

# What Are You Eating?

**Dr. Albert Kausch**



**Food: Big Agriculture,  
Nutrition, GMOs and Organic Crops**

# **Food:**

## **Nutrition, GMOs and Organic Crops**

### **Myth-Understood**



# The Informed Consumer Questions....

**Are there actual risks to our food supply?**

**What are the real issues???**

**Where is the evidence?**

**Labeling**

**Safety**

**Health**

**New Allergens**

**Gene Flow**

**The StarLink Story**

**The Monarch Butterfly Story**

**Antibiotic Resistant Bacteria**

**Resistance to Pesticides**

**Production of New Toxins**

**Concentration of toxic chemicals  
and heavy metals**

**Unknown risk and long term harm**



Although genetically modified organisms (GMOs), primarily plants are used around the world, in food products, as feed and for biofuels, their use has become a contentious issue for some consumers.

One issue around the controversy involves proposals regarding the mandatory labeling of food containing ingredients made from GMO crops.

Several U.S. states are considering legislation to mandate such labels.



Supporters of bills to legislate mandatory GMO labeling cite the ‘right to know’ what is in their food. Opponents think that labeling is unnecessary and will only serve to confuse the consumer and raise the costs of food.

Further implications extend beyond borders for the consequences of world agriculture concerning this technology

Hundreds of independent studies have determined that foods made with GMO ingredients are safe and substantially equivalent to their non-GMO counterparts, whether those are grown by conventional or organic agriculture.

In addition, hundreds of studies have shown the benefits of these crops to the consumer, the farmer, sustainable agriculture, agricultural economics and world food security.

Yet the controversy persists...



# A recent article by the Council for Agricultural Science and Technology (CAST) examined key aspects

- Public opinion, polls, and methods used
- Consumer choice and interpretations that support both sides in this respect
- Right-to-know issues—and the complications inherent with the right to know “what” and “at what cost”
- Food safety and testing—and the lack of any evidence that GE foods have harmful effects

Many state labeling initiatives

CAST Issue Paper Number 54 April 2014

**The Potential Impacts of Mandatory Labeling for Genetically Engineered Food in the United States**



# The CAST Concludes that:

1. There is no science-based reason to single out GMO foods and feeds for mandatory process-based labeling.
2. Mandatory labeling based on process abandons the traditional U.S. practice of providing for consumer food preferences through voluntary product differentiation and labeling.
3. Market-driven voluntary labeling measures are currently providing consumers with non-GMO choices.

CAST Issue Paper Number 54 April 2014

**The Potential Impacts of Mandatory Labeling for Genetically Engineered Food  
in the United States**





# The CAST Concludes that:

4. Mandatory labeling could have negative implications for First Amendment rights and trade issues.
5. Mandatory labeling will increase food costs.

CAST Issue Paper Number 54 April 2014

**The Potential Impacts of Mandatory Labeling for Genetically Engineered Food  
in the United States**

# Genetically Modified Organisms and Food

## Issues and Concerns about GMOs in Food

Given the success of  
Agricultural Biotechnology



What is behind the  
turmoil?



**Uncertainty about safety**  
**Regulatory issues**  
**Right of choice**  
**Environmental concerns**  
**Globalization**  
**Food culture**  
**Big science, big companies**  
**“Crossing the line”**  
**Distrust of Science**

# **GMOs in Food**

## **FAQ: Issues and Concerns**

**GMOs and Nutrition**

**Uncertainty about safety**

**Regulatory issues**

**Right of choice: Mandatory labeling**

**Environmental concerns**

**Globalization**

**Big science, big companies**

**Distrust of Science**

**Food culture**

**“Crossing the line”, Playing God**

# GMOs and Organics in

## Myths

**GMOs Are Unhealthy**

**GMOs Are Not Safe**

**GMOs Are Not Natural**

**Monsanto Conspirers To  
Hide Data about GMOs  
From the Public**

**GMOs Increase Herbicide Use**

**GMOs Increase Pesticide Use**

**Genetic Engineering Creates  
Dangerous Side Effects**

## Food

## Questions

**Why Do People Think That  
GMOs Are Unhealthy?**

**Why Do People think GMOs  
Are Not Safe?**

**Has Adequate Independent testing on  
GMOs been done?**

**Is this information available to the  
Public?**

**Why Do People Think That  
GMOs Increase Herbicide and  
Pesticide Use?**

**Does Genetic Engineering  
Create Dangerous Side Effects?**



# *More* **GMOs and Organics in** *More* **Myths Food Questions**

**GMOs Harm the Environment**

**Do GMOs Harm the Environment?** How do GMOs Harm the Environment?

**GMOs Need Mandatory Labeling**

**What is the best method to support American Consumers “Right to Know”?**

**GMOs Do Not Increase Yields And Work Against Feeding a Hungry World**

**Are GMOs a larger threat than starvation?**

# **We just want good food**

*A Balance of Large Scale Agriculture, Nutrition  
and Food Safety*

# Nutrition Calories

*Calories In = Calories Out*

*Really?*

# *Calories In = Calories Out*

## *Dietary Intake*

## *Metabolism*

Activity level	Male			Female		
	Sedentary	Moderately	Active	Sedentary	Moderately	Active
Age (years)						
19–20	2,600	2,800	3,000	2,000	2,200	2,400
21–25	2,400	2,800	3,000	2,000	2,200	2,400
26–30	2,400	2,600	3,000	1,800	2,000	2,400
31–35	2,400	2,600	3,000	1,800	2,000	2,200
36–40	2,400	2,600	2,800	1,800	2,000	2,200
41–45	2,200	2,600	2,800	1,800	2,000	2,200
46–50	2,200	2,400	2,800	1,800	2,000	2,200
51–55	2,200	2,400	2,800	1,600	1,800	2,200
56–60	2,200	2,400	2,600	1,600	1,800	2,200
61–65	2,000	2,400	2,600	1,600	1,800	2,000
66–70	2,000	2,200	2,600	1,600	1,800	2,000
71–75	2,000	2,200	2,600	1,600	1,800	2,000
76+	2,000	2,200	2,400	1,600	1,800	2,000

The reference man is 5 feet 10 inches tall and weighs 154 pounds. The reference woman is 5 feet 4 inches tall and weighs 126 pounds.



a. Based on Estimated Energy Requirements (EER) equations, using reference heights (average) and reference weights (healthy) for each age-gender group. For adults, the reference man is 5 feet 10 inches tall and weighs 154 pounds. The reference woman is 5 feet 4 inches tall and weighs 126 pounds. EER equations are from the Institute of Medicine. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids. Washington (DC): The National Academies Press; 2002.

b. Sedentary means a lifestyle that includes only the light physical activity associated with typical day-to-day life. Moderately active means a lifestyle that includes physical activity equivalent to walking about 1.5 to 3 miles per day at 3 to 4 miles per hour, in addition to the light physical activity associated with typical day-to-day life. Active means a lifestyle that includes physical activity equivalent to walking more than 3 miles per day at 3 to 4 miles per hour, in addition to the light physical activity associated with typical day-to-day life.

*Calories In = Calories Out*

*Dietary Intake                      Metabolism*

Activity level Age (years)	Male			Female		
	Sedentary	Moderately	Active	Sedentary	Moderately	Active
19-20	2,600	2,800	3,000	2,000	2,200	2,400
21-25	2,400	2,800	3,000	2,000	2,200	2,400
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31-35	2,400	2,600	3,000	1,800	2,000	2,200
36-40	2,400	2,600	2,800	1,800	2,000	2,200
41-45	2,200	2,600	2,800	1,800	2,000	2,200
46-50	2,200	2,400	2,800	1,800	2,000	2,200
51-55	2,200	2,400	2,800	1,600	1,800	2,200
56-60	2,200	2,400	2,600	1,600	1,800	2,200
61-65	2,000	2,400	2,600	1,600	1,800	2,000
66-70	2,000	2,200	2,600	1,600	1,800	2,000
71-75	2,000	2,200	2,600	1,600	1,800	2,000
76+	2,000	2,200	2,400	1,600	1,800	2,000

# *Calories In = Calories Out*

## *Dietary Intake*

**2,400-2600 calories  
per day**

*But Wait...*

**What should these  
calories comprise?**

## *Metabolism*

**Moderately activity means a  
lifestyle that includes physical  
activity equivalent to walking  
about 1.5 to 3 miles per day at 3  
to 4 miles per hour, in addition to  
light physical activity associated  
with typical day-to-day life.**

*And Wait...*

**What should this  
exercise comprise?**

# *Calories In = Calories Out*

## *Dietary Intake*

2,400-2600 calories per day

## *Metabolism*

**What should we burn?**

2,400-2600 calories per day

**Does it matter what  
we eat?**

**Does it matter how  
we exercise?**

# *Calories In = Calories Out*

## *Dietary Intake*

**What should we eat?**

2,400-2600 calories per day

USDA Dietary Reference Intakes  
for Energy, Carbohydrate, Fiber,  
Fat, Fatty Acids, Cholesterol,  
Protein, and Amino Acids.

- A balanced diet-vegetables, fruit,  
meat, starch, water

Vegan    Carnivore    Omnivore    Frugivore

Paleo    Atkins    South Beach    Low Fat

## *Metabolism*

**What should we burn?**

2,400-2600 calories per day

### **Exercise**

- Walking 3-4 miles per day at 3  
to 4 miles per hour
- Swimming 30 laps
- Resistance training 1 hour
- Yoga 1 hour
- Pilates 1 hour
- 1 hour African Dance
- 1 hour Aerobics

*So does it matter? All calories are not created equal...and either is all exercise*

# *Calories In = Calories Out*

## *Dietary Intake*

2,400-2600 calories per day

**Does it matter what  
we eat?**

**The Beer Diet**

**The Jelly Bean Diet**

**The Jelly Bean Diet**  
2,000 calories per day

## *Metabolism*

**What should we burn?**

**Does it matter how  
We exercise?**

**The Couch Potato Training Regime**

**The Soap Opera Exercise Video**

**Michael Phelps Daily Workout**  
12,000 calories per day



*‘Humans are the only animal  
who chews the ice in their drink’*

*‘Humans are the only animal who  
doesn’t know how to feed themselves’*

# **We eat Food every Day**

**A sensitivity about our food- Food culture**

## **Ethnic, Cultural and Religious Concerns**

- Italian Food                      Macrobiotic**
- Chinese Food                     Vegetarian**
- Japanese Food                  Flexitarian**
- German Food                     Frugitarian**
- Irish Food                         Omnivore**
- American Food                 Atkins, South Beach....**

**Religious concerns**

**“Crossing the line” playing God with genes**

**Dietary restrictions crossed**

# Dr. Kausch's Nutritional Advice

With influence from Michael Pollan

- Eat good food
- Not too much
- Mostly plants

*And*

*Move as much as possible!*

*Exercise is Key to Good Health and Nutrition*

# **GMOs and Food Issues and Concerns**

**The public remains undecided and relatively uninformed resulting in a compounding controversy**

# The Organic Food Debate

# What is Organic?

No Synthetic Pesticides

No Synthetic Fertilizers

No GMOs

# Is Organic Food Better for You?



# Is Organic Food Better for the Environment?

# Is Organic Food Safer?

# Are Organic Foods Really Better For You?

What Consumers really want is good, clean, safe food  
Is that too much to ask?

