

*UCLA GE Cluster 71A
Biotechnology & Society*

*Genetic Engineering & Agriculture: An
Insider's View of GMOs*

*Bob Goldberg
10/31/16*



The Politics of GMOs



GMOs?



Genetically Modified Salmon Is Safe To Eat, FDA Says

G.M.O. Labels for Food Proliferate Even as a Battle Over Them Rages

Colorado, Oregon Reject GMO Labeling

L.A. backpedals on proposal to ban growing genetically modified crops

Justices Back Monsanto on Biotech Seed Planting

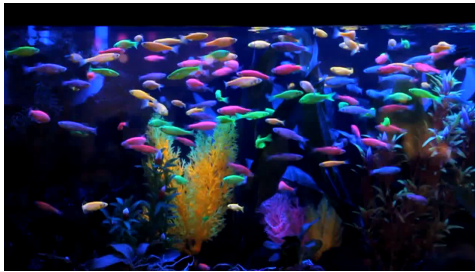
What's a *GMO*?



What's a GMO?



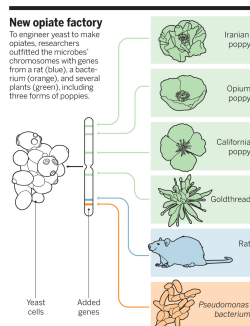
*A Genetically Engineered Bacteria
Synthesizing
Human Insulin Used as a Drug to
Treat Diabetics?*



*A Genetically Engineered GloFish
Used as a Pet?*



*A Genetically Engineered Pig
With Double Muscles For Leaner
& More Meat*



*A Genetically Engineered Yeast
That Synthesizes Opiates For
Medicine?*

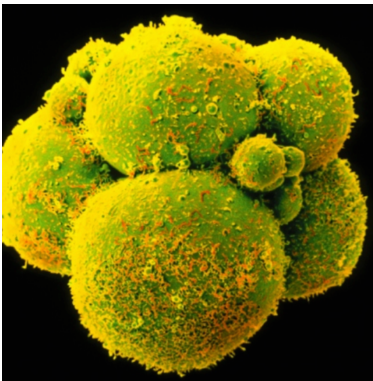
What's a GMO?



A Genetically Engineered Salmon That Grows Faster Than Non-Engineered Salmon & Has Been Approved by the FDA For Human Consumption?



A Genetically Engineered Person With a Gene That They Weren't Born With That "Cures" a Lethal Genetic Disease?



A Human Embryo With a Defective Blood Disease Gene That Was "Edited" and Engineered to Be Normal?

So.....What's a GMO?



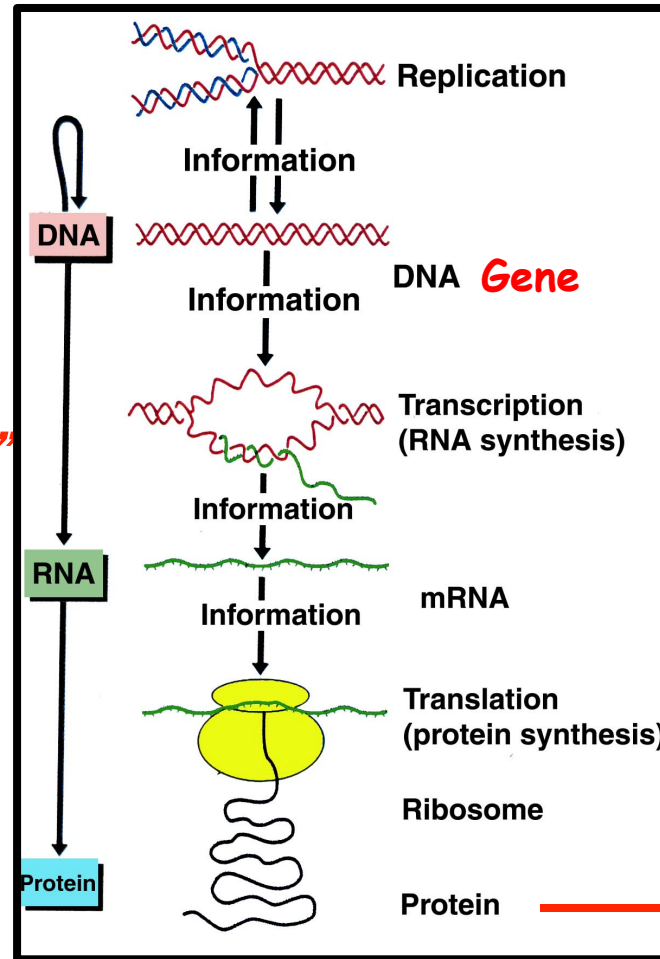
*Crops That Are Grown
For For
Human & Animal
Consumption?*



Genes Obey the Same Rules Using **Either** Classical or Molecular Genetic Engineering Approaches!!

Can Intervene in This Process in Cells

Genetic Engineering Is not "Hocus Pocus." It Uses "Natural" Cell Processes!!!!



All Organisms Use The SAME Processes And "RULES" to Generate Traits!! And The SAME Molecules & Chemistry!!

Coat Color Trait





Agriculture is Facing the Perfect Storm

Population Growth & Increased Demand For Food

Reduced Land For Agriculture

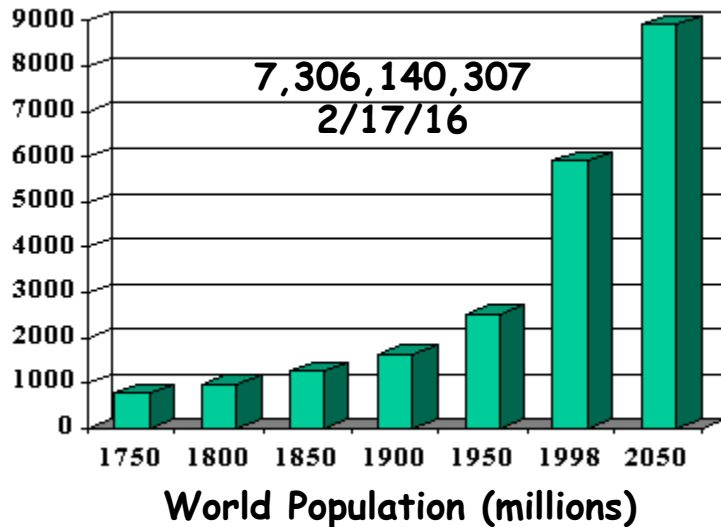
Scarcity of Natural Resources (e.g., Water)

Climate Change

Expanding Pest Habitats



We Face Major Challenges in Agriculture

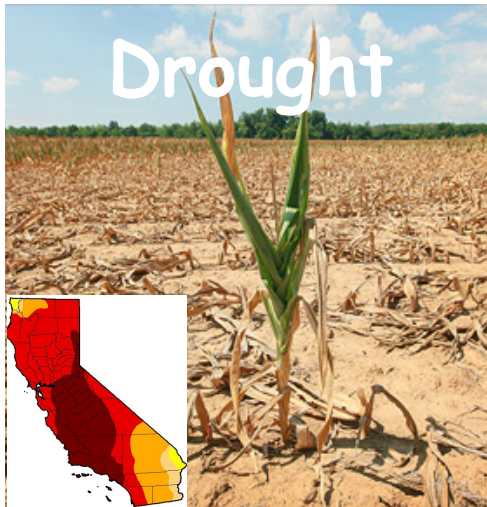


OVER THE NEXT 50 YEARS WE WILL NEED TO PRODUCE MORE FOOD THAN IN THE WHOLE OF HUMAN HISTORY AND DO IT WITH FEWER INPUTS ON LESS ARABLE LAND!!!!

CROP YIELDS NEED TO BE INCREASED SIGNIFICANTLY!!

There is a Constant Battle Between Crops & Environment That Affects Yield!!

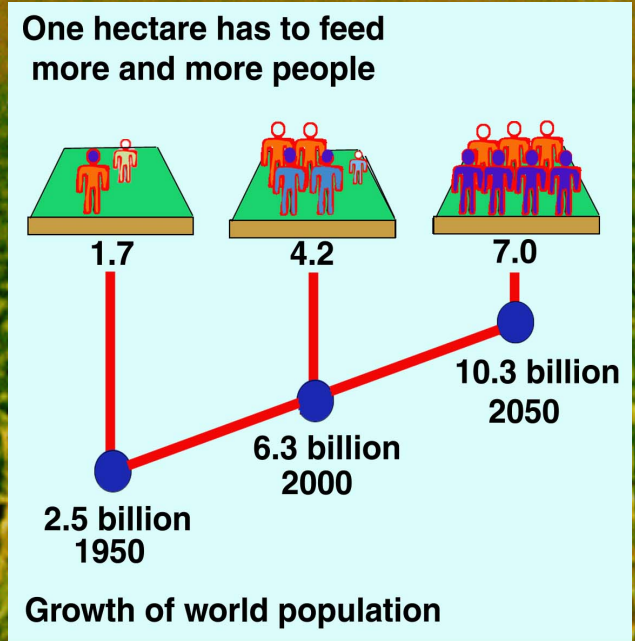
***Abiotic** (Drought, Heat) & **Biotic** (Insects, Fungi, Viruses) Stresses Reduce Crop Production (Yield) Worldwide Significantly*

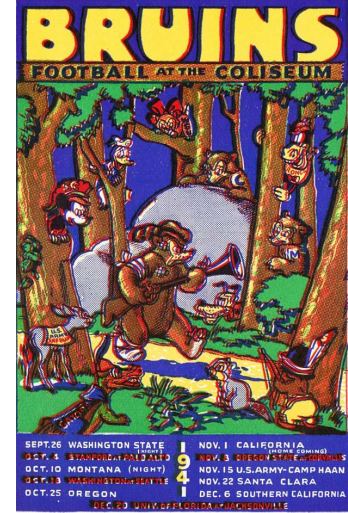


Biotic Stress Results in 30-40% Crop Loss Per Year or \$500B Annually! *FAO Statistics*

