

Genetically Engineered Organisms (GEOs) from a Climate Change Perspective.

Presented to the SOCAN Leadership Circle for consideration 4/12/14

Preamble

I use the term Genetically Engineered Organisms (GEOs) because I think the term Genetically Modified Organisms (GMOs) fails to distinguish between conventional plant and animal breeding programs and the process of Genetically Engineering Organisms where alien DNA is inserted into cells.

I have followed at a distance the discussions surrounding GEOs for many years without having decided whether the scientific evidence justifies the concerns. My first encounter with the problem was some 15 years ago when I heard Canadian canola Farmer Percy Shmeiser talk about his legal case involving Monsanto and allegedly accidentally contaminated crop. I have more recently learned that this case is not quite the benign farmer suffering contamination and being sued for patent infringement that it was claimed to be - and thus does not offer evidence on the issue.

However, since then I have heard much about the claims of potential health problems associated with GEO foods. I confess that I have found these less than compelling based on a lack of scientific substantiation. Thus, my concern about GEOs rests predominantly in the arena of their ecological impact and the potential influence of their deployment on climate change.

The Climate Connection:

Addressing climate change involves two approaches:

- 1) **Adaptation** refers to enhancing our ability to withstand the climate changes that are happening and will happen. The primary concerns in this context are promoting crops that can withstand heat and especially drought, and promoting crops that exhibit enhanced yield – thus enabling us to feed global populations that are expected to continue increasing.
- 2) **Mitigation** refers to our need to promote activities that reduce greenhouse gas emissions and enhance carbon dioxide storage. Greenhouse gas emissions result from mechanized industrial agriculture as a result of vehicle use, fertilizer use, and pesticide use. Carbon storage occurs in well managed soils. If genetically engineered crops exhibited an ability to achieve improvements in these areas, they could be beneficial in our efforts to address climate change; if they result in increased use of fertilizers and pesticides they will have the opposite effect.
- 3) In relation to GEOs, to these concerns, we must add the Health question. One dominant issue in the public debate about GEOs concerns their impact on human health. This is the concern that I have thought probably is the least persuasive. While this might not be the top climate change issue, however, any crop yield benefits that might result from these organisms would be negated if negative health impacts were evident in those crops - so assessment of health consequences becomes relevant.

Considering GEOs in the context of climate change leads me to the following concerns.

1. Adaptation Proponents of GEOs have frequently argued that their products either currently do, or in the future will, provide benefits in terms of conditions that climate change suggests we will experience: drought tolerance and water use efficiency. Additionally, greater crop yield has been promised. However, despite the ongoing claims, as I review the literature and analyses of these claims, there seems considerable evidence that GEOs have not delivered on these promises. “Over the first 15 years of commercial use, GE seeds have not been shown to increase yield potentials of the varieties. In fact, the yields of herbicide tolerant or insect resistant seeds may be lower than the yields of conventional varieties if the varieties used to carry the HT or Bt genes are not the highest yielding cultivars...” ([Fernandez-Cornejo J, Wechsler S, Livingston M, and Mitchell L. 2014](#) a USDA report).

Of additional concern is the fact that the GEO products are mainly tailored to serve large-scale farmers and industrial agriculture in developed nations rather than resource-poor farmers in developing nations who thus fail to benefit from whatever advantages there might be in GEOs.

http://www.ucsusa.org/food_and_agriculture/our-failing-food-system/genetic-engineering/high-and-dry.html

<http://www.greenamerica.org/pubs/greenamerican/articles/JanFeb2014/GMO-Problems.cfm>

<http://www.tandfonline.com/doi/full/10.1080/14735903.2013.806408#.Uch2dPm1GQ4>

<http://www.fao.org/docrep/004/y3557e/y3557e09.htm>

2. Mitigation Additionally, proponents of GEOs have argued that their products will reduce fertilizer and pesticide use and allow conservation tillage – which reduces soil erosion and promotes carbon storage. However, there is evidence that those short term gains that appeared have been replaced by returns to historical levels. Additionally, rather than reducing pesticide use, there is evidence that the *Bacillus thuringiensis* insertion and the glyphosate resistant insertion result in accelerated use of pesticides - at least partly because pest species (whether insects or competing plant weeds) evolve resistance. Curiously, where reduction in pesticide use has occurred in regions which employ GEO crops, these reductions seem to be less than in regions where GEO crops are not used. “It has been shown that in some developing countries, the cost of the adverse health consequences for the farmer applying the pesticide more than offsets the savings that the farmer earns by reducing the loss of pest-inflicted damage to the crop” [Huang, J, Pray C and Rozelle S 2002](#). An [FAO report](#) underlines this problem in showing that even as Bt corn yield in China increased prior to 2002, pesticide use, production costs, and farmer poisonings increased dramatically.

<http://www.worldwatch.org/node/5950>

<http://www.tandfonline.com/doi/pdf/10.1080/14735903.2013.806408>

<http://www.greenamerica.org/pubs/greenamerican/articles/JanFeb2014/GMO-Problems.cfm>

The Attendant Problem of Genetic Simplification

A basic genetic principle is that populations of organisms with greater genetic variability are better able to withstand environmental change and resist insect pests than those with less genetic variability. Populations or species that pass through circumstances where the number of individuals (seeds or plants) is reduced dramatically suffