Genetically Modified Foods

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Background Information

Genetically modified foods are those derived from seeds and plants that contain genetically modified organisms, which have had specific changes introduced by genetic engineering techniques

Transgenic: Containing DNA from another organism

Abiotic: Non-living

Yield: Produce or provide

Salinity: Concentration of dissolved salts in water

Thesis:

Through the advancement of biotechnology, genetically modified organisms have been engineered to be more beneficial, available, and efficient

1. Resistances added to the organisms to reduce the use of herbicides and pesticides, benefiting the environment
2. Changes to the genetic makeup of organisms to adhere to climate change and insure organism growth on infertile land and in harsh climates
3. Livestock health and growth efficiency improved when on the genetically engineered feed

Argument 1

Resistances added to the organisms to reduce the use of herbicides and pesticides, benefiting the environment

Engineered resistance to insects, weeds, etc., means fewer pesticides with increased yields

Enhanced safety for farmers and the environment, while lowering the cost of food and increasing its availability

Added Resistances

- Multiple applications of herbicides during a growing season cause an increased risk of damage to the environment and to people's health because of the toxicity of so many chemicals

- Scientists took genes of rare plants that are resistant to broad-spectrum herbicides and introduced them into crops. The results were crops that could safely be sprayed with these broad-spectrum herbicides as needed, killing almost every weed that threatened the crop

Figure 1: GMO Crop Cultivation Areas

Country	Millions of Hectares	Crops
USA	54.6	Soybeans, Corn, Cotton, Canola, Squash, Papaya, Alfalfa
Argentina	18.0	Soybeans, Corn, Cotton
Brazil	11.5	Soybeans, Cotton
Canada	6.1	Canola, Corn, Soybeans
India	3.8	Cotton
China	3.5	Cotton
Paraguay	2.0	Soybeans
South Africa	1.4	Corn, Soybeans, Cotton

GMO Crop Cultivation Areas. (2006). Retrieved December 6, 2018 from Global Connections Textbook

This chart outlines the cultivation areas for genetically modified crops by major producers (over 1 million hectares) in 2006. The GMO area in the US is about the same size as the total area of Manitoba. The total 102.2 million hectares of transgenic crops is about the size of Ontario, grown by 10.3 million farmers in 22 different countries.

Insect Resistant Crops

- Creating crops that were resistant to insect infestations required the modification of a gene from a soil bacterium called *Bacillus thuringiensis* (Bt), which was then introduced into the crops

- New gene allows the Bt-modified plant to produce a toxin that kills specific types of insects, yet is harmless to non-target insects, and people or animals that might eat the plant or its fruit

Pests Affecting Canadian Crops

Reisig, D. Corn Earworm (Helicoverpa zea). (n.d.) Retrieved December 7, 2018 from NCSU Entomology

Dolinski, M. Seedpod Weevil (Ceutorhynchus assimilis). (n.d.) Retrieved December 7, 2018 from Top Crop Manager

Elford, E. Goosefoot Groundling Moth larvae. (n.d.) Retrieved December 7, 2018 from ON Specialty Crops

Argument 2

Changes to the genetic makeup of organisms to adhere to climate change and insure organism growth on infertile land and in harsh climates

- Increased food supply in areas where climate change will increasingly require that crops can grow in dry and salty soils and tolerate extreme temperatures

- Increased food supply/production on a global scale to meet the demands of the world’s growing population

Goal of Crop Modification in Unsuitable Growing Conditions

- Increasing agricultural productivity in tropical areas where crop yields are significantly lower than in temperate climate zones will be essential in the future with a growing population and climate change

- The genetically modified plants/seeds will help farmers of Third World countries by lowering costs of fertilizers, herbicides, and pesticides

