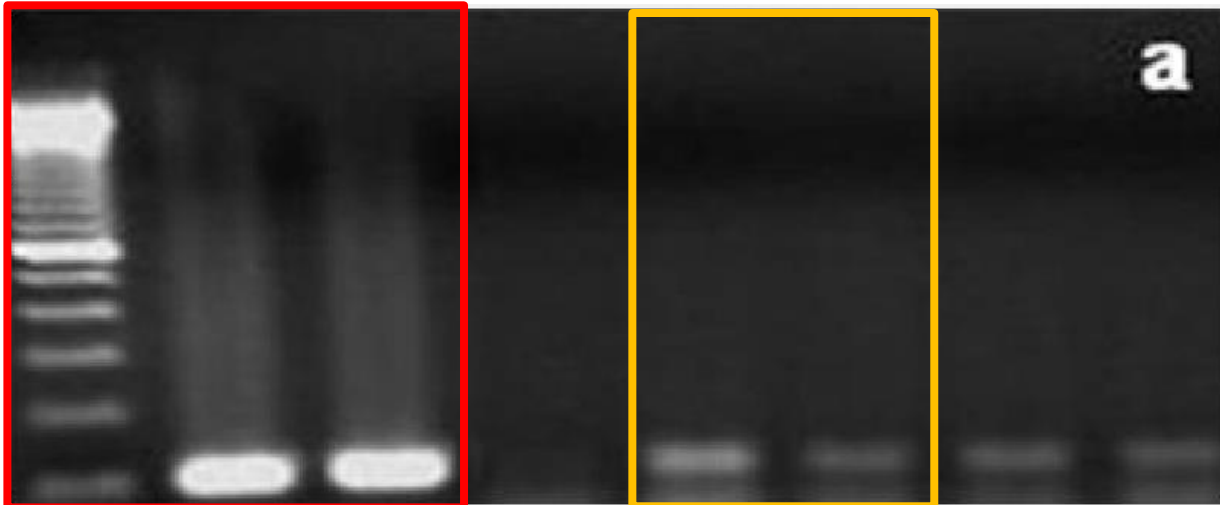


Fig 2 2015

Colostrum

Looking at the retraction



Food and Nutrition Sciences, 2013, 4, 50-54

<http://dx.doi.org/10.4236/fns.2013.46A006> Published Online June 2013 (<http://www.scirp.org/journal/fns>)

 Scientific
Research

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Vincenzo Mastellone, Raffaella Tudisco*, Giovanni Monastra, Maria Elena Perini, Serena Calabrò, Pietro Lombardi, Micaela Grossi, Monica Isabella Cutrignelli, Luigi Avallone, Federico Infascelli