*Organic Foods promise safety from pesticides*

*No synthetic fertilizer*

*No GMO*

*Natural Foods*



# Is Organic more nutritious?

- **Sixty-eight percent of the respondents in a recent US poll said a product labeled “USDA Certified Organic” would indicate the food was safer than non-organic foods**
- **Sixty-seven percent believe the label would indicate food of higher quality than non-organic foods**
- **Sixty-two percent believe the label would mean the food is more healthful for consumers than non-organic food**

4 September 2012, Vol 157, No. 5

## **Are Organic Foods Safer or Healthier Than Conventional Alternatives?: A Systematic Review**

Crystal Smith-Spangler, MD, MS; Margaret L. Brandeau, PhD; Grace E. Hunter, BA; J. Clay Bavinger, BA; Maren Pearson, BS; Paul J. Eschbach; Vandana Sundaram, MPH; Hau Liu, MD, MS, MBA, MPH; Patricia Schirmer, MD; Christopher Stave, MLS; Ingram Olkin, PhD; and Dena M. Bravata, MD, MS

**Conclusion:** The published literature lacks strong evidence that organic foods are significantly more nutritious than conventional foods

# Are Organic Foods Safer or Healthier Than Conventional

## Alternatives?: A Systematic Review

Crystal Smith-Spangler, MD, MS; Margaret L. Brandeau, PhD; Grace E. Hunter, BA; J. Clay Bavinger, BA; Maren Pearson, BS; Paul J. Eschbach; Vandana Sundaram, MPH; Hau Liu, MD, MS, MBA, MPH; Patricia Schirmer, MD; Christopher Stave, MLS; Ingram Olkin, PhD; and Dena M. Bravata, MD, MS

**Data Synthesis:** 17 studies in humans and 223 studies of nutrient and contaminant levels in foods met inclusion criteria. Only 3 of the human studies examined clinical outcomes, finding no significant differences between populations by food type for allergic outcomes (eczema, wheeze, atopic sensitization) or symptomatic *Campylobacter* infection. Two studies reported significantly lower urinary pesticide levels among children consuming organic versus conventional diets, but studies of biomarker and nutrient levels in serum, urine, breast milk, and semen in adults did not identify clinically meaningful differences. All estimates of differences in nutrient and contaminant levels in foods were highly heterogeneous except for the estimate for phosphorus; phosphorus levels were significantly higher than in conventional produce, although this difference is not clinically significant. The risk for contamination with detectable pesticide residues was lower among organic than conventional produce (risk difference, 30% [CI, -37% to -23%]), but differences in risk for exceeding maximum allowed limits were small. *Escherichia coli* contamination risk did not differ between organic and conventional produce. Bacterial contamination of retail chicken and pork was common but unrelated to farming method. However, the risk for isolating bacteria resistant to 3 or more antibiotics was higher in conventional than in organic chicken and pork (risk difference, 33% [CI, 21% to 45%]).

**Limitation:** Studies were heterogeneous and limited in number, and publication bias may be present

**Conclusion:** The published literature lacks strong evidence that organic foods are significantly more nutritious than conventional foods. Consumption of organic foods may reduce exposure to pesticide residues and antibiotic-resistant bacteria

# Are organic foods more nutritious?



**The head of the U.S. Organic Trade Association recently had to admit organic food was no more nutritious than any other food and that organic food standards had nothing to do with food safety**



# Is Organic Food Better for the Environment?

# Is the Organic solution viable for sustainable world agriculture?



**Organic Advocates Argue: Wiser Land Use.  
Less Pesticides. More Biodiversity.**

**Sustainable Agriculturists Argue....**

# Is the Organic solution viable for sustainable world agriculture?



**Critics argue:**

**Feeding Humanity From Organic Fields  
Would Mean Cropping Twice As Much  
Land As We Currently Plant**

# Is Organic Food Safer?

# Organic Food

- **Has sickened thousands**
- **Has killed hundreds**
- **E. coli Spinach (EarthBound Farms CA 2006)**
- **Salmonella Green Onions**
- **Listeria Antelopes**
  
- **Is this a Food Safety issue only?**  
**Or an Organic food issue?**



# Organic vs. GMO



- **Wild-type corn variety with secondary fungal infection**

- **Bt corn resistant to corn borer damage, resulting in less secondary fungal infections**

**.Mycotoxins**

# What the public wants is safe food that is good



So while the organic standards may attempt to ensure freedom from pesticide residues, the freedom of organic foods from vermin, mycotoxins and other contamination may be less certain

## **Mycotoxins**

Organic farmers are more likely to let their crops suffer rodent and insect damage, which leads to more fungal infections and more natural toxins in the food



*Question*

# **Organic Food-**

## **Is The Emperor Wearing Any Clothes?**

**Are organic foods all they're cracked up to be?**

We've been curious about how Americans view their food options. Concerns about toxins in produce have led people to buy organic.

**Organic does not mean Safe**

Recent outbreaks of foodborne illness linked to organically grown produce

- E. coli spinach
- Listeria cantaloupe
- Salmonella green onions
- Sprouts in Europe

**Organic food has sickened hundreds and resulted in death  
Perhaps there needs to be a warning label?**

- **Perhaps New Organic Food Standards Could Use Warning Labels**
- **Organic Products Are Not Necessarily Tastier, Healthier Or Pesticide-Free**

*Fact*

# Organic Foods Have Broad Appeal But Costs Temper Demand



# Price Comparison Conventional vs. Organic

McQuade's Marketplace		McQuade's Marketplace	
14 Clara Drive Mystic, CT 06355 (860) 536-2054		14 Clara Drive Mystic, CT 06355 (860) 536-2054	
A RECEIPT IS REQUIRED FOR ALL RETURNS!		A RECEIPT IS REQUIRED FOR ALL RETURNS!	
	BACHMAN MULTIGRAIN 3.99 F		DR DETKER VAN CKE 3.89 F
	WISE WHITE CHED:PO 3.29 F		MUIR FIRE ROASTED 3.99 F
	KELLOGS CORN FLAKE 4.19 F		SAGE VALLEY POPCOR 1.29 F
2 @ 1.29			LUNDBERG LONG BROW 5.09 F
	B. V. BROWN RICE 2.58 F		UTZ ORGANIC W. G. 3.49 F
	BARILLA SPAGHETTI 1.49 F		NATURE PATH OPT PO 3.99 F
	BC GOLD CAKE MIX 2.09 F		DE BOLES LINGUINE 3.29 F
	PEET'S COFFEE GROU 11.99 F		DEBOLS SPAG 2.69 F
	MOTT APPLESAUCE 6 2.59 F		JIM FRENCH ROAST 13.79 F
	A. B. ROMAINE HEARTS 2.99 F		UTZ WHITE TORTILLA 3.49 F
	BACHMAN NUTZELS 3.29 F		SANTACRUZ APPLESAU 4.39 F
	PREGO MUSHROOM SAU 2.69 F		ORGANIC MUSHROOMS 2.49 F
	KRAFT SPIRAL MAC&C 1.59 F		N. P. CORN FLAKES C 8.59 F
	B. V. INSTANT OATS 2.49 F		G. H. F. ORGANIC POPC 1.99 F
	GIORGIO MUSHROOMS 1.89 F		E. B. SNACK RAISINS 3.99 F
	BABY PEELED CARROT 1.69 F		MG TOM KETCHUP 3.49 F
2 @ 1.69			KNUDSEN APPLE JUIC 3.49 F
	CALIFORNIA AVOCADO 3.38 F		B. T. N. WHITE CHEDDA 2.59 F
1.43 lb @ 1.69 /lb			AMYS MUSHROOM SOUP 3.29 F
WT HOT HOUSE TOMATOES 2.42 F			AMYS CREAMY TOMATO 2.79 F
1.46 lb @ 1.69 /lb			F. C. RAISIN BRAN 3.69 F
WT DELICIOUS SMALL GO 2.47 F			MUIR GLEN SAUSA GR 4.09 F
0.60 lb @ 1.79 /lb			E. B. F. ROMAINE HEAR 3.99 F
WT BRIGHT LIGHTS CHAR 1.07 F			AM P&B CREAMY N.S. 5.69 F
0.96 lb @ 1.69 /lb		1.17 lb @ 3.99 /lb	
WT BROCCOLI CROWNS 1.62 F		WT ORG BEEFSTK TOM 4.67 F	
1.46 lb @ 1.49 /lb			ORGANIC GRAPE TOMS 2.49 F
WT LARGE RED DELICIOUS 2.18 F			E. F. PEELED CARROT 1.69 F
1.99 lb @ 0.69 /lb			EB HALF & HALF LEAF 3.99 F
WT SWEET GOLDEN BANAN 1.37 F		2 @ 1.99	
	ATTITUDE BABY ROMA 2.99 F		AVACADO ORGANIC 3.98 F
	F. L. MEDIUM SALSA 3.29 F		ORGANIC RED LEAF 2.99 F
	CAMPBELL MUSHROOM 1.29 F		ORGANIC LEEKS 5.99 F
	CAMP H. R. TOMATO SO 1.69 F		ORGANIC RED CHARD 3.49 F
	POST RAISIN BRAN 3.99 F	1.98 lb @ 0.99 /lb	
	RED LEAF LETTUCE 1.69 F	WT ORGANIC BANANAS 1.96 F	
	GRAPE TOMATOES 1.99 F	1.47 lb @ 1.29 /lb	
	SKIPPY R/F PB 2.79 F	WT ORGANIC GARNET YAM 1.90 F	
	CELERY 1.69 F	1.33 lb @ 1.99 /lb	
	LEEKs 3.99 F	WT RED DELICIOUS APPL 2.65 F	
	SUNMAID RAISINS 6P 2.49 F		ORGANIC BROCCOLI 4.29 F
	MOTT APPLE JUICE 2.09 F		ORG. CAULIFLOWER 3.49 F
	HUNTS KETCHUP 24OZ 1.89 F		ORGANIC CELERY 2.49 F
1.12 lb @ 0.89 /lb		1.44 lb @ 2.49 /lb	
WT YAMS 1.00 F		WT ORG. GOLDEN APPLE 3.59 F	
TAX 0.00		TAX 0.00	
**** BALANCE 96.22		**** BALANCE 149.22	
*****		*****	
Visa Card - SUTPEN		Visa Card - SUTPEN	



# Price Comparison Conventional vs. Organic



SUNMAID RAISINS 6P 2.49 F  
 MOTT APPLE JUICE 2.09 F  
 HUNTS KETCHUP 24OZ 1.89 F  
 1.12 lb @ 0.89 /lb  
 WT YAMS 1.00 F  
 TAX 0.00  
 \*\*\*\* BALANCE 96.22

ORGANIC BROCCOLI 4.29 F  
 ORG. CAULIFLOWER 3.49 F  
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 POST RAISIN BRAN 3.99 F  
 RED LEAF LETTUCE 1.69 F  
 GRAPE TOMATOES 1.99 F  
 SKIPPY R/F PB 2.79 F  
 CELERY 1.69 F  
 LEEKS 3.99 F  
 SUNMAID RAISINS 6P 2.49 F  
 MOTT APPLE JUICE 2.09 F  
 HUNTS KETCHUP 24OZ 1.89 F  
 1.12 lb @ 0.89 /lb  
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ORGANIC BRANDED TUNA 4.49 F  
 E.F. PEELED CARROT 1.69 F  
 EB HALF & HALF LEA 3.99 F  
 2 @ 1.99  
 AVACADO ORGANIC 3.98 F  
 ORGANIC RED LEAF 2.99 F  
 ORGANIC LEEKS 5.99 F  
 ORGANIC RED CHARD 3.49 F  
 1.98 lb @ 0.99 /lb  
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## Why is Organic Food So Expensive?