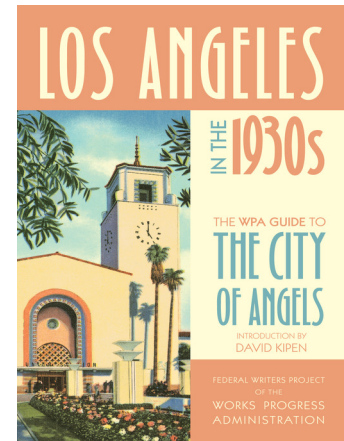
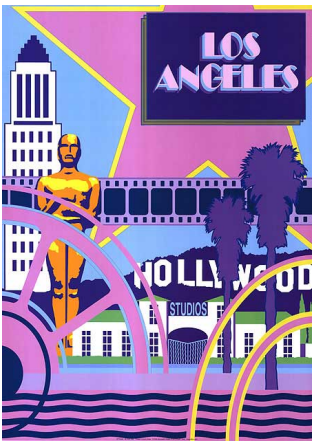
Abiotic Drought Stress Costs California Agriculture \$1.84B and 10,000 jobs in 2015! *UC Davis News & Information*

***Thus....Crop YIELDS MUST Be Increased
Using Every Discovery & Technique
Available!***

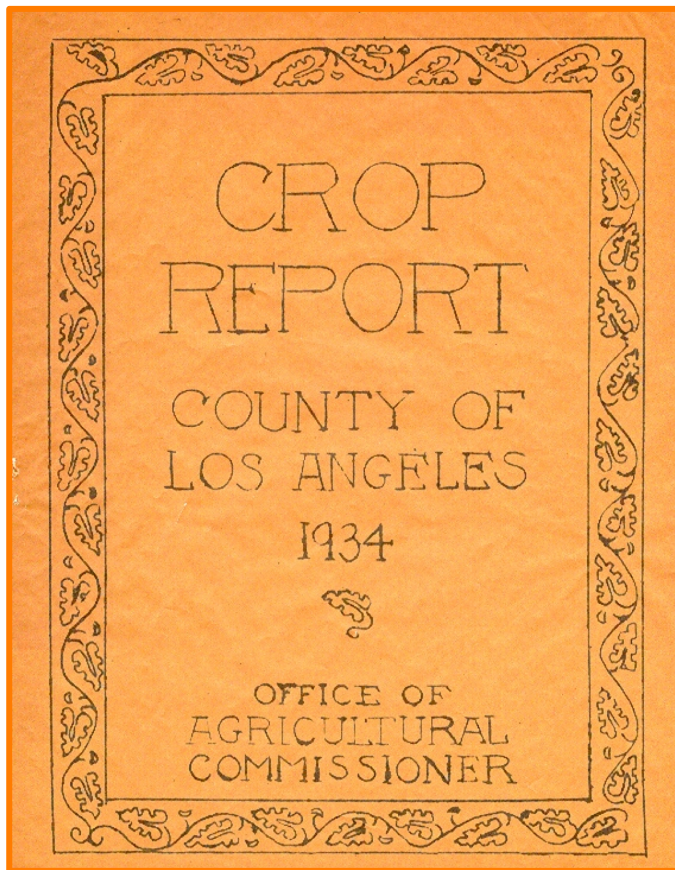




One Example From Los Angeles & UCLA History



A Sample of LA County Agriculture in the 1930s



CITRUS FRUITS*			
Oranges	44,566	9,211,900 boxes	\$ 17,786,100
Lemons	11,134	2,063,000 "	5,923,000
Grapefruit	712	190,800 "	305,700
	<u>56,412</u>	11,465,700	\$ 24,014,800
OTHER FRUITS & NUTS			
Apples	441	17,600 boxes	13,200
Apricots	944	2,800 tons (green)	77,000
Almonds	1,008	504,000 lbs	70,600
Avocados**	2,191	4,260,000 lbs	303,100
Figs	772	920 tons	66,000
Grapes-table	1,919	4,800 "	76,800
Grapes-wine	2,550	7,000 "	91,000
Grapes-raisin	324		
Olives	1,236	575 "	20,800
Peaches-cling	692	1,200 "	39,600
Peaches-free	986	1,700 "	56,100
Pears	2,481	5,000 "	125,000
Persimmons	226	450 "	18,000
Plums	241	480 "	16,800
Prunes	54	110 "	2,200
Walnuts	25,217	18,947,000 lbs	1,540,000
			11,500

600,000 Acres ~30% of LA County Total Area!!

Cash Value of \$2.8B in 2014 Dollars!!!

Aerial Photograph of UCLA in 1929

There Were 18,000 Farms in Los Angeles County in 1930!!!

From 1901 to 1950 Los Angeles County Was the Highest Agricultural Producing County in the USA!!!

Bel-Air

Farms!!

Beverly Hills

Sunset Blvd.

Hilgard Blvd.

Westwood Blvd.

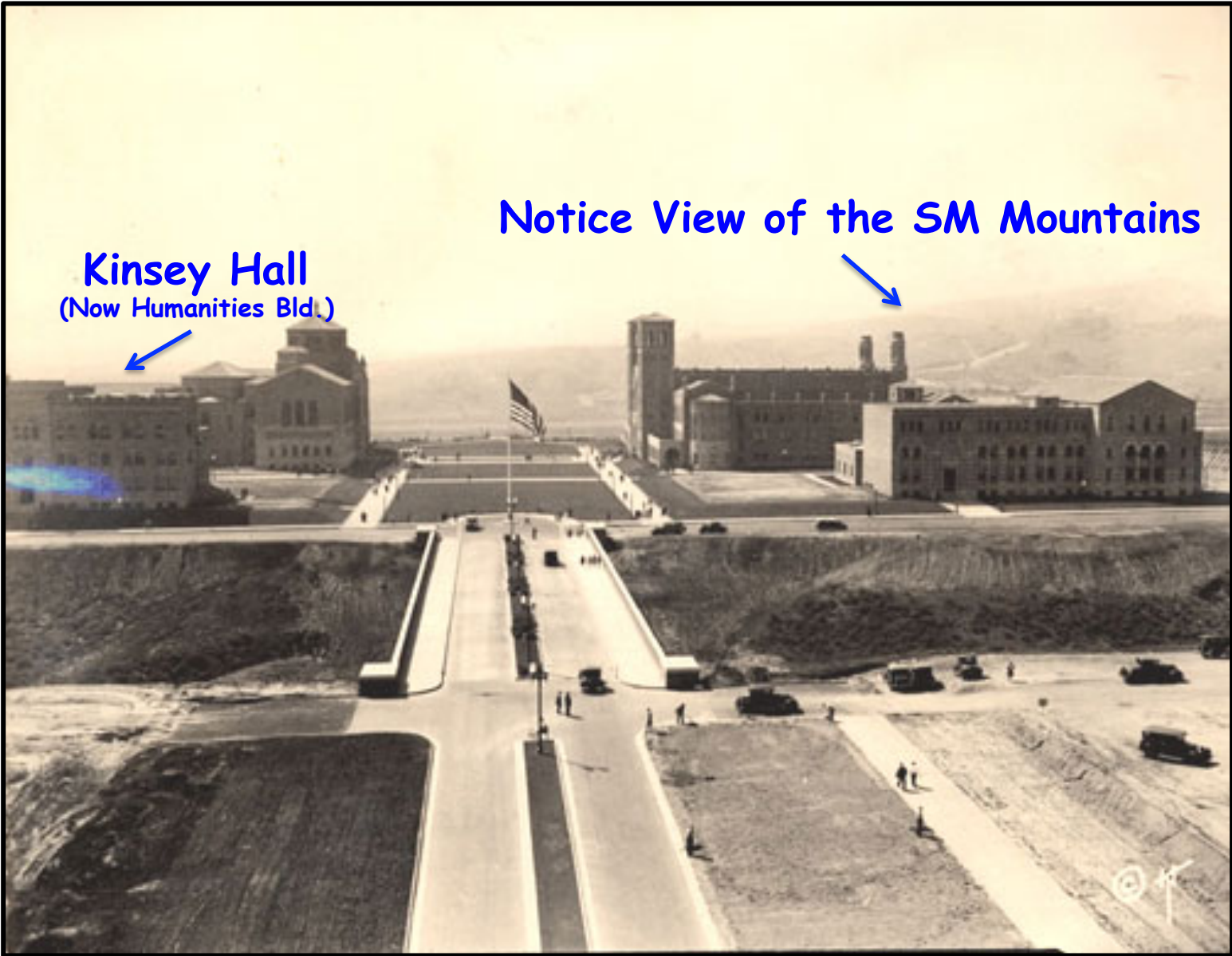
Original Agricultural College and Citrus/Avocado Orchard

*Thelner Hoover
4/11/29*

Los Angeles Population = 1,238,000



Original UCLA College of Agriculture-1930



Kinsey Hall
(Now Humanities Bld.)

