NATIONAL CENTER FOR CASE STUDY TEACHING IN SCIENCE

# The Canadian Canola Controversy:

## The Role of Genetically Modified Organisms in Agriculture

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## Part I – Green Revolutions

Modern agriculture arose from several key technological developments that collectively came out of the Green Revolution. Starting in the 1940s and running throughout the 1960s agricultural technologies were developed and shared with developing countries to increase the yield of many staple crops with the goal of eliminating world hunger. The Green Revolution was successful in significantly increasing global production of food crops (Tilman *et al.*, 2002).

One technology that came out of the Green Revolution was the development of high yield varieties of key crops including maize, wheat and rice (Branfireun *et al.*, 2014). New varieties were created through selective breeding, which is accomplished through traditional open pollination techniques or with newer methods of crossing different varieties of closely related plants to produce hybrid varieties. Many of the new varieties produced higher yields and better responses to other new technologies developed during this time such as inorganic fertilizers, pesticides, and irrigation systems (FAO, 2003). The development of new varieties takes many years in order to isolate desired characteristics and eliminate unwanted ones (Hughes & Bryant, 2002). The much higher yields helped overcome the fact that the seeds from hybrid varieties cannot be collected and planted the following season as the seeds of these hybrid varieties no longer express the desired traits of the parents.

Many of the new hybrid varieties of crops produced much higher yields but had to be used in conjunction with other crop enhancers including fertilizers, pesticides, and irrigation systems (Tilman *et al.*, 2002). Despite the positive impacts that agricultural chemicals have on yields, many negative impacts have also been recorded. For example, nutrients can be added to farms to increase crop yield, but when surplus nutrients run off farmlands into nearby water bodies, they can stimulate excess algae growth leading to eutrophication. (Eutrophication occurs when the excess algae die, sink to the bottom of the water body and their decomposition consumes much of the oxygen in the water leaving benthic organisms to suffocate.) Pesticides are another example; although they can be effective at eliminating pests, their toxicity can also have negative consequences for human and ecosystem health, and pests are often able to develop resistance to the pesticides. Finally, the increased use of water for irrigation has led to unsustainable water use in many regions, which are now facing water scarcity (Tilman *et al.*, 2002).

In part due to the actual and perceived negative impacts of agricultural chemicals, organic agriculture (farming that does not use synthetic chemicals and hence produces "organic" food) is becoming more popular, although it still only makes up a small percentage of farming.

Today there are over 7.5 billion people in the world, and projections estimate that human population will reach 10 billion by 2050 (Branfireun *et al.*, 2014). With human population increasing so rapidly, the world is faced again with the challenge of how to feed all these people. The best available farmland is already in use, so new ways to increase yields are needed (Tillman *et al.*, 2002).

The Green Revolution 2.0 is now underway and involves a new method of farming with the use of genetically modified organisms (GMOs), in which an organism's genetic information is modified in a laboratory to produce more desirable characteristics (Branfireun *et al.*, 2014). GMOs differ from seed varieties produced through selective breeding because they are not limited to expressing traits found within closely related strains of plants, but instead can express traits from completely unrelated species, thereby resulting in transgenic organisms. The new genes allow species to become drought or pest resistant, increase nutritional value of the food crop, and increase crop yield, for example. These changes can be made without the lag time of having to select for the desired traits over many generations as with selective breeding. Once identified, the genes can be transferred directly in a laboratory.

## *Tasks*

Read, watch and listen to the following resources before coming to class; then answer Questions 1 and 2 further below on your own and bring your answers to class.

- Food and Agriculture Organization of the United Nations (FAO). *n.d.* Agricultural biotechnology: will it help? <http://www.fao.org/english/newsroom/focus/2003/gmo1.htm>.
  Access and read the additional links found on the menu on the right-hand side of this webpage:
  - Crop breeding: the Green Revolution and the preceding millennia
  - Going down to the genes
  - Weighing the GMO arguments for
  - Weight the GMO arguments against
- Phillips, T. 2008. Genetically modified organisms (GMOs): transgenic crops and recombinant DNA technology. *Nature Education* 1(1): 213. <https://www.nature.com/scitable/topicpage/genetically-modified-organisms-gmos-transgenic-crops-and-732>.
- Hsaio, J. GMOs and pesticides: helpful or harmful? August 10, 2015. [Blog]. *Science in the News, Harvard Graduate School of the Arts and Sciences*. <http://sitn.hms.harvard.edu/flash/2015/gmos-and-pesticides/>.
- Denkmal-Film Verhaag. 2009 Trailer for "Percy Schmeiser: David versus Monsanto." [Video]. Running time: 7:22 min. <https://youtu.be/oPKoSrc99p4>.
- *CBC News Online.* May 21, 2004. Percy Schmeiser's battle. <http://www.cbc.ca/news2/background/genetics_modification/percyschmeiser.html>.
- Monsanto. *n.d.* What is roundup ready canola? [Company information sheet].<https://www.monsantoglobal.com/global/au/products/documents/tech-topic-what-is-roundup-ready-canola.pdf>.

