

# Rethinking Communication in Agricultural Biotechnology

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# THE THREE THINGS I DO...

## DEPARTMENT CHAIRMAN



- Breeding / new varieties
- Crop physiology and production
- Molecular genetics
- Genomics
- Organic and sustainable production
- Weed science
- Plant nutrition, water use
- Space biology
- Cell and developmental biology
- Postharvest physiology

## SPONSORED RESEARCH



- Functional genomics
- Gene discovery
- Marker development
- Light signaling
- Light effects on high-value plant /fruit traits

## SCIENCE COMMUNICATION



- Promoting public understanding of biotechnology
- Training scientists to discuss biotech with concerned audiences.

- Why is there a problem with acceptance of biotech?
- What are the current technologies?
- How do we communicate the science effectively?
- What are our lost opportunities and costs of non-action?
- What can you do to participate?

# Top Concerns About Life Issues



## Moms

- Rising Cost of Food (8.71)
- Keeping Healthy Food Affordable (8.65)
- Rising Healthcare Costs (8.51)
- Rising Energy Costs (8.35)
- Food Safety (8.29)
- U.S. Economy (8.28)



## Millennials

- Keeping Healthy Food Affordable (8.18)
- Rising Cost of Food (8.13)
- Rising Healthcare Costs (8.09)
- U.S. Economy (8.01)



## Early Adopter

- Keeping Healthy Food Affordable (8.55)
- Rising Healthcare Costs (8.50)
- Rising Cost of Food (8.47)
- The U.S. Economy (8.44)
- Rising Energy Costs (8.29)



## Foodies

- Keeping Healthy Food Affordable (9.27)
- Food Safety (9.18)
- Rising Cost of Food (9.10)
- Rising Healthcare Costs (9.08)
- U.S. Economy (9.08)



# Irony at the Apple Store



New improved products!

We loves new Apple products!



New improved products!



I demand new technology!

The best company on earth!

Don't want new apple products!

If nature didn't make it, I don't want it!!

Down with corporations!





# What Plant Genetic Improvement Is



**More varieties**



**Improved yields**



**Grow better under  
given conditions**

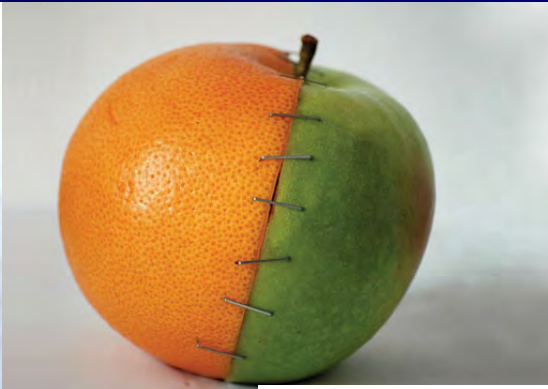


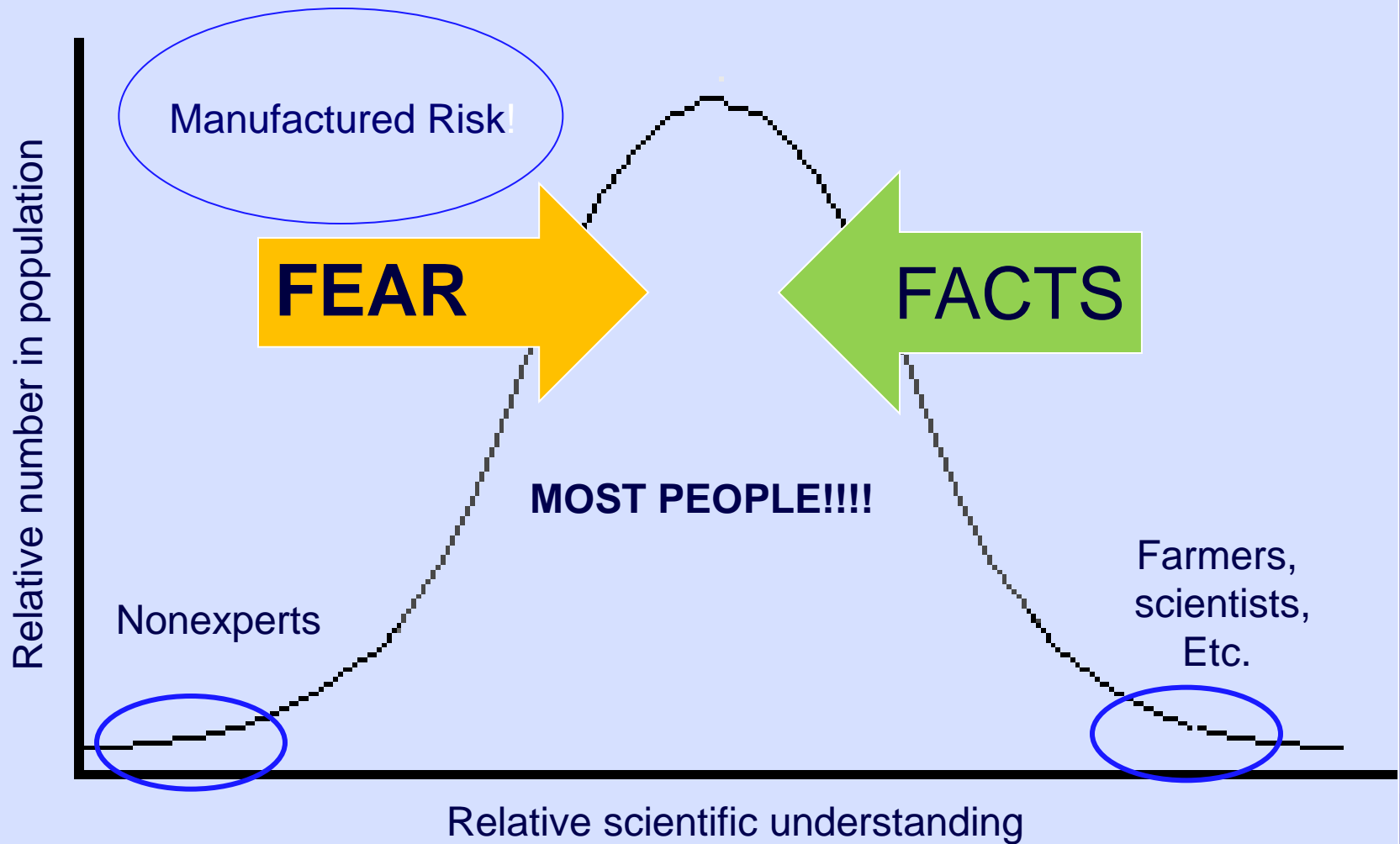
**Improved nutrntion**



**Safer products**

# What Plant Genetic Improvement Is People think







# FOODS

FOOD DEMAND SURVEY

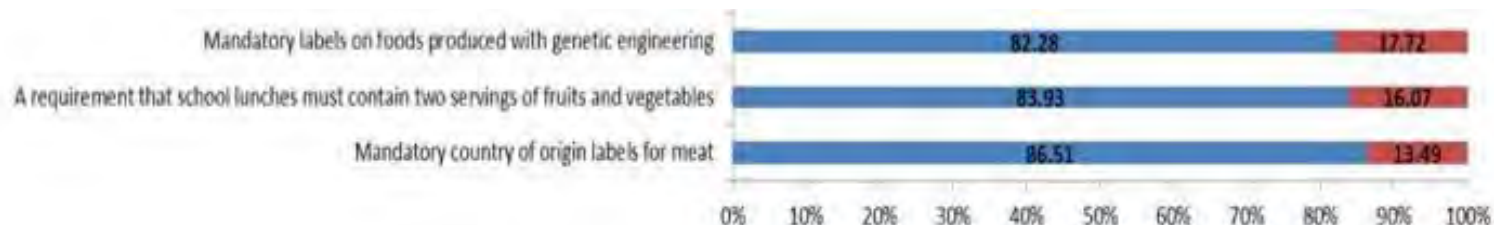


DEPARTMENT OF  
Agricultural  
Economics

Volume 2, Issue 9: January 16, 2015

## Support or Oppose of Government Policies

■ Support ■ Oppose



# FOODS

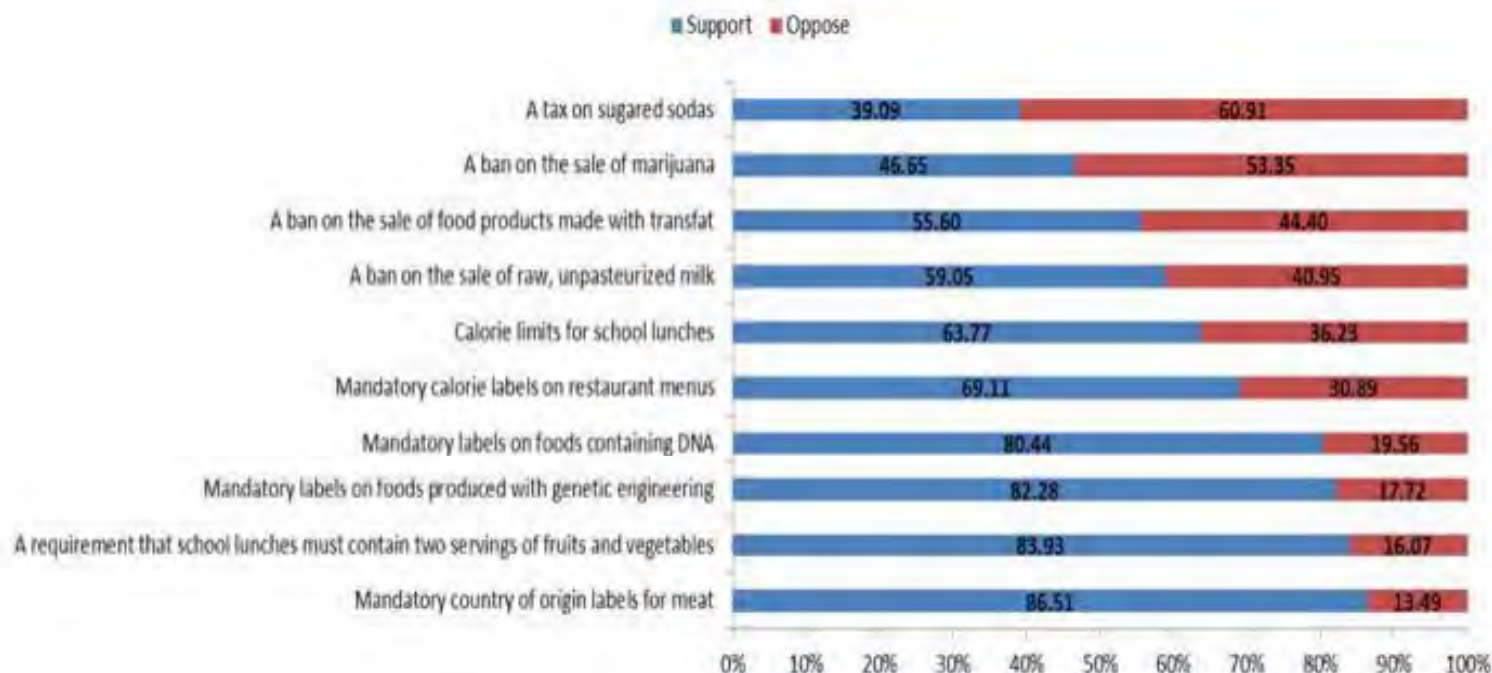
FOOD DEMAND SURVEY



DEPARTMENT OF  
Agricultural  
Economics