Notice View of the SM Mountains

Avocado Rootstock Progeny Nursery on the UCLA Campus in 1936



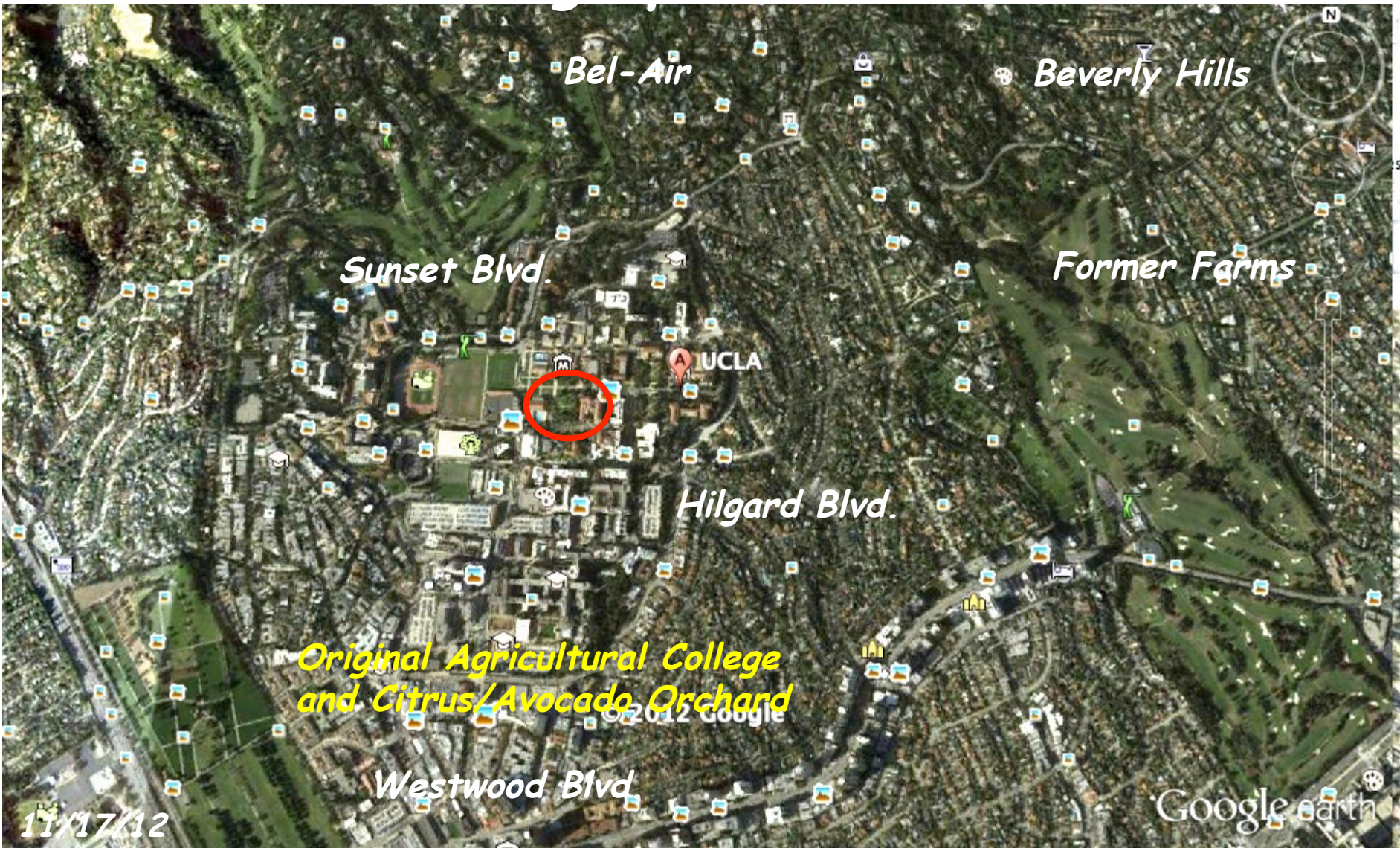
Origins of Avocado Research



Avocado Variety Chart



Aerial Photograph of UCLA in 2016



Note: Los of Crop Land!! Gone Forever!!

Los Angeles Population = 3,893,000

*How Have Crop Yields Increased Over
the Past 100 Years?*



THE ADMINISTRATION'S PROMISES HAVE BEEN KEPT

Big Changes in the US Over The Past 100+ Years


“We’ve Come a Long Way Baby”

	1900	2016
Life Expectancy	48 (women)	81 (women)
Average Family Income (2016 Dollars)	\$8,000	\$50,000
Gasoline Use Per Capita	34 gallons	1,100 gallons
Flush Toilets Per Housing Unit	10%	99%
High School Grads	13%	90%
Farm Workers	55%	1.5%

CROP **YIELD** INCREASES HAVE “ROCKETED UPWARDS” OVER THE LAST 100 YEARS AND CONTRIBUTED TO A **LONGER AND “BETTER” LIFE**

% Farm % Income
Workers on Food

Life Span

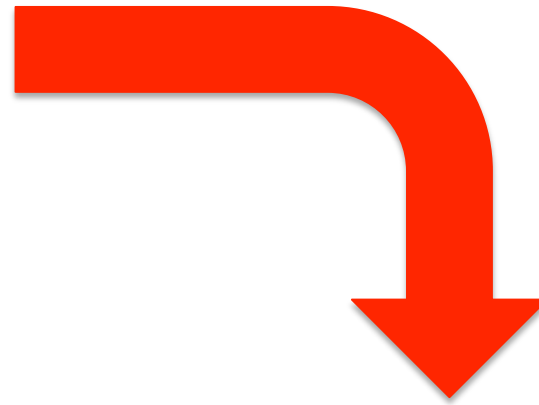
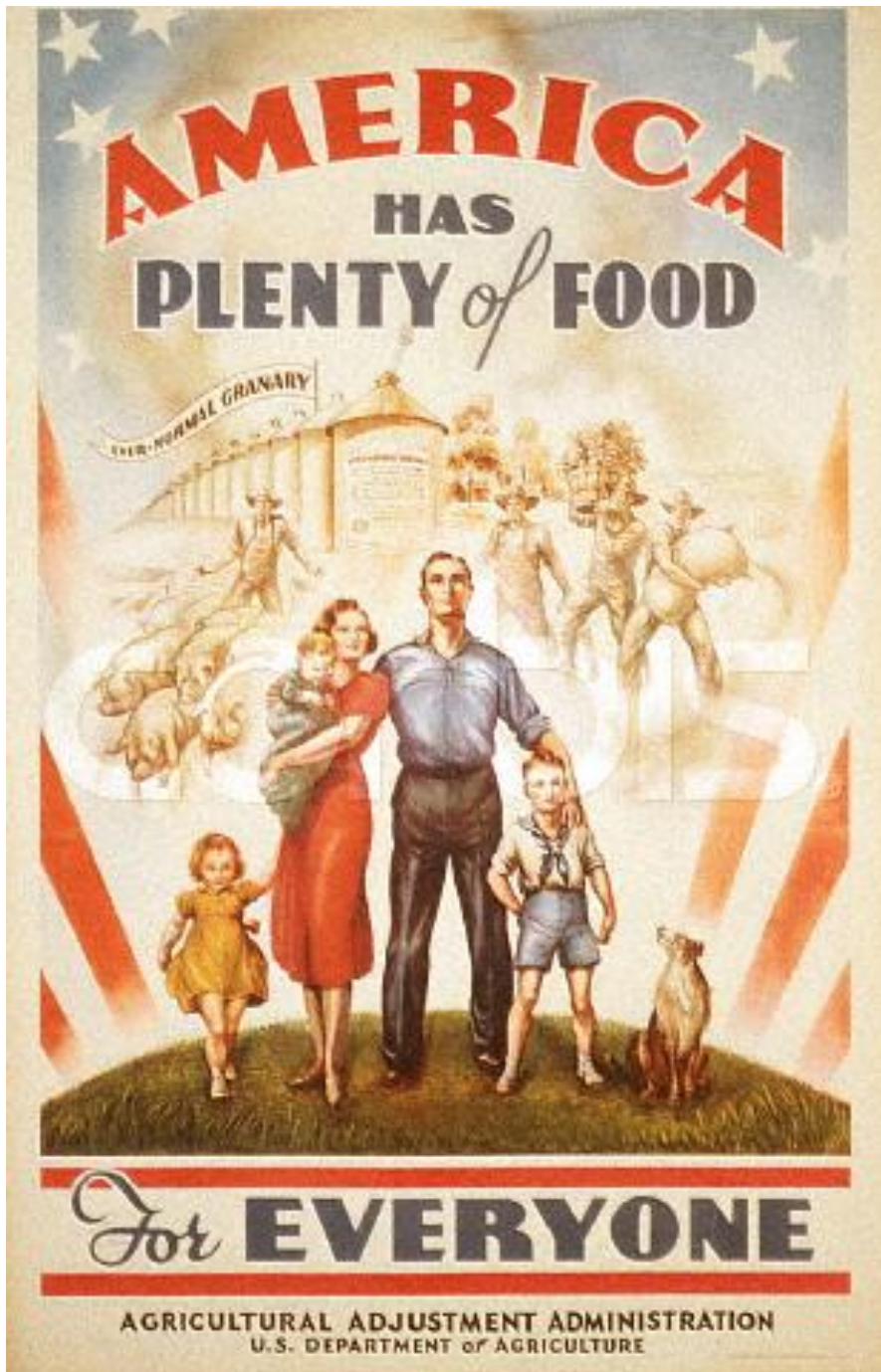
			<u>Bushels/Acre</u>		
55%	50% →	•	1900	30	
		•	1920	30	
		•	1940	40	
		•	1960	60	
		•	1980	100	
1.5%	7% →	•	2015	185	← 80 Years
					← 48 Years

1930: 30 bushels/acre
1930: 1 farmer fed 10 people

2015: 185 bushels/acre
2015: 1 farmer feeds 200 people

Conclusion: Crop yields increased >500% over the past 100 years
and lead to a similar reduction in food costs!!!!





*How Was This Accomplished
Over the Past 100+ Years?*





Explore The Possibilities





WHAT TECHNOLOGIES CAUSED AN INCREASE IN CROP YIELDS OVER THE PAST 100 YEARS?

- **PLANT BREEDING (New Hybrids-Green Revolution)**
- **IRRIGATION**
- **FERTILIZERS**
- **PESTICIDES & HERBICIDES**
- **MECHANIZATION (e.g., Tractor)**
- **GLOBAL POSITIONING AND SATELLITE IMAGING**
- **GENOMICS & GENETIC ENGINEERING (New Traits)**

These technologies have resulted in a >300% increase in US crop productivity!

Need to sustain this yield increase by applying the best technology and agricultural practices!



*How Will Crop Yields Be Increased
In the Next 100 Years?*



*Our Food is Derived From Fifteen Crops & Over Half Produce
Seeds For Human and Animal Consumption
All of These Genomes Have Been Sequenced!*

Seed Crops



- *Wheat*
- *Rice*
- *Corn**
- *Barley*
- *Sorghum*
- *Soybean**
- *Common Bean*
- *Coconut*
- *Canola**

Non-Seed Crops

- *Potato*
- *Sweet Potato*
- *Cassava*
- *Sugar Beet**
- *Sugar Cane*
- *Banana*

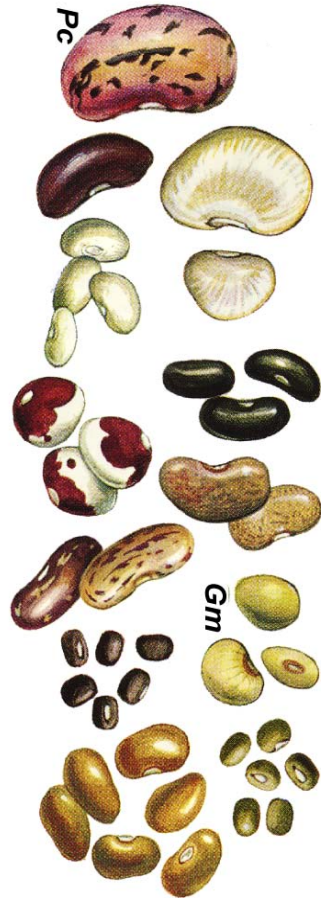
*We Understand the Science of These
Genomes - It's No Longer a "Black Box"
as in the Pre-Genomics Era!!!!*

** Genetically Engineered*

...By Using a Variety of Approaches to Identify Genes and Processes That Will Help Increase Crop Yields and Food Production Significantly in the 21st Century...

