

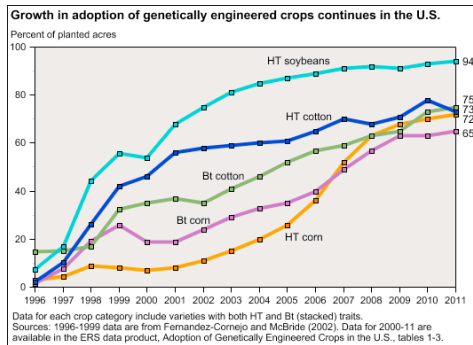
Genetically Modified Organisms: Part II. Examples and Concerns

US275 Scientific Ethics
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U.S. farmers have widely adopted herbicide-tolerant and insect-resistant crops.

- commercial introduction in 1996
- soybeans
- cotton
- corn



<http://www.ers.usda.gov/Data/BiotechCrops/>

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Genetically modified food sources are monitored by the FDA and the USDA

- Food and Drug Administration
 - substantially equivalent to existing foods
 - concern for potential allergens or toxins
- US Department of Agriculture
 - risk to plant health



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Bt-corn is genetically modified to express a soil bacterial protein.

- *Bacillus thuringiensis* (Bt)
 - protein that kills Lepidoptera larvae (caterpillars)
 - does not harm insects of other orders such as beetles, flies, bees, and wasps.
 - Bt available as insecticide since 1960's
- FDA ruled the extremely low levels of Bt do not pose a safety concern



European corn borer damage and fungal infection in non-Bt (left) and Bt hybrids
<http://www.ipm.iastate.edu/ipmicmi/1998/1-19-1998/btdisco.html>

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An early study indicated that monarch butterfly caterpillars were harmed by Bt corn pollen

- 1999 study
 - fed only leaves with more than 6x higher concentration of Bt pollen
- 2000 study
 - much larger, standardized pollen exposure
 - determined no significant risk due to Bt corn
 - risks lower than exposure to normal pesticides

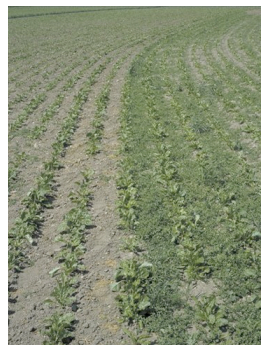


Papillon monaque (Monarch Butterfly)
Wikimedia Commons

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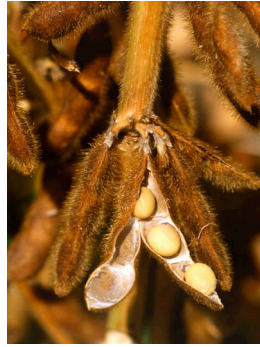
Farmers use herbicides to kill weeds in crop fields.

- herbicide-tolerant crops are resistant to some chemicals that are less toxic to humans and animals
 - roundup (glyphosate)
 - bromoxynil
- kill weeds with reduced chemical exposure to humans and animals



Genetically-modified soybeans require less harmful pesticides.

- soybeans
 - primarily used for cattle, swine, and chicken feed
 - in many food additives

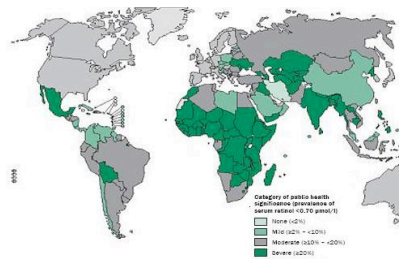


Soybeans
U.S.D.A

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Vitamin A deficiency is a widespread form of malnutrition.

- leading cause of preventable blindness in children
 - 250,000 - 500,000 new cases of blindness each year
 - half will die within 1 year of losing sight
- WHO estimates supplementation of vitamin A will have as great or greater effect than that of any one vaccine.



Global Prevalence of Vitamin A Deficiency in Populations at Risk, 2009, World Health Organization.

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Golden rice has been genetically modified to produce vitamin A.

- natural rice plants
 - produce B-carotene in leaves but not rice seeds
 - white-fleshed crops are vitamin A deficient
- Golden rice
 - new strains of golden rice have even higher levels of B-carotene
 - biofortified to produce large quantities of B-carotene
 - converted to vitamin A in body.



<http://irri.org/goldenrice>

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Golden rice was developed in 1999, but is not yet available for human use.

- Golden Rice Network
 - royalty-free access to non-profit humanitarian projects
- estimated final regulatory approval in 2013
 - opposition to genetically modified crops
 - regulations and requirements for costly experiments



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Published reports provide conflicting information on safety of genetically modified foods.

- not all studies are scientific
 - lack appropriate controls
- toxicity levels
 - virtually everything is toxic at high levels
- often reference old or refuted arguments



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Assignment

How to feed a hungry world?

Read

1. "How to feed a hungry world" (2010) Nature 466:531-532
<http://www.nature.com/nature/journal/v466/n7306/full/466531a.html>

2. "Regulation must be revolutionized." (2010) Nature 466: 561
http://www.goldenrice.org/PDFs/Nature_Opinion_Potrykus_2010.pdf

In your discussion group: Consider the example of Golden Rice, which has improved nutritional properties that will prevent blindness and death. The current approval process could take many years to ensure safety of the product, but traditional agricultural methods are associated with some safety risks such as exposure to chemical pesticides and herbicides or contamination. What regulatory criteria should a genetically modified source meet in order to be available for consumption?

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Readings

Harvest of Fear (2001) NOVA/
Frontline Special Report.
Should we grow GM crops?
Engineer a crop.
Viewpoints.
<http://www.pbs.org/wgbh/harvest/>



The Reader
Mary Cassatt, 1877

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Any Questions?

Email me at:
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<http://www.pippibullennets.com/images/animated-question-mark.gif>

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