Volume 2, Issue 9: January 16, 2015

## Support or Oppose of Government Policies



# **Why is there even a problem?**

**Manufactured risk for profit**

**Political motivations (anti-corporate sentiment)**

**Well meaning people responding to a compelling bad-science message**



# Why is there even a problem?



Oz



Smith



Shiva



Adams



Mercola

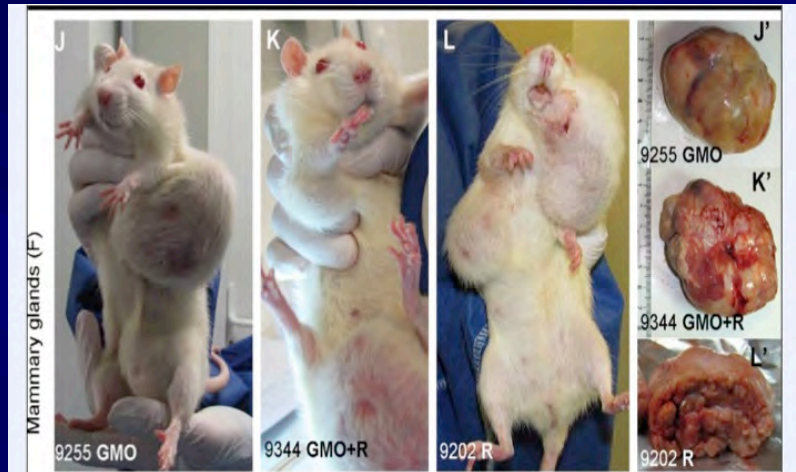


Food Babe

There is a lot of money to be made in manufacturing risk around food.

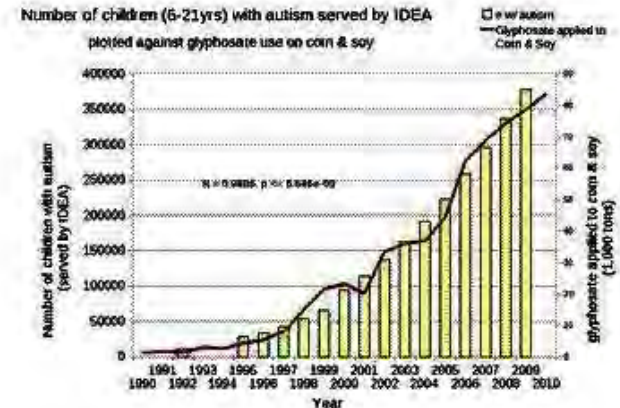


# Why is there even a problem?



Questionable research and publication; deliberate misinterpretation of good research.

