GMOs (Genetically Modified Organisms)

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Monsanto Company
About Monsanto...

Innovations Combine to Maximize Production
Breeding

Teosinte
Crop Technology is an Extension of Plant Breeding

Biotechnology in agriculture has been researched for over 35+ years and grown commercially for 20 years

1700s Farmers and scientists cross-bred plants for new traits

1940s Researchers used mutagenesis to alter the genetic makeup of seeds

1990s The first GM crops were introduced to the marketplace

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
- Papaya
- Sugar Beets
- Squash

For more information, visit www.GMOAnswers.com

MONSANTO
Crop Biotechnology is an Extension of Traditional Plant Breeding

Traditional Plant Breeding

\[ \text{DESIRED GENE} + \text{MANY GENES ARE TRANSFERRED} = \text{DESIRED GENE} \]

Plant Biotechnology

\[ \text{DESIRED GENE} + \text{DESIRED GENE} = \text{ONLY SELECTED GENE IS TRANSFERRED} \]
Biotechnology is Used in Many Common Products

**Enzymes**
Nearly all cheese is made using rennet produced through biotechnology

**Yeast**
Scientists use biotechnology to create unique yeast strains for use in brewing beer and making bread

**Medicine**
Most insulin used by diabetics is produced through biotechnology
Scientists noticed *Agrobacterium* transfers genes to plants in nature

- *This natural process has been modified to introduce genes that provide beneficial traits in crops of interest*

- **Crown Gall disease**
- **Agrobacterium delivering a gene into a plant cell**
- **Agrobacterium growing on a petri plate**

Source: A. G. Matthysse, K. V. Holmes, R. H. G. Gurlitz
We Focus on Identifying Best Genes and Introducing Leads into Plants for Development

The Biotechnology Overview

Agrobacterium Transformation

DNA

AGROBACTERIUM TUMEFACIENS

GENE TRANSFER PLASMID

TRANSFORMED PLANT CELL WITH GENE

NUCLEUS

CHROMOSOME

Regeneration of Transformed Tissue

Plant Transfer to Soil (Greenhouse Testing)

Plant Transfer to Soil (Field Testing)
Lab and Field Testing for Performance

- Plants incur less damage by insect herbivores, such as soybean loopers and Velvetbean caterpillars

Chesterfield labs (June 2016)

Mike Stern Presentation Morgan Stanley Agribusiness Conference – Brazil (April 2014)
Safety of GM Foods

GMO RESEARCH, REVIEW AND REGULATION

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 bodies** 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 countries²** since 1996.

U.S. REGULATORY AGENCY REVIEWS

USDA > Safe to grow

EPA > Safe for the environment

FDA > Safe to eat

¹Estimated numbers from Deloitte Plc. or based on studies from various biotech applications. ²Includes agencies reviewing new biotechnology applications from 67 individual countries and 12 EU member countries. ¹Country count cited from SWKorg.
GMO Myths

❖ GMO crops, and the food they produce are unsafe and untested...

❖ GMOs are causing an increase in allergies...

❖ There have been no long term health studies conducted on GMO plants...

❖ If livestock eat GMO grain, there will be GMOs in my meat....

❖ Biotech companies are against labeling GMO foods

❖ Farmers are forced to buy GM seed

❖ GMOs are creating an increase in the use of pesticides...

❖ GM crops have no economic benefits for the farmer or consumer
Need More Background?

GMOANSWERS.COM
Extra slides
IN THE U.S., THERE ARE EIGHT COMMERCIALY AVAILABLE GMO CROPS*:

- Corn
- Soybeans
- Cotton
- Alfalfa
- Sugar Beets
- Canola
- Papaya
- Squash

Visit GMOAnswers.com for GMO safety information.

*as of 2014
GMO crops, and the food they produce are unsafe and untested...
Genetically Modified Crops

Produce Food that is as Safe and Nutritious as Conventional

4.9 BILLION ACRES OF FARM LAND
USED FOR GMO CROPS SINCE 1996

1000+ PEER-REVIEWED STUDIES
SUPPORT THAT GMO CROPS ARE JUST AS SAFE AS THOSE DEVELOPED THROUGH TRADITIONAL BREEDING

35 YEARS
THAT GMO CROPS HAVE BEEN RESEARCHED AND DEVELOPED

67 COUNTRIES
WHERE GM CROPS HAVE BEEN FOUND SAFE FOR GROWING OR IMPORT

13 YEARS
ON AVERAGE TO DEVELOP AND TEST GM SEEDS BEFORE THEY’RE GROWN COMMERCIALY IN THE U.S.

Sources: ISAAA.org; biofortified.org; croplife.org/PhillipsMcDougallStudy
Expert Scientific Findings

U.S. Food and Drug Administration

“Food and food ingredients derived from GE plants must adhere to the same safety requirements ... that apply to food and food ingredients derived from traditionally bred plants. The consultation is complete only when FDA’s team of scientists are satisfied with the [GE Food] developer’s safety assessment and have no further questions regarding safety or other regulatory issues.”

MAY 2013

World Health Organization

“GM foods currently available on the international market have passed risk assessments and are not likely to present risks for human health. In addition, 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.”

FEBRUARY 2002

American Medical Association Council on Science and Public Health

“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”

JUNE 2012
Expert Scientific Findings

American Council on Science and Health

“It’s irresponsible to assert that GMOs pose any dangers to consumers or the environment since billions of tons of crops have been produced using GMO technology and harvested over many years, and still not a single case of adverse health or environmental effects from such farming practices have been documented.”

