Rethinking Our Ag Biotech Message

They Love What We Do...But They Just Don't Know It!

Kevin M. Folta
Professor and Chairman
Horticultural Sciences Department

kevinfolta@gmail.com
kfolta.blogspot.com
@kevinfolta
www.talkingbiotechpodcast.com

UF UNIVERSITY of FLORIDA
The Foundation for The Gator Nation

We have a wonderful situation

Our food supply in the USA has never been more diverse, safe and plentiful.

Food costs, as a function of annual income, have never been lower.

The fact that 99% of the country does not have to produce food, means there's plenty of time for other innovations, leisure, etc.

Free Time + Internet Connection = Instant Experts!

Never before in history have humans enjoyed such immediate access to bad information.

Online Communication is Tribal/Insular

Traditional Communication Model

Tribal Communication Model

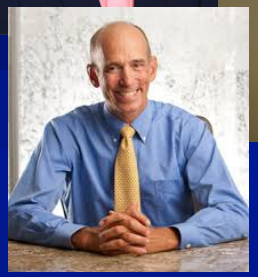
THE CENTER FOR FOOD INTEGRITY

Why is there even a problem?

How can we help you? We're sorta farmers, producers and scientists.

We need to understand food, farming and technology!

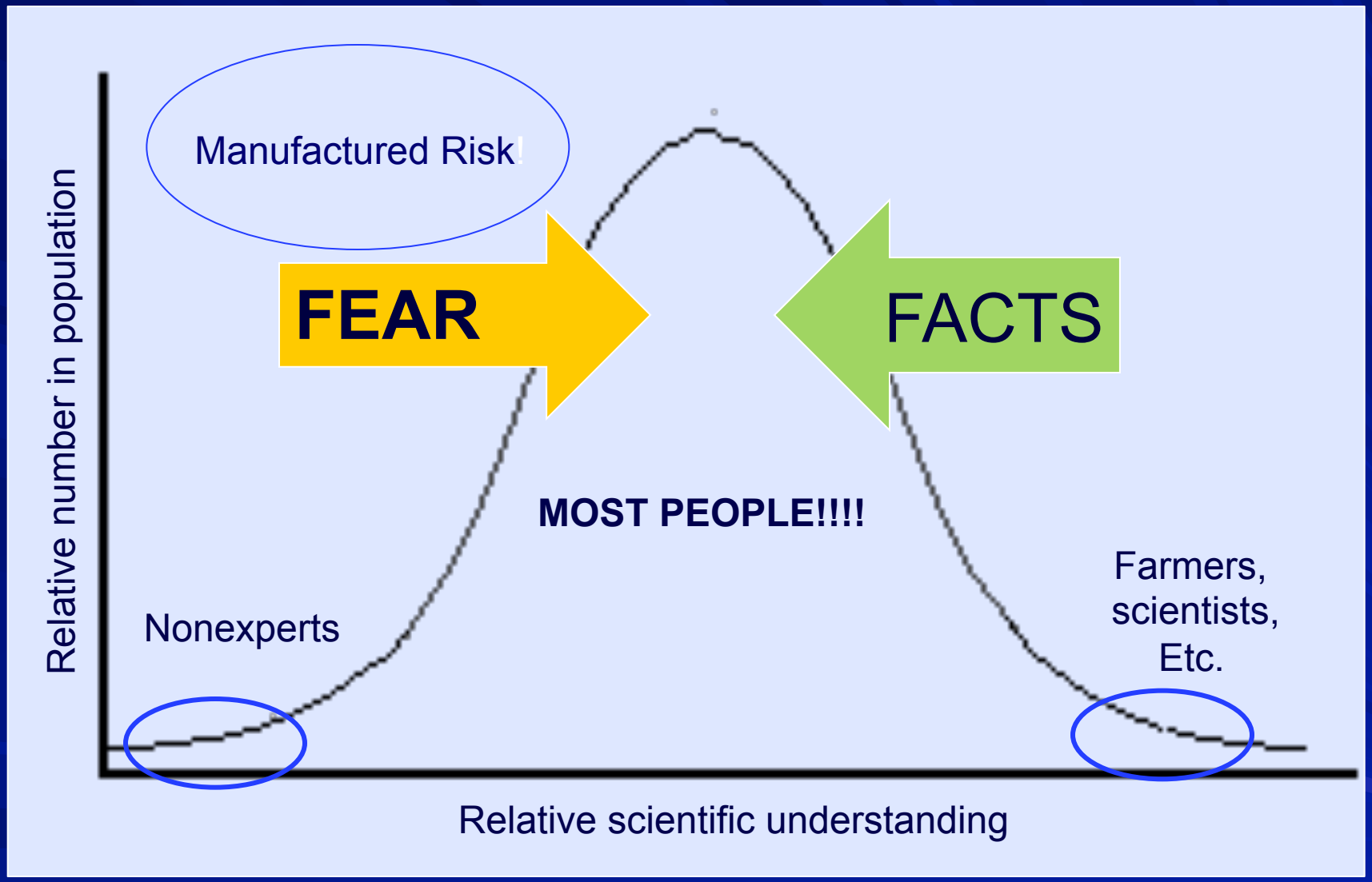
We're actually farmers, producers and scientists, but we're too busy.



We have a problem.
We have the power.
We decided not to use it.

Farmers are 2.0% of the population, yet are ~0.001% of the presence in social media.

Activist groups want to outlaw animal practices, use of biotechnology, limit use of safe ag chemicals.


Manufactured Risk!
FEAR
FACTS
MOST PEOPLE!!!!
Nonexperts
Farmers, scientists, Etc.
Relative number in population
Relative scientific understanding

Here's how we fix it.

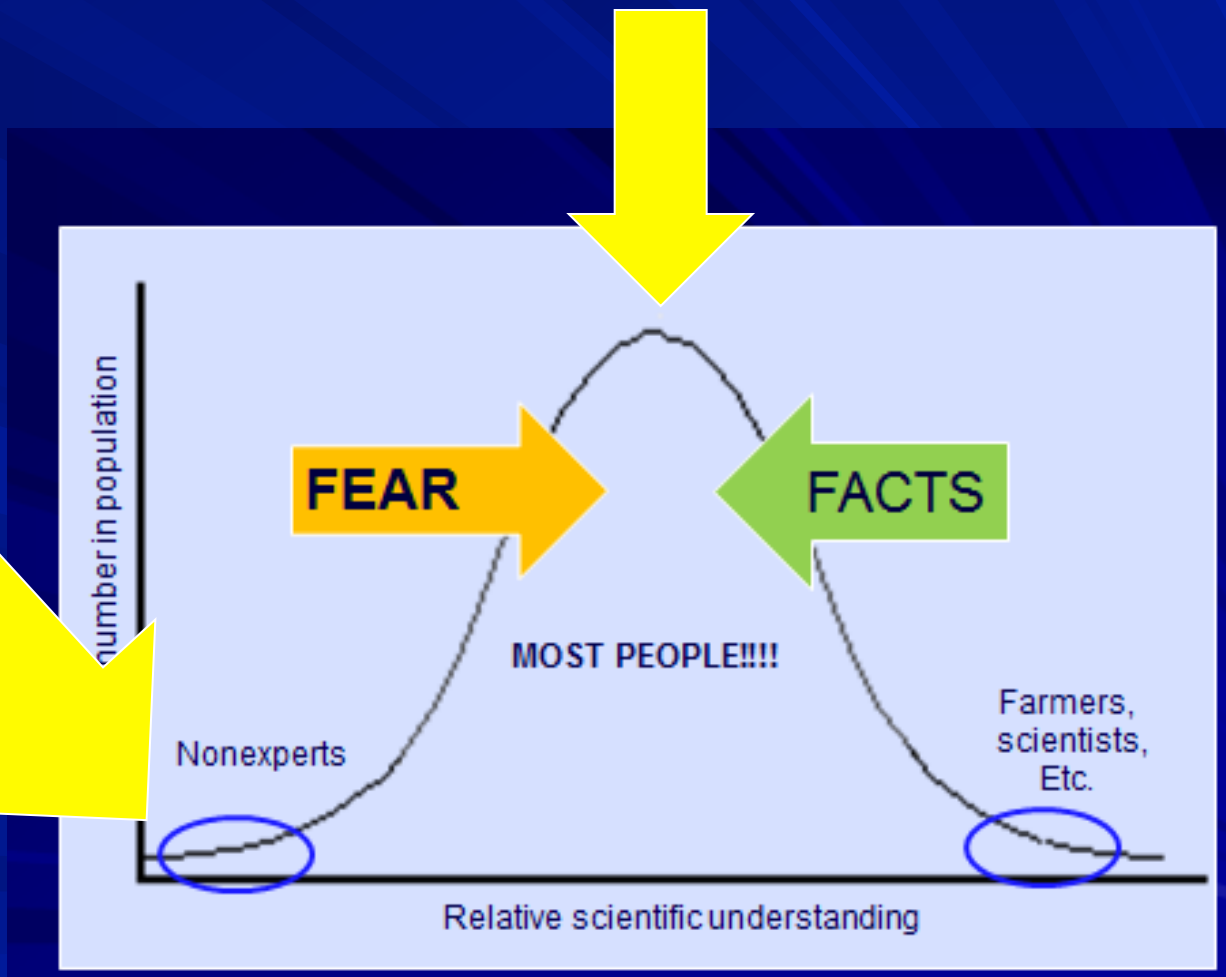
1. Understand your audience
2. Dispel the appeal to nature
3. Establish your shared values
4. Personalize your message, engage with honesty, transparency, and establish trust.
5. Know the core concepts
6. Emphasize missed opportunities

Last- Your eReal Estate- Go Get It.