## Glyphosate and Autism\*



\* <http://www.examiner.com/article/data-show-correlations-between-increase-neurological-diseases-and-gmos>

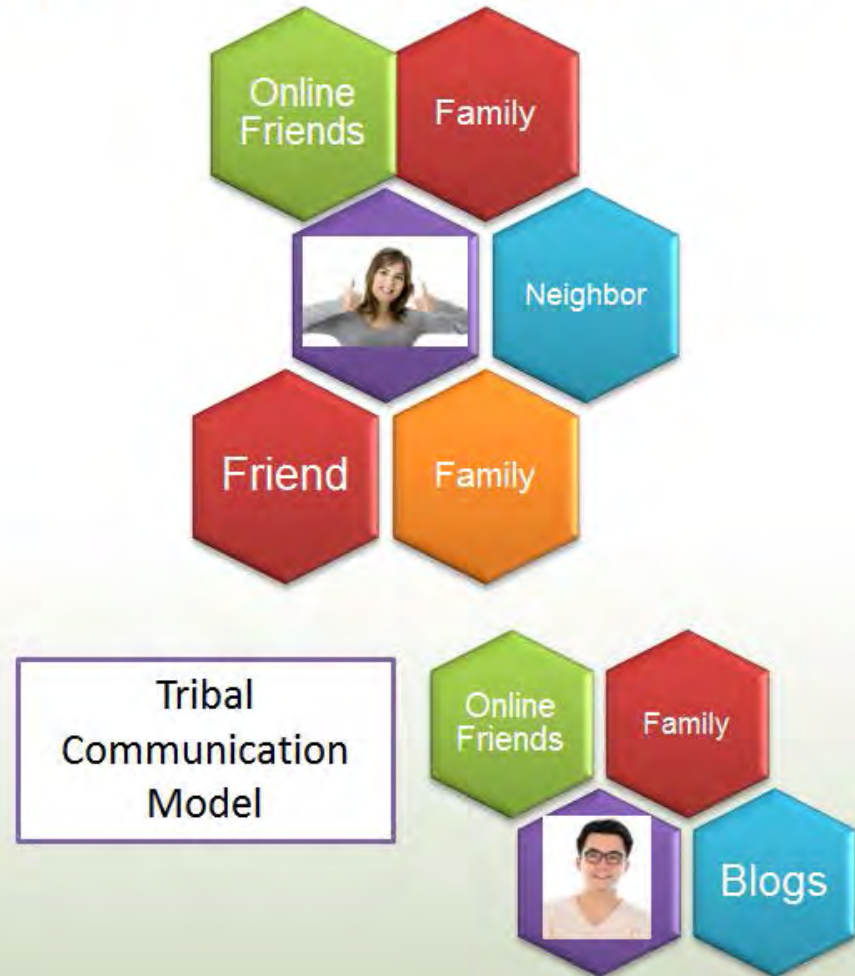


Dr Young: Roundup Herbicide Is Endocrine Disruptor in Human Cells at Drinking Water Levels

Roundup is an endocrine disruptor and is toxic to human cells in vitro (tested in culture dishes in the laboratory) at levels permitted in drinking water in Australia, a new study has found.

This is the first study to examine the effects of glyphosate and Roundup on progesterone production by human female cells in an in vitro system that models key aspects of reproduction in women.

# Online Communication is Tribal/Insular





# Why is there even a problem?

## The “Mom” Tribe

**What information sources have you used to come to your conclusion that GMOs are dangerous?**



Heidi: “I’m part of a moms group. When there is a big consensus, I think ‘there’s something here.’ You don’t need doctors or scientists confirming it when you have hundreds of moms.”

**Fixing the problem.**

**Who is your audience?**

**This is not a formula for insincerity.**

**If you don't believe it, don't say it.**

**These are just hints of how to better  
communicate science more effectively, and  
there is a method to earning trust.**

# How Do Reach that Middle?

## 1. FACTS DON'T MATTER.

You have to start from SHARED VALUES.

What are some common themes shared by those that embrace the technology and those that deplore it ?

## WHO IS YOUR AUDIENCE?

Most of the time these are people that don't know about science and are concerned about food. Share science with them.



# State your larger priorities up front

Developing World



Environment



Farmers



Food Safety



The Needy



Consumers



# How Do Reach that Middle?

## 2. Plant genetic improvement is not “natural”

Remind audiences that genetic improvement of food is a continuum.

Almost none of the plants we regularly consume originated in North America. Almost all were brought here by humans.

None of the food you eat is like its “natural” form

GM technology is simply the most precise version of an age-old practice of breeding and selection.

