

Selected Evidence-Based Scientific References

- Lemaux, P. (2008) Annual Review Plant Biology 59, 771-812
- Lemaux, P. (2009) Annual Review Plant Biology 60, 511-559
- Parrott, W. (2010) New Biotechnology, 27, 545-551
- Williams, M. (2013) *Plant Cell*, Teaching Tools in Plant Biology, October, 2013, 1-14
- Smith-Spangler et al. (2012) Ann Intern Med, 157-366

The Politics of GMOs













Genetically modified crops could help improve the lives of millions

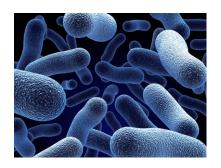
L.A. council to weigh ban on growing genetically modified crops

Editorial Sowing the seeds of an illogical crop ban

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?

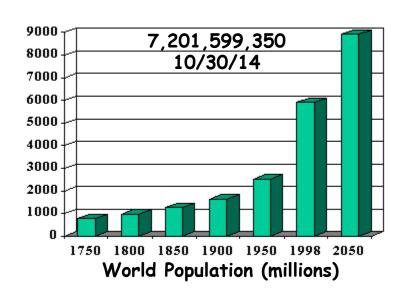


A Genetically Engineered Person With a Gene That They Weren't Born With That "Cures" a Lethal Genetic Disease?

What's a GMO?



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!!!!

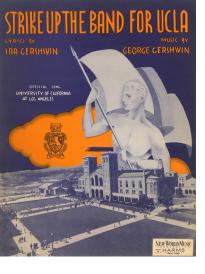
CROP YIELDS NEED TO BE INCREASED SIGNIFICANTLY!!

3,000 Acres/Day of Productive Farmland is Lost to Development Each Day in the United States

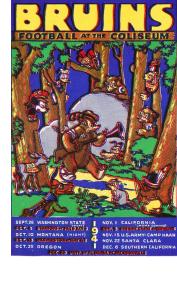




"Major Land Uses Overview." USDA, Economic Research Service, Web, April 3, 2013.



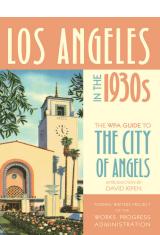




An Example From UCLA & Los Angeles History....



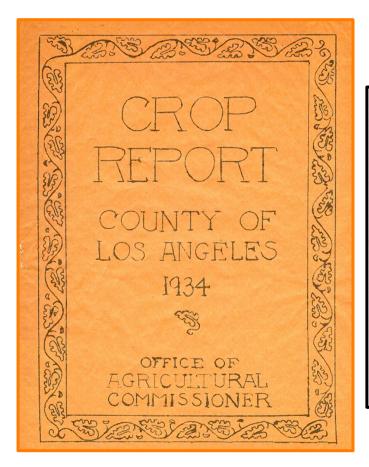




Aerial Photograph of UCLA in 1929



A Sample of LA County Agriculture in the 1930s

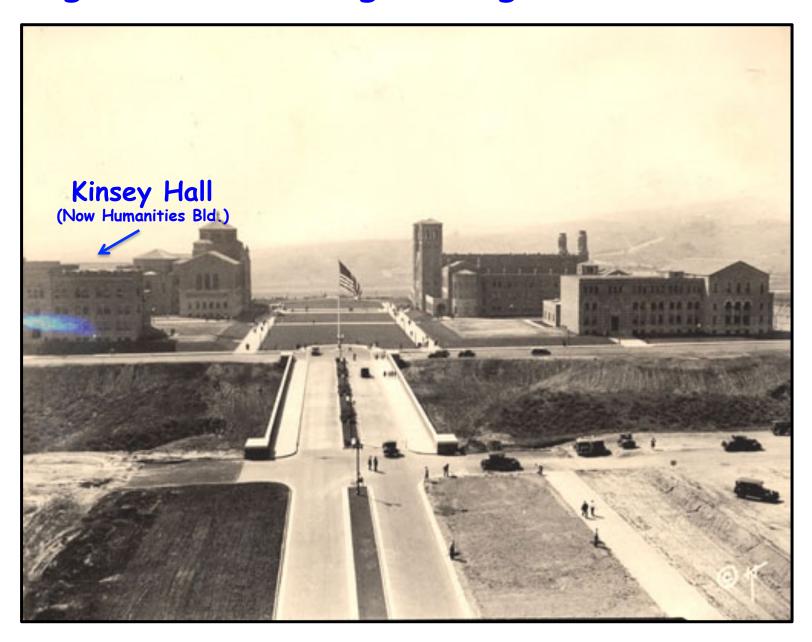


CITRUS FRUITS* Cranges Lemons Grapefruit	44,566 11,134 712 56,412	9,211,900 2,063,000 190,800	boxes "	\$ 17,786,100 5,923,000 305,700 \$ 24,014,800
OTHER FRUITS & NUTS Apples Apricots Almonds Avocados** Figs Grapes-table Grapes-wine	441 944 1,008 2,191 772 1,919 2,550)	17,600 2,800 504,000 4,260,000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

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

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

Original UCLA College of Agriculture-1930



UNIVERSITY OF CALIFORNIA BULLETIN

General Catalogue

1939-40

DEPARTMENTS AT LOS ANGELES

For sale by the
STUDENTS COÖPERATIVE BOOK STORE, LOS ANGELES
PRICE, TWENTY-FIVE CENTS

COLLEGE OF AGRICULTURE

THE COLLEGE OF AGRICULTURE of the University of California offers at Los Angeles the Plant Science curriculum and the major in Subtropical Horticulture leading to the Bachelor of Science degree. Students electing other majors in this curriculum may spend the freshman and sophomore years at Los Angeles and then transfer to the campus where their major work is offered. Graduate work in agriculture is also offered which leads to the degrees of Master of Science and Doctor of Philosophy.

Students electing other curricula in the College of Agriculture—Animal Science, Agricultural Economics, Entomology and Parasitology, Forestry, Soil Science, Home Economics, and Agricultural Education—and those electing the curriculum in Agricultural Engineering, may spend the first two years at Los Angeles and then transfer to Berkeley or Davis without serious loss of time. Students who plan to major in Landscape Design are advised to transfer to Berkeley at the beginning of the sophomore year. Students who register at Los Angeles with the intention of later transferring to Berkeley or Davis to pursue other curricula or to obtain majors in the Plant Science curriculum other than Subtropical Horticulture are requested to consult the Prospectus of the College of Agriculture and the appropriate adviser in Agriculture at Los Angeles.