1. **Understand your audience**

YOUR AUDIENCE

NOT YOUR AUDIENCE



Top Concerns About Life Issues

Moms

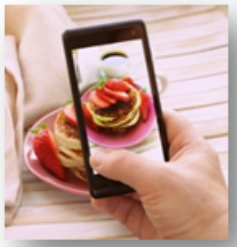
- Rising Cost of Food (8.71)
- Keeping Healthy Food Affordable (8.65)
- Rising Healthcare Costs (8.51)
- Rising Energy Costs (8.35)
- Food Safety (8.29)
- U.S. Economy (8.28)

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)

WHO IS YOUR AUDIENCE?

The center of the curve is composed of people that don't know about food production, farming, and science.

They are concerned about food.

Share your story with them.

2. Dispel the appeal to nature

What is Natural?

Humans have played a pivotal role in plant and animal improvement.

Genetics

Management

Nutrition, etc.

2. Plant genetic improvement is not “natural”

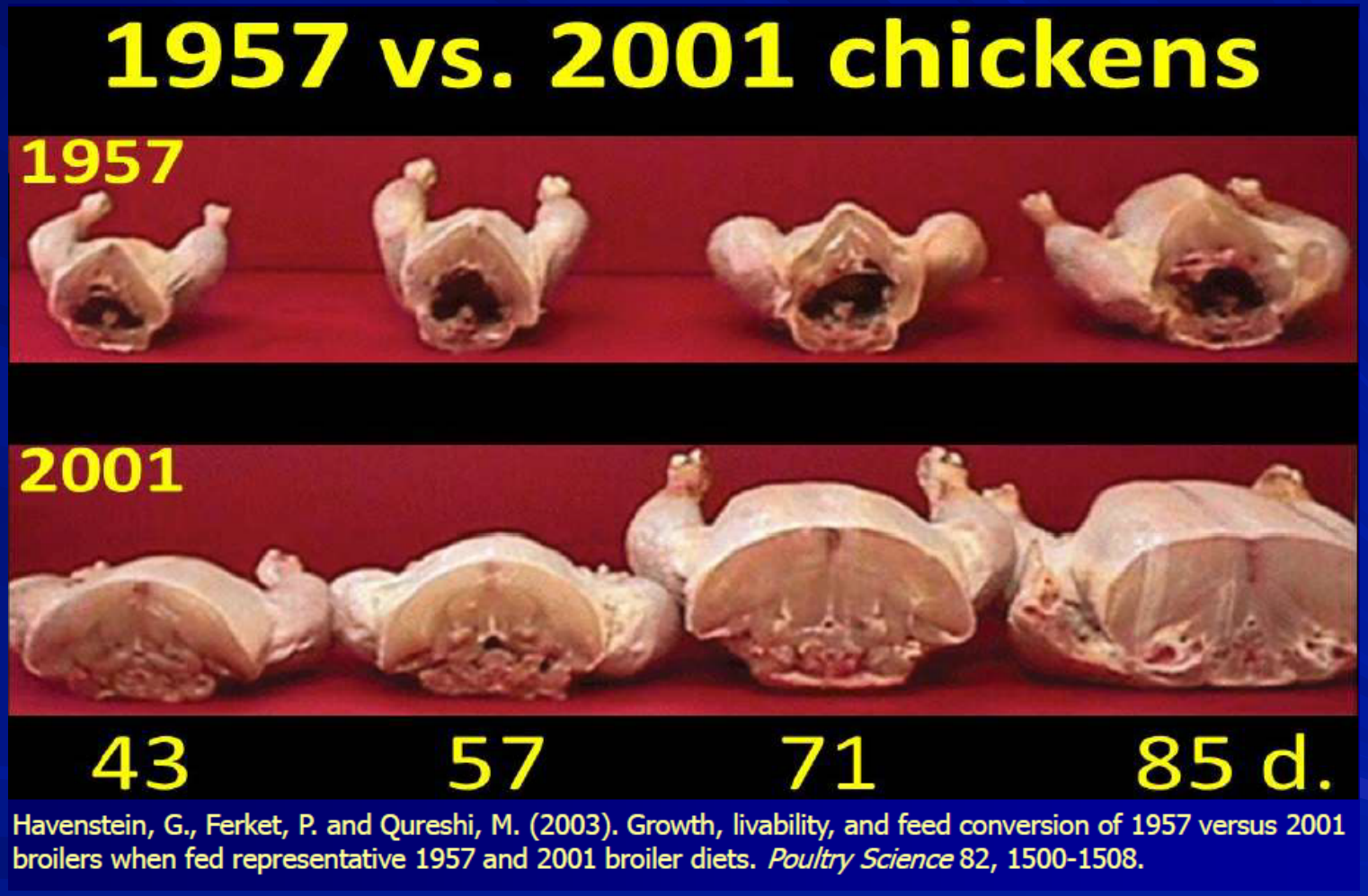
Remind audiences that genetic improvement of food is a continuum.

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.

What Animal Genetic Improvement Is



Havenstein, G., Ferket, P. and Qureshi, M. (2003). Growth, livability, and feed conversion of 1957 versus 2001 broilers when fed representative 1957 and 2001 broiler diets. *Poultry Science* 82, 1500-1508.

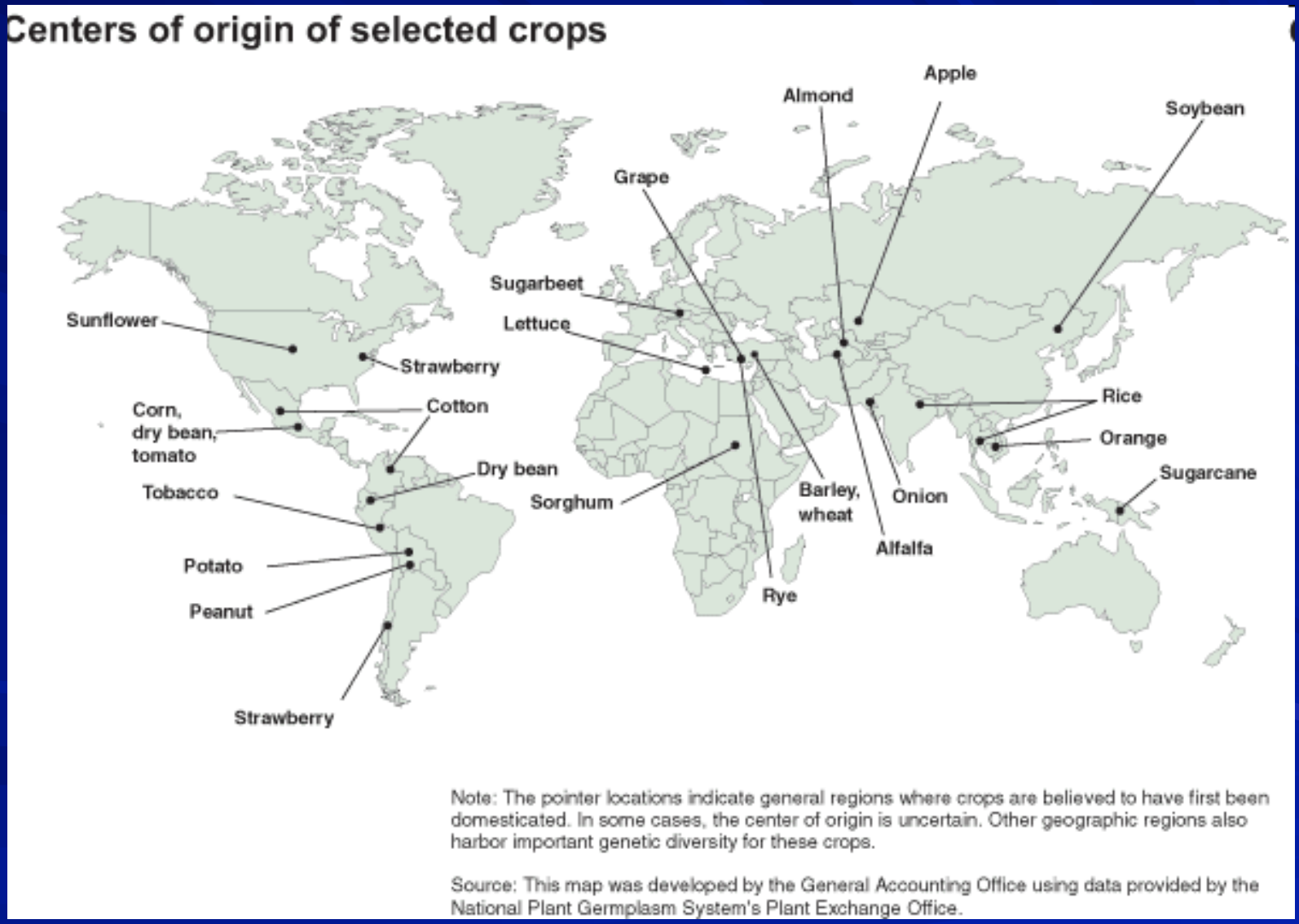
What Animal Genetic Improvement Is **NOT**