Yield (Developmental Traits)

- *Seed Number*
- *Seed Size*
- *Growth Rate*
- *Organ Size (More Seeds)*
- *Plant Architecture*
- *Flowering Time*
- *Senescence*
- *Maturity*
- *Stature*



Yield (Stress Traits)

- *Nutrient Uptake*
- *Drought Resistance*
- *Heat Resistance*
- *Cold Tolerance*
- *Salt Tolerance*
- *Shade Tolerance*
- *Disease Resistance*



.....And by Using Genomics, Breeding, and Genetic Engineering to Introduce These “Yield” Genes Into Crops (One thing we can be sure of-we can't predict what new technology will be the driver 10-25 years out!)

All Crops Have Been Engineered - Turning Wild Teosinte Into Domesticated Corn 10,000 Years Ago - Seed & Plant Engineering!!



All Vegetables in Grocery Stores Are "GMOs!!"

- Types & amounts of seed starch production
- Seeds not dropping from cob
- Length and number of seed rows
- Seed size, shape, and color
- Seed taste
- Resistance to pests



Teosinte

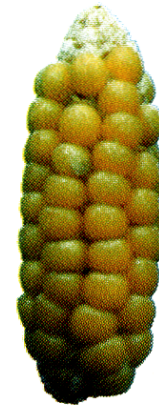


Domesticated corn



Made by "Nature"

Teosinte



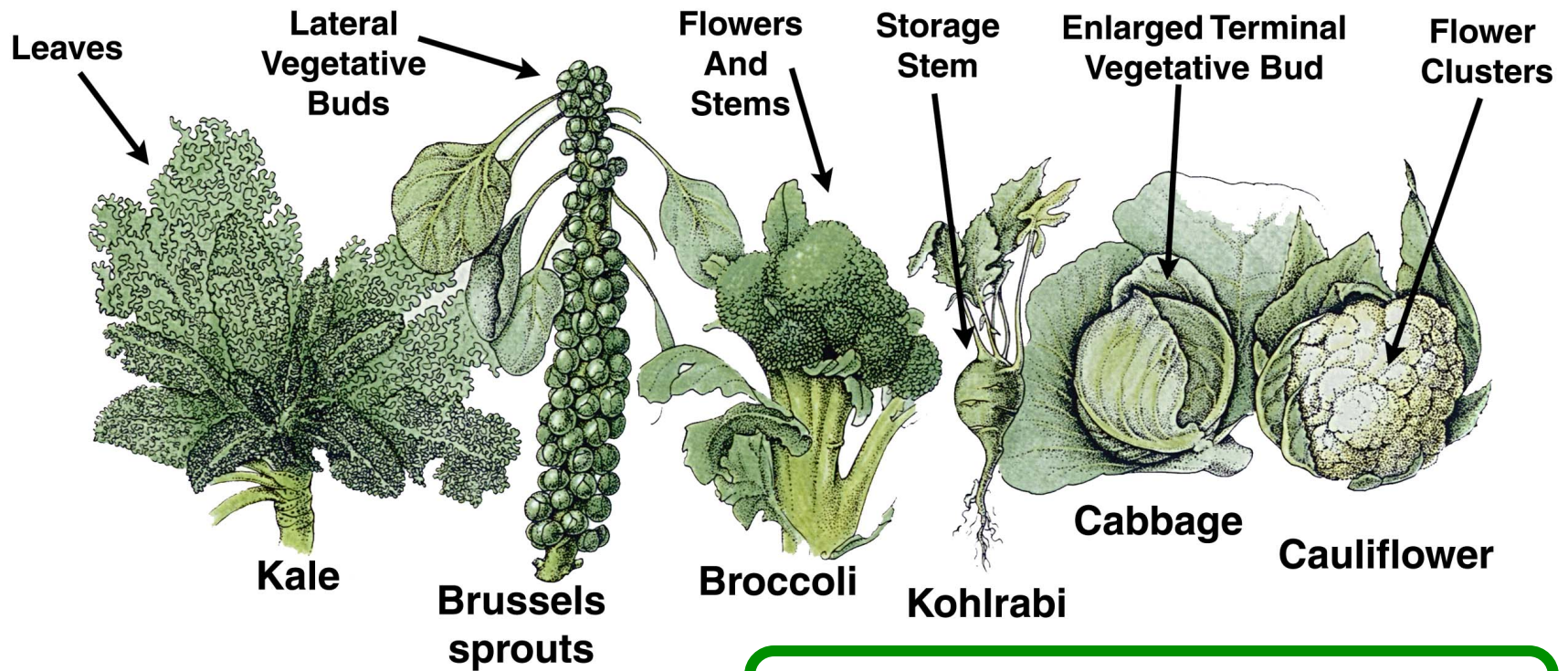
Engineered by Humans

Early domesticated corn

Note: Architecture and Fruit (cob) Size

Only Five Genes Cause These Plants to Differ & We Now Know What They Are

Engineering Vegetables With Different Plant Architectures



Manipulating Existing Genetic Variability Brought About By Chance Mutations!

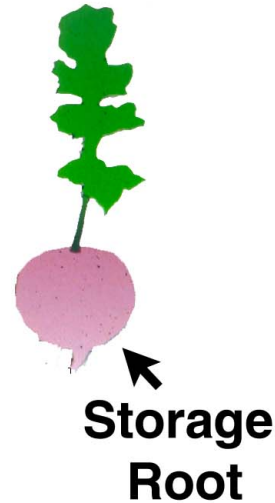
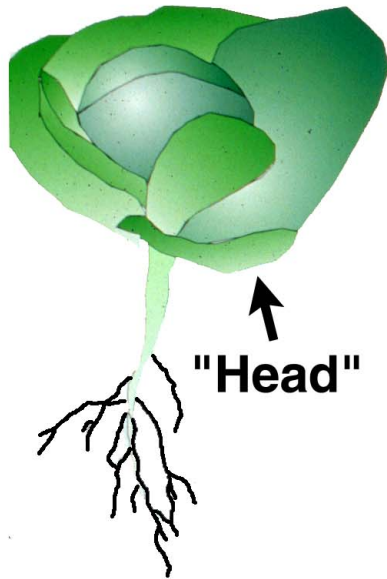
How Are These Plants Related?

The Problem With Breeding the "Old Fashioned Way"

Engineering A Novel Crop By "Wide" Breeding

Cabbage (*Brassica*)

Radish (*Raphanus*)



X



???

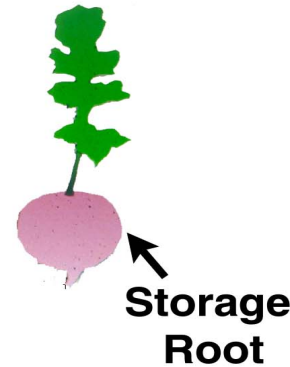
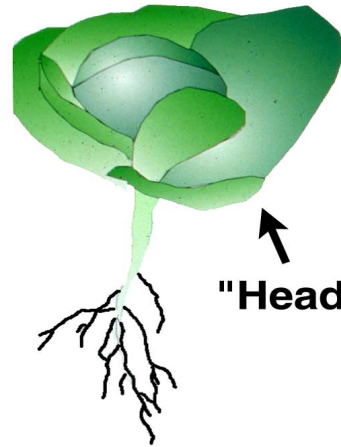
Karpechenko
1925



Engineering A Novel Crop By "Wide" Breeding

Cabbage (*Brassica*)

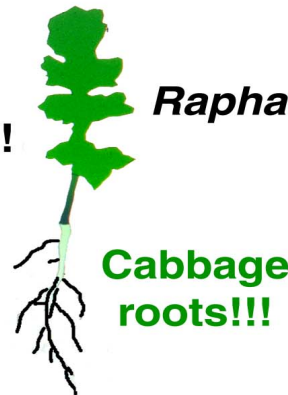
Radish (*Raphanus*)



X

Radish leaves!!!

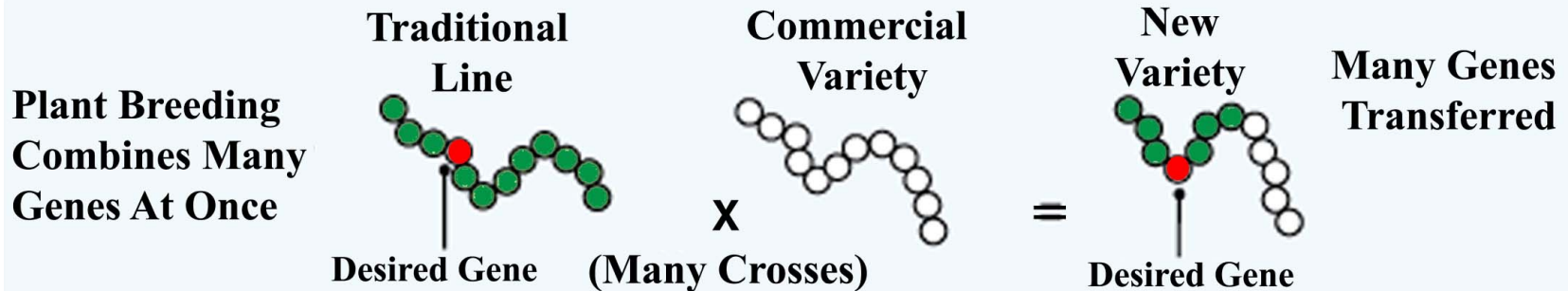
RaphanoBrassica



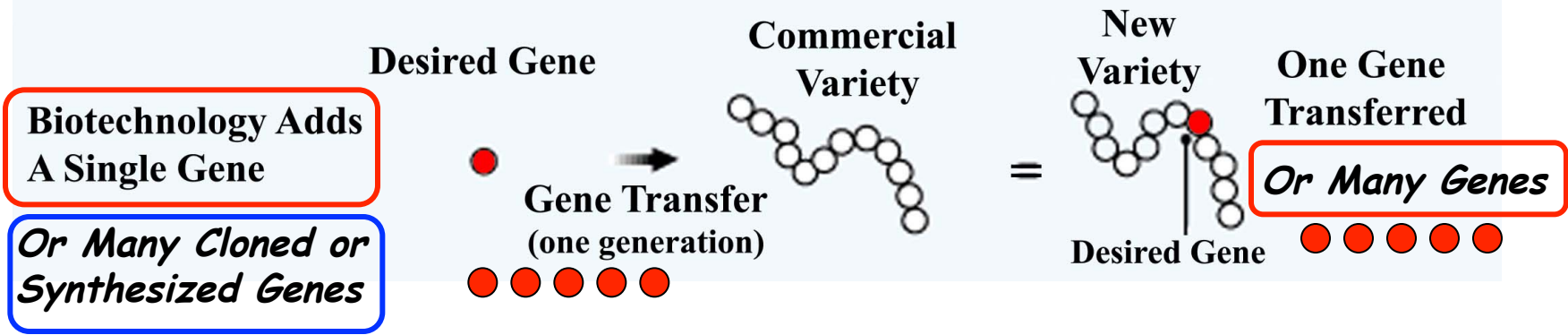
Results Show the Unpredictability of Classical Breeding Approaches!!