Genetically Modified Organisms (GMOs):  
The Consumer's **Right** to Know

# Genetic Engineering



WHOLE  
FOODS  
MARKET®

Responds

May, 2000

“Our goal of no-GMO ingredients in our Whole Foods market brand and 365 products is focused on accessing ingredients derived from non-genetically modified seeds. Unfortunately, absolute “GMO-free” guarantees cannot be made on any manufacturer’s product. Not only is it impossible to test every container of product, but currently there is no system in the United States to guard against drift from farmers using GMO seed that could potentially contaminate non-GMO crops.”



# **GMOs in Food**

## **FAQ: Issues and Concerns**

- **Uncertainty about safety**

**Regulatory issues**

**Right of choice**

**Environmental concerns**

**Globalization**

**Big science, big companies**

**Distrust of Science**

**Food culture**

**“Crossing the line”**

# **Safety Issues of GM Foods**

- (i) Genetic modification process**
- (ii) Safety of new protein**
- (iii) Occurrence and implications of unintended affects**
- (iv) Role of new food in diet**
- (v) Allegenicity of new proteins**
- (vi) Influence of food processing**

*Myth*

# **GMOs Are Unhealthy**

**•Every independent scientific body that has ever evaluated the safety of biotech crops has found them to be safe for humans to eat.**

**A 2004 report from the National Academy of Sciences (NAS) concluded** “no adverse health effects attributed to genetic engineering have been documented in the human population.”

**In 2003 the International Council for Science, representing 111 national academies of science and 29 scientific unions, found** “no evidence of any ill effects from the consumption of foods containing genetically modified ingredients.”

**The World Health Organization (WHO) flatly states,** “No effects on human health have been shown as a result of the consumption of such foods by the general population in the countries where they have been approved.”

*Myth*

# Are GMOs Unhealthy?

**In 2010, a European Commission review of 50 studies on the safety of biotech crops found** “no scientific evidence associating GMOs with higher risks for the environment or for food and feed safety than conventional plants and organisms.”

**The American Medical Association endorsed a report on the labeling of bioengineered foods from its Council on Science and Public Health concluding,** “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.”

*Question*

# **Why Then Do People Think That GMOs Are Unhealthy?**

**There is no shortage of bogus studies and internet rhetoric suggesting that biotech crops are not safe.**

**Examples:**

- Russian researcher Irina Ermakova’s claim, (unpublished in any peer-reviewed scientific journal), that eating biotech soybeans turned mouse testicles blue.**
- French researcher Gilles-Eric Seralini reported that rats fed pesticide resistant corn died of mammary tumors and liver diseases.** Independent scientific review of Seralini’s work by groups, such as the **European Society of Toxicologic Pathology** and the **French Society of Toxicologic Pathology**, found it essentially to be meretriciously unpublishable and flawed. Six French academies of science issued a statement declaring that the journal should never have published such a low-quality study and excoriating Seralini for orchestrating a media campaign in advance of publication. **The European Food Safety Agency’s** review of the Seralini study “found [it] to be inadequately designed, analyzed and reported.”

*However, the real-world consequences: since Seralini’s article was apparently cited when Kenya made the decision to ban the importation of foods made with biotech crops.*

# The Controversies and Concerns In Ag Biotech are Multi-faceted



**Agbiotech**



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# Genetically Engineered Food: Promises & Perils

By Karen Charman Illustrations by Dave Channon



# **Rely On Credible Primary Resources**

- **Peer reviewed scientific articles**
- **Evidenced based science and practice**

# *Foods*

*from Genetically Modified Crops*

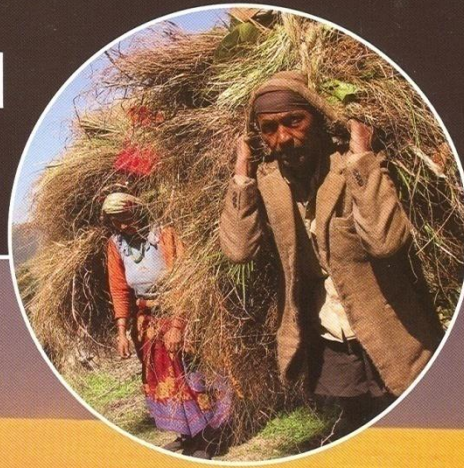


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# Agricultural Ethics in a Changing World

Edited by Maarten J. Chrispeels

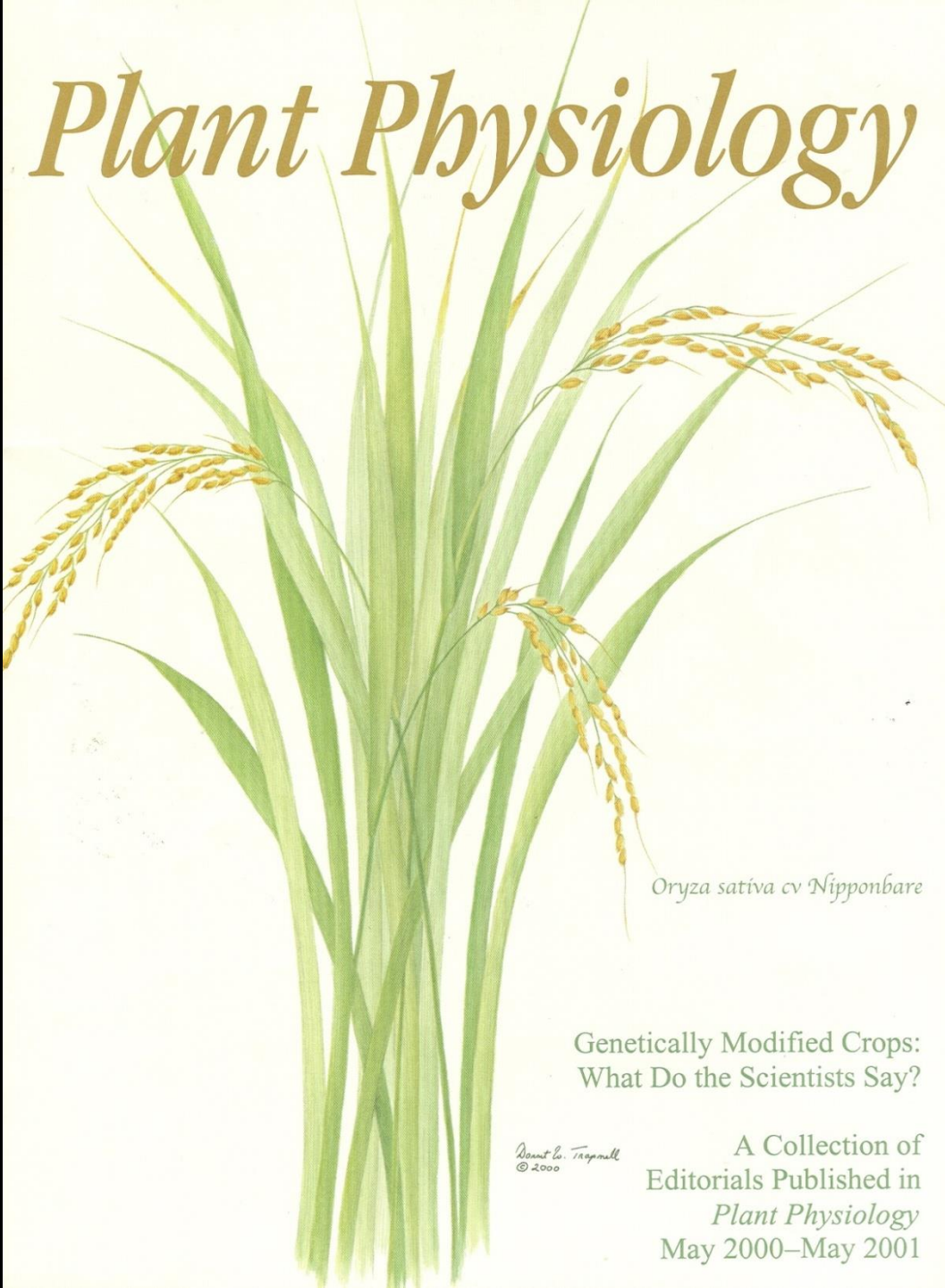


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The essays in this volume first appeared in *Plant Physiology*



# *Plant Physiology*



*Oryza sativa* cv *Nipponbare*

Genetically Modified Crops:  
What Do the Scientists Say?