108. Fruit Physiology and Storage Problems. (2) I.



Mr. Biale

Lectures and discussions, two hours.

Prerequisite: consent of the instructor.

Ripening processes of fruit on the tree; maturity standards and tests; ripening and respiration as affected by ethylene gas treatment; chemical and physiological changes at low temperatures; cold storage and refrigerated gas storage; role of volatile substances; differences in species and varietal responses.

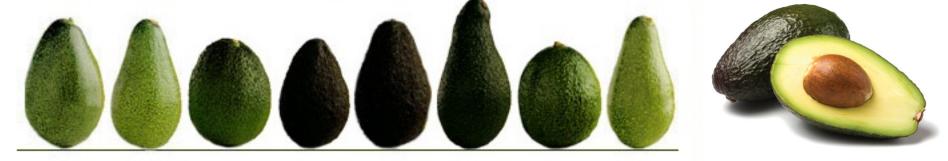


Origins of Avocado Research

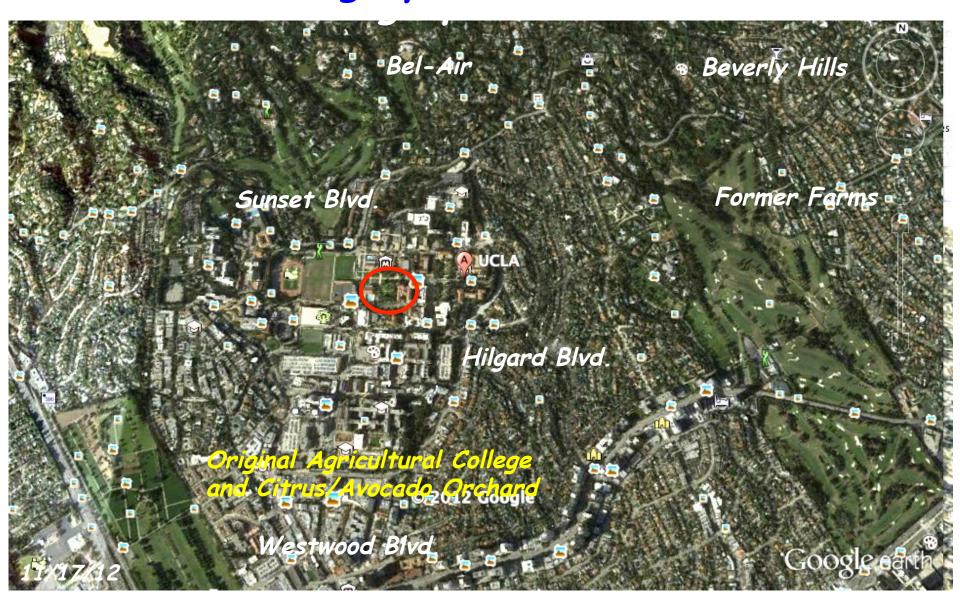




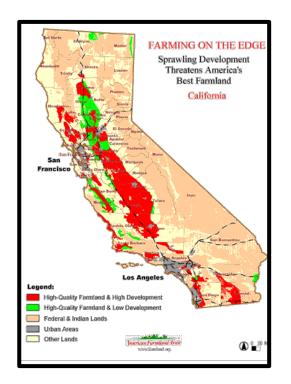
Avocado Variety Chart

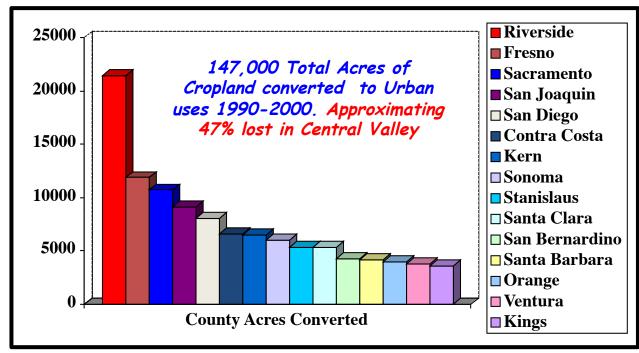


Aerial Photograph of UCLA in 2014



California Conversion of Cropland to Urban Uses is Occurring Statewide - Crop Yields Need to Be Increased!!





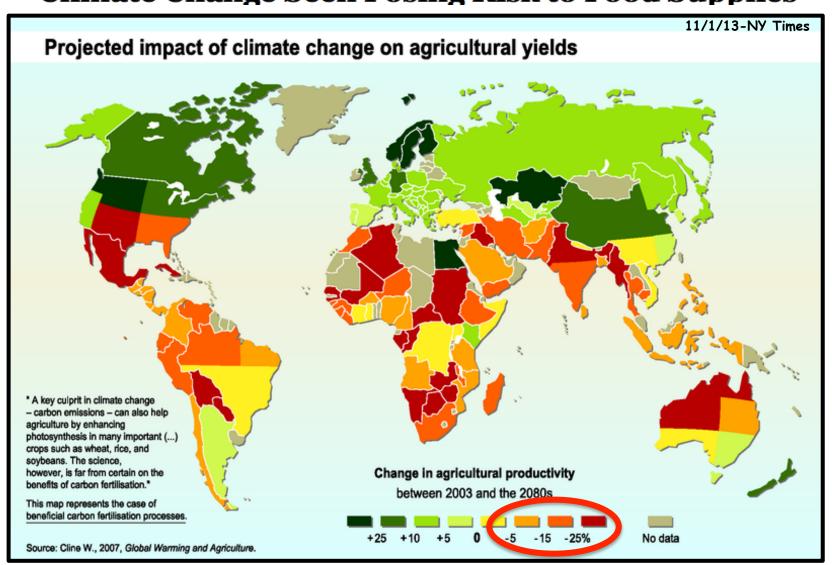
12,000,000 Total Acres of Cropland
15,000,000 Total Acres of Grazing Land