## *Questions*

1. What are the benefits and drawbacks of agricultural pesticides?
2. What are the benefits and drawbacks of genetically modified crops?
3. Once in class, your professor will put you into groups. In your groups, take all of the points from your homework questions (Questions 1 and 2 above) and assign each benefit and drawback to one or more of the following categories: ecological, economic, ethical, human health.

## Part II – Monsanto *v.* Schmeiser

Canola (originally known as rapeseed) was first grown commercially in Canada not as an edible oil but as a replacement for imported oils used to grease machine parts of steam engines and other war machinery during the Second World War (Eaton, 2013). It was not suitable as a food oil because it contained high levels of erucic acid among other problematic components. Canola grew very well, however, and the country decided to invest in the development of canola as an edible oil. Several partners including government and academic researchers worked together to selectively breed a canola plant that was suitable as a domestic source of edible oil for Canadians. The resulting variety became an important cash crop for farmers in the Canadian prairies and parts of Ontario and became locally known as a product of Canadian innovation, proudly developed by scientists and farmers (Eaton, 2013). Although much improved and of high value, canola is also known to be a challenging and risky crop to grow because it is prone to disease and weed outbreak (Eaton, 2013).

Monsanto Canada Inc. is an agricultural company and producer of genetically modified (GM) seeds in Canada. More recently, investment in canola moved from a primarily state funded area of development to a highly privatized one. To assist with the challenges from excessive weeds, Monsanto modified the genetic makeup of canola and created a seed (named Roundup Ready®) whose plant was resistant to their herbicide called Roundup® (Monsanto, 2015). Monsanto patented the gene and the GM canola plants that they created. Because of the patent, farmers who wish to plant Roundup Ready® in their fields must pay an annual fee per acre and enter a legally binding technology use agreement. Although GM seeds are viable, the agreement prohibits the collection of seeds for use in subsequent years (Eaton, 2013).

By 1997, genetically modified canola made up about 12% of canola grown in Canada (Canola Council of Canada, 2017). In late 1997, in Saskatchewan, Canada, pollen from the GM canola seed Roundup Ready® blew from a neighbouring farm to settle on Percy Schmeiser's non-GM canola farm (Withgott *et al.*, 2013). Schmeiser first discovered Roundup Ready® canola plants growing near his farm, so he sprayed the herbicide Roundup® on this nearby patch to determine the extent of the contamination; much of the canola survived the spraying, indicating it was Roundup Ready®. Schmeiser then harvested the Roundup Ready® crop, and intentionally planted the crop in 1998 (SCC, 2004).

Monsanto determined that Schmeiser was growing Roundup Ready® canola on his farm and had not paid the licensing fee to use the patented technology. Monsanto requested that Schmeiser pay the licensing fee, which Schmeiser refused, stating that the unwanted seed belonged to him because it was growing on his land. On 6 August 1998, Monsanto sued Schmeiser for patent infringement.

### *Questions*

4. What are the benefits for a farmer who plants Roundup Ready® canola seeds over non-GM canola?
5. Many sectors of society and people, in addition to farmers, have a vested interest in the issues surrounding the use of GM crops, and are referred to as "stakeholders." Which sectors of society or groups of people could be considered stakeholders and have a vested interest in the outcome of a court case where Monsanto sues Percy Schmeiser for patent infringement?

## Part III – Different Perspectives

*You will be assigned to one of several stakeholder groups. Read the follwoing passage and answer the questions below from the stakeholder perspective you have been assigned.*

As a result of the lawsuit that Monsanto launched against Percy Schmeiser, the Supreme Court ultimately ruled in favour of Monsanto. They determined that although higher-level GM organisms in Canada are not patentable, the gene itself (the gene that makes Roundup Ready resistant to Roundup) can indeed be patented (SCC, 2004). Thus, Schmeiser was found guilty of patent infringement, and the courts ordered Schmeiser to pay Monsanto $238,000. Schmeiser appealed the court decision. The courts confirmed the patent infringement but agreed that Schmeiser had not intended to plant the seeds and he had not benefited from the seeds so reversed the requirement to pay the fine and fees to Monsanto (Withgott *et al.*, 2013).

### *Questions*

6. From the perspective of your stakeholder, who do you think was in the right: Monsanto or Schmeiser? Why? Do you think the Supreme Court of Canada's decision was fair? Why or why not?
7. Overall, what concerns does your stakeholder have about the use of GMOs in Canada or the United States?
8. Do you think there is anything that can be done to prevent these kinds of lawsuits in the future?

## Part IV – Terminator Technology

There is speculation that "terminator seed technology" could have prevented the Schmeiser and Monsanto lawsuit (Yusuf, 2010). Terminator seed technology essentially prevents plants from producing viable seeds. Currently, companies have agreed not to commercialize this technology (Mayer, 2002), but the technology was previously under development.

### *Questions*

9. What would be the economical, ethical and ecological benefits and/or drawbacks of using terminator seed technology in North America?
10. Do you think terminator technology should be allowed? Why or why not?

## References

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