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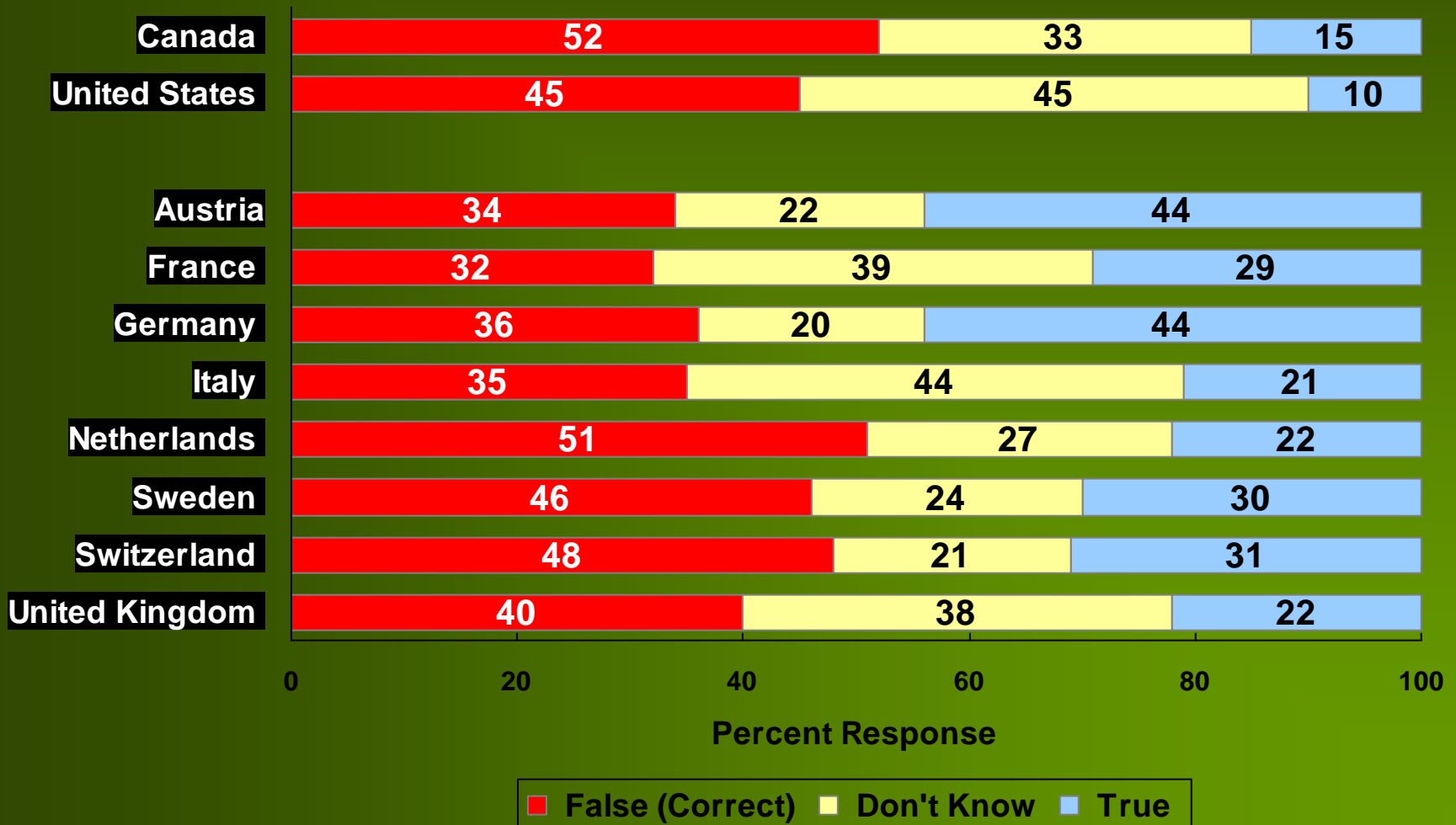
***“Ordinary Tomatoes Do Not Contain Genes,  
while Genetically Modified Ones Do”***

**A. True**

**B. False**

**C. I don't know**

# *“Ordinary Tomatoes Do Not Contain Genes, while Genetically Modified Ones Do”*



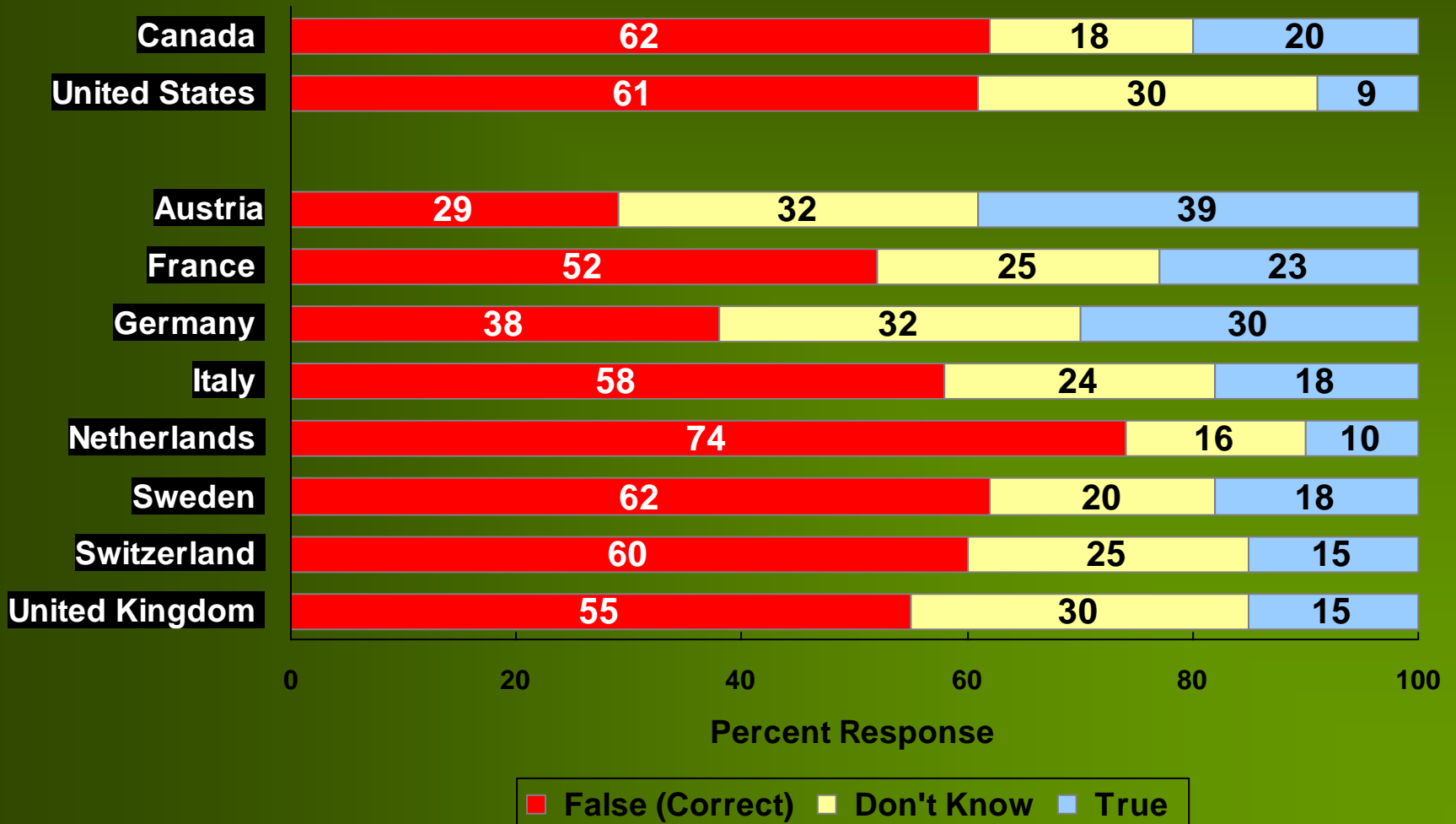
***“By Eating a Genetically Modified Fruit, a Person’s Genes Could also Be Changed”***

**A. True**

**B. False**

**C. I don’t know**

# *“By Eating a Genetically Modified Fruit, a Person’s Genes Could also Be Changed”*





*Myths*

# **GMOs Are Not Safe**

**Many people often say-**

**GMOs have not been adequately tested for safety**

**We don't know the long term health effects**

**Large companies (i.e. Monsanto) conspires to hide data from the public**

**Monsanto does not want you to know about GMOs in Food**

**GMOs contain toxic compounds or antibiotics**

**GMOs are responsible for the rise in allergies**

**GMOs are responsible for the rise in autism**

**By eating a genetically modified plant a persons genes could also be changed**



WHAT ARE WE EXPECTING?

**GREENPEACE**

CAMPAIGN AGAINST GENETICALLY MODIFIED ORGANISMS

Embryos with a mix of human  
and animal genes are now a reality.

They are created, patented  
and used for commercial purposes.

If this bothers you a great deal  
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What is the level of understanding?



# GREENPEACE





# Professional Protestors Against GM Crops

**Greenpeace. Dr Patrick Moore, ecologist and co-founder of Greenpeace. “the campaign of fear now being waged against genetic modification is based largely on fantasy and a complete lack of respect for science and logic...**

**“In the real balance, it is clear that the real benefits of genetic modification far outweigh the hypothetical and sometimes contrived risks claimed by its detractors.”**

**“...accusing [Greenpeace] of abandoning science and following agenda that have little to do with saving the earth.”**



# Health Concerns and GMO Food are Unsubstantiated



Not A Single Case of a Health Related Incident Associated with Any GMO World-Wide since Use Began

March 2001. EPA announced it would no longer provide separate registrations for animal feed and human food

From the News Media and Popular Press  
the message comes out...

**GMO = BAD**





*Question*

# **Why Do People think GMOs Are Not Safe?**

**Common Responses in Polling questions** (Pew Foundation  
and IFIC responses):

**“GMOs have not been adequately tested”**

**“We do not know the long term effects”**

**“Monsanto and other Big Ag Companies suppress or manipulate  
independent investigations”**

**Has Adequate Independent testing on GMOs been  
accomplished?**

**Is this information available to the Public?**

**Why do people think  
GMOs Are Not Safe  
GMOs and Safety**

**Evidenced Based  
Peer Reviewed Scientific Testing of GMO Crops**

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# 600 Peer Reviewed References on the Safety of GMOs

## NONE show substantial difference to Non- GMO counterparts

## NONE show health related consequences

*Myths*

# **GMOs Are Not Natural**

**Many people often say-**

**Mixing genes in plants is not Natural**

**I don't want to eat any genes**

**Genetic engineering is not Natural**

**Genetic engineering is 'Playing God'**

**I don't think we should mess with Nature**

*Myths*

# **Monsanto Conspirers To Hide Data about GMOs From the Public**

## **How could this possibly be?**

**Lastly, conspiracy theories themselves are suspicious and do not hold up to scrutiny. (The NSA can't keep a secret).**

**Perhaps if you believe that big Ag Companies conspire to control all of the data from the public- Then, perhaps-**

*JFK was shot from the grassy knoll; Men did not really land on the moon but were filmed somewhere in Arizona; The US Air Force has a secret hidden UFO; The Pentagon did shoot a missile into the Pentagon on 9/11; Evolution is a lie; Climate change is a hoax; and China has a secret army of armed flying monkeys.....*

*Myths*

# **Monsanto Conspirers To Hide Data about GMOs From the Public**

## **How could this possibly be?**

**The USDA APHIS, EPA and the FDA oversee the regulation of commercialization of these crops.**

**Thousands of Independent University and Foundation Researchers have studied these crops, their biology and ecological effects**

**The industry itself MUST avoid any problems or suffer the consequence in the stock market and the marketplace (self-policing). Each GM variety costs \$150 M and 10 yrs investment to produce.**

**Lastly conspiracy theories themselves are suspicious and do not hold up to scrutiny. The NSA can't keep a secret).**

# The Threat of Pesticides to Health and the Environment



- Toxic compounds
- Allergenicity
- Carcinogenic
- Estrogen-like  
Compounds
- Persistent

# Chemicals





# SILENT SPRING

The CLASSIC that LAUNCHED  
the ENVIRONMENTAL MOVEMENT

RACHEL  
CARSON

Introduction by LINDA LEAR      Afterword by EDWARD O. WILSON



# *Myth* **GMOs Increase Herbicide Use**

## **First, NOT ALL HERBICIDES ARE CREATED EQUAL**

This claim is simply an attempt to mislead people into thinking that more herbicide use must somehow be more dangerous. As a U.S. Department of Agriculture (USDA) report has noted, planting herbicide resistant biotech crops enables farmers to substitute the more environmentally benign herbicide glyphosate (commercially sold as Round Up) for “other synthetic herbicides that are at least 3 times as toxic and that persist in the environment nearly twice as long as glyphosate.”