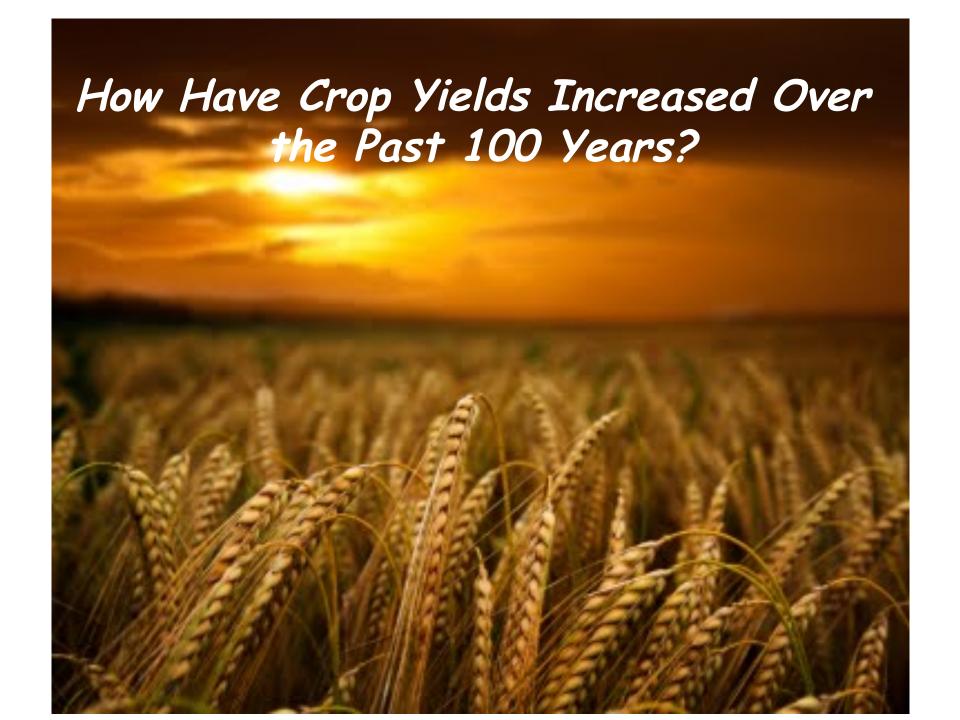


Climate Change Will Also Have a Major Impact on Crop Yields in the Future!



Climate Change Seen Posing Risk to Food Supplies



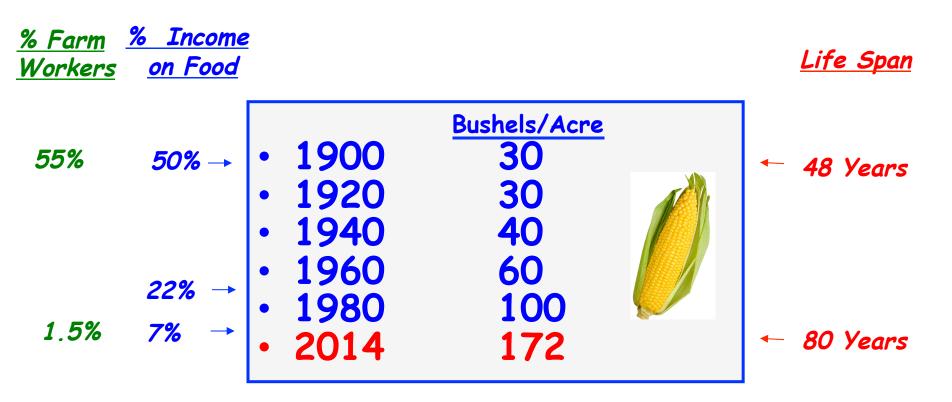


THE ADMINISTRATION'S PROMISES HAVE BEEN KEPT

Big Changes in the US Over The Past 100 Years "We've Come a Long Way Baby"

	1900	2014
Life Expectancy	48 (women)	81 (women)
Average Family Income (2014 Dollars)	\$8,000	\$50,000
Gasoline Use Per Capita	34 gallons	1,100 gallons
Flush Toilets Per Housing Unit	10% CAN FLAG	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



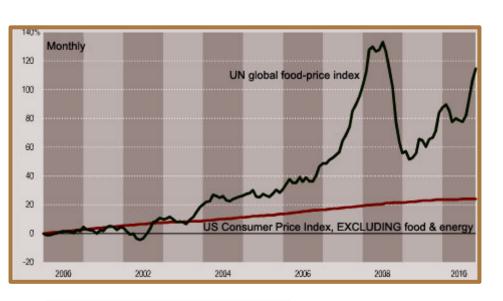
<u>1930:</u> 30 bushels/acre <u>2014:</u> 172 bushels/acre

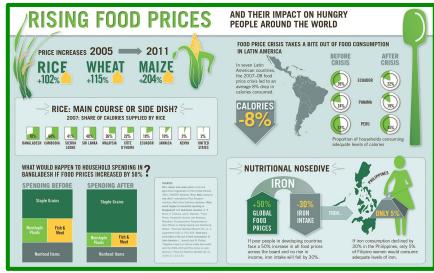
1930: 1 farmer fed 10 people 2014: 1 farmer feeds 200 people

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



World Crop Production is Leveling Off on a Per Capita Basis-Higher Prices Ahead?



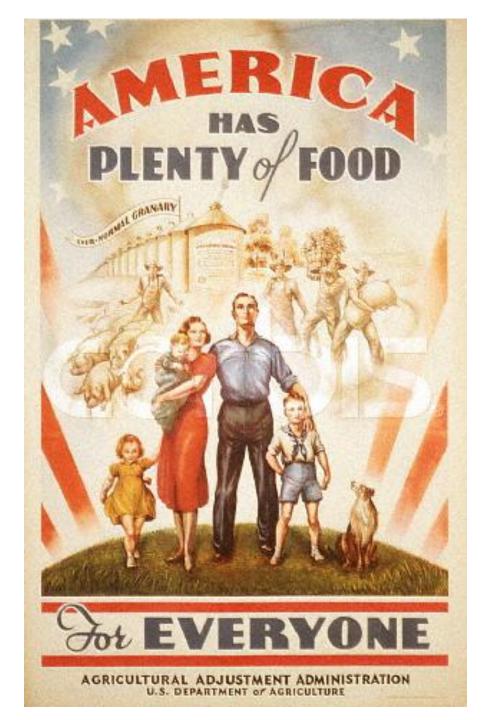


Food riots fear after rice price hits a high

Rising food prices: A global crisis

Action needed now to avert poverty and hunger

Yields Need to Increase to Produce More Food & Grow More on Less Land





How Was This Accomplished Over the Past 100 Years?