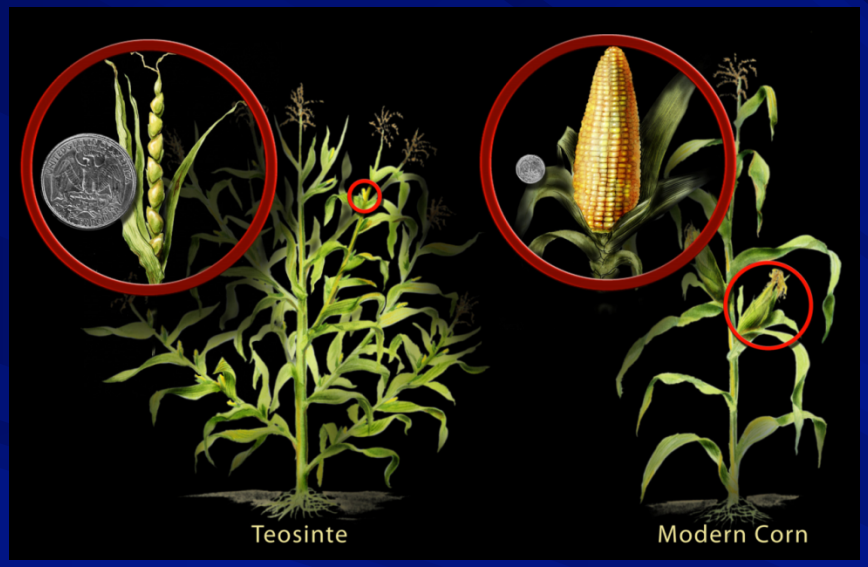
What Animal Genetic Improvement Is

Round Oak Rag Apple Elevation (born 1965)
>80,000 daughters, 2.3 million granddaughters,
and 6.5 million great-granddaughters

Thanks Alison Van Eenennaam for the slide!

Humans have always manipulated crop genetics





All existing crops and animals have been radically reshaped by humans, to enhance performance that has aided the human condition.

3. Identify and Appeal to Shared Values

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 ?

The human brain responds to stories. Tell yours.

Q: What are your values around food and food production?

Shared Values? Millennial Priorities

Developing World

Environment

Farmers

Animal Welfare

Food Safety

The Needy

Consumers

4. Personalize your message.

Understand why they feel the way they do.

Tell your story. Start with your concerns.

Talk about points that everyone can agree upon

Refer to your family, your personal goals.

Be transparent. Establish trust.

5. A Few Central Core Concepts

Humans have always participated in plant and animal genetic improvement.

Transgenic 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 18 years of use in plants, there has not been one case of illness or death related to these products. No approved animals.

In the USA there are several traits used in only 10 (- +) commercial crops

GM Crops Available Now

BIOTECH

1 corn

2 soy

3 alfalfa

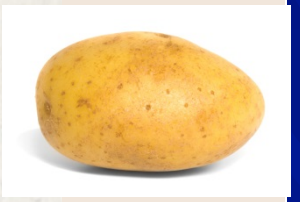
4 cotton

5 squash

6 papaya

7 sugar beets

8 canola



potato

apple

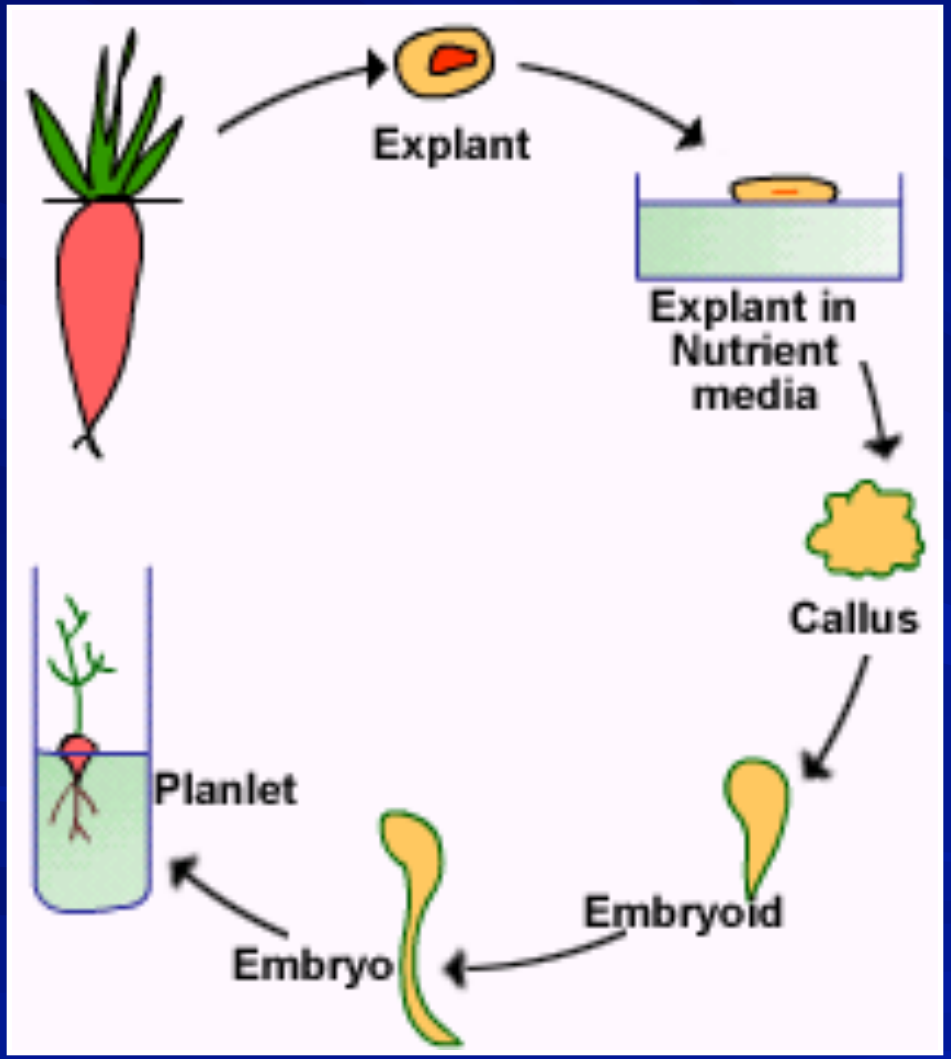
10 8 Common Crops Commercially Available Use Biotech Seeds, reducing crop loss to insect and plant diseases as well as drought and other environmental conditions.

SOURCE: www.isaaa.org

How do you get a gene into a plant?

How Do We Add a Gene to a Plant?

How Do You Make a Transgenic Plant – Exploit Totipoentcy

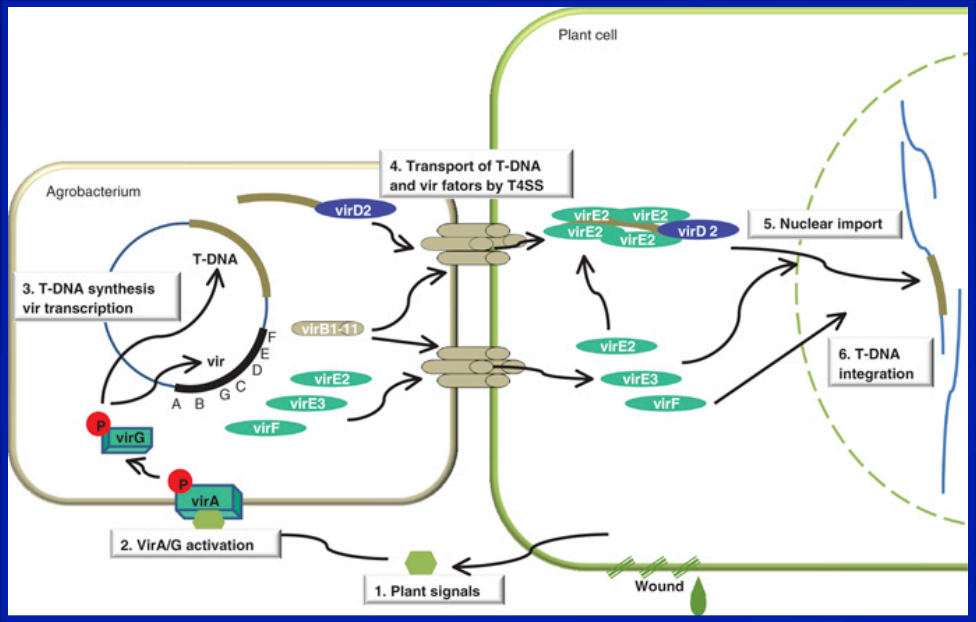


Agrobacterium is used to place gene of interest into a single cell.