## **Glyphosate (Round Up)**

- Very low toxicity, breaks down quickly in the environment
- Enables farmers to practice conservation tillage, reducing topsoil erosion by up to 90%
- Weed control in essential for large scale Agriculture
- Eliminating weeds increases yield by providing more water for the crops
- “Best thing to happen to agriculture since the plow” Iowa corn farmer



*Question*

# **Why Then Do People Think That GMOs Increase Herbicide Use?**

**“Chemicals are chemicals”**

**“All chemicals are BAD”**

**“Chemicals are not natural and must be harmful”**

**“Herbicides, pesticides, they’re all the same right?”**

**“We don’t need pesticides to grow our food”**

*Myth*

# **GMOs Increase Pesticide Use**

**Comparative data (USDA) from pesticide use since 1996 in the US on Corn (a GMO) crop shows a drop in pesticide use attributed to Bt (A GM trait that control European Corn Borer without synthetic pesticides) compared with Wheat (a Non-GMO crop) where synthetic pesticide use has increased during that period**



*Question* **Why Then Do People Think**

**That GMOs Increase Pesticide Use?**

**When it comes to GMO crops and pesticide use data, anti-biotech activist Charles Benbrook has been very influential**

- Benbrook, is a research professor in the Center for Sustaining Agriculture and Natural Resources at Washington State University.**

- He has a long history of publishing studies allegedly showing that the adoption of GMO crops boosts the use of pesticides.**

- Four years after commercial biotech crops were first planted in the United States in 1995 , for example, he concluded in a 2001 paper that herbicide use had “modestly increased.”**

*Question* **Why Then Do People Think  
That GMOs Increase Pesticide Use?**

**When it comes to GMO crops and pesticide use data, anti-biotech activist Charles Benbrook has been very influential**

**Benbrook's article contradicts research published the year before by scientists with the U.S. Department of Agriculture, who had found that biotech crops had reduced pesticide applications.**

**•In a 2004 report funded by the Union of Concerned Scientists, Benbrook asserted that “GE [genetically engineered] corn, soybeans, and cotton have led to a 122 million pound increase in pesticide use since 1996.”**

**In contrast, a 2005 study in the Journal Pest Management Science, reported that planting GMO crops had “reduced herbicide use by 37.5 million lbs.”**

*Question* **Why Then Do People Think  
That GMOs Increase Pesticide Use?**

**In 2009, Benbrook issued a report for the anti-GMO Organic Center claiming that “GE crops have been responsible for an increase of 383 million pounds of herbicide use in the U.S. over the first 13 years of commercial use of GE crops.”**

**Benbrook’s latest study, found that the adoption of pest-resistant crops had reduced the application of insecticides by 123 million pounds since 1996 but increased the application of herbicides by 527 million pounds, an overall increase of about 404 million pounds of pesticides.**

*Question* **Why Then Do People Think  
That GMOs Increase Pesticide Use?**

**Mother Jones' anti-biotech advocate Tom Philpott reported falsified results where Benbrook largely got his 2012 results by making some strategic extrapolations of herbicide use trends to make up for missing data from the U.S. Department of Agriculture.**

**Where in fact, the USDA does not provide herbicide use data for corn in 2004, 2006, 2007, 2008, 2009, or 2011, for soybeans in any year after 2006, and for cotton in 2002, 2004, 2006, 2009, and 2011.**



*Question* **Why Then Do People Think  
That GMOs Increase Pesticide Use?**

**Meanwhile as the University of Wyoming weed biologist Andrew Kniss points out, in order to get an increasing herbicide trend, Benbrook's extrapolations turned a negative herbicide use trend for corn positive.**

**A 2012 study by Graham Brookes and Peter Barfoot at the PG Economics consultancy found planting modern biotech crop varieties had globally cut pesticide spraying by 997 million pounds from 1996 to 2010, an overall reduction of 9.1 percent.**

**Brookes and Barfoot calculated the amount of pesticide used by multiplying the acreage planted for each variety by the average amounts applied per acre.**

# *Fact* **GMOs Have Decreased Pesticide Use**

- **A 2007 study done for National Center for Food and Agricultural Policy, (founded by the W.K. Kellogg Foundation), reported that planting biotech crops in the U.S. had reduced in 2005 herbicide use by 64 million pounds and insecticide applications by about 4 million pounds.**
- **Another 2007 study, by Gijs Kleter from the Institute of Food Safety at Wageningen University in the Netherlands, concluded that in the U.S., crops genetically improved to resist herbicides used 25 to 30 percent less herbicides than conventional crops did.**

In 2009, Benbrook issued a [report](#) for the anti-GMO Organic Center claiming that “GE crops have been responsible for an increase of 383

*Question* **Why Then Do People Think  
That GMOs Increase Pesticide Use?**

When it comes to GMO crops and pesticide use data, anti-biotech activist Charles Benbrook has been very influential.

.After a long career with various anti-biotech groups, Benbrook now serves as a research professor in the Center for Sustaining Agriculture and Natural Resources at Washington State University. He has a long history of publishing studies allegedly showing that the adoption of biotech crops boosts the use of pesticides. Four years after commercial biotech crops were first planted in the United States, for example, he [concluded](#) in 2001 that herbicide use had “modestly increased.”

Benbrook’s article contradicted research published the year before by scientists with the U.S. Department of Agriculture, who had found that biotech crops had [reduced pesticide applications](#).

In a 2004 [report](#) funded by the Union of Concerned Scientists, Benbrook asserted that “GE [genetically engineered] corn, soybeans, and cotton

# **Controversies on Food Safety and the Public**



**Alar on Apples**



# **Why You Shouldn't Panic About Pesticide In Produce**



# **Why You Shouldn't Panic About Pesticide In Produce**

**Look beyond the fearful internet rhetoric**

**Joseph Schwarcz, Director of the Office for Science and Society at McGill University in Montreal**

**Apples, occupy the top spot on the non-profit Environmental Working Group, (EWG) "dirty dozen" list of the most contaminated fruits and vegetables, followed by celery, red peppers and strawberries. The group notes that nearly all apples contain detectable levels of pesticide residues.**

**But it's a mistake to "equate the presence of a chemical with the presence of risk," Schwarcz. "Where is the evidence that these trace residues are dangerous?"**

**There just isn't much there, he writes.**



# Not all Pesticides are Created Equal

## Agricultural, Health and Environmental Liabilities



- **Estrogen Mimics**
- **UnSafe Compounds**
- **Indiscriminate  
Insect Death**
- **Food Chain  
Disruption**
- **Watershed  
Contamination**
- **Persistent Toxicity**



# Not all Pesticides are Created Equal

## Agricultural, Health and Environmental Benefits



- **Increased Yields**
- **Safer Compounds**
- **Mosquito Control**
- **Pest Control**
- **Invasive Species**

# Pesticides Kill Insects Indiscriminately

*“A butterfly beats it’s wings  
in the Amazon...  
and changes the weather  
in Chicago.”*

It's time to emerge.

© life\_edu





# GM Crops Can Lower

## Pesticide and Chemical use



© life\_edu

- Protein-based
- Safer Compounds
- Using Less Fuel
- Conservation Tillage
- Specific Targets
- Biological Basis
- Lower Environmental Impacts

# **Why You Shouldn't Panic About Pesticide In Produce**

**Look beyond the fearful internet rhetoric**

**The U.S. Department of Agriculture database, shows that just 1 of 744 apple samples it tested had a pesticide residue level higher than the government limit.**

**Most were far below the permissible level.**

**USDA results were similar for fruits and vegetables in baby foods, (tested by the USDA for the first time this year).**

**Amounts of pesticide residue were extremely small, and no baby food samples exceeded permissible levels of pesticides.**

# **Why You Shouldn't Panic About Pesticide In Produce**

**Look beyond the fearful internet rhetoric**

**Despite the USDA results, the EWG urges consumers to buy organic fruits and vegetables, which it states generally have lower levels of pesticides, but are not necessarily pesticide-free, as shown in USDA reports**

**A 2011 study (Winter\* and Katz, J Toxicol. 2011; 2011: 589674) from the University of California, Davis found that swapping organics for conventional produce wouldn't make people any healthier.**

# **Why You Shouldn't Panic About Pesticide In Produce**

**Look beyond the fearful internet rhetoric**

**The study, published in the *Journal of Toxicology*,**

**stated: "Our findings do not indicate that substituting organic forms of the 'Dirty Dozen' commodities for conventional forms will lead to any measurable consumer health benefit."**

**No one should stop eating fruits and vegetables because of fears about pesticides.**



J Toxicol. 2011; 2011: 589674.

Published online May 15, 2011. doi: [10.1155/2011/589674](https://doi.org/10.1155/2011/589674)

PMCID: PMC3135239

## **Dietary Exposure to Pesticide Residues from Commodities Alleged to Contain the Highest Contamination Levels**

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Academic Editor: Ian Munro

## **Abstract**

Probabilistic techniques were used to characterize dietary exposure of consumers to pesticides found in twelve commodities implicated as having the greatest potential for pesticide residue contamination by a United States-based environmental advocacy group. Estimates of exposures were derived for the ten most frequently detected pesticide residues on each of the twelve commodities based upon residue findings from the United States Department of Agriculture's Pesticide Data Program. All pesticide exposure estimates were well below established chronic reference doses (RfDs). Only one of the 120 exposure estimates exceeded 1% of the RfD (methamidophos on bell peppers at 2% of the RfD), and only seven exposure estimates (5.8 percent) exceeded 0.1% of the RfD. Three quarters of the pesticide/commodity combinations demonstrated exposure estimates below 0.01% of the RfD (corresponding to exposures one million times below chronic No Observable Adverse Effect Levels from animal toxicology studies), and 40.8% had exposure estimates below 0.001% of the RfD. It is concluded that (1) exposures to the most commonly detected pesticides on the twelve commodities pose negligible risks to consumers, (2) substitution of organic forms of the twelve commodities for conventional forms does not result in any appreciable reduction of consumer risks, and (3) the methodology used by the environmental advocacy group to rank commodities with respect to pesticide risks lacks scientific credibility.

*Myth*

# **Genetic Engineering Creates Dangerous Side Effects**

**The USDA, EPA and FDA Use  
The Concept of Substantial Equivalence**

**GM crops are substantially equivalent to their  
counterparts**

The Counter ‘Opinion by The Institute for Responsible Technology’s list on this one, claims, “By mixing genes from totally unrelated species, genetic engineering unleashes a host of unpredictable side effects.”