Classical vs. DNA or Molecular Genetic Engineering Techniques

TRADITIONAL PLANT BREEDING



PLANT BIOTECHNOLOGY

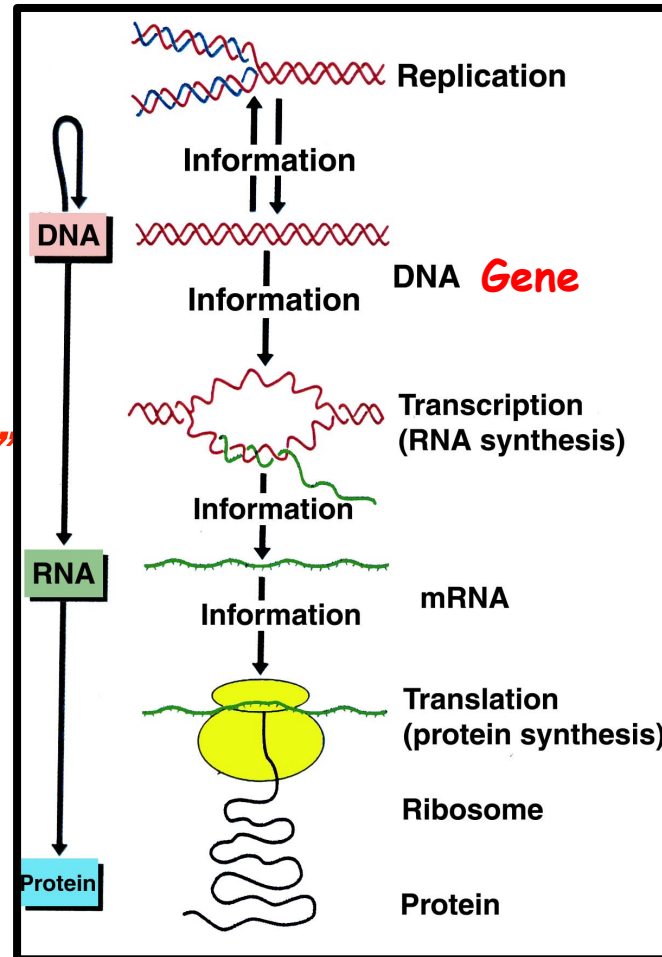


All Manipulate Genes - But in Different Ways!!

Genes Obey the Same Rules Using **Either** Classical or Molecular Genetic Engineering Approaches - **BOTH Produce GMOs!**

Can Intervene in This Process in Cells

Genetic Engineering Is not "Hocus Pocus." It Uses "Natural" Cell Processes!!!!



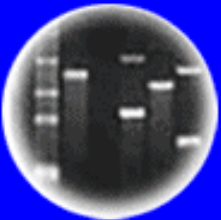
All Organisms Use The **SAME** Processes And "RULES" to Generate Traits!! And The **SAME** Molecules & Chemistry!!



DNA
Genetic Code of Life



Entire Genetic Code
of a Bacteria



DNA Fingerprinting



Cloning: Ethical Issues
and Future Consequences



Plants of Tomorrow

Genetic Engineering is a TECHNIQUE!

What Is a GMO? | GMOs are the product of a specific type of plant breeding where precise changes are made to a plant's DNA to give it characteristics that cannot be achieved through traditional plant breeding methods.

SELECTIVE BREEDING

Plant breeders look for, select and cross-breed the best performing plants in the field, similar to how farmers have naturally improved the crops they grow since farming began.

ADVANCED BREEDING

Breeders identify and tag desirable characteristics (traits) within a plant genome. They use this information to pick which plants to cross-breed and create better performing crops.

DROUGHT TOLERANCE

STRONG STALKS AND ROOTS

GM PLANT BREEDING

If a plant needs a trait that can't be achieved through advanced breeding, a gene can be turned off or moved, or a gene from another source can be inserted.

GMOs can help farmers ...

- prevent crop disease
- control insects
- manage weeds
- change nutritional profile

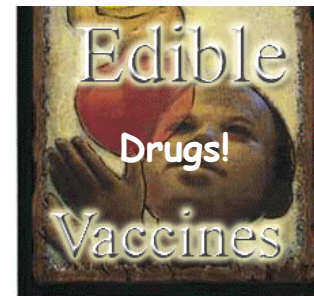
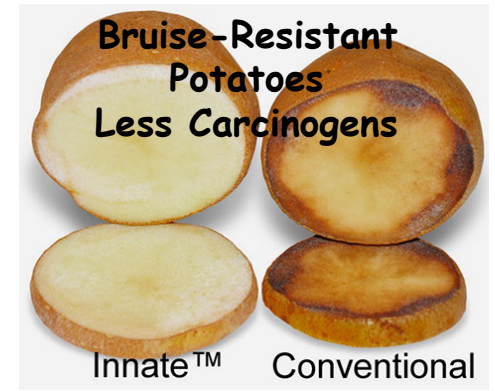
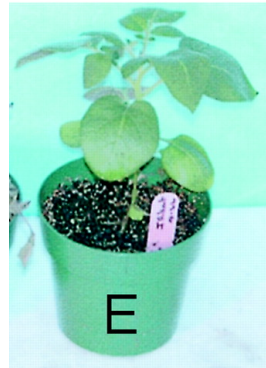
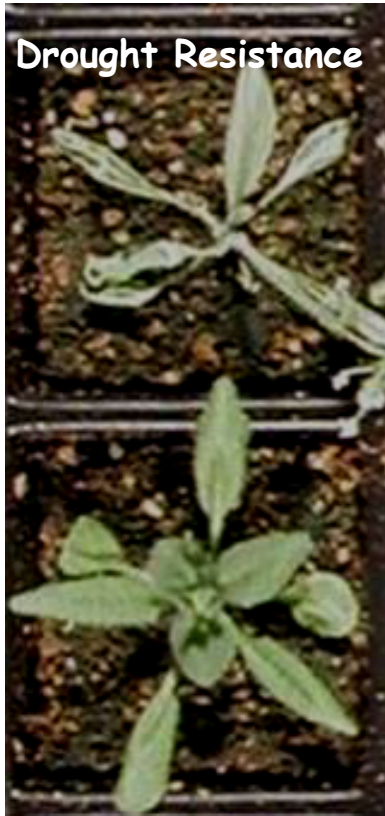
There are eight GMO crops available in the U.S. today:

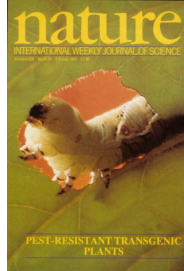
- Corn (field and sweet)
- Soybeans
- Cotton
- Canola
- Alfalfa
- Sugar Beets
- Papaya
- Squash

For more information, visit www.GMOAnswers.com

Breeding or DNA - It's the Same
& Called *Gene Manipulation*
WHAT IS A GMO!!!!

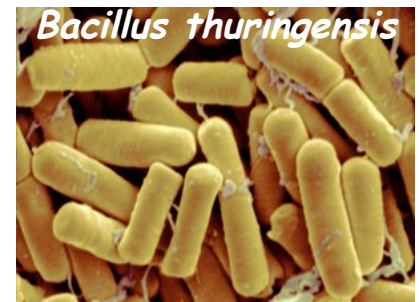
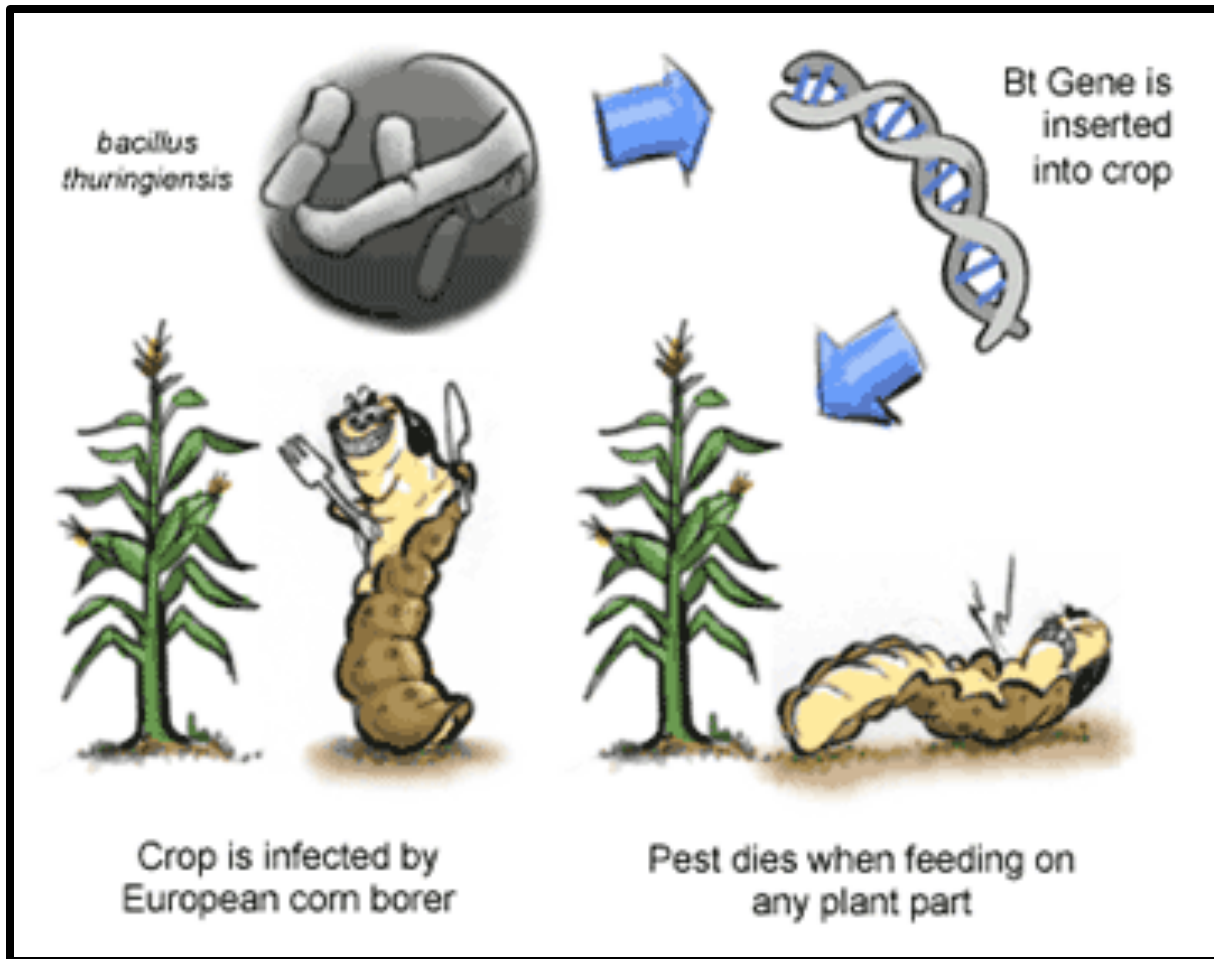
Crop Genetic Engineering Examples



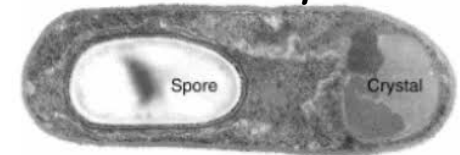


Example: How to Make an Insect-Resistant Plant?