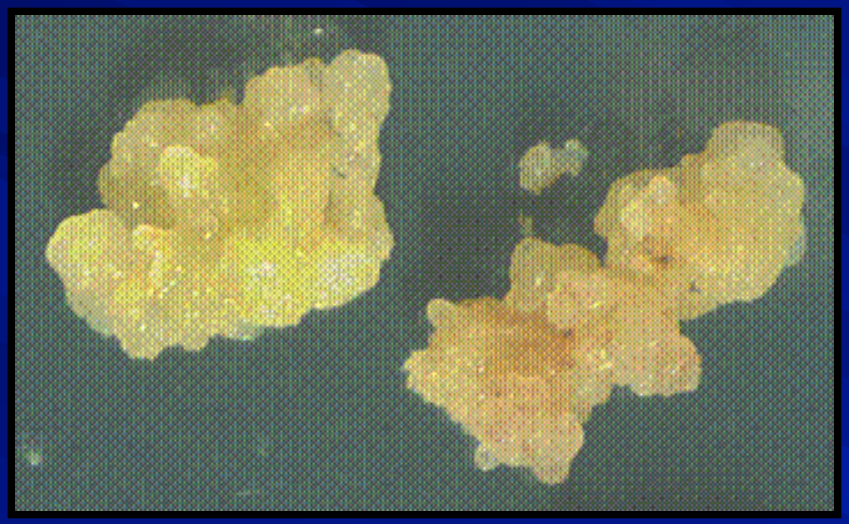
The single cell is then cultured into an entire plant containing the gene.

How Do We Add a Gene to a Plant?

Agrobacterium tumefaciens



Making a New Plant from a Single Cell



What are the Three Main Traits?

Virus Resistance

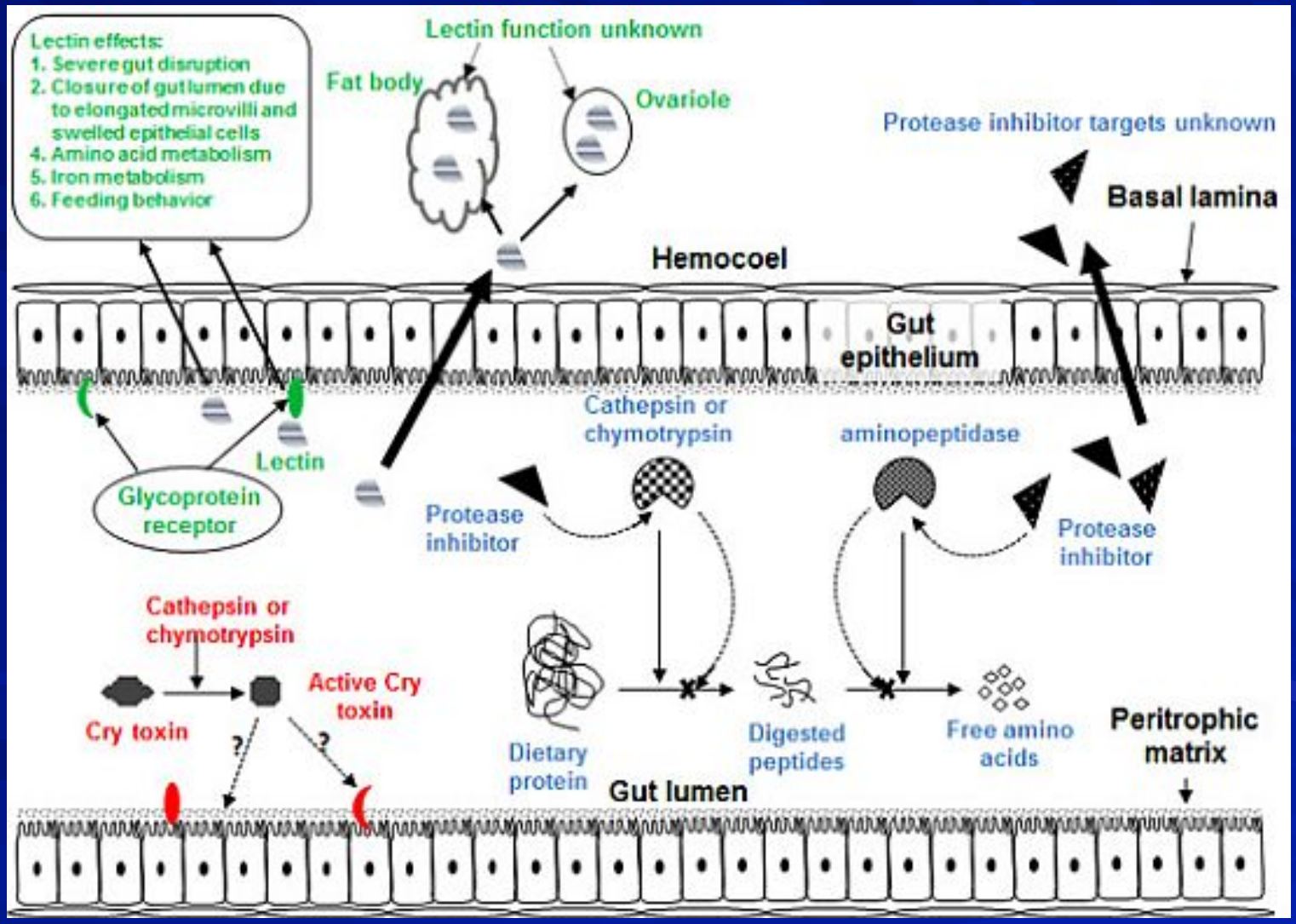
Insect Resistance

Herbicide Resistance

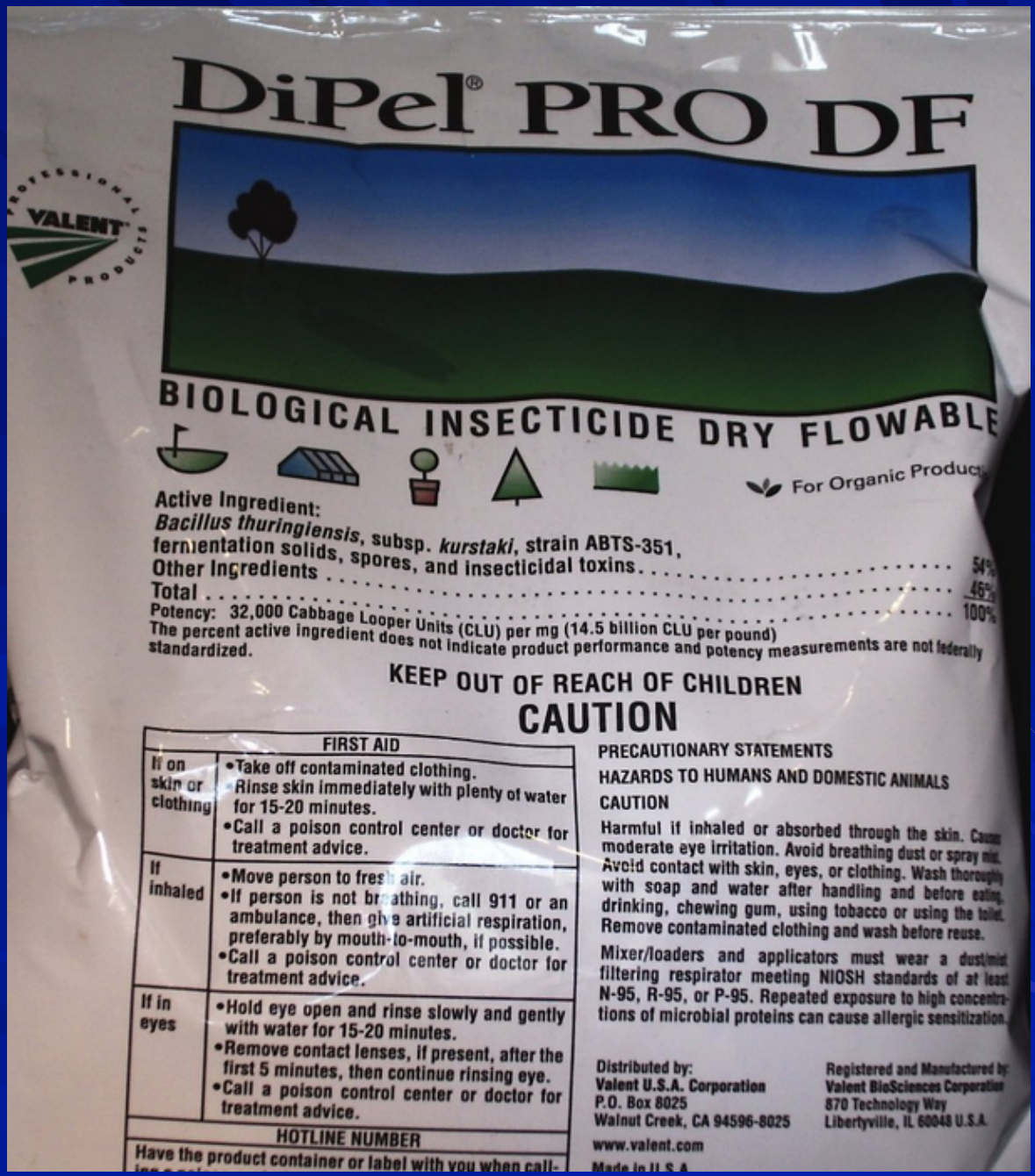
(how the traits work lecture online – (google “ UF biotechnology literacy day”)