# Humans have always manipulated crop genetics

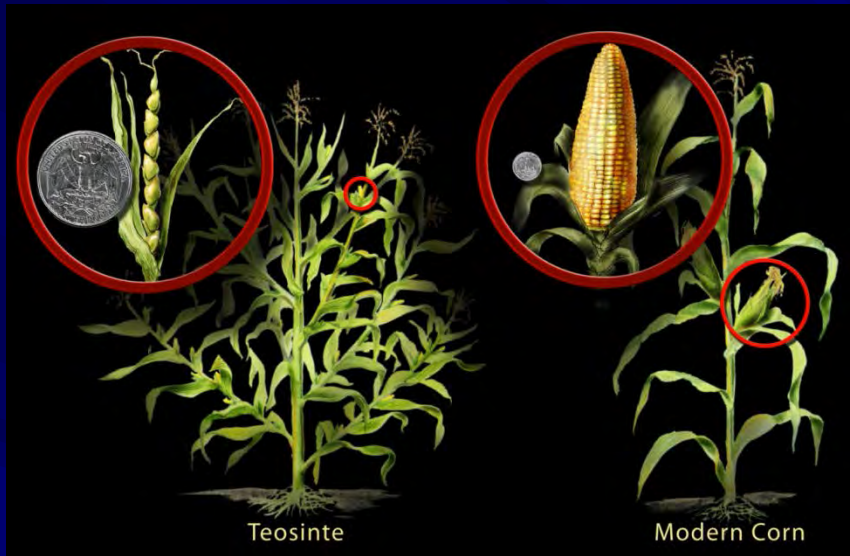
## Centers of origin of selected crops



Note: The pointer locations indicate general regions where crops are believed to have first been domesticated. In some cases, the center of origin is uncertain. Other geographic regions also harbor important genetic diversity for these crops.

Source: This map was developed by the General Accounting Office using data provided by the National Plant Germplasm System's Plant Exchange Office.





## **How Do Reach that Middle?**

**3. Plant Biotechnology is an extension of traditional breeding, just much more precise.**

	<b>Hybrids</b> (cross between two non-clonal plants)	<b>Polyploids</b> (whole genomes duplicated or added)	<b>Mutation breeding</b> (Chemical or radiation induced damage to DNA)	<b>Crossing Species Barriers</b> (interspecific crosses)	<b>Transgenics</b> (rDNA method to add a gene- "GMO")	<b>Cisgenics</b> (rDNA method to add a gene)
Examples in common foods	Almost everything	Strawberries, wheat, bananas, brassicas, others	Some bananas, pears, apples, rice, yams, mint, others	Pluots, tangelos, some apples, rice, wheat	Much corn, canola, soybeans, cotton, papaya	Coming soon.
Transfers genes from one species to another	Yes, sometimes	Yes, often	No	By definition	Yes	No
Occurs in nature	Yes	Yes	Yes, transposon movement, mutation from environment	Yes, rare, seldom fertile	Yes, Agrobacterium, other horiz. trans.	N/A.
Human intervention	Yes, for crop improvement	Can be induced chemically to improve crops	Yes, to introduce variation for crop improvement	Yes, for crop improvement	Yes, for precision crop improvement	Yes, for precision crop improvement
Number of genes affected	10K to >300K, depending on species	10K to >800K	No way to assess	10-300K	1-3	1-3, usually 1
Know what genes moved or affected do	No	No	No	No	Yes	Yes
Know where affected genes are in genome	No	No	No	No	Yes	Yes
Plant patentable	Yes	Yes	Yes	Yes	Yes	Yes
Documented adversity	Yes	??	???	Yes	No	No
Environmental assessment	No	No	No	No	Yes	Will see.
Organic acceptable	Yes	Yes	Yes	Yes	No	No
Time for new variety	5-30 years	>5 years	>5 years	5-30 years	<5 years	<5 years
Demanding label	No	No	No	No	Yes	Will see.



## 4. Know a Few Central Core Concepts

Humans have always participated in plant genetic improvement.

Transgenic crop technology (familiar “GMO”) is a precise extension of conventional plant breeding.

“The techniques used pose no more risk (actually less risk) than conventional breeding.” (NAS, AAAS, AMA, EFSA many others)

In the 18 years these products have been used, there has not been one case of illness or death related to these products

In the USA there are several traits used in only 8 (- +) commercial crops

## **How Do Reach that Middle?**

**5. There are only several biotech crops commercially available and only three traits.**

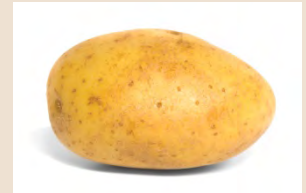
# GM Crops Available Now

## BIOTECH



**8** Common Crops Commercially Available Use Biotech Seeds, reducing crop loss to insect and plant diseases as well as drought and other environmental conditions.

SOURCE: [www.isaaa.org](http://www.isaaa.org)



potato



apple



# What are the Three Main Traits?

Virus Resistance

Insect Resistance

Herbicide Resistance

(how the traits work lecture online – (google “ UF biotechnology literacy day”))

## 6. Honestly discuss strengths and limitations.

### Strengths

### Limitations

Virus resistance

Works great, no foreign material

Can spread to nonGM populations

Insect resistance

Has cut insecticide use by 10-70%

Pockets of developing resistance

Herbicide resistance

Saves time, labor, fuel.  
Allows conservation tillage

Resistant weeds are a problem in areas.