What Role Did Science & Technology Play in Increasing Crop Yields?

What About in the Future
When There are 350 Million
People in the USA and
9 Billion in the World?



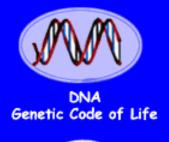




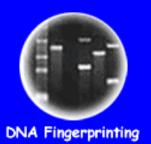














Cloning: Ethical Issues and Future Consequences



Plants of Tomorrow

Science is NOT "Hocus Pocus" or Based on Opinions and Beliefs







Science is Based on Observation, Hypothesis Testing, Rigorous Experimentation, and Verification

•Technology, or the Application of Scientific Knowledge, Has Transformed Dramatically Our Lives and How We Live

It's Not Politics or Talk Showology!!!

The Past 100 Years Has Produced a Revolution in Genetic Research and Knowledge Leading to Remarkable Advances in Medicine and Agriculture

1900: Rediscovery of Mendel's Work



DeVries, Correns and Tschermak independently rediscover Mendel's work.

Three botanists - Hugo DeVries, Carl Correns and Erich von Tschermak - independently rediscovered Mendel's work in the same year, a generation after Mendel published his papers. They helped expand awareness of the Mendelian laws of inheritance in the scientific world.

The three Europeans, unknown to each other, were working on different plant hybrids when they each worked out the laws of inheritance. When they reviewed the literature before publishing their own results, they were startled to find

Mendel's old papers spelling out those laws in detail. Each man announced Mendel's discoveries and his own work as confirmation of them.

1909: The Word Gene Coined



Danish botanist Wilhelm Johannsen coined the word gene to describe the Mendelian units of heredity.

He also made the distinction between the outward appearance of an individual (phenotype) and its genetic traits (genetype).

Four years earlier, William Bateson, an early geneticist and a proponent of Mendel's ideas, had used the word genetics in a letter; he felt the need for a new term to describe the study of heredity and inherited variations. But the term didn't start spreading until Wilhelm Johannsen suggested that the Mendelian factors of inheritance be called genes.

The proposed word traced from the Greek word genos, meaning "birth". The word spawned others, like genome.

1911: Fruit Flies Illuminate the Chromosome Theory



Using fruit flies as a model organism, Thomas Hunt Morgan and his group at Columbia University showed that genes, strung on chromosomes, are the units of heredity.

Morgan and his students made many important contributions to genetics. His students, who included such important geneticists as Alfred Sturtevant, Hermann Muller and Calvin Bridges, studied the fruit fly *Drosophila melanogaster*. They showed that chromosomes carry genes, discovered genetic linkage - the fact that genes are arrayed on linear chromosomes - and described chromosome recombination.

In 1933, Morgan received the Nobel Prize in Physiology or Medicine for helping establish the chromosome theory of inheritance.



1973: Genetic Engineering is Invented

Biochemists working in California have developed a practical method of transplanting genes, the chemical units of heredity, from cells as complex as those of animals into the extremely simple, fast-multiplying cells known as bacteria. [END OF FIRST PARAGRAPH]



1983: First Genetically Engineered Plant



1990: First Genetically Engineered Human



2004: Refined Analysis of Complete Human Genome Sequence



The International Human Gene Sequencing Consortium led in the United States by the National Human Genome Research Institute and the Department of Energy buildhed a description of the Infished human gene sequence. The analysis reduced the estimated to only 20,000-2500. The fact that the human genome has far fewer greens than was originally thought suggests that humans "get more" out of their genetic information than do other animats. For example, the everage human gene is able to produce in a second or second to the control of the cont

The finished sequence contains 2.85 sillion nucleotides interrupted by only 341 agas, 12 covers 9.9 across 1, 350 per total configures and interrupted 2, 288 other 0.84 sequences that explains the existence of 1959 protein-coding genes and interrupted 2, 288 other 0.84 segments that are thought to be protein-coding genes. Although the genema sequence is described as "finished," it tank perfect. The annual gass that remain came to be exponenced by the influental celements used by the influental Genema sequence of the contract of the con

20110: Era of Synthetic Biology Begins -

Genome Synthesized From Chemicals



2013: Genome Sequencing Explosion





FERTUZER

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!

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

Seed Crops



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

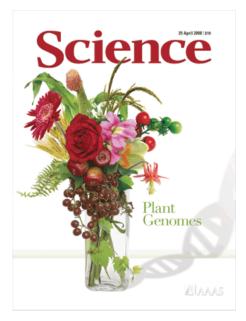
Non-Seed Crops

- 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!!!!!

2014 - The Genomics Revolution Goes Green!!!







A Rich Harvest of Plant Genes & Basic Plant Processes!





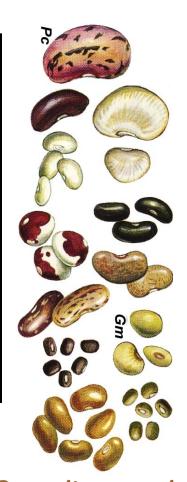




...By Using a Variety of Approaches to Identify Genes and Processes That Will Help Increase Crop Yields and Food Production Significantly in the 21st Century....

Yield (Developmental Traits)

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



<u> Yield (Stress Traits)</u>

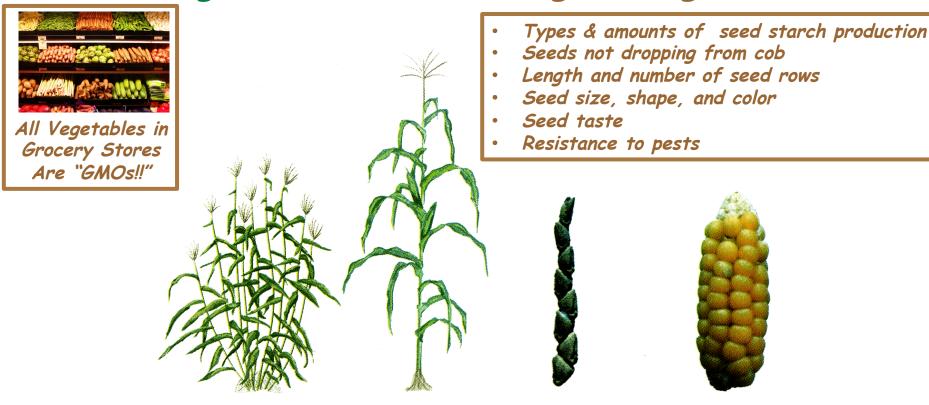
- · Nutrient Uptake
- · Drought Resistance
- · Heat Resistance
- · Cold Tolerance
- Salt Tolerance
- · Shade Tolerance
- · Disease Resistance





...... 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!!