Recall - Crops are in Perpetual Warfare With Pests



Bt Toxin in Spores



INSECT RESISTANCE with Bt

CONTROL

Bt




How to Use Bt Pesticide as an Organic Pest Control

Learn how to use Bt pesticide to kill cabbage worms, tomato hornworms and other pests in your organic vegetable garden.

GARDEN GUIDE | SUNSET

WHAT TO DO IN YOUR GARDEN IN SEPTEMBER

Southern California Checklist



PROTECT CABBAGE CROPS. The minute you plant a brassica, squadrons of cabbage white butterflies seem to descend on it to lay their eggs. The easiest way to thwart them is to cover your cabbage crops with row covers right from the start. The next best option is spraying with *Bacillus thuringiensis* to kill the young caterpillar larvae. ♦

*Here's The Irony - The Bt Gene Used in Genetically Engineered Corn & Cotton Codes For **EXACTLY** the Same Protein Used in Organic Agriculture!! What's the Fuss About?*



Bt is one of the safest natural pesticides you can use to control caterpillar pests without harming beneficial insects.

Photo Courtesy Safe Brand

FOR ORGANIC GARDENING

OMRI
Listed

Monterey

Active Ingredient:
Bacillus thuringiensis subspecies *kurstaki* strain SA-12 solids, spores and Lepidopteran active toxins (At least 6 million viable spores per mg)* 98.35%

Other Ingredients: 1.65%

Total: 100.00%

*The percent active ingredient does not indicate product performance and potency measurements are not federally standardized.

Genetically Engineered Crops in Cultivation Today



Cotton



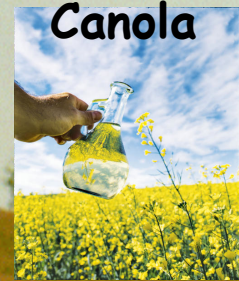
Soybean



Corn



Sugar Beet



Canola



Alfalfa

*There Are Ten Crops
Grown For Human &
Animal Consumption*

Arctic
Apple



Papaya

Innate
Potato



Squash



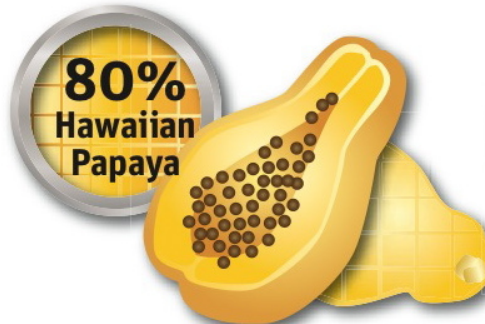
Most Genetically Engineered Crops Are Fed To Animals or in Processed Foods

GMOs are found in **80%** of packaged food in the US

Percentage of each Genetically Modified Crop that is grown in the United States



Most Fruits & Vegetables Bought in Grocery Stores Are **Not** DNA-Spliced GMOs!



*Most Fruits & Vegetables Bought in Grocery Stores Are **Not** DNA-Spliced GMOs!*



These Are GMOs
Produced By Selective
Breeding

Genetic Engineering - Most Rapidly Adopted Technology in Agricultural History

2014 GLOBAL STATUS OF COMMERCIALIZED BIOTECH/GM CROPS

18 MILLION FARMERS BENEFITED FROM BIOTECH CROPS

90% SMALL, RESOURCE POOR FARMERS FROM DEVELOPING COUNTRIES



GLOBAL BIOTECH CROP AREA MARKS

19 YEARS (1996-2014)

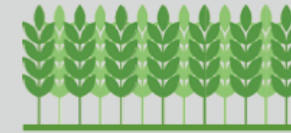
OF CONSECUTIVE GROWTH



MORE DEVELOPING COUNTRIES GROW BIOTECH CROPS

28 COUNTRIES ALL OVER THE WORLD PLANT BIOTECH CROPS

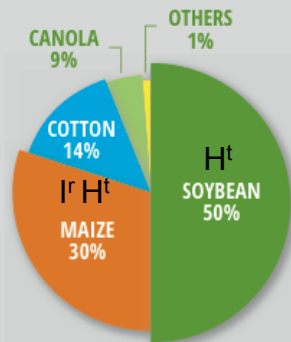
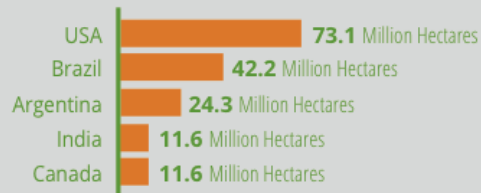
20 DEVELOPING **8** INDUSTRIAL



1.8 BILLION HECTARES

BIOTECH CROPS PLANTED SINCE 1996

TOP 5 COUNTRIES IN BIOTECH CROPS HECTARAGE:



MAJOR BIOTECH CROPS

SOYBEAN
MAIZE
COTTON
CANOLA

OTHER BIOTECH CROPS

SUGAR BEET
ALFALFA
PAPAYA



FIRST COMMERCIAL PLANTING OF **Bt BRINJAL/EGGPLANT** IN **BANGLADESH**

POLITICAL WILL AND PUBLIC-PRIVATE PARTNERSHIP WERE ESSENTIAL FOR SUCCESS

HERBICIDE TOLERANCE IS DOMINANT TRAIT DEPLOYED IN SOYBEAN, MAIZE, CANOLA, COTTON, SUGAR BEET, & ALFALFA
Also Insect Tolerance & Viral Resistance



FOOD SAFETY IS A MAJOR ISSUE

Estimates of Foodborne Illness in the United States



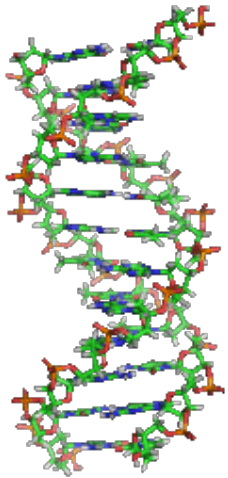
Attribution
 Attribution of Foodborne Illness

CDC estimates that each year roughly 1 in 6 Americans (or 48 million people) get sick, 128,000 are hospitalized, and 3,000 die of foodborne diseases. Estimating illnesses, hospitalizations, and deaths for various types of diseases is a common and important public health practice.

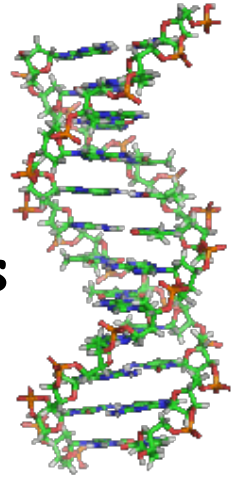
Estimating the number of illnesses associated with specific food sources is called [foodborne illness source attribution](#). These analyses are the logical extension of our 2011 analyses estimating the burden, or number, of foodborne illnesses, hospitalizations, and deaths in the US.



How Many Genes Did You Eat Today?



- One Lettuce Leaf Has Two Million Cells
- Each Lettuce Cell Has ~25,000 Genes
- One Lettuce Leaf Has Fifty Billion Genes
- A Small Salad Has 10 Lettuce Leaves Or Five Hundred Billion Genes!!!



What About the Carrots, Celery, Tomatoes, etc.?

What Happens to the Genes That You Eat?

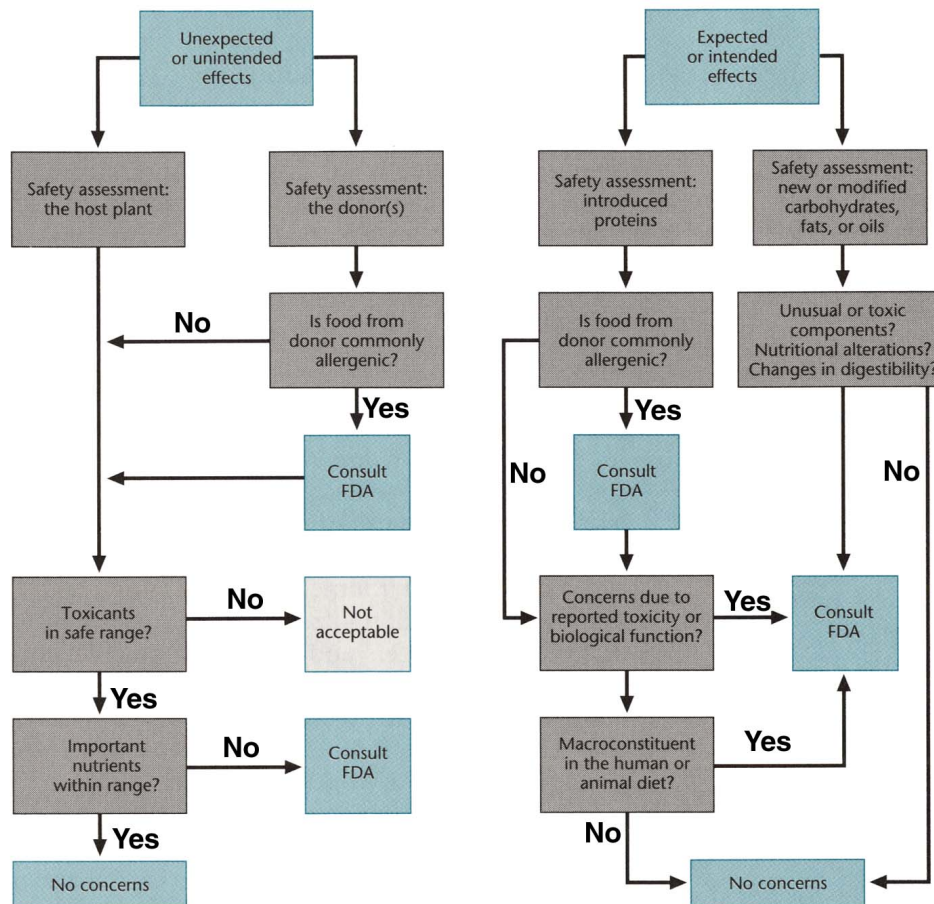


Summary of Acute Toxicity Evaluation of Proteins Introduced in Commercial GM Crops