## 7. Win back emotional capital with lost opportunities

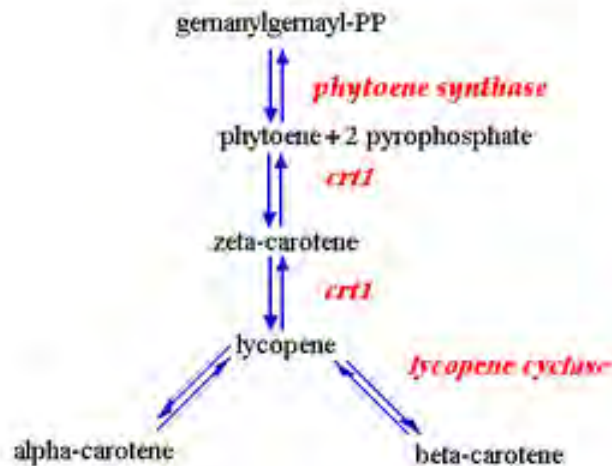
Glyphosate resistant and insect resistant crops, while helpful to farmers, do not win the hearts and minds of the general public



# Golden Rice



Opposition to golden rice cost \$2 billion to farmers in developing countries and 1.4 million human years – Wesseler et al., 2014



- 250,000-500,000 children go blind each year
- Half of them die within 12 months of losing their sight
- 1.9-2.7 million deaths per year may be due to VAD
- Impoverished families cannot afford vitamin A-rich food sources
- Supplementation is expensive and limited in effectiveness

**Farmers**

**Consumers**

**Environment**

**X**

**Needy**

# Cassava

250 million depend on cassava

50 million tons lost to virus.



Virus Resistant Cassava (VIRCA)

Biocassava Plus (BC Plus)

X

**Farmers**

**Consumers**

**Environment**

X

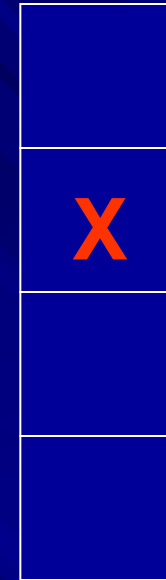
**Needy**

# Allergy-Free Peanuts

Peanut – RNAi suppression Ara h2

Characteristics of Peanut Allergens

Allergen	Molecular Mass	Characteristics
Ara h 1	63 k-Da	Member of vicilin family of seed storage proteins, a 7S globulin
Ara h 2	17–19 k-Da	Member of conglutin family of seed storage proteins, a 2S albumin
Ara h 3	14–45 k-Da, processed from 64 k-Da protein	Member of glycinin family of seed storage proteins; heteromultimeric protein formed from differently proteolytically processed products of the same gene, an 11S globulin
Ara h 4	37 k-Da	Isoform of Ara h 3
Ara h 5	15 k-Da	Member of profilin family of G-actin-binding proteins
Ara h 6	15 k-Da	Member of conglutin family of seed storage proteins, a 2S albumin
Ara h 7	17 k-Da	Member of conglutin family of seed storage proteins, a 2S albumin
Ara h 8	16 k-Da	Homologous to major birch pollen allergen, Bet v 1 and other pathogenesis-related proteins
Ara h 9	9.8 k-Da	Lipid transfer protein
Ara h 10	16 k-Da	Oleosin seed storage protein
Ara h 11	14 k-Da	Oleosin seed storage protein

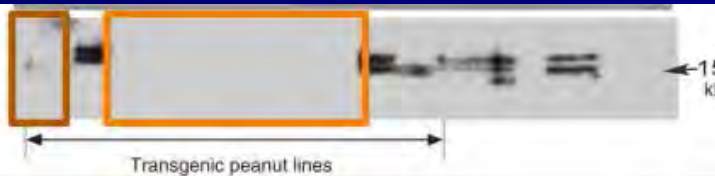


Farmers

Consumers

Environment

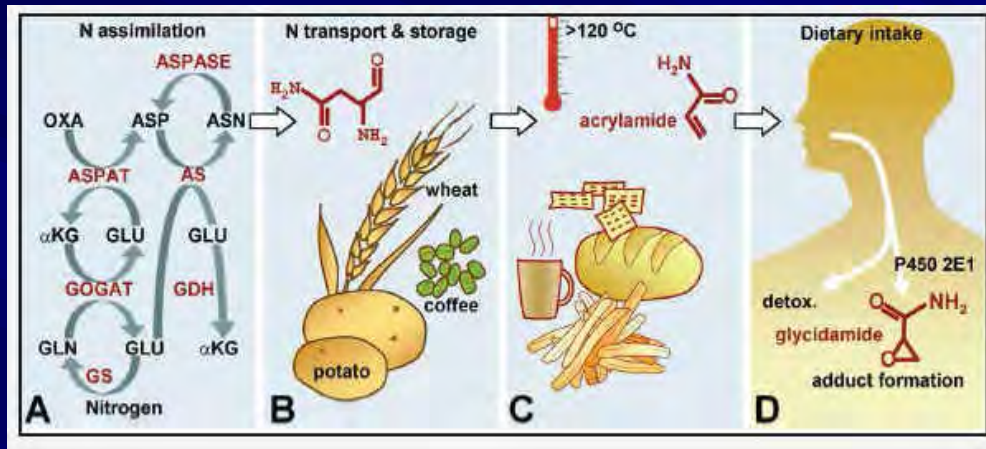
Needy



Plant tested	Two letter code	Ara h 2 protein concentration
Wild Type	WT	27.73%
12.1.1	S1	4.24%
32.1.1	S2	3.08%
45.6	S3	4.04%