Teosinte Domesticated corn

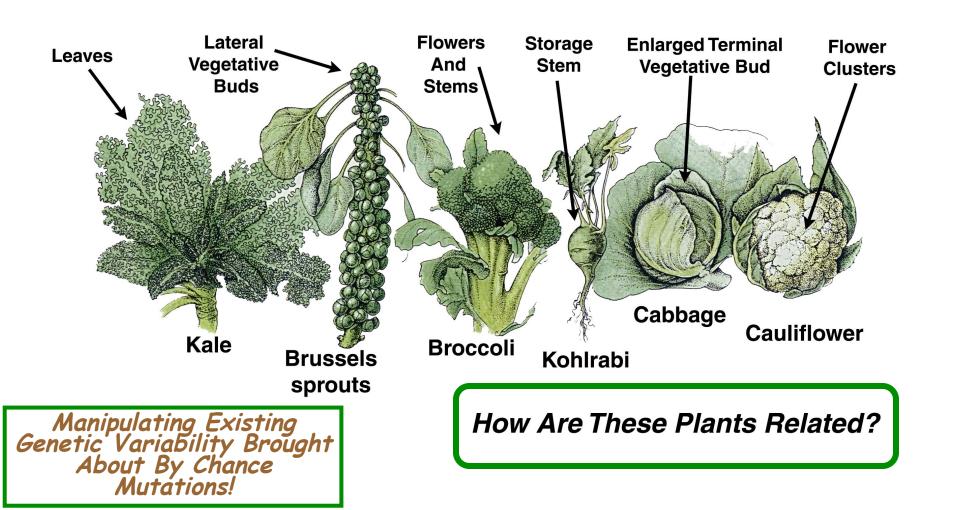
Teosinte

Early domesticated corn

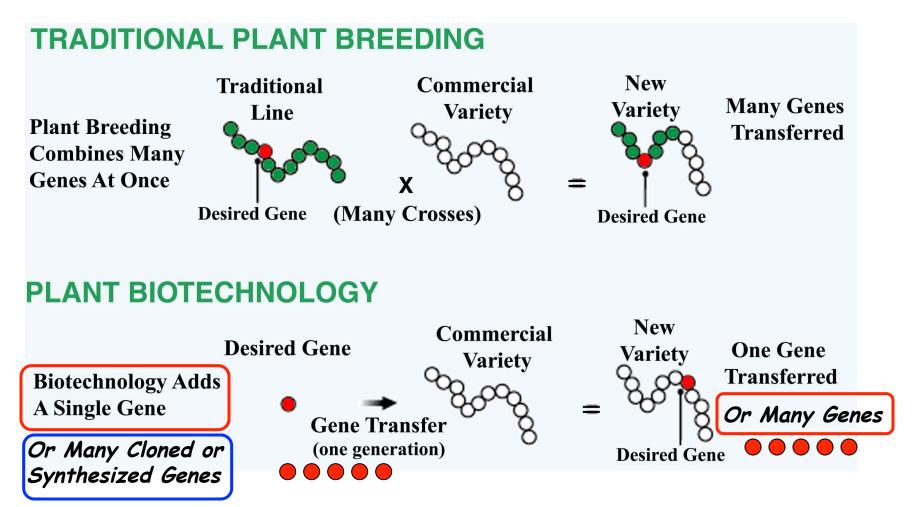
Note: Architecture and Fruit (cob) Size

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

Engineering Vegetables With Different Plant Architectures



Classical vs. Molecular Genetic Engineering Techniques



Both Manipulate Genes - But in Different Ways!!

Plants Have Been Engineered For Large Numbers of Traits in Laboratories Around the World -And More Exciting Traits to Come! Tens of Thousands of Genetic Engineering Experiments!!

Genetically Engineered Traits

Improving Pest and Weed Management

Herbicide tolerance Virus resistance Insect resistance Bacterial resistance Fungal resistance

Chemical Free Crops

Improving Agronomic Properties

Crops in Desert & Drought

Longer

Lasting

Crops

Altering cold sensitivity
Improving water stress tolerance
Improving salt tolerance
Improving nutrient uptake
Drought Resistance*

Improving PostHarvest Qualities

Delay of fruit ripening
Delay of flower senescence/timing
High-solids tomatoes

High-starch potatoes
Sweeter vegetables

Improving Plant Breeding

Male sterility; production of hybrid seeds

Improving Nutritional Quality

High-methionine and high-lysine seeds

Decaffeinated Coffee*
Vitamin-enriched grains
Allergen-free seeds/grains*

Molecular Farming

Oils Starch

Plastic

Enzymes, Pharmaceuticals Ethanol/Transportation Fuel*

Detoxifying Contaminated Soils

oils

Crops as

Factories &

*Vaccines

Clean Environment

Crops to

*Healthiei

Crops

But Only a Few Have Helped Generate New Crops! The "Simple Ones With Economic Drivers"

Genetic Engineering Examples















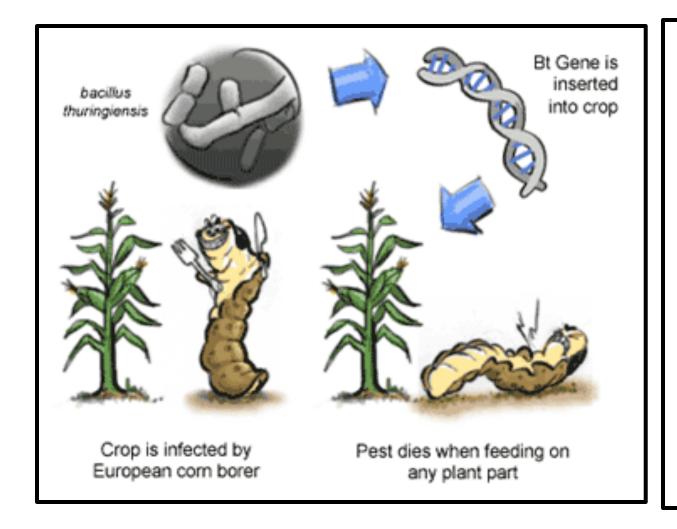






How to Make an Insect-Resistant Plant?