GMO Crops Make Pesticides

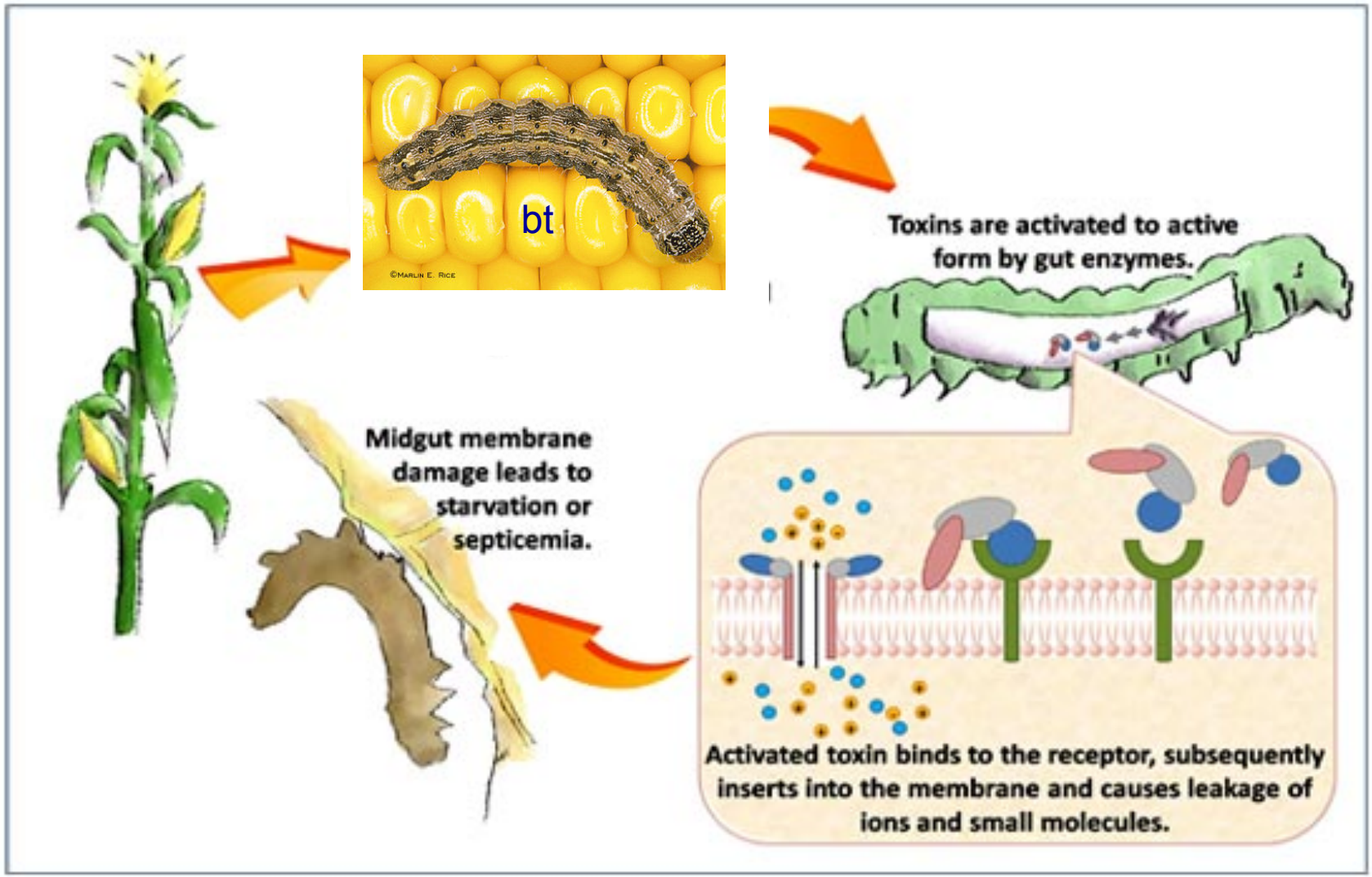
Bt is one of many natural anti-insect proteins



Bt is one of many natural anti-insect proteins



How Bt Works


bt
©Marlin E. Rice
Toxins are activated to active form by gut enzymes.
Midgut membrane damage leads to starvation or septicemia.
Activated toxin binds to the receptor, subsequently inserts into the membrane and causes leakage of ions and small molecules.

Advantages

Decrease in broad-spectrum insecticide use on corn and cotton

Lower fuel and labor costs for farmers

Solid dividends in the developing world

No effect on beneficials

Limitations

Need to plant refugia to slow resistance

Pockets of resistance are seen and require use of insecticides

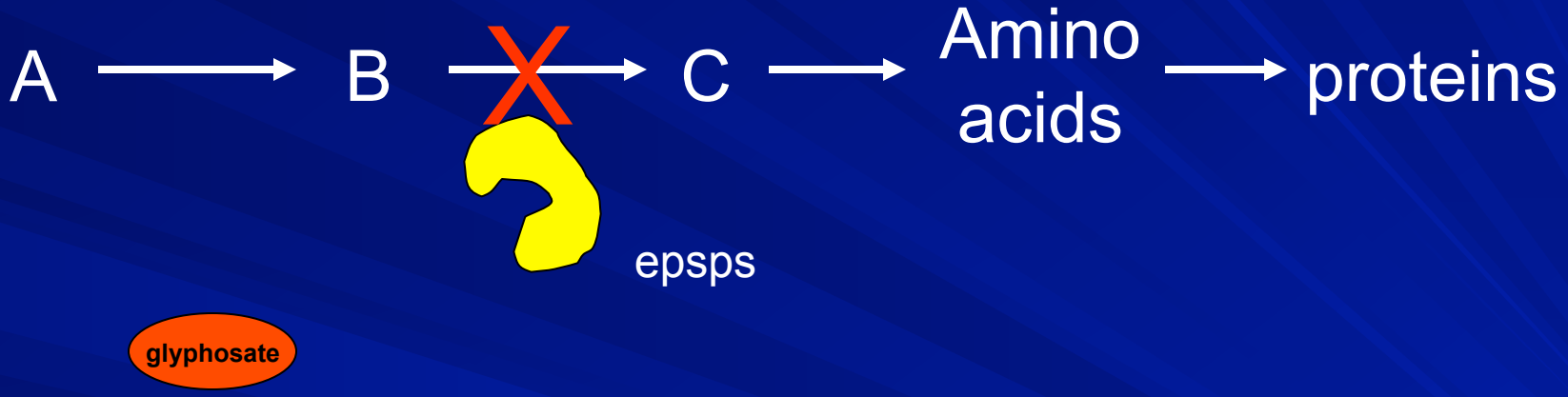
Requires careful scouting

Glyphosate-Resistant (Roundup Ready) Products

A gene is inserted that allows plants to survive in the presence of the herbicide. Farmers can spray to kill non-transgenic plants.