Protein Studied*	Noel**	Stable to Digestion?	Stable to Processing?
Cry1Ab	>4000	No (30s)	No
Cry1Ac	>5000	No (30s)	No
Cry2Aa	>4011	No (30s)	No
Cry2Ab	>1450	No (30s)	No
Cry3A	>5220	No (30s)	No
Cry3Bb	>3780	No (30s)	No
Cry9C	>3760	+/- (30 min)	Partial
NPT II	>5000	No	No
CP4 EPSPS	>572	No	N.A.
GUS	>100	No	N.A.



Regulatory Process For Release of Transgenic Crops



*These are the MOST Tested Plants Ever!!!
More Than Any Food Produced by Classical Breeding Methods!!!
Average Cost = \$150M*

There is NO Testing For Conventional or Organic Foods!

Toxicants Allergens Composition

NATIONAL ACADEMY OF SCIENCES

National Academy of Sciences Report: Focus on the Food Not the METHOD of Production!!!

Similar to Those Used For Antibiotics, Vaccines, and Drugs!!

Genetically Engineered Crops Are the Most Tested Crops in Agricultural History!

GMO RESEARCH, REVIEW AND REGULATION | How Does a GMO Get to Market?

On average, GMOs take **13 years** and **\$130 million**  of R&D **BEFORE** coming to market

The **regulatory process** alone can take **5 to 7 years**

REGULATORY SCIENCE

75+ different studies¹ are conducted to demonstrate each new GMO is:

Safe to grow

- Crop grows the same as non-GM varieties
- Crop exhibits expected characteristics (e.g., insect resistance)



Safe for the environment and beneficial insects



Safe to eat

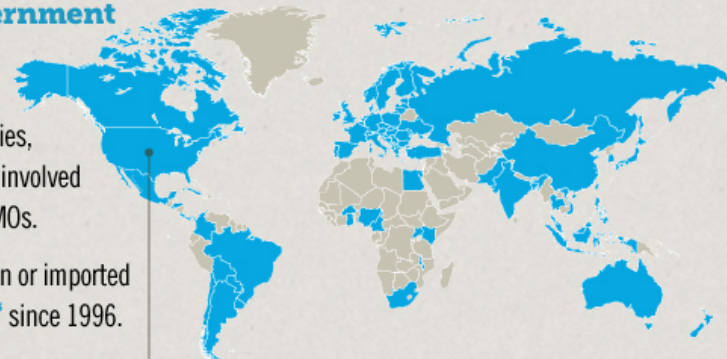
- Same nutrients as non-GM crops
- No new dietary allergens



REGULATORY REVIEW

More than **90 government bodies²** globally review and approve GMOs. In many countries, multiple agencies are involved in the regulation of GMOs.

GMOs have been grown or imported by **70 countries³** since 1996.



U.S. REGULATORY AGENCY REVIEWS


Safe to grow




Safe for the environment




Safe to eat



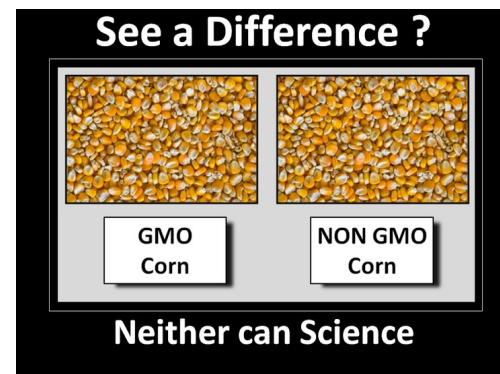
¹Estimated numbers from DuPont Pioneer based on studies from recent biotech applications. ²Includes agencies reviewing new biotechnology applications from 62 individual countries and 28 EU member countries. ³Country count cited from ISAAA.org

Which Food Would YOU Eat?



- No Testing
- No Regulatory Oversight
- Contains Known Allergen
- 9,000 Hospitalizations Per Year

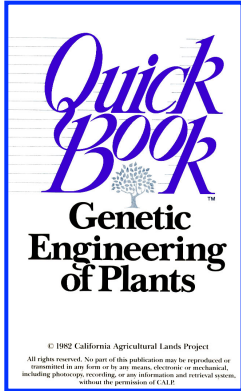
- Extensive Testing (~10 years)
- FDA, USDA, & EPA Oversight
- Eaten By Billions of People
- **No Documented Health Problems**



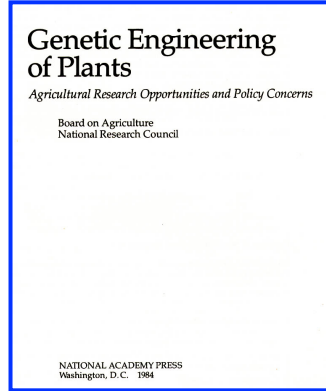
Researchers Develop First Hypoallergenic Soybeans

*Will These Ever Get To
The Market?*

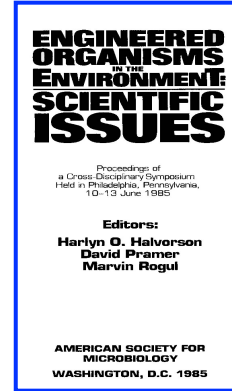
Safety Issues of Genetically Engineered Plants Have Been Investigated and Discussed For 35 Years - Thousands of Studies - Unanimous Conclusion - GMOs are Safe For Human Consumption!!



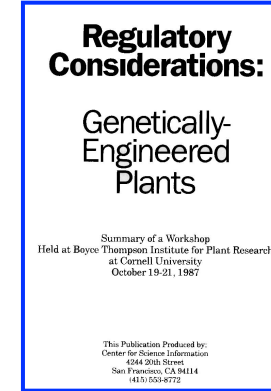
1982



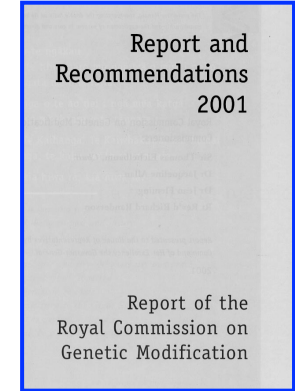
1984



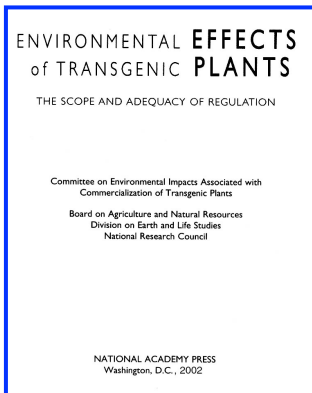
1985



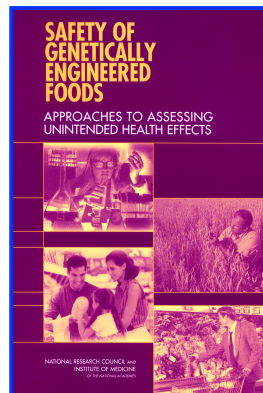
1987



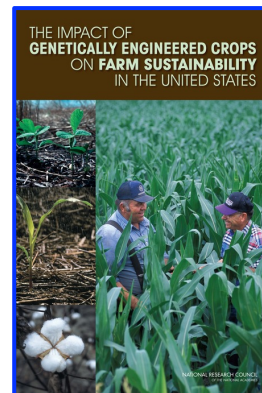
2001



2002



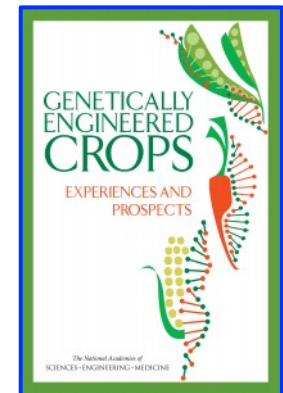
2004



2010



2011



2016



"The AMA adopted policy supporting this science-based approach, recognizing that there currently is **no evidence** that there are material differences or safety concerns in available bioengineered foods."



"To date **no adverse health effects** attributed to genetic engineering have been documented in human populations."

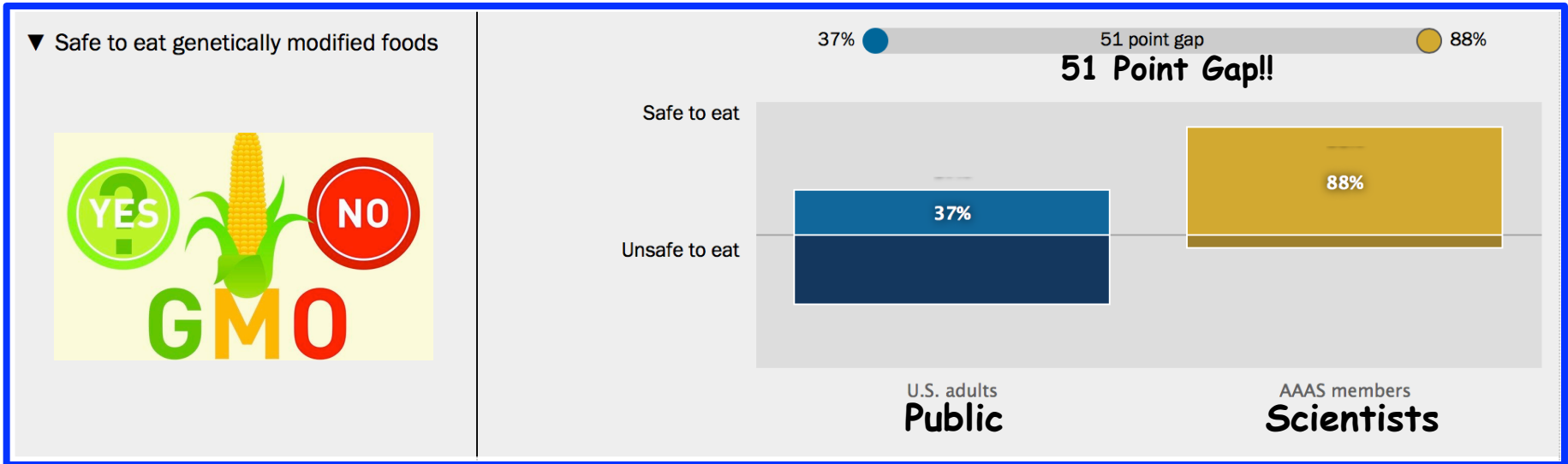


"The scientific literature shows **no compelling evidence** to associate such crops, now cultivated worldwide for more than 15 years, with risks to the environment or with safety hazards for food."