**This claim is wholly unsubstantiated by scientific literature**

*Myth*

# **Genetic Engineering Creates Dangerous Side Effects**

## **The Contradiction**

All types of plant breeding—conventional, mutagenic, and biotech—can, on rare occasions, produce crops with unintended consequences. The 2004 National Academy of Sciences (NAS) report includes a section comparing the unintended consequences of each approach; it concludes that GMOs are “not inherently hazardous.”

**Conventional breeding and Hybrids** transfer thousands of unknown genes with unknown functions along with desired genes, and mutation breeding induces thousands of random mutations via chemicals or radiation.

*Myth*

## **Genetic Engineering Creates Dangerous Side Effects**

### **The Contradiction**

**The NAS report (2004) notes, GMOS are arguably “more precise than conventional breeding methods because only known and precisely characterized genes are transferred.”**

# **Genetic Engineering Creates Dangerous Side Effects**

## **The Contradiction**

**•Mutation breeding has been used for decades. Gamma radiation or mutagenic compounds produce thousands of uncharacterized mutations, to produce new varieties. The most interesting new mutants are then crossed with commercial varieties, which are then released to farmers.**

**•The Food and Agriculture Organization's Mutant Varieties Database offers more 3,000 different mutated crop varieties to farmers. Many of these mutated varieties are planted as organic crops.**



# **Genetic Engineering Creates Dangerous Side Effects**

## **The Contradiction**

**•Durham Wheat is one example, Fuji and Gala apples, many corn varieties, ...the list is long...The point here is not that mutation breeding is inherently dangerous and is well used by conventional plant breeding. There is a solid record of 80 years of safety. The point is that the more precise methods of modern gene-splicing are even safer than that.**

*Myth*

# **Genetic Engineering Creates Dangerous Side Effects**

## **The Contradiction**

**The Institute for Responsible Technology warns that producing GMO crops can produce “new toxins, allergens, carcinogens, and nutritional deficiencies.” There is no substantiated evidence for any of this.**

Consider the panic back in 2000 over Starlink corn, in which a biotech variety approved by the EPA as feed corn got into two brands of taco shells. Some 28 people claimed that they had experienced allergic reactions to eating “contaminated” tacos. The Centers for Disease Control and Prevention tested their blood and found that none reacted in a way that suggested an allergic response to Starlink.

As far as cancer goes, it is worth noting that even as Americans have now consumed billions of meals GMO ingredients, the age-adjusted cancer incidence rate has been going down. In fact, research shows that GMO corn engineered to resist insects is much lower in potent cancer-causing mycotoxins. The same safety record does not hold for most pharmaceuticals or even organic food.

*Myth*

# **GMOs Harm the Environment**

## **Poster Child for this Claim is the Monarch Butterfly Study**

**The Proceedings of the National Academy of Sciences (PNAS) published a series of articles evaluating the effects of GMO (Bt) corn on monarch butterflies in the wild. Those researchers described the impact on monarch butterflies as “negligible.”**

**A 2011 review of more than 150 scientific articles found that “commercialized GM crops have reduced the impacts of agriculture on biodiversity, through enhanced adoption of conservation tillage practices, reduction of insecticide use and use of more environmentally benign herbicides, and increasing yields to alleviate pressure to convert additional land into agricultural use.”**

**Members of the National Academies of Sciences, Engineering, and Medicine (NASEM) have concluded that the benefits of GM crops far outweigh the risks.**

*Myth*

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*Myth*

# **GMOs Harm the Environment**

## **Still This Myth Persists**

**Meanwhile, the alternative technology-Pesticides-kill indiscriminately.**

**GMOs offer a biological control method with limited environmental damage**

No matter what effects either conventional or GM crops have on biodiversity in crop fields, they pale in comparison to the impact that the introduction of modern herbicides and pesticides 60 years ago had on farmland biology.

# **GMO**

## **Health Concerns**

**Unintended consequences**

**Production of new toxins**

**Food Allergies**

**Antibiotic Resistance**



# SILENT SPRING

The CLASSIC that LAUNCHED  
the ENVIRONMENTAL MOVEMENT

RACHEL  
CARSON

Introduction by LINDA LEAR

Afterword by EDWARD O. WILSON

**The process by which it was  
produced is not significant....  
only its content**

# Concept of Substantial Equivalence

- Starting point for safety assessment
- Comparison between GM organism and its closest traditional counterpart
- Identification of intended and unintended differences on which further safety assessment should be focused



# Concept of Substantial Equivalence

- **(i) substantially equivalent** *no further testing is required as the product has been characterized as substantially equivalent to traditional counterpart (i.e. starch from potato)*
- **(ii) substantially equivalent, except for the inserted trait** *focus of testing safety testing is on the new trait (i.e. insecticidal protein in corn)*
- **(iii) not equivalent at all** *not substantially equivalent with a traditionally equivalent crop (i.e. pharmaceuticals, vaccines, antibodies, bioplastics)*

# Toxicity Studies Of Proteins Expressed In Commercialized Genetically Modified Crops

(Kuiper et al. 2001)



**Table 3.** Toxicity studies of proteins expressed in commercialized genetically modified crops<sup>a</sup>

Transgene product	Tests <sup>b,c</sup>									
	SC	ID	AO	AI	SO	SE	IR	HP	BI	
Acetolactate synthase ( <i>Arabidopsis thaliana</i> )	1									
12 : 0 Acyl carrier protein thioesterase ( <i>Umbellularia californica</i> )	2	2	2							
1-Aminocyclopropane-1-carboxylic acid deaminase ( <i>Pseudomonas chloroaphis</i> )	3	3								
Barnase ( <i>Bacillus amyloliquefaciens</i> )	4									
Barstar ( <i>Bacillus amyloliquefaciens</i> )	4									
Beta-glucuronidase ( <i>Escherichia coli</i> K12)	5	5	5							
Bromoxynil nitrilase ( <i>Klebsiella pneumoniae</i> var. <i>ozaenae</i> )	6	7								
Coat protein (cucumber mosaic virus)	8									
Coat protein (potato virus Y)	9									
Coat protein (watermelon mosaic virus 2)	8									
Coat protein (zucchini yellows mosaic virus)	8									
Cry1Ab endotoxin ( <i>Bacillus thuringiensis</i> var. <i>kurstaki</i> )	10	11	12	13	11			11	11	
Cry1Ac endotoxin ( <i>Bacillus thuringiensis</i> var. <i>kurstaki</i> )	14	12	12				15		16	
Cry1F endotoxin ( <i>Bacillus thuringiensis</i> var. <i>aizawai</i> )	17	17	17							
Cry3A endotoxin ( <i>Bacillus thuringiensis</i> var. <i>tenebrionis</i> )	18	12	12							
Cry9C endotoxin ( <i>Bacillus thuringiensis</i> var. <i>tolworthi</i> )	13	13	13	13	13	13			13	
5-Enolpyruvylshikimate-3-phosphate synthase ( <i>Agrobacterium</i> sp. CP4)	19	19	19							
5-Enolpyruvylshikimate-3-phosphate synthase ( <i>Zea mays</i> )	20	20	20							
Glyphosate oxidoreductase ( <i>Ochromobactrum anthropii</i> LBAA)	21	21	21							
Neomycin phosphotransferase II ( <i>Escherichia coli</i> Tn5)	4	22	22							
Phosphinothricin acetyltransferase ( <i>Streptomyces hygrosopicus</i> , <i>bar</i> gene)	4	23	14							
Phosphinothricin acetyltransferase ( <i>Streptomyces viridochromogenes</i> , <i>pat</i> gene)	24	23	25							
Replicase (potato leaf roll virus)	26									

<sup>a</sup>Data from publicly available reports.

<sup>b</sup>AO, acute oral toxicity, rodent, gavage; AI, acute intravenous toxicity, rodent, single dose; BI, binding to mammalian intestinal tissues; HP, haemolytic potential; ID, *in vitro* digestion; IR, immune response, rodent; SC, sequence comparisons with allergens and toxins; SE, sensitization, oral and intraperitoneal, rodent.; SO, subchronic oral toxicity, 4-week, rodent.

<sup>c</sup>References: **1** flax Cdc Triffid Fp967, 1999 (Health Canada, 2001); **2** canola, high-laurate, DD96-08 (CFIA, 2001); **3** Reed *et al.* (1996); **4** canola MS1 × RF1, DD95-04 (CFIA, 2001); **5** EPA (2000c); **6** Bxn plus Bt cotton, 2000 (Health Canada, 2001); **7** canola Westar-oxy-235, 1997 (Health Canada, 2001); **8** Squash Czw-31999 (Health Canada, 2001); **9** potato lines SEMT15-02 etc., 1999 (Health Canada, 2001); **10** ANZFA (2000c); **11** Noteborn *et al.* (1995); **12** FIFRA SAP (2000a); **13** FIFRA SAP (2000b); **14** maize DBT418, 1997 (Health Canada, 2001); **15** Vazquez Padron *et al.* (1999); Vazquez *et al.* (1999); **16** Vazquez Padron *et al.* (2000); **17** EPA (2000d); **18** potato lines ATBT04-6 etc., 1999 (Health Canada, 2001); **19** Harrison *et al.* (1996); **20** ANZFA (2000b); **21** ANZFA (2000a); **22** Fuchs *et al.* (1993); **23** Wehrmann *et al.* (1996); **24** canola HCN92, DD95-01 (CFIA, 2001); **25** maize T14 and T25, 1997 (Health Canada, 2001); **26** potato lines RBMT21-129 etc., 1999 (Health Canada, 2001).