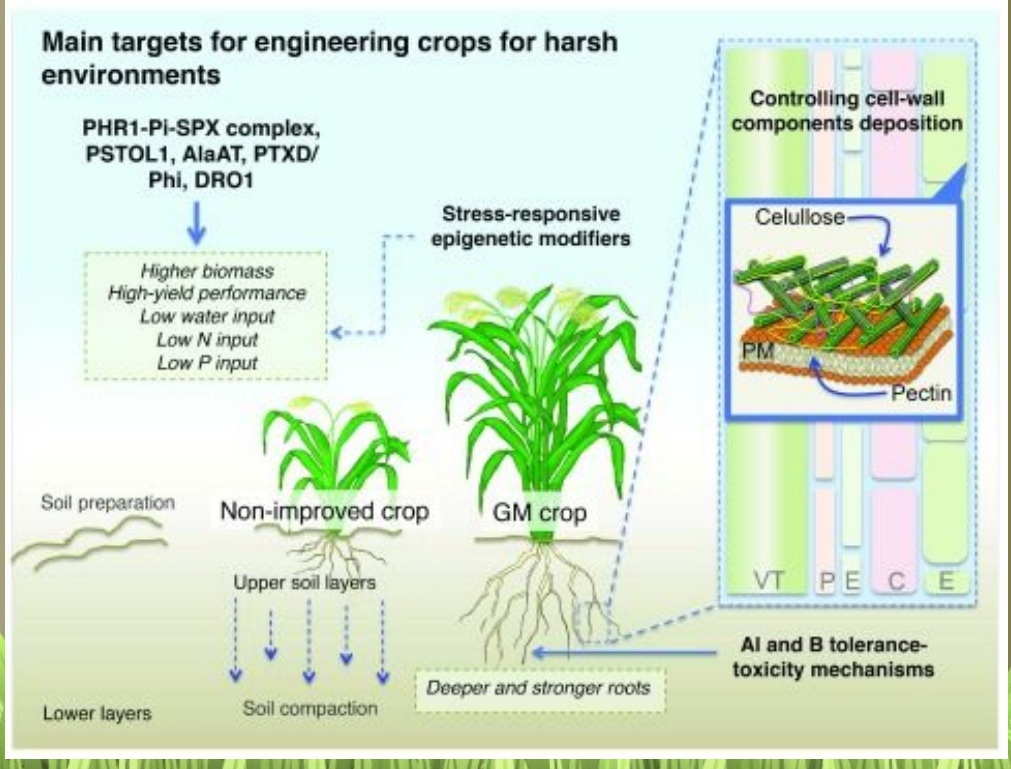
How is This Achieved?

- Improving Nitrogen, Phosphorus, and water intake efficiency of the crops would drastically improve yields for growing in bad soil conditions

- Improvement of plant root resistance to toxic levels of Aluminium and Boron in the soil

- Introducing genes of drought tolerant crops as well as improved productivity and tolerance to other abiotic stresses such as cold, heat, and high salinity

Figure 2: Main Targets for Engineering Crops in Harsh Environments



This diagram showcases the target transgenic engineered crop. This crop would thrive in harsh conditions mentioned in the previous slide. Low Nitrogen, Phosphorus, and water levels required in the soil for efficient growth. Deeper and stronger roots to be able to deal with not only dry and salty soils, but toxic levels of aluminium and boron as well.

Main Targets for Engineering Crops in Harsh Environments. (September 2015). Retrieved from National Center for Biotechnology Information

Golden Rice Textbook Example

“New varieties of rice produced that would provide sufficient amounts of vitamin A and Iron. Vitamin A-rich “golden rice” was produced by modifying the genetic makeup of the rice with the addition of two genes from a type of daffodil and one from a bacterium. The resulting variety is high in beta-carotene, a nutrient that the body can convert to vitamin A and thus prevent blindness. A similar approach was used to produce an iron-rich variety of rice.”

Clark B., & Wallace J. (Eds.). (2009). *Global Connections: Canadian and World Issues*. Don Mills, Ontario. Pearson Education Canada

Argument 3

Livestock health and growth efficiency improved when on the genetically engineered feed

- Animals raised on feed containing genetically modified organisms with no evidence of harm. Animal health and growth efficiency improved on the engineered feed (2014 review in Journal of Animal Science)