MSECT RESISTANCE with Bt

CONTROL

Вŀ

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.



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?

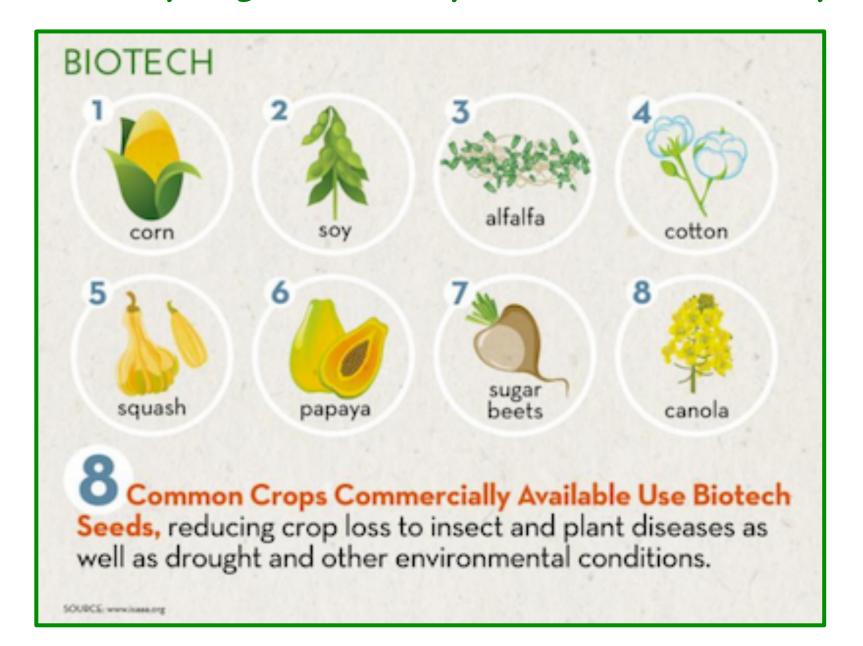
> Bt is one of the safest natural pesticides you can use to control caterpillar pests without harming beneficial insects.

Photo Courtesy Safe Brand



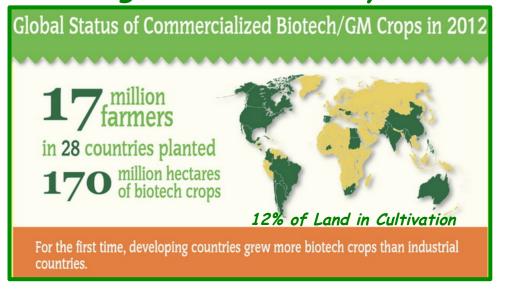


Genetically Engineered Crops in Cultivation Today



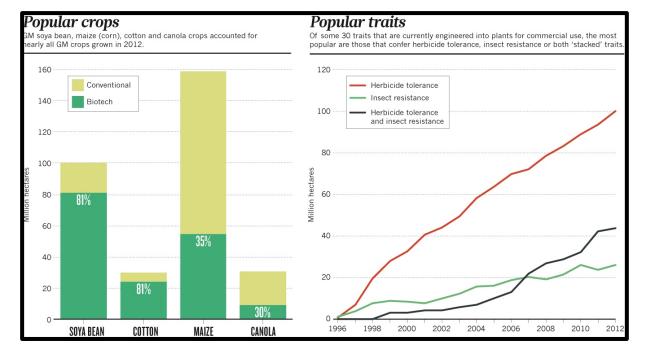
Genetic Engineering - Most Rapidly Adopted Technology in Agricultural History





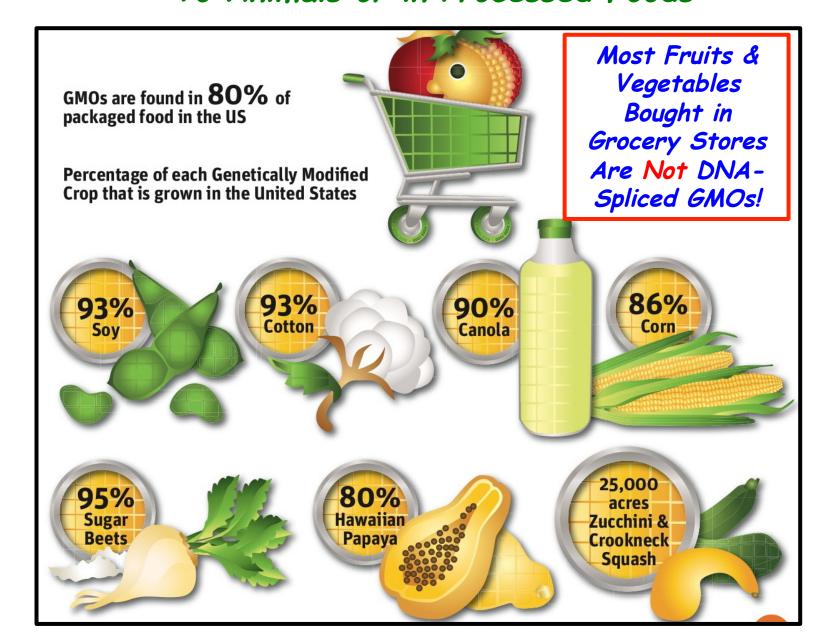




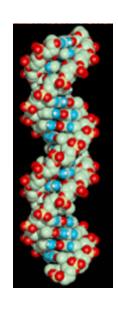




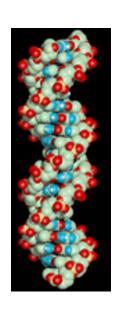
Most Genetically Engineered Crops Are Fed To Animals or in Processed Foods



WHAT ABOUT SAFETY? 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?