How Herbicide Resistance Works

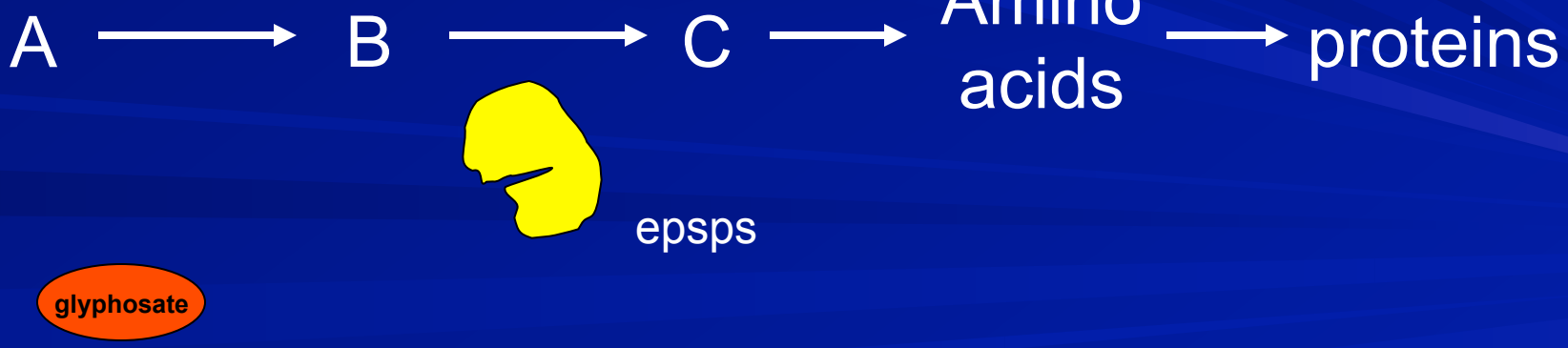
Plants



How Herbicide Resistance Works

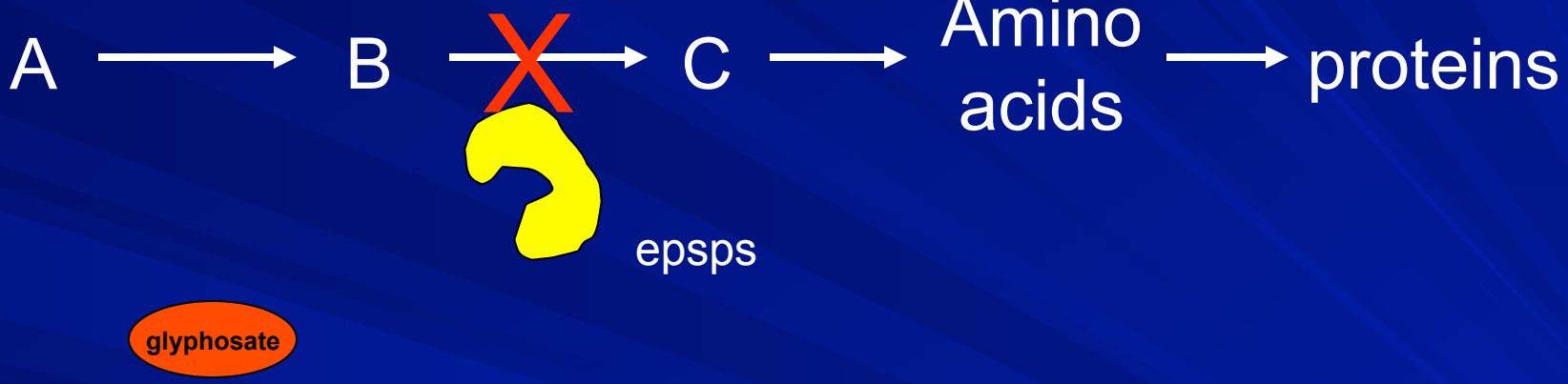
Plants

Bacteria

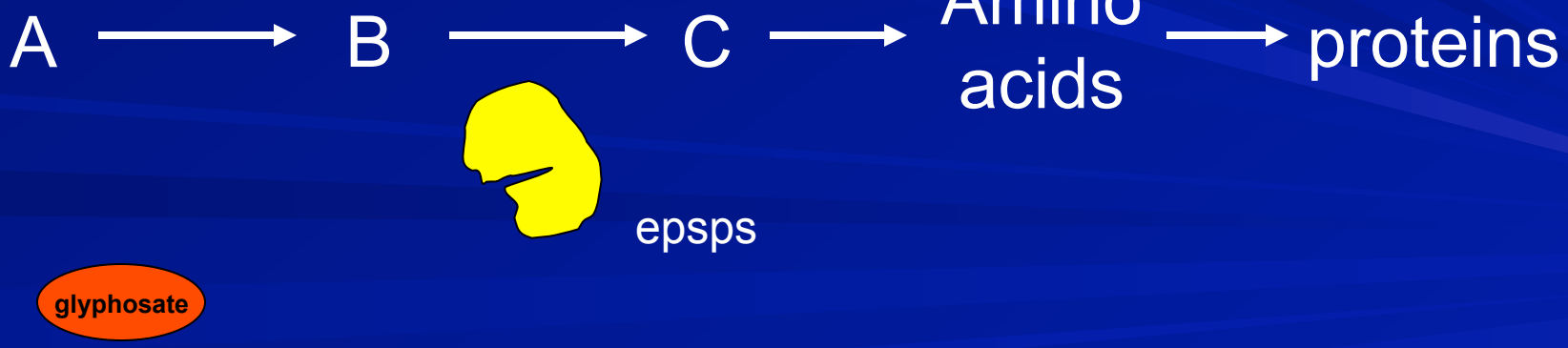


How Herbicide Resistance Works

Plants



Bacteria



How Herbicide Resistance Works

Plants

A → B → C → Amino acids → proteins

epsps

glyphosate

Resistance!

Advantages

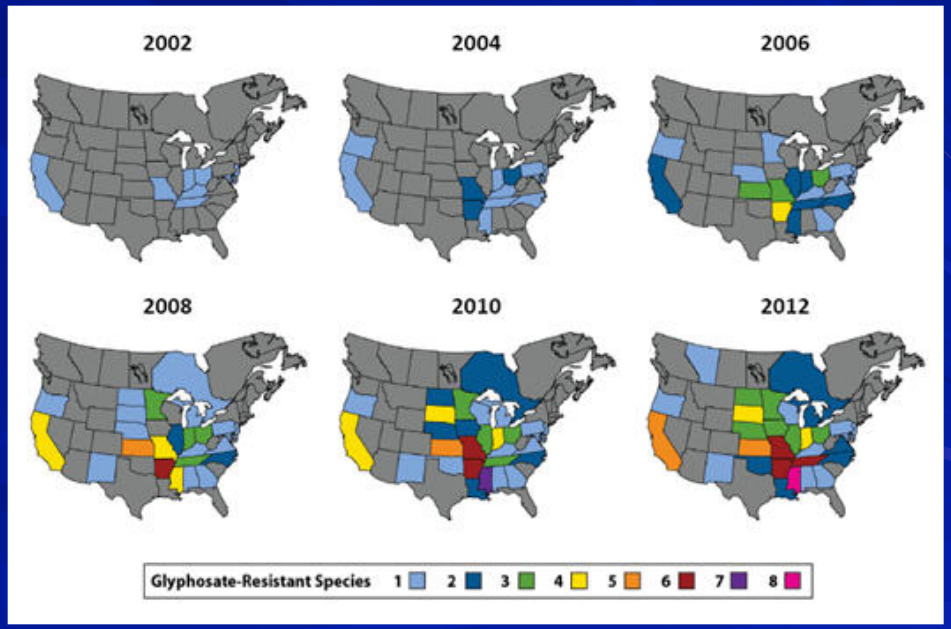
Switch to a low-toxicity herbicide, cheap and effective

Lower fuel and labor costs for farmers

Decreased tilling, saved topsoil

Limitations

Weeds can evolve resistance, requiring increased labor, lower yields, and new control strategies. New chemistries.

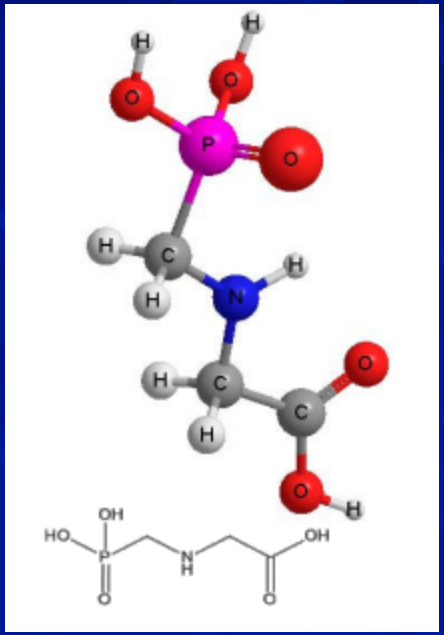


What is Glyphosate?

Non-selective herbicide. Kills all plants.

Pathway not present in animals

Acute toxicity is low (4320 -10,000 mg/kg)



TOXICITY CLASSIFICATION - GLYPHOSATE

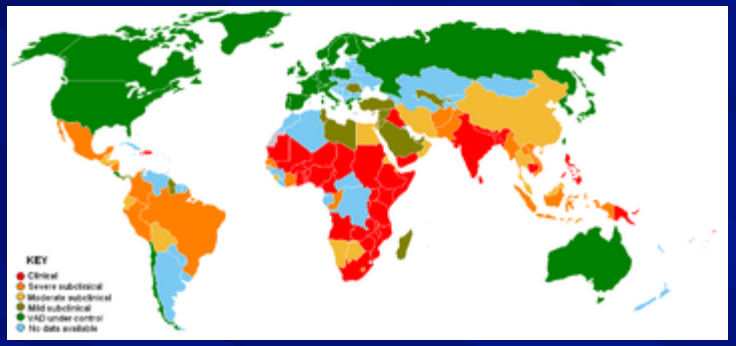
	High Toxicity	Moderate Toxicity	Low Toxicity	Very Low Toxicity
Acute Oral LD_{50}	Up to and including 50 mg/kg (≤ 50 mg/kg)	Greater than 50 through 500 mg/kg (> 50 – 500 mg/kg)	**Greater than 500 through 5000 mg/kg (> 500 – 5000 mg/kg)**	**Greater than 5000 mg/kg (> 5000 mg/kg)**
Inhalation LC_{50}	Up to and including 0.05 mg/L (≤ 0.05 mg/L) (aerosol)	Greater than 0.05 through 0.5 mg/L (>0.05 – 0.5 mg/L)	**Greater than 0.5 through 2.0 mg/L (> 0.5 – 2.0 mg/L)**	**Greater than 2.0 mg/L (> 2.0 mg/L) (dust)**
Dermal LD_{50}	Up to and including 200 mg/kg (≤ 200 mg/kg)	Greater than 200 through 2000 mg/kg (> 200 - 2000 mg/kg)	**Greater than 2000 through 5000 mg/kg (>2000 – 5000 mg/kg)**	Greater than 5000 mg/kg (> 5000 mg/kg)
Primary Eye Irritation	Corrosive (irreversible destruction of ocular tissue) or corneal involvement or irritation persisting for more than 21 days	Corneal involvement or other eye irritation clearing in 8 – 21 days	**Corneal involvement or other eye irritation clearing in 7 days or less**	**Minimal effects clearing in less than 24 hours**
Primary Skin Irritation	Corrosive (tissue destruction into the dermis and/or scarring)	Severe irritation at 72 hours (severe erythema or edema)	Moderate irritation at 72 hours (moderate erythema)	**Mild or slight irritation at 72 hours (no irritation or erythema)**

The highlighted boxes relfect the values in the "Acute Toxicity" section of this fact sheet. Modeled after the U.S. Environmental Protection Agency, Office of Pesticide Programs, Label Review Manual, Chapter 7: Precautionary Labeling. http://www.epa.gov/oppfead1/labeling/lrm/chap-07.pdf