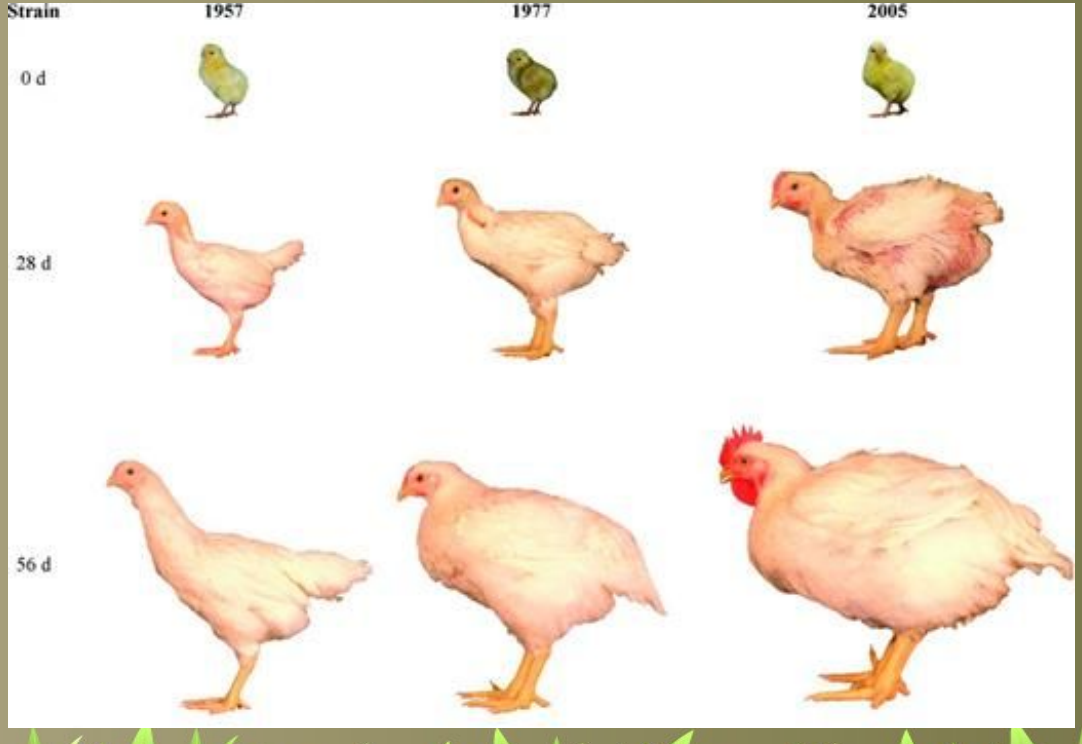
Benefits of Genetically Modified Feed

Nutritionally enhanced crops have been designed to address improvements in feed for livestock and poultry.

- Animal feed crops have been generated to produce higher levels of amino acids so that fewer supplements will be required (hormones and steroids).

- Feed crops have also been developed with the aim of producing more environmentally friendly manure.

Figure 3: Broiler Chicken Growth Efficiency



This image shows the growth efficiency of broiler chickens (bred and raised specifically for meat production). Chicken growth at the 8 week mark has seen large improvements from 1957-2005. This change was achieved by intentional genetic selection through natural breeding techniques, and improvements to the genetically modified chicken feed to excel growth and increase body weight/mass

Broiler Chicken Growth Efficiency. (December 2014). Retrieved December 9th, 2018 from Poultry Science

Benefits of Genetically Modified Feed CONT'D

- An increase in the abundance of other essential amino acids such as aspartate and lysine was also observed. Strategies such as these can help to enhance the nutritional value of feed crops used for livestock.

- No presence of genetically engineered DNA or proteins in the milk, meat, or eggs from animals that have eaten genetically engineered feed. These animals are NOT genetically modified by eating the feed, but become sources of genetically modified organisms

Conclusion

Genetically modified crops require less fertilizer and fewer pesticides, while increasing crop yields. This means enhanced safety for farmers and the environment, while lowering the cost of food and increasing its availability

Advancements in transgenic crops mean an increased food supply/production in unsuitable growing conditions (especially in Third World countries), and on a global scale to meet the demands of the world's growing population

Genetically modified feed improves growth efficiency of livestock, more cost efficient for farmers (cheaper to buy, less hormones/steroids required, and increased nutritional value), and is beneficial to the environment

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