# Low Acrylamide, non Browning Potatoes



X

Farmers

X

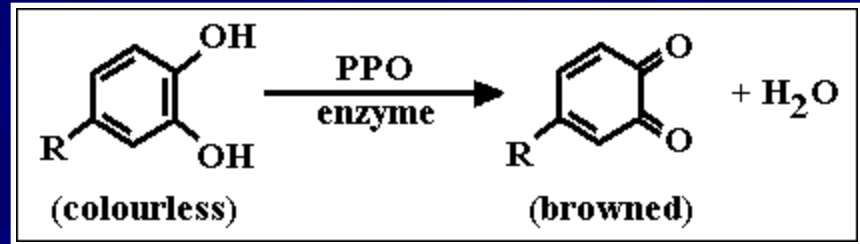
Consumers

Environment

Needy

# Non Browning Apples

Silencing a gene that leads to discoloration



**X**

**Farmers**

**X**

**Consumers**

**Environment**

**Needy**

**X**

**Small Business!**

# *Colletotrichum* Crown Rot

*C. gloeosporioides*

Preliminary Results

Non-trans H4

NPR1-28



**Figure 6** Phenotype of the *Colletotrichum* Crown Rot on the transgenic plants. Plants with 25 DAI.



# Stopping Citrus Greening



Spinach defensin

NPR1

Lytic peptides

Many show promise

Earliest deregulation is  
2019



# BS2 Tomato

A pepper gene in tomato eases black spot and wilt.



**X**

**Farmers**

**Consumers**

**X**

**Environment**

**Needy**

# Restoring the American Chestnut?



Chestnut blight has destroyed the American Chestnut.

A single gene confers resistance to the disease.

Not food... so deregulation is an interesting question.

# 8. Rely on Graphics Over Words

Instead of “glyphosate is relatively harmless- don’t worry about it.”

Material	What the heck is it?	LD50 (mg/kg)*	toxic category**
water	You know this one.	90000	practically non-toxic
sucrose	...and this one. Refined from sugar cane or sugar beets	30000	practically non-toxic
citric acid	A chemical in citrus fruits (lemons, oranges, etc)	12000	slightly toxic
ethanol (component in many bevies)	Hic! 	7000	slightly toxic
glyphosate	A broad-spectrum systemic herbicide used to kill weeds brought to market under tradename RoundUp	5600	slightly toxic
sodium bicarbonate (baking soda)	One word: Biscuits 	4220	moderately toxic
sodium chloride (table salt)	 Not too much now...	3000	moderately toxic
acetaminophen	Whoa...I'm getting a headache	1944	moderately toxic
hydrogen peroxide	Common household product often used industrially for drinking water and waste water treatment	1580	moderately toxic
theobromine	Is a bitter alkaloid of the cacao plant in CHOCOLATE ( <i>What the heck is this doing on this list?</i> ) 	1265	moderately toxic
Rotenone	A broad-spectrum insecticide and pesticide approved for use in organic production	132-1500	very toxic
copper sulfate	A compound approved for use in organic production as a fungicide	300	very toxic
caffeine	 Gasp. See <i>italicized</i> comment on chocolate^	192	very toxic
DDT	Tasteless and almost odorless chemical known for its insecticidal properties. Was used in WWII to control malaria and typhus.	113-800	very toxic
Nicotine	A potent alkaloid found in the nightshade family of plants (Solanaceae) and a stimulant drug and a major contributing factor to the dependence-forming properties of tobacco smoking. 	50	extremely toxic
cyanide	Cyanides are produced by certain bacteria, fungi, and algae and are found in a number of plants - used in mining, industrial organic chemistry and for pest control.	10	extremely toxic
vitamin D	Vitamin D toxicity can occur when you have excessive amounts of vitamin D in your body by megadoses of vitamin D supplements (not by diet or exposure to the sun). 	10	extremely toxic
Strychnine	Is a highly toxic, colorless, bitter crystalline alkaloid used as a pesticide, particularly for killing small vertebrates such as birds and rodents.	1-2	super toxic
aflatoxin	Naturally occurring mycotoxins produced by species of fungi. 14 different types of aflatoxin are produced in nature. They can colonize and contaminate grain before harvest or during storage.	0.003	super toxic
botulin	A protein and neurotoxin produced by a bacterium. Its pure form, it is the most acutely toxic substance known. Preparations of the toxin can be effectively used for therapeutic or cosmetic purposes.	0.00001	super toxic

Sources: "The Dose Makes the Poison" In *Assessing Toxic Risk* ([http://ei.cornell.edu/teacher/pdf/ATR/ATR\\_Chapter1\\_X.pdf](http://ei.cornell.edu/teacher/pdf/ATR/ATR_Chapter1_X.pdf)); various Wikipedia entries; various MSDS sheets found online.  
 Inspiration: Joni Rose's witty and informative FB post in response to (mis)understanding about chemicals and toxicity.  
 \*Please note: the LD50 levels outlined are based on oral ingestions by rats  
 \*\*Toxicity rankings are based on the EPA's categorization (I through IV) (Title 40 of the Code of Federal Regulations).