FEBRUARY 2013

Anne Glover, European Commission Chief Scientific Advisor

“If we look at evidence from 15 years of growing and consuming GMO foods globally, then there is no substantiated case of any adverse impact on human health, animal health or environmental health, so that’s pretty robust evidence, and I would be confident in saying that there is no more risk in eating GMO food than eating conventionally farmed food.”

JULY 2012

American Dietetic Association

“It is the position of the American Dietetic Association that agricultural and food biotechnology techniques can enhance the quality, safety, nutritional value, and variety of food available for human consumption and increase the efficiency of food production, food processing, food distribution, and environmental and waste management.”

FEBRUARY 2006
“The production of more food, more sustainably, requires the development of crops that can make better use of limited resources ... Sustainable agricultural production and food security must harness the potential of biotechnology in all its facets.”

JUNE 2013

“The results need to be viewed in the context of a normal diet, which for humans and animals comprises large amounts of DNA. Given the very long history of DNA consumption from a wide variety of sources, we conclude that such consumption poses no significant risk to human health, and that additional ingestion of GM DNA has no effect.”

FEBRUARY 2002
GMOs are causing an increase in allergies...
GMOs do not introduce any new allergens

- No commercially available crops contain allergens that have been created by genetically engineering a seed/plant.
- And the rigorous testing process ensures that will never happen
There have been no long term health studies conducted on GMO plants...
Long Term Studies

• Scientist and regulators rely on long-term feeding studies to access the impact of bioaccumulation of DNA or proteins.

• As with other regulated products (food ingredients, pharmaceuticals), 90 day animal studies are used to access safety of GM food as defined by international scientific authorities.
Independent Studies

• Independent university researchers are always doing research on GM products and publishing their results.

• From 2001-2010, more than 50 studies were conducted in Europe alone funded by the European Commission and performed by more than 400 research groups.
If livestock eat GMO grain, there will be GMOs in my meat....
GE crops are digested in the same way as conventional crops

- In the U.S., livestock have been consuming feed made from GM crops for 20 years.

- GMOs have never been detected in the milk, meat or eggs derived from animals fed GM feed.

- Feeding livestock GE crops is equivalent to feeding conventional feed sources in terms of nutrient composition, digestibility and feeding value.
Biotech companies are against labeling GMO foods
“We support mandatory labeling of food, when it raises a safety of health issue”

Cathy Enright
Former Executive Director for the Council for Biotechnology Information

• The purpose of mandatory food labeling is to convey information to consumers about safety and nutrition

• Monsanto FULLY supports voluntary labeling, such as “organic” or “non-GMO”
GM crops have no economic benefits for the farmer or consumer
Increased Crop Production

Between 1996 and 2014, Crop Biotechnology was Responsible for an Additional Global Production of:

- 24.7M Metric Tons of Cotton Lint
- 321.8M Metric Tons of Corn
- 158.4M Metric Tons of Soybeans

Source: pgeconomics.co.uk
Economic Benefits

Economic gains of ~US$150 billion were generated globally by biotech crops between 1996 to 2014.

30% Due to reduced production costs
70% Due to substantial yield gains of 515 million tons

Biotech crops in developing countries has already made a significant contribution to the income of 16.5 million smallholder resource-poor farmers in 2014.

Sources: pgeconomics.co.uk; ISAAA.org
Environmental Benefits

The reduction in pesticides from 1996 to 2014 was estimated at 581.4 million kilograms or 8.2% reduction.

In 2014 alone, biotech helped prevent an estimated 22.4 billion kg of CO₂ emissions, equivalent to removing 10 million cars from the road for a year.

Without biotech, it would take an additional 51.1 million acres to produce the same amount of food produced in 2014.

Source: pgeconomics.co.uk
Consumer Benefits

- Corn based products would be 6% higher
- Soy based products would be 10% higher
- The drop in price of food is due to increased productivity by farmers, which have arisen via the adoption of new technologies

Source: 2010 study by Graham Brookes et al.
Farmers are forced to buy GM seed
At the start of every season, farmers choose to buy seeds from whomever they want.

- Farmers who choose GM crops do so because they find them advantageous
- GM crops save farmers money by decreasing their input costs and reduced their workload.
- In 2016, US farmers chose to plant GM seed on: 94% of U.S. soybean acres, 93% of U.S. cotton acres and 92% of U.S. corn acres (USDA, 2016)

“If biotechnology did not deliver, if it did not offer farmers benefits in terms of operational efficiency, land husbandry and profitability, they simply would not use it year after year.” (USSEC, 2013)
GMOs are creating an increase in the use of pesticides...
Overall, pesticide applications have decreased, largely due to the adoption of insect-resistant crops... (PG Economics)

- Several GM crops have been developed specifically for insect resistance allowing farmers to use fewer pesticides on GM crops.

- GM crops can help make agricultural production more efficient while reducing the environmental impact of pesticides.
GMOs are contributing to the death of bees and butterflies...
Honey Bees

• GMOs are not believed to any impact on honey bee populations.

• Bee populations may be challenged by a number of factors including pests and parasites, microbial disease, inadequate diet and loss of genetic diversity.
Monarch Butterflies

A number of factors impact butterfly populations

• Deforestation
• Parasitism
• Loss of milkweed plants
  • Milkweed is the primary food source for monarch larvae
  • Shifting land management practices can restore monarch habitat
GMO crops reduce biodiversity...
Biotech crops can actually help protect biodiversity....

• Biotech crops increase productivity on existing agricultural land and protect biodiversity by sparing lands not intensively cultivated (Raven, 2010).

• The pressure on biodiversity will continue to decrease as global agricultural systems including biotech crops expand to feed a growing world population (Carpenter, 2011).