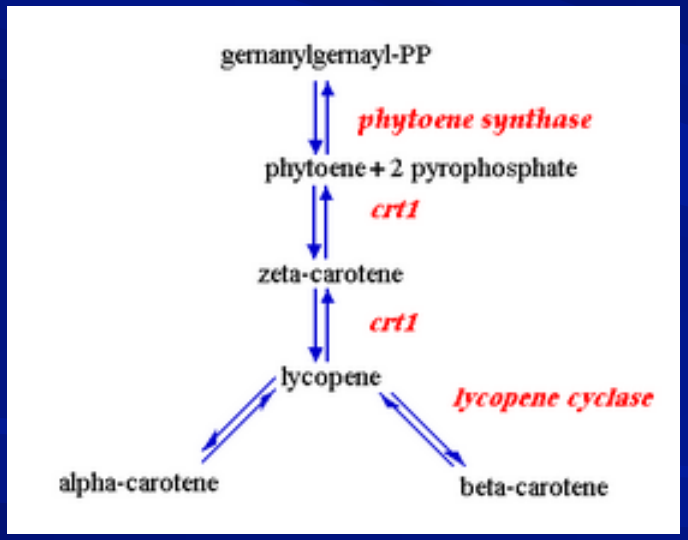
6. Win back emotional capital with lost opportunities

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

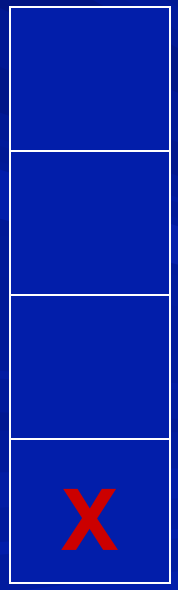
Golden Rice



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

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**

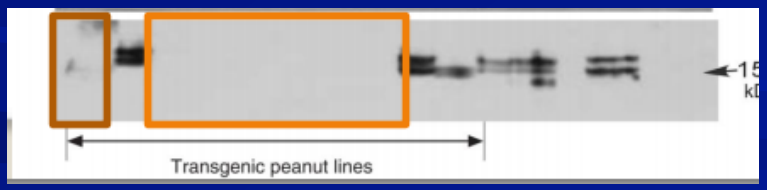
Allergy-Free Peanuts

Peanut – RNAi suppression Ara h2

	Farmers
X	Consumers
	Environment
	Needy

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 proteoltically 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



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%

Stopping Citrus Greening

Talking Biotech

Episode 009 (planned)

Spinach defensin

NPR1

Lytic peptides

Many show promise

Earliest deregulation is 2019

X	**Farmers**
X	**Consumers**
X	**Environment**
	Needy

GE chickens do not pass on Avian Influenza

Suppression of Avian Influenza Transmission in Genetically Modified Chickens

Jon Lyall,[1] Richard M. Irvine,[2] Adrian Sherman,[3] Trevelyan J. McKinley,[1] Alejandro Núñez,[2] Auriol Purdie,[3]* Linzy Outtrim,[2] Ian H. Brown,[2] Genevieve Rolleston-Smith,[3] Helen Sang,[3]† Laurence Tiley[1]†‡

Infection of chickens with avian influenza virus poses a global threat to both poultry production and human health that is not adequately controlled by vaccination or by biosecurity measures. A novel alternative strategy is to develop chickens that are genetically resistant to infection. We generated transgenic chickens expressing a short-hairpin RNA designed to function as a decoy that inhibits and blocks influenza virus polymerase and hence interferes with virus propagation. Susceptibility to primary challenge with highly pathogenic avian influenza virus and onward transmission dynamics were determined. Although the transgenic birds succumbed to the initial experimental challenge, onward transmission to both transgenic and nontransgenic birds was prevented.

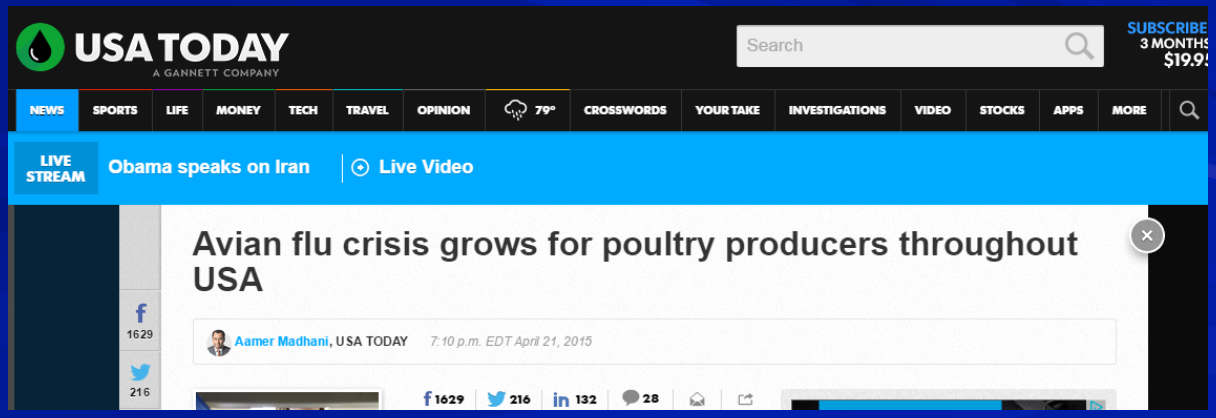
The diversity of avian influenza viruses (AIVs) and their propensity for interspecies transmission make them a global threat to animal and public health communities. Cross-species transmission of influenza viruses mediate host species that amplify and diversify virus populations, notably domestic chickens, ducks, and pigs (*1*). Although control of AIV infection in its wild aquatic bird reservoir is impractical, control of AIV in domesticated hosts is The diversity of viral antigenic sub-

Science 331:223-226. 2011 SCIENCE VOL 331 14 JANUARY 2011

X	Farmers
X	Consumers
X	Environment
X	Needy
X	Animal welfare

Talking Biotech

Episode 007



AquaBounty Salmon – attains market weight in less time.

Salmon may be farmed on inland pools, generating high protein food on fewer inputs.

GROWTH ENHANCEMENT IN TRANSGENIC ATLANTIC SALMON BY THE USE OF AN "ALL FISH" CHIMERIC GROWTH HORMONE GENE CONSTRUCT

Shao Jun Du, Zhiyuan Gong, Garth L. Fletcher[1], Margaret A. Shears[1], Madonna J. King[1], David R. Idler[1] and Choy L. Hew*

Research Institute, The Hospital for Sick Children and Departments of Clinical Biochemistry and Biochemistry, University of Toronto, Toronto, Canada M5G 1L5. [1]Ocean Sciences Centre, Memorial University of Newfoundland, St. John's, Newfoundland, Canada A1C 5S7. *Corresponding author.

We have developed an "all fish" growth hormone (GH) chimeric gene construct by using an antifreeze protein gene (AFP) promoter from ocean pout linked to a chinook salmon GH cDNA clone. After microinjection into fertilized, nonactivated Atlantic salmon eggs via the micropyle, transgenic Atlantic salmon were generated. The presence of the transgene was

X	Farmers
X	Consumers
X	Environment
X	Needy
X	Wild populations

Talking Biotech

Episode 008

Enviropig™ (Low-phosphorus manure)

RESEARCH ARTICLE

Nature Biotechnology 19, 741–745 . 2001

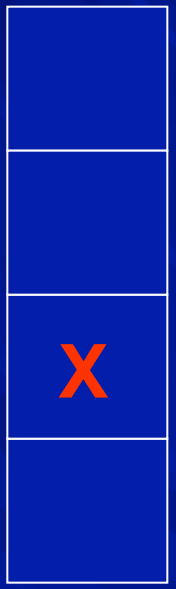
Pigs expressing salivary phytase produce low-phosphorus manure

Serguei P. Golovan[1,2], Roy G. Meidinger[2], Ayodele Ajakaiye[3], Michael Cottrill[1], Miles Z. Wiederkehr[4], David J. Barney[4], Claire Plante[5], John W. Pollard[5], Ming Z. Fan[3], M. Anthony Hayes[6], Jesper Laursen[7,8], J. Peter Hjorth[7], Roger R. Hacker[3], John P. Phillips[2,*], and Cecil W. Forsberg[1,*]

To address the problem of manure-based environmental pollution in the pork industry, we have developed the phytase transgenic pig. The saliva of these pigs contains the enzyme phytase, which allows the pigs to digest the phosphorus in phytate, the most abundant source of phosphorus in the pig diet. Without this enzyme, phytate phosphorus passes undigested into manure to become the single most important manure pollutant of pork production. We show here that salivary phytase provides essentially complete digestion of dietary phytate phosphorus, relieves the requirement for inorganic phosphate supplements, and reduces fecal phosphorus output by up to 75%. These pigs offer a unique biological approach to the management of phosphorus nutrition and environmental pollution in the pork industry.