@DocCamiryan

## 9. Communications Barriers

People reject the validity of scientific conclusions if they contradict their deeply held views

“Backfire Effect”- when confronted with evidence that is contrary to their views, people tend to believe that the evidence is distorted. They also “dig in the heels” with their beliefs

Cultural Cognition – belief in transgenic harm as part of a package of beliefs

False Equivalence, “no consensus among scientists”



# More Barriers: Avoid these Mistakes

Avoid “feed the world” rhetoric

Always discuss strengths and limitations

Don’t ever claim it is a single solution.

Don’t discount all facets of “organic” ag

Don’t criticize other forms of genetic improvement...

**Never get backed into the “science no”**

*“Can you guarantee that these are absolutely safe?”*

# 10. Maximizing your e-Real Estate

## Talking to public audiences – Get Involved!

Encourage your grower clients and producers to get involved.

Obtain a dedicated Gmail account- use their real names.

Sign up for facebook, twitter, instagram, pintrest, etc.

Get a blog space on blogspot.com or wordpress.

Answer questions in comments sections of news articles.

# Claiming your e-Real Estate

## Talking to public audiences – Get Involved!

Plant genetic improvement techniques are safe.

All methods involve some small risk– but all are about the same risk as traditional breeding.

Techniques that breed in traits can take a long time

Directed changes are more precise and more rapidly available, but frequently require regulatory hurdles



Communication



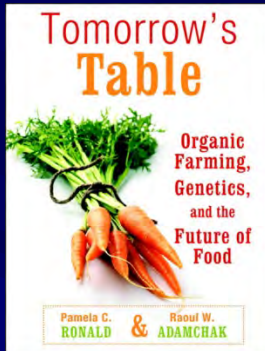
“Big Ag” crops  
Lacking Trust  
Misunderstanding  
Activist-driven risk

Traits used in many crops  
Solving problems

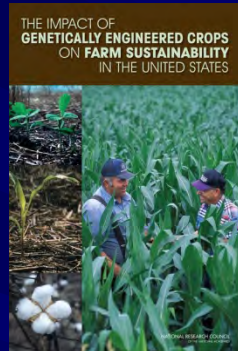
- Environment
- Farmers
- The needy
- Consumers



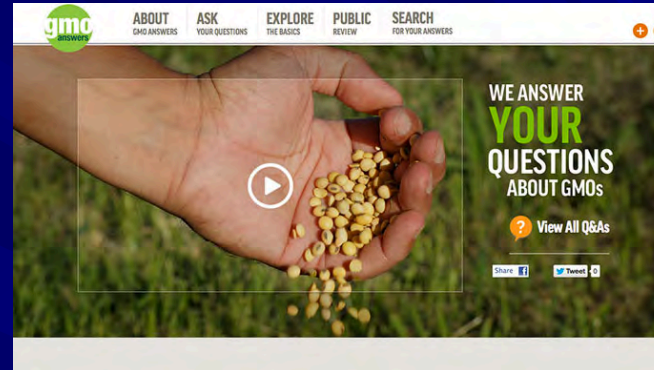
# Where do I get good information?



Warm welcome



Cold facts



GMOanswers.com



Biofortified.org



geneticliteracyproject.com

GMOLOL  
On  
Facebook

# SOLUTIONS:

Scientists, industry people and farmers need to get involved in public awareness and education.

We need to stand up for good science that can help farmers, the needy, the environment and give consumers more choice.

It is most important to concentrate on the middle, the people that are unsure about technology, and tend to be influenced by fear.

Talk to them, don't just push science.

# Bio • talk • knowledge • y

Training for academics in how to discuss biotechnology and engage public audiences effectively.

## Phase I- train the trainers

- Basic facts and mechanisms
- Mythbusting
- How to engage
- Includes complete resource USB

## Phase II- Practice Public Interaction

- Presentation in public venue
- Q&A session
- One-on-one follow up

**Scheduling no-cost sessions at major universities, one per month**

[www.talkingbiotech.com](http://www.talkingbiotech.com)

Twitter: @biotalkknowledge

# Thank you

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 @kevinfolta

[www.talkingbiotechpodcast.com](http://www.talkingbiotechpodcast.com) (also iTunes)



**Thanks to Dr. Borlaug**

"There is a path to truth and sincerity  
that you must guard and defend"

-- Teruyuki Okazaki



It is our mission to stand up for the truth  
that science gives us.

Dr. Jack Payne  
SVP UF/IFAS