TABLE 12.1 PRIMARY FEDERAL REGULATORY AGENCIES IN THE UNITED STATES

Regulatory Oversight of Biotechnology Products Agency	Product Regulated
U.S. Department of Agriculture	Plants, plant pests (including microorganisms), animal vaccines
Environmental Protection Agency	Microbial/plant pesticides, other toxic substances, microorganisms, animals producing toxic substances
U.S. Food and Drug Administration	Food, animal feeds, food additives, human and animal drugs, human vaccines, medical devices, transgenic animals, cosmetics

Major Laws that Empower Federal Agencies to Regulate Biotechnology

Law	Agency	Γ
The Plant Protection Act	USDA	
The Meat Inspection Act	USDA	
The Poultry Products Inspection Act	USDA	
The Eggs Products Inspection Act	USDA	
The Virus Serum Toxin Act	USDA	
The Federal Insecticide, Fungicide, and Rodenticide Act	EPA	
The Toxic Substances Control Act	EPA	
The Food, Drug, and Cosmetics Act	FDA, EPA	
The Public Health Service Act	FDA	L
The Dietary Supplement Health and Education Act	FDA	
The National Environmental Protection Act	USDA, EPA, FD	λ

GM Crops Are the Most Tested Crops In Agricultural History

There is NO Testing
For
Conventional or
Organic
Foods!

Education, Inc.

Which Food Would YOU Eat?

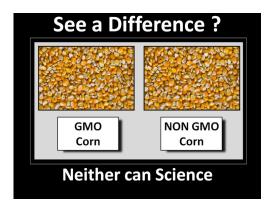


- No Testing
- No Regulatory Oversight
- Contains Known Allergen
- 200 People Die Each Year

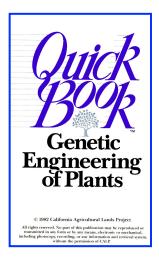


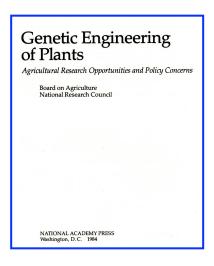


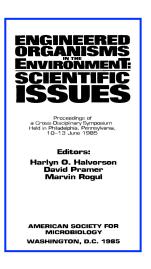
- Extensive Testing (~10 years)
- FDA, USDA, & EPA Oversight
- Eaten By Billions of People
- No Documented Health Problems

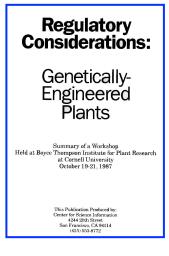


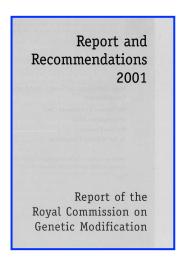
Safety Issues of Genetically Engineered Plants Have Been Investigated and Discussed For 30 Years - Thousands of Studies - Unanimous Conclusion - <u>GMOs are Safe For Human Consumption!!</u>







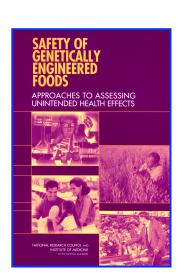


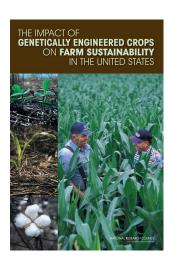


1982 1984 1985 1987 2001

ENVIRONMENTAL EFFECTS
of TRANSGENIC PLANTS
THE SCOPE AND ADEQUACY OF REGULATION

Committee on Environmental Impacts Associated with Commercialization of Transgenic Plants
Board on Agricultura and Natural Resources
Division on Earth and Life Studies
National Research Council







2002 2004 2010 2011



"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."

Critical Reviews in Biotechnology

http://informahealthcare.com/bty ISSN: 0738-8551 (print), 1549-7801 (electronic)

Crit Rev Biotechnol, Early Online: 1–12 © 2013 Informa Healthcare USA, Inc. DOI: 10.3109/07388551.2013.823595



REVIEW ARTICLE

An overview of the last 10 years of genetically engineered crop safety research

Alessandro Nicolia^{1*}, Alberto Manzo², Fabio Veronesi¹, and Daniele Rosellini¹

¹Department of Applied Biology, Faculty of Agriculture, University of Perugia, Perugia, Italy and ²Ministry of Agriculture, Food and Forestry Policies (MiPAAF), Rome, Italy

Abstract

The technology to produce genetically engineered (GE) plants is celebrating its 30th anniversary and one of the major achievements has been the development of GE crops. The safety of GE crops is crucial for their adoption and has been the object of intense research work often ignored in the public debate. We have reviewed the scientific literature on GE crop safety during the last 10 years, built a classified and manageable list of scientific papers, and analyzed the distribution and composition of the published literature. We selected original research papers, reviews, relevant opinions and reports addressing all the major issues that emerged in the debate on GE crops, trying to catch the scientific consensus that has matured since GE plants became widely cultivated worldwide. The scientific research conducted so far has not detected any significant hazards directly connected with the use of GE crops; however, the debate is still intense. An improvement in the efficacy of scientific communication could have a significant impact on the future of agricultural GE. Our collection of scientific records is available to researchers, communicators and teachers at all levels to help create an informed, balanced public perception on the important issue of GE use in agriculture.

Keywords

Biodiversity, environment, feed, food, gene flow, –omics, substantial equivalence, traceability

History

Received 17 December 2012 Revised 24 June 2013 Accepted 24 June 2013 Published online 13 September 2013



Journal of Animal Science



The premier journal and leading source of new knowledge and perspective in animal science

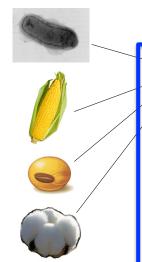
Prevalence and impacts of genetically engineered feedstuffs on livestock populations A. L. Van Eenennaam and A. E. Young

J ANIM SCI 2014, 92:4255-4278. doi: 10.2527/jas.2014-8124 originally published online September 2, 2014

Conclusions

Commercial livestock populations are the largest consumers of GE crops, and globally, billions of animals have been eating GE feed for almost 2 decades. An extensive search of peer-reviewed literature and field observations of animals fed diets containing GE crop products have revealed no unexpected perturbations or disturbing trends in animal performance or health indicators. Likewise, it is not possible to distinguish any differences in the nutritional profile of animal products following consumption of GE feed. Animal agricul-

Here's the Irony.....The Engineered Protein in GMO Soybeans is a Protein that Occurs Naturally in All Plants and that You Eat Everyday in Organic and Non-GMO Vegetables!!!