"reduces fecal phosphorus output by up to 75%"

www.uoguelph.ca/enviropig



Farmers

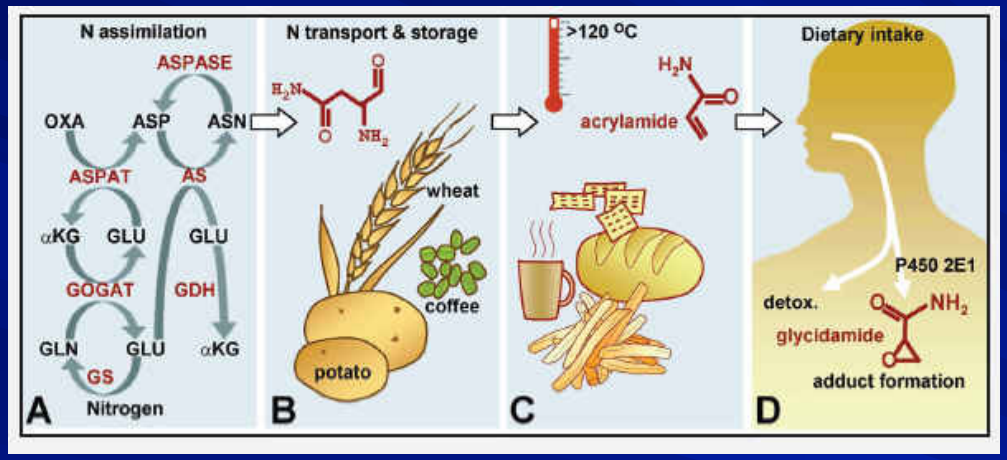
Consumers

Environment

Needy

Thanks Alison Van Eenennaam for the slide!

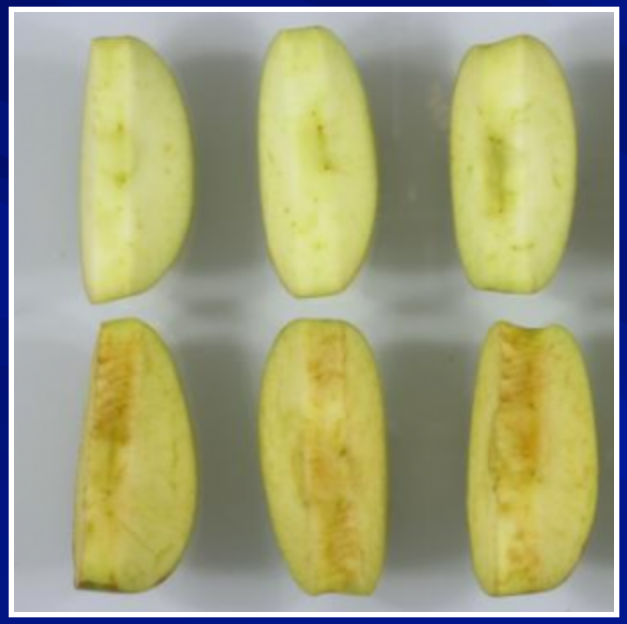
Low Acrylamide, non Browning Potatoes

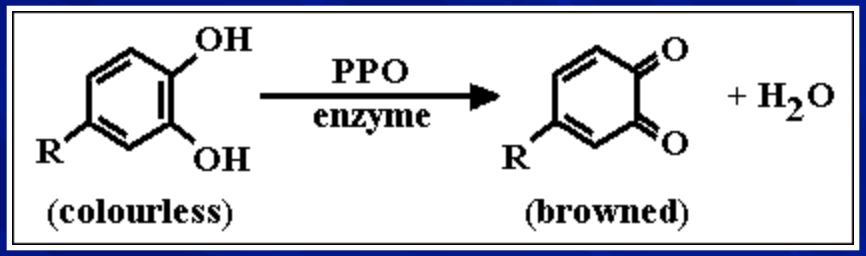


X	Farmers
X	Consumers
	Environment
	Needy

Non Browning Apples

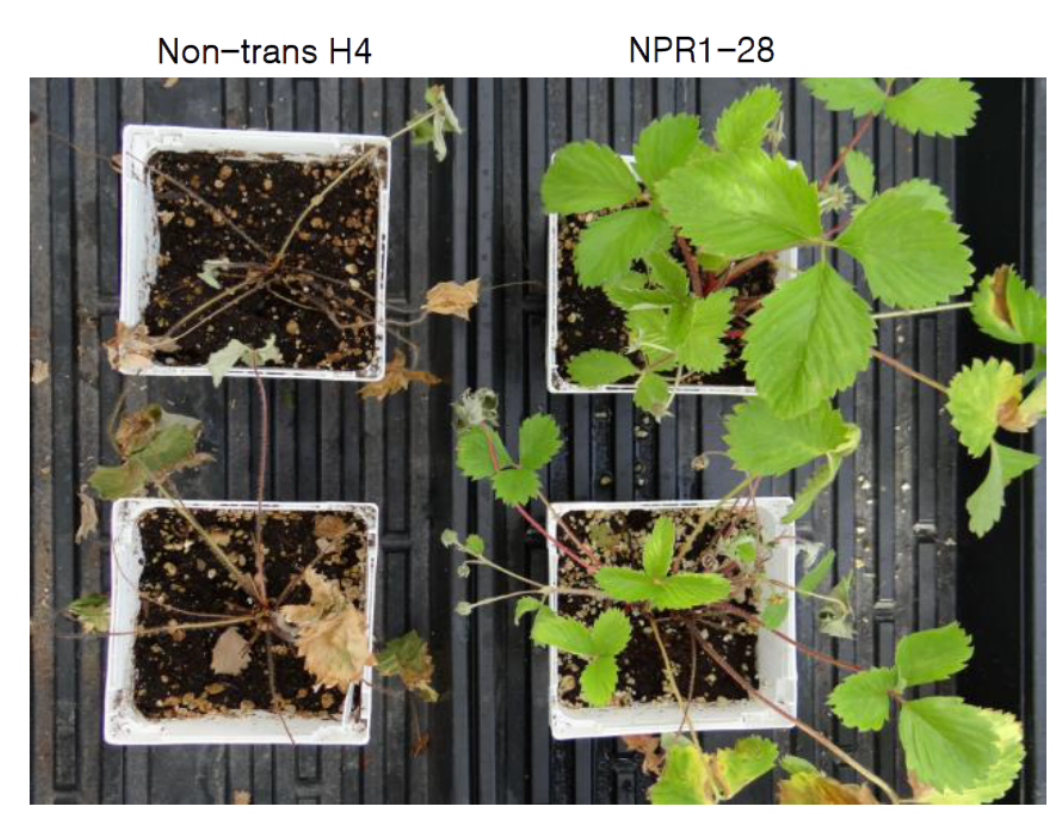
Silencing a gene that leads to discoloration





X	Farmers
X	Consumers
	Environment
	Needy
X	Small Business!

Fungicide-Free Strawberries?



X	Farmers
X	Consumers
X	Environment
	Needy

Silva et al., 2015

More Barriers: Avoid these Mistakes

Avoid “feed the world” rhetoric– Provide specifics.

Always discuss strengths and limitations

Don’t ever claim it is a single solution.

Don’t trash other production methods.

Never get backed into the “science no”

“Can you guarantee that these are absolutely safe?”

Grab your e-Real Estate
Talking to public audiences – Get Involved!

1. Obtain a dedicated Gmail account- use their real names.
2. Sign up for facebook, twitter, instagram, pintrest, etc.
3. Get a blog space on blogspot.com or wordpress.
4. Answer questions in comments sections of news articles.

CONTACT ME IF YOU WANT HELP, STARTING OR AMPLIFYING YOUR MESSAGE!

Farmers taking action.

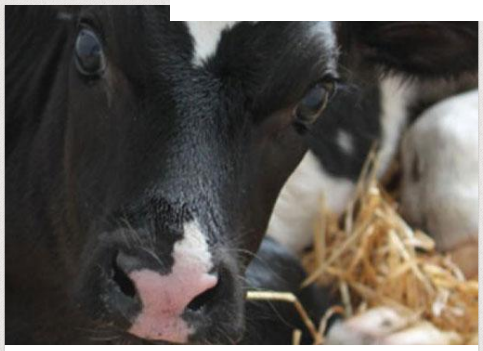
Brian Scott
www.thefarmerslife.com
@thefarmerslife

Jennie Schmidt
@FarmGirlJen

Sarah Schultz – Nurse Loves Farmer
@NurseLovesFarmr

Amanda
@farmdaughterusa

#farm365

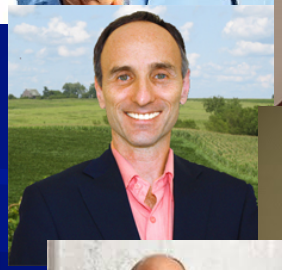


AMPLIFICATION

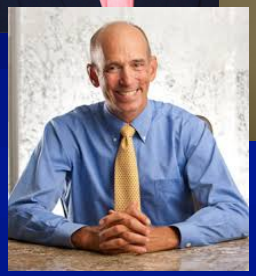
Who will talk to the concerned consumer?

Science

Truth



Reason



Facts

Here's how we fix it.

1. Understand your audience
2. Dispel the appeal to nature
3. Establish your shared values
4. Personalize your message, engage with honesty, transparency, and establish trust.
5. Know the core concepts
6. Emphasize missed opportunities

Last- Your eReal Estate- Go Get It.

Conclusions:

Humans have made plants and animals better for a long time.

We live in a time with the best food supply- safe and abundant.

A few vocal critics are dominating the public conversation.

This is technology does not belong to Big Ag- it belongs to all of us, and we can use it to do good things for people.

There are many good opportunities for crop and animal improvement that can benefit the farmer, the environment, the consumer and the needy.

Find your electronic real estate and start using it.

Thank you

kevinfolta@gmail.com
kfolta.blogspot.com
@kevinfolta

Talking Biotech

www.talkingbiotechpodcast.com

iTunes, Stitcher, Player FM

Dr. Norman Borlaug

You can't build world peace on empty stomachs and human misery.

"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
(my boss)

Follow FOIA developments using #Science14