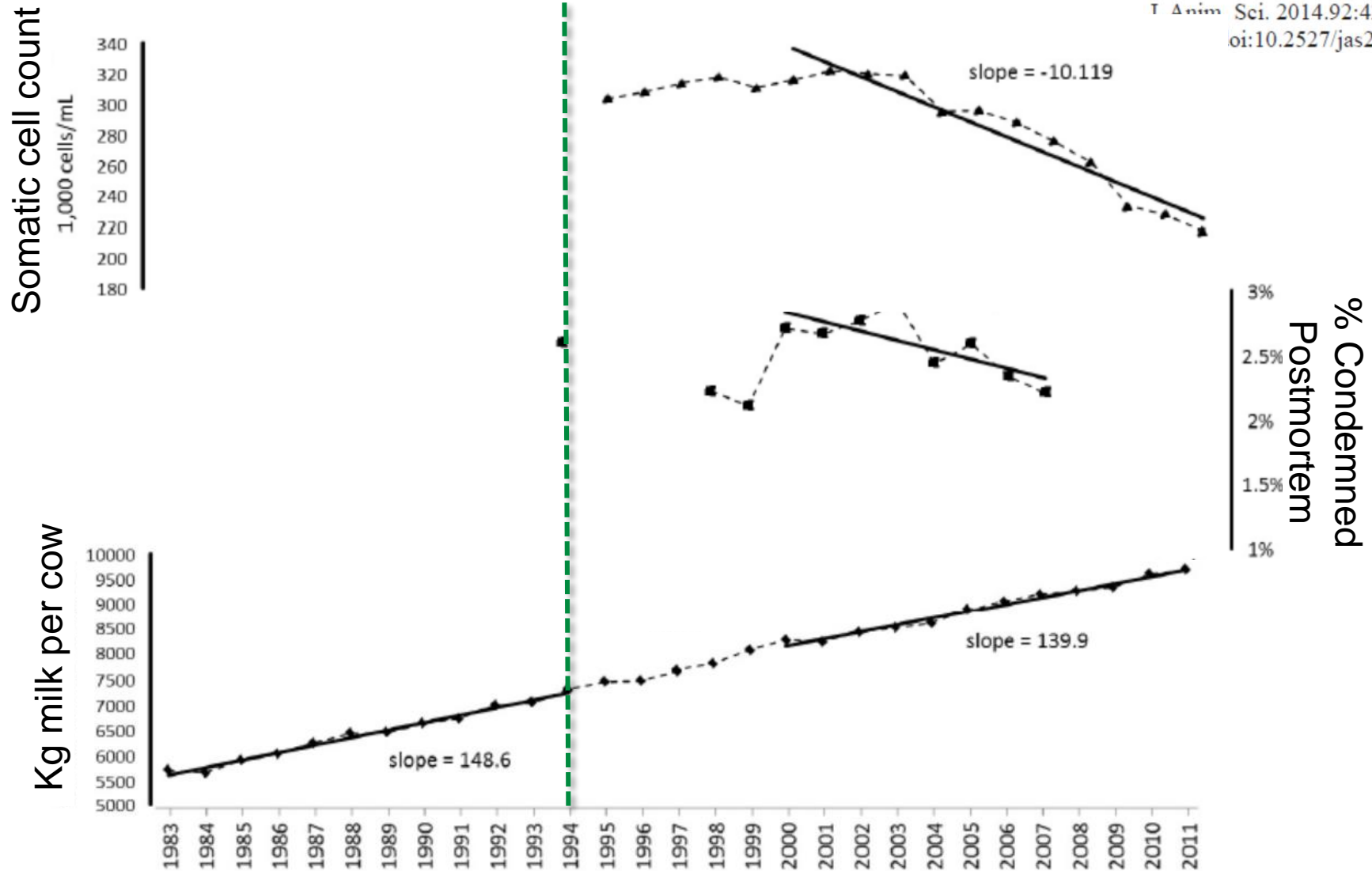
Retracted

- Reason: ~~Self-plagiarism~~
Fraud-Data fabrication
- Author's conduct: ~~Honest error~~
Academic misconduct
- Results: ~~Are still valid~~ Overall invalid