Bacteria Corn Soybean -MAOVSRVHNLAOSTOIFGHSSNSNKLKSVNSVSLRPRLWGASKSRIPMHKNGSFMGNFNVGKGNSGVFKVSASVAAAEKPS 81 Cotton MATOVGKIYNGTOKTCVLPNVSKTONPKHVPFVSFKSNLNGKTSSWGLVVKNNGKFGSIKARS----LKVSASTATAEKPS 77 Bacteria MIELTITPPDHPLSGKVEPPGSKSITNRALLLAGLAKGKSRLTGALKSDDTLYMAEALREMGVKVT-EPDATTFVVEGTG-- 79 GAEEIVLOPIKEISGTVKLPGSKSLSNRILLLAALSEGTTVVDNLLNSEDVHYMLGALRTLGLSVEADKAAKRAVVVGCGGK 83 Corn TSPEIVLEPIKDFSGTITLPGSKSLSNRILLLAALSEGTTVVDNLLYSEDIHYMLGALRTLGLRVEDDKTTKQAIVEGCGGL 163 Sovbean Cotton RASEIVLOPINEISGTVKLPGSKSLSNRILLLAALSEGTTVVENLLNSDDVHHMLVALGKLGLYVKHDSEKKOAIVEGCGGO 159 Bacteria ----VLOOPEKPLFLGNAGTATRFLTAAAALVDG--AVIIDGDEHMRKRPIMPLVEALRSLGVEAEAPTG--CPPVTVCGKG 153 FPVEDAK-EEVOLFLGNAGTAMRPLTAAVTAAGGNATYVLDGVPRMRERPIGDLVVGLKOLGADVDCFLGTDCPPVRVNGIG 164 Corn FPTSKESKDEINLFLGNAGTAMRPLTAAVVAAGGNASYVLDGVPRMRERPIGDLVAGLKQLGADVDCFLGTNCPPVRVNGKG 245 Soybean Cotton FPVGKGEGOEIELFLGNAGTAMRPLTAAITAAGGNSSYVLDGVPRMRERPIGDLVTGLKOLGADVDCILGTNCPPVRIEGKG 241 Bacteria TGFPKGSVTIDANLSSOYVSALLMAAACGDKPVDIVLKGEEIGAKGYIDLTTSAMEAFGAKIERVSNAIWRVHPTG---YTA 232 Corn -GLPGGKVKLSGSISSOYLSALLMAAPLALGDVEIEIIDKLISIP-YVEMTLRLMERFGVKAEHSDSWDRFYIKGGOKYKSP 244 Soybean -GLPGGKVKLSGSVSSQYLTALLMAAPLALGDVEIEIVDKLISVP-YVEMTLKLMERFGVSVEHSGNWDRFLVHGGQKYKSP 325 Cotton -GLPGGKVKLSGSISSQYLTALLMAAPLALGDVEIEIIDKLISIP-YVEMTMKLMERFGVTVEHTDSWDRFFIRGGQKYMSP 321 Bacteria TDFHIEPDASAATYLWGAELLTGGAIDIGTPADKFTOPDAKAYDVMAKF-----PHLPAEIDG----- 289 KNAYVEGDASSASYFLAGAAITGGTVTVEGCGTTSLOGDVKFAEVLEMMGAKVTWTETSVTVTGPPREPFGRKHLKAIDVNM 326 Corn GNAFVEGDASSASYLLAGAAITGGTITVNGCGTSSLQGDVKFAEVLEKMGAKVTWSENSVTVSGPPRDFSGRKVLRGIDVNM 407 Soybean GNAYVEGDASSASYFLAGAAVTGGTVTVEGCGTSSLQGDVKFAEVLEMMGAKVTWTENSVTVTGPPRNSSGRKHLRAIDVNM 403 Cotton Bacteria SOMODAIPTIAVLAAFNETPVRFVGIANLRVKECDRIRAVSLGLNEIRNGLAHEEGDDLIVHADPALAGOTVKASIDTFADH 371 NKMPDVAMTLAVVALFADGPTAIRDVASWRVKETERMVAIRTELTKL--GASVEEGPDYCIITPPEKLNVT---AIDTYDDH Corn NKMPDVAMTLAVVALFANGPTAIRDVASWRVKETERMIAICTELRKL--GATVEEGPDYCVITPPEKLNVT---AIDTYDDH Soybean NKMPDVAMTLAVVALYADGPTAIRDVASWRVKETERMIAICTELRKL--GATVEEGPDYCVITPPEKLNVT---AIDTYDDH 480 Cotton Bacteria RIAMSFALAALKIGGIAIONPACVGKTYPGYWKALASLGVDYTEKESAAEPOH 425 RMAMAFSLAACAEVPVTIRDPGCTRKTFPDYFDVLSTFVKN------Corn Soybean RMAMAFSLAACGDVPVTIKDPGCTRKTFPDYFEVLERLTKH------RMAMAFSLAACAEVPVTIKDPGCTRKTFPDYFEVLDRVTKH------Cotton













Some Benefits of Biotech Crops - Dispelling the Myths (1996-2013)

- Increased Crop Value by \$78B
- ~75% of Crop Added Value Went to Small Farmers
- Reduced Pesticide Use 10% 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

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

















Los Angeles Proposes Banning GMOs



The GMO "Controversy" is Complex and Not Science Based



- Organic Growers/Markets Gain Market Share (Follow the \$!!)
- Pollen Flow & Transgene "Contamination" Native Species "Contamination" With GMO Transgenes
- Ideology /Anti-Technology / Anti-Science/ Not "Natural"
- Labeling Right to Know and Choose What is Eaten (CA-Proposition 37)
- No "Obvious" Consumer Benefit
- Unsafe "Perceived" Negative Health Effects
- Mistrust of International/US Corporations (Monsanto!)/ Anti-Market
- Anti-Globalization Anti-Patent/Intellectual Property
- Ecological & Environmental Issues Lack of Confidence in Government - No Strong USDA, FDA, or EPA Tradition in Europe (Protect Food Supply - Mad Cow - Dioxin)!
- Industrial-Oriented Conventional Farming That Uses GMOs
- Lack of Public Science Awareness



August 18, 2002

Zambia Bars Altered Corn From U.S.

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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.



Finally - What About Organic Foods?



- Follow Strict Organic Standards
- No Synthetic Pesticides
- No Modern Genetic Engineering
- Small % of US Agriculture
- · Goal-Sustainable Agricultural

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

The Goals of Using 21st Century Genomic Science in Agriculture & Organic Agriculture ARE THE SAME!!



The End.... or The Beginning?



Thank You!!!!