There Is Major Public Skepticism About GMOs!!!



PewResearchCenter Public and Scientists' Views on Science and Society 2015



How Do We Change This?





Some Benefits of Biotech Crops - Dispelling the Myths (1996-2014)

- Increased Crop Value by \$78B**
- ~75% of Crop Added Value Went to Small Farmers**
- Reduced Pesticide Use 37% or 200M Pounds!**
- Reduced CO₂ Emissions by 40B Pounds or the Equivalent of Taking 9M Cars Off the Road**
- Saved Billions of Tons of Topsoil by Using No-Till Farming (1B per year)**
- Improved the Health of Farmers in Developing Countries (Reduced Pesticides)**
- Contributed to Reduced Food Costs in the US and Elsewhere**



A Meta-Analysis of the Impacts of Genetically Modified Crops

Funded by German Federal Ministry of Development & European Union

Wilhelm Klümper, Matin Qaim*

Department of Agricultural Economics and Rural Development, Georg-August-University of Goettingen, Goettingen, Germany

Abstract

Background: Despite the rapid adoption of genetically modified (GM) crops by farmers in many countries, controversies about this technology continue. Uncertainty about GM crop impacts is one reason for widespread public suspicion.

Objective: We carry out a meta-analysis of the agronomic and economic impacts of GM crops to consolidate the evidence.

Data Sources: Original studies for inclusion were identified through keyword searches in ISI Web of Knowledge, Google Scholar, EconLit, and AgEcon Search.

Study Eligibility Criteria: Studies were included when they build on primary data from farm surveys or field trials anywhere in the world, and when they report impacts of GM soybean, maize, or cotton on crop yields, pesticide use, and/or farmer profits. In total, 147 original studies were included.

Synthesis Methods: Analysis of mean impacts and meta-regressions to examine factors that influence outcomes.

Results: On average, GM technology adoption has reduced chemical pesticide use by 37%, increased crop yields by 22%, and increased farmer profits by 68%. Yield gains and pesticide reductions are larger for insect-resistant crops than for herbicide-tolerant crops. Yield and profit gains are higher in developing countries than in developed countries.

Limitations: Several of the original studies did not report sample sizes and measures of variance.

Conclusion: The meta-analysis reveals robust evidence of GM crop benefits for farmers in developed and developing countries. Such evidence may help to gradually increase public trust in this technology.

However... There's a Battle Raging to Get Bioengineered Crops Banned in Many Parts of the World



Los Angeles Proposes Banning GMOs

NO ON 37
STOP THE DECEPTIVE
FOOD LABELING SCHEME



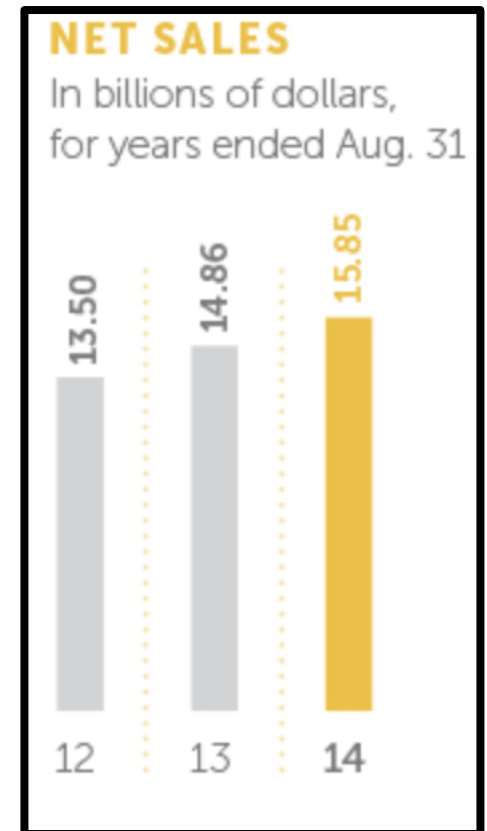
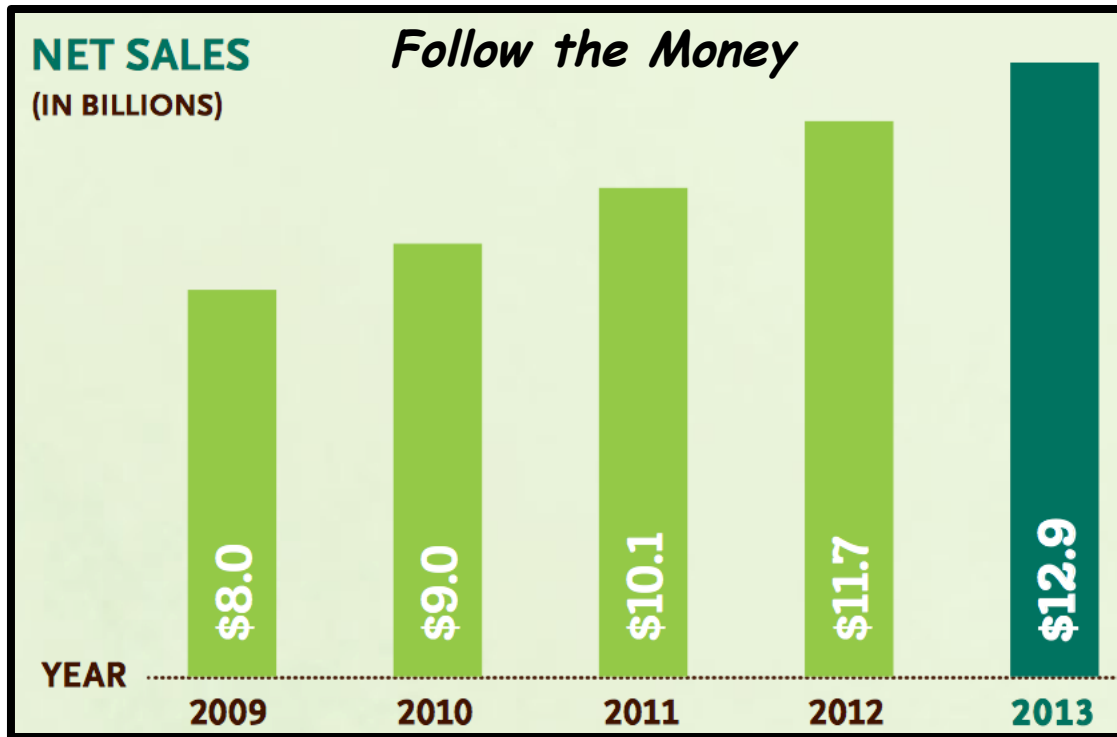
The GMO "Controversy" is Complex and Not Science Based



- *Successful Well-Financed Anti-GMO "Propaganda" Campaign*
- *Perceived "Negative" Health Effects*
- *Bogus Science Studies Sensationalized by the Popular Media*
- *Organic Growers/Markets - Gain Market Share (Follow the \$!!)*
- *Anti-Globalization - Anti-Patent/Intellectual Property*
- *Industrial-Oriented Conventional Farming That Uses GMOs*
- *Anti-Large American AgBiotech Companies (e.g., Monsanto)*
- *Labeling - Right to Know and Choose What is Eaten*
- *"Perceived" Negative Health Effects*
- *No Obvious Consumer Benefits*
- *Ecological & Environmental Issues (e.g., Pollen Flow)*
- *Lack of Public Science Awareness*



A Tale of Two Giants



What Has Been Some of the *Real Life* Affects of the *GMO Controversy*?

AFRICAN COUNTRIES REJECT GM FOOD AID

Zimbabwe and Zambia have rejected genetically modified food donations intended to avert drought-induced food shortages. Wisdom Mdzungairi reports for Harare that participants to an international conference on genetic engineering and sustainable agriculture in Lusaka, Zambia commended the countries' decision to mill some of the donated food instead.

Dr. Luke Mumba, chairman of the Biosafety Council of Zambia and research of the University of Zambia, commented that while there was respect for the two countries' decision, there was need to adopt safe biotechnological advances, and that the use of GM technology could contribute to the complex problems of alleviating poverty and malnutrition. Meanwhile, Zambian Minister of Science and Technology Judith Kapijimpanga said the problem of food insecurity in Africa was a result of complex issues that required an integrated approach for sustainability.

See the article in <http://allafrica.com/stories/200510110710.html>.

Destroying Golden Rice Test Plots



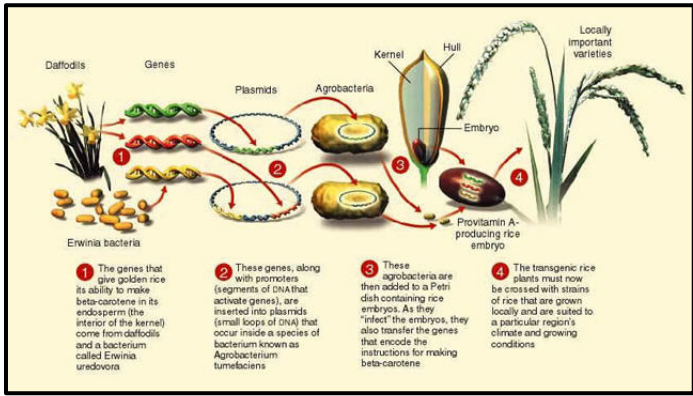
Greenpeace's Crime Against Humanity

8 Million Children Dead

AllowGoldenRiceNow.org



Nobel Laureates Line Up To Support GMOs And Push Back Greenpeace





The End...or The Beginning?