Real data: Dairy trends



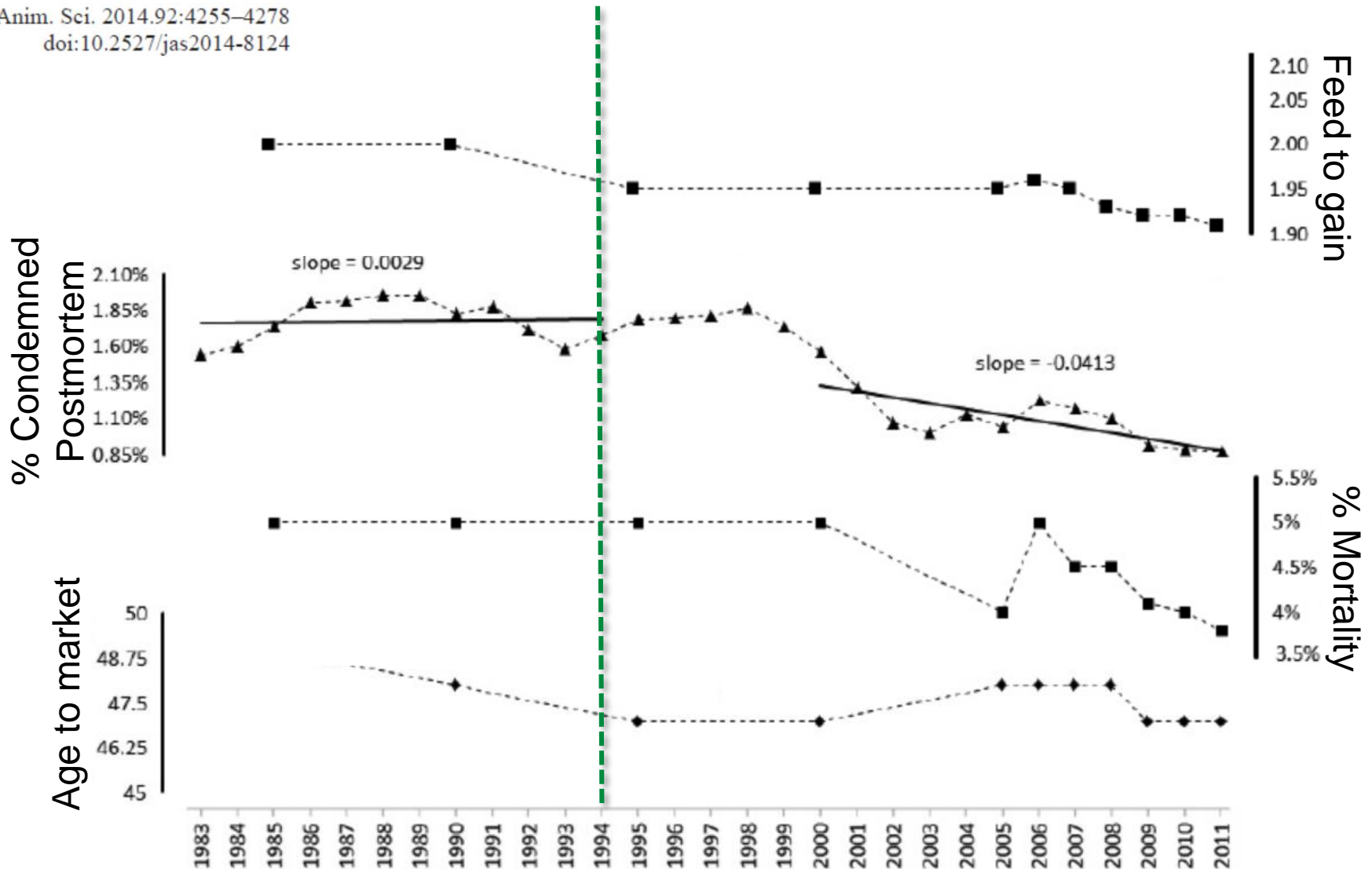
J. Anim. Sci. 2014.92:4255-4278
doi:10.2527/jas2014-8124



Real data: Broiler trends



J. Anim. Sci. 2014.92:4255–4278
doi:10.2527/jas2014-8124



GMOs can be useful!



NEW HI-TECH
GENETICALLY
ALTERED
POTATOS
KILL PESTS...

UNFORTUNATELY, MY
HUSBAND WAS BOTH
A LAWYER AND A
POLITICIAN. I GUESS
HE NEVER STOOD
A CHANCE...



1004-4181-001
W.D.

Inverted risks

CDC: 121 outbreaks & 4,413 illnesses, 239 hospitalizations, and 3 deaths between 1996-2006 from raw milk



GMOs & Dairy



"I want GMOs in my feed."
Said NO cow ever.

the stoneyfield
yogurt
DISH