**Table 4.** Toxicity studies performed with genetically modified food crops<sup>a</sup>

Crop	Trait	Species	Duration	Parameters	Reference
Cottonseed	Bt endotoxin ( <i>Bacillus thuringiensis</i> )	rat	28 days	body weight feed conversion histopathology of organs	Chen <i>et al.</i> (1996)
Maize	Cry9C endotoxin ( <i>Bacillus thuringiensis</i> var. <i>tolworthi</i> )	human		blood chemistry reactivity with sera from maize-allergic patients	EPA (2000e)
Potato	lectin ( <i>Galanthus nivalis</i> )	rat	10 days	histopathology of intestines	Ewen and Pusztai (1999)
Potato	Cry1 endotoxin ( <i>Bacillus thuringiensis</i> var. <i>kurstaki</i> HD1)	mouse	14 days	histopathology of intestines	Fares and El Sayed (1998)
Potato	glycinin (soybean, <i>Glycine max</i> )	rat	28 days	feed consumption body weight blood chemistry blood count organ weights liver- and kidney- histopathology	Hashimoto <i>et al.</i> (1999a) Hashimoto <i>et al.</i> (1999b)
Rice	glycinin (soybean, <i>Glycine max</i> )	rat	28 days	feed consumption body weight blood chemistry blood count organ weights liver- and kidney- histopathology	Momma <i>et al.</i> (2000)
Rice <sup>b</sup>	phosphinothricin acetyltransferase ( <i>Streptomyces hygroscopicus</i> )	mouse, rat	acute and 30 days	feed consumption body weight median lethal dose blood chemistry organ weight histopathology	Wang <i>et al.</i> (2000)
Soybean GTS 40-3-2	CP4 EPSPS ( <i>Agrobacterium</i> )	rat, mouse	105 days	feed consumption body weight histopathology of intestines and immune system serum IgE and IgG levels	Teshima <i>et al.</i> (2000)
Soybean GTS 40-3-2	CP4 EPSPS ( <i>Agrobacterium</i> )	human		reactivity with sera from soybean-allergic patients	Burks and Fuchs (1995)
Soybean GTS 40-3-2	CP4 EPSPS ( <i>Agrobacterium</i> )	rat	150 days	blood chemistry urine composition hepatic enzyme activities	Tutel'yan <i>et al.</i> (1999)
Soybean	2S albumin (Brazil nut, <i>Bertholletia excelsa</i> )	human		reactivity with sera from Brazil nut-allergic patients	Nordlee <i>et al.</i> (1996)
Tomato	Cry1Ab endotoxin ( <i>Bacillus thuringiensis</i> var. <i>kurstaki</i> )	rat	91 days	feed consumption body weight organ weights blood chemistry histopathology	Noteborn <i>et al.</i> (1995)
Tomato	antisense polygalacturonase (tomato, <i>Lycopersicon esculentum</i> )	rat	28 days	feed consumption body weight organ weights blood chemistry histopathology	Hattan (1996)

<sup>a</sup>Data from publicly available reports.<sup>b</sup>Mutagenicity additionally tested.

# Toxicity Studies Performed With Genetically Modified Crops (Kuiper et al. 2001)

No toxicity found by any  
substantiated analysis associated  
with GM crops

No substantiate health problems -  
Short term or long term  
(over 20 yrs) safety record



**Table 5.** Performance studies on animals fed genetically modified crops<sup>a</sup>

Crop	Trait	Animal	Parameters	Duration	Reference
Canola GT73, meal	herbicide resistant	quail	weight increase feed consumption mortality	5 days	ANZFA (2000a)
Canola GT73, meal	herbicide resistant	trout	weight increase	70 days	ANZFA (2000a)
Maize GA21, kernel	herbicide resistant	broiler chicken	weight increase feed consumption fat pads	40 days	Sidhu <i>et al.</i> (2000)
Maize CBH351, kernel	insect resistant	broiler chicken	weight increase feed consumption breast muscle weight fat pads weight mortality	42 days	EPA (2000f)
Maize, kernel	herbicide resistant	swine	feed conversion	8 days	Böhme and Aulrich (1999)
Maize Bt176, kernel	insect resistant	broiler chicken	weight increase feed consumption organ weights	41 days	Brake and Vlachos (1998)
Maize Bt176, kernel	insect resistant	broiler chicken	feed consumption feed conversion	35 days	Aulrich <i>et al.</i> (1999)
Maize Bt176, kernel	insect resistant	laying hen	feed consumption egg production feed conversion	10 days	Aulrich <i>et al.</i> (1999)
Maize Bt176, silage	insect resistant	sheep	feed conversion	?	Aulrich <i>et al.</i> (1999)
Maize Bt176, silage	insect resistant	beef steer	weight increase feed conversion meat yield	246 days	Aulrich <i>et al.</i> (1999)
Soybean GTS 40-30-2, raw	herbicide resistant	lactating cow	body weight milk production milk composition dry matter digestibility ruminal fluid composition	29 days	Hammond <i>et al.</i> (1996b)
Soybean GTS 40-30-2, meal	herbicide resistant	broiler chicken	weight increase feed consumption breast muscle weight fat pads weight mortality	42 days	Hammond <i>et al.</i> (1996b)
Soybean GTS 40-30-2, meal	herbicide resistant	channel catfish	weight increase feed consumption filet composition	70 days	Hammond <i>et al.</i> (1996b)
Soybean, meal	high oleic acid	swine	weight increase feed consumption	17 days	ANZFA (2000d)
Soybean, meal	high oleic acid	broiler chicken	weight increase feed consumption	18 days	ANZFA (2000d)
Sugar beet, beet	herbicide resistant	swine	feed conversion	8 days	Böhme and Aulrich (1999)

<sup>a</sup>Data from publicly available reports.

# Performance Studies On Animals Fed Genetically Modified Crops (Kuiper et al. 2001)

Arguably the safest  
new agricultural  
technology ever  
introduced

# Confronting the Gordian Knot

L Val Giddings, Ingo Potrykus, Klaus Ammann & Nina V Fedoroff

Nature Biotechnology Volume 30 Number 3 March 2012

“To our knowledge, every claim of a negative consequence to health or the environment from the use of these crops has failed to withstand scrutiny.”



# **AgBiotech**

## Issues and Concerns

**Uncertainty about safety**

**Regulatory issues**

**Right of choice**

**Environmental concerns**

**Globalization**

**Food culture**

**Big science, big companies**

**“Crossing the line”**

**Distrust of Science**

# Labeling

# Labeling

*“The consumer has a right to know”*

# Labeling

**“Mandatory labeling alone is a poor substitute for education and conveys negativity to an important agricultural tool. A label will not serve to inform the consumer, but rather misinform the public that GMOs are to be avoided.”**

**Albert Kausch March 3, 2013**

# Labeling

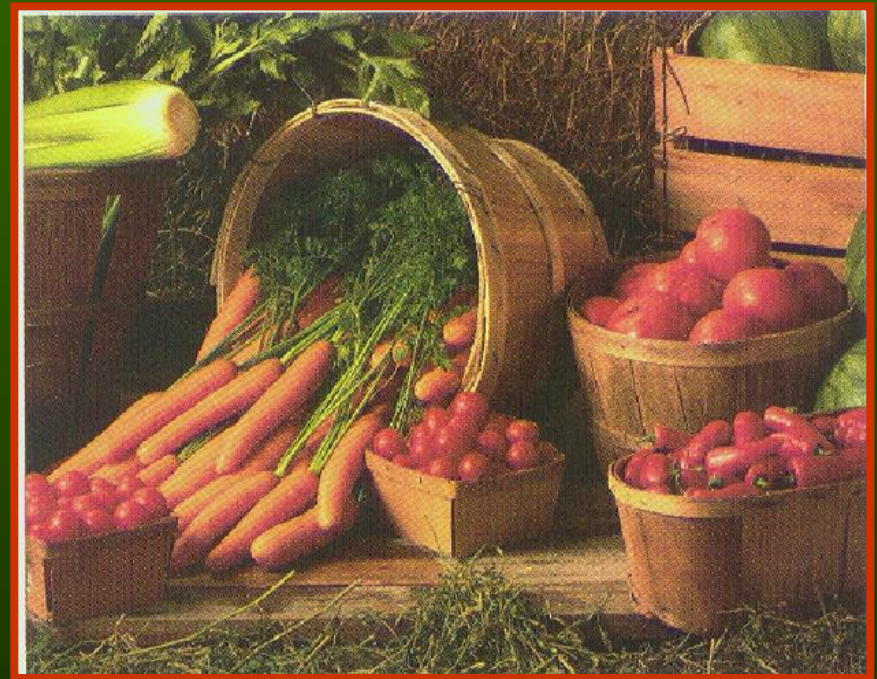
What then is the best method to support American Consumers “Right to Know”?



# FDA and Labeling

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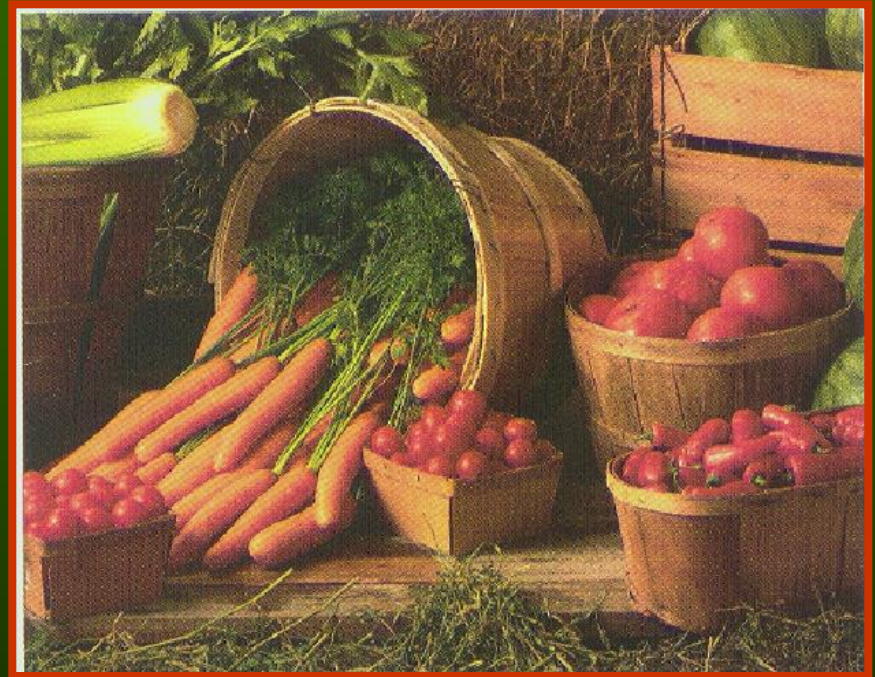
- ❑ All labeling must be truthful,
- ❑ Informative, and not misleading
- ❑ FDA has not identified any common characteristic that would justify labeling foods derived using the methods of biotechnology as a class
- ❑ FDA requires labeling when there is a material health or safety concern
- ❑ Voluntary labeling is allowed



# FDA and Labeling

## The Concept of Familiarity

Familiarity does not necessarily mean safe but ‘familiar’ is to have enough information to determine the safety or risk



# Confronting the Gordian Knot

L Val Giddings, Ingo Potrykus, Klaus Ammann & Nina V Fedoroff

Nature Biotechnology Volume 30 Number 3 March 2012

“Although Europe is sufficiently wealthy to buy its food, the indirect effects of European regulations and attitudes (towards GMOs) have had a unconscionably inhibitory effect on the introduction of biotech crops in less developed countries in most need of them, particularly on the African continent”



# Confronting the Gordian Knot

L Val Giddings, Ingo Potrykus, Klaus Ammann & Nina V Fedoroff

Nature Biotechnology Volume 30 Number 3 March 2012

“It is imperative that the impediments now obstructing innovations in these critical areas be examined, and those that cannot be justified must be removed”





# AgBiotech

## Issues and Concerns

**Uncertainty about safety**

**Regulatory issues**

**Right of choice**

**Environmental concerns**

**Globalization**

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**Big science, big companies**

**“Crossing the line”**

**Distrust of Science**

In 1962, Carson wrote: “A truly extraordinary variety of alternatives to the chemical control of insects is available. Some are already in use and have achieved brilliant success. Others are in the stage of laboratory testing. Still others are little more than ideas in the minds of imaginative scientists, waiting for the opportunity to put them to the test. All have this in common: they are *biological* solutions, based on understanding of the living organisms they seek to control, and of the whole fabric of life to which these organisms belong. Specialists representing various areas of the vast field of biology are contributing—entomologists, pathologists, geneticists, physiologists, biochemists and ecologists—all pouring their knowledge and their creative inspirations into the formation of a new science of biotic controls”

# Bt Corn Pollen is Described to affect Monarch Butterfly Larvae

Losey, J. et al. (1999) Transgenic pollen harms Monarch larvae. Nature 399, 214.



By Kent Loeffler, courtesy Cornell



*An example of a Bt Corn variety is YieldGard (left)*



# The Monarch Story

Shelton, A. and Sears, M (2001)

The monarch butterfly controversy:  
scientific interpretations of a phenomenon.  
The Plant Journal 27(6) 483-488.

- ❖ **Not good science**
- ❖ **Media focus, negative impact**
- ❖ **Outcry from the public**
- ❖ **Misrepresentation occurred**
- ❖ **Consequence Assessment**



By Kent Loeffler, courtesy Cornell

# **AgBiotech**

## Issues and Concerns

**Uncertainty about safety**

**Regulatory issues**

**Right of choice**

**Environmental concerns**

**Globalization**

**Big science, big companies**

**Distrust of Science**

**Food culture**

**“Crossing the line”**

# AgBiotech

## Issues and Concerns

### Food culture

#### Ethnic, Cultural and Religious Concerns

- Italian Food                      Macrobiotic
- Chinese Food                      Vegetarian
- Japanese Food                      Flexitarian
- German Food                      Frugitarian
- Irish Food                      Omnivore
- American Food                      Atkins, South Beach....

### Religious concerns

“Crossing the line” playing God with genes

Dietary restrictions crossed

**Will Biotechnology help  
create sustainable Agriculture,  
Or  
exacerbate the problems of large  
AgriBusiness & Monoculture farming?**

**18. Genetic engineering of crop plants is controversial because:**

**(A) so many people have died or become sickened as a consequence of eating them**

**(B) they have been shown to be massively destructive to the environment when the genes they contained are transferred from plants to the insects that feed on them**

**(C) cloned DNA is used to create them and people are uncertain about the process**

**(D) big business has consistently lied and misled the public about their safety**

**(E) they have been shown to cause heart disease in mice, humans and primates**

*Myth*

# **GMOs Do Not Increase Yields And Work Against Feeding a Hungry World**

## **The Assertion**

**The Union of Concerned Scientists' 2009 report Failure to Yield, “the definitive study to date on GM crops and yield.”**

**But clearly GMO crops boost yields (ask any farmer-or why would they use them?)**

By preventing weeds from using water, sunlight and soil nutrients and by preventing insect and pest damage...yield increase.

*Myth*

# **GMOs Do Not Increase Yields And Work Against Feeding a Hungry World**

**More recently, a 2010 review article in Nature  
Biotechnology found that**

**“of 168 results comparing yields of GM and conventional  
crops, 124 show positive results for adopters compared to  
non-adopters, 32 indicate no difference and 13 are  
negative.”**



*Myth*

# **GMOs Do Not Work Against Feeding a Hungry World**

**With regard to feeding the world, yield increases are greater for poor farmers in developing countries than for farmers in rich countries.**

“The average yield increases for developing countries range from 16 percent for insect-resistant corn to 30 percent for insect-resistant cotton,” the Nature Biotechnology article notes, “with an 85 percent yield increase observed in a single study on herbicide-tolerant corn.”

A 2012 article by two British environmental scientists, reviewing the past 15 years of published literature on the agronomic and environmental effects of biotech crops, finds that they increase yields and produce impacts that are largely “positive in both developed and developing world contexts.” They add, “The often claimed negative impacts of GM crops have yet to materialize on large scales in the field.”



# Biotechnology in Agriculture

## Agronomic and environmental considerations and reflections based on 15 years of GM crops

<sup>1</sup>Mannion, A.M., and <sup>2</sup>S. Morse

<sup>1</sup> University of Reading, and <sup>2</sup>UK University of Surrey, UK

### Abstract

Genetically modified (GM) varieties of crops, notably soybean, maize, rape (canola) and cotton, were first grown commercially in 1996. In 2010 they occupied 148 million ha in 29 countries, mostly in the Americas and Asia but with an obvious absence in Europe where their introduction has been controversial due to concerns about environmental impairment and adverse impacts on human health. This paper reviews the published literature on the agronomic and environmental impact of GM crops in the last 15 years. Overall, the impact of GM crops has largely been agronomically and environmentally positive in both developed and developing world contexts. The often claimed negative impacts of GM crops have yet to materialize on large scales in the field. Agronomically, there have been yield increases per unit area, mainly due to reduced losses as a result of improved pest (i.e. insect) and weed control; in the case of conventional crops grown near GM varieties with insect resistance there have been benefits due to the so-called 'halo' effect.

Environmentally, the decrease in insecticide use has benefited non-target and beneficial organisms while surface and groundwater contamination is less significant; human-health problems related to pesticide use have also declined. Equally important is the reduced carbon footprint as energy inputs are reduced. Of particular note, however, is the recognition that the success or longevity of GM crops is reliant on the speed with which resistance develops in target weeds and insects. However, resistance to GM-based plant resistance is already being detected in some pest populations and this suggests that scientists and farmers cannot be complacent. Current GM approaches are relatively transitory as a means of combating pests, as are conventional pesticides, and good management will determine how long this strategy proves positive. However, GM is a comparatively new science and the possibilities are considerable.

*Myth*

# **GMO Crops Are NOT Necessary to Feed The World.**

**Margaret Mellon, Union of Concerned Scientists, writes<sup>1</sup>.**

**“American-style farming doesn't really grow food for hungry people”**

**“Forty percent of the biggest crop — corn — goes into fuel for cars.**

**Most of the second-biggest crop — soybeans — is fed to animals.”**

**Growing more grain isn't the solution to hunger anyway-  
If you're really trying to solve that problem, there's a long list of  
other steps that are much more important.**

**"We need to empower women; we need to raise incomes; we need  
infrastructure in the developing world; we need the ability to get  
food to market without spoiling."**

<sup>1</sup>Margaret mellon; The Equation- August 30, 2013

*Myth*

# **GMO Crops Are Contributing to Feeding The World.**

**The world is now 7 billion people**

**By 2050, there will be 10 billion people-where will the food come from?**

**Christopher Barrett, Agricultural Economist at Cornell University who studies international agriculture and poverty. "Sometimes the opposite of a truth isn't a falsehood, but another truth, right?"**

- Chinese pigs are now raised soybean meal grown by farmers in the U.S. and Brazil- and hundreds of millions of people in China are eating much better than a generation ago
- Grain (corn) exports to developing countries have risen steadily in the last two decades

*Fact*

# Organic Foods Have Broad Appeal But Costs Temper Demand



*Question*

# **Organic Food-**

## **Is The Emperor Wearing Any Clothes?**

**Are organic foods all they're cracked up to be?**

We've been curious about how Americans view their food options. Concerns about toxins in produce have led people to buy organic.

**Organic does not mean Safe**

Recent outbreaks of foodborne illness linked to organically grown produce

- E. coli spinach
- Listeria cantaloupe
- Salmonella green onions
- Sprouts in Europe

**Organic food has sickened hundreds and resulted in death  
Perhaps there needs to be a warning label?**

*Question*

# **Organic Food- Is The Emperor Wearing Any Clothes?**

**What is the US preference for Organic based on?**

**The top reasons people prefer organics:**

**36 percent want to support local farmers**

**34 percent are concerned about toxins, such as pesticides**



*Question*

# **Organic Food- Is The Emperor Wearing Any Clothes?**

**What is the US preference for Organic based on?**

**The people who prefer non-organic food?**

**54 percent — say organic food is too expensive**

**21 percent say they're more readily available**

*Question*

# **Organic Food- Is The Emperor Wearing Any Clothes?**

**What is the US preference for Organic based on?**

**The people who prefer non-organic food?**

**54 percent — say organic food is too expensive**

**21 percent say they're more readily available**



# **Organic Pesticides: Not An Oxymoron**

**It may seem counterintuitive, but foods that are grown to organic standards can contain commercially manufactured pesticides.**

**A U.S. Department of Agriculture survey of produce that found nearly 20 percent of organic lettuce tested positive for pesticide residue.**

**Lots of the lettuce contained quite a bit of spinosad, a pesticide marketed by Dow Chemical under the brand name Entrust.**

So we called [Jeff Gillman](#), a professor of nursery management at the University of Minnesota, who has [written about organic practices](#) for lay readers. Right off the bat he told us:

When people are buying organic food, they often make the incorrect

# Organic Pesticides: Not An Oxymoron

**Dr. Jeffery Gillman, Professor of Nursery Management, University of Minnesota,** “When people are buying organic food, they often make the incorrect assumption that there are no pesticides. It's true that organic production often uses fewer dangerous chemicals, but certain pesticides are allowed.”

**“Organic pesticides can be used if crops they occur ‘naturally’.**

Spinosad, for example, comes from the soil bacterium *Saccharopolyspora spinosa*. It can fatally scramble the nervous systems of insects. It's also poisonous to mollusks.

Bacillus thuringiensis (Bt) is an organic pesticide

# **Organic Pesticides: Not An Oxymoron**

**The USDA maintains an official list of substances that can and can't be used for organic farming.**

Other potent natural extracts that have been approved for use as pesticides include pyrethrin, derived from chrysanthemums, and azadirachtin, from the Asian neem tree, which was also detected on some samples of organic lettuce.

**All three of these substances are considered slightly toxic by the EPA.**

# **Organic Pesticides: Not An Oxymoron**

**Synthetic compounds can also make it onto the list as organic pesticides, if they are relatively nontoxic combinations that include minerals or natural elements, such as copper or sulfur.**

**Are naturally derived pesticides less toxic than synthetic ones?**

The answer depends a lot on the dosage, (Gillman) "To control fire blight on the same acre of land, a tiny amount of a potent synthetic that has proved safe over the last 50 years can be used, or a much larger amount of an organic pesticide- there are definitely tradeoffs."



# **Organic Pesticides: Not An Oxymoron**

**Are naturally derived pesticides less toxic than synthetic ones?**

- The seeming contradiction between organic labeling and potentially harmful pesticide practices may lie in the relative leniency of the USDA organic guidelines.**

## **What does the Organic Label Mean?**

The answer to the ambiguity around organic labeling is to go local. "I go to the farmers market and talk to the growers to see who is serious about reducing pesticide use," he says. "I'd rather buy food from someone who used Roundup once than someone who uses organic pesticides all the time."

*‘Humans are the only animal  
who chews the ice in their drink’*

*‘Humans are the only animal who  
doesn’t know how to feed themselves’*

*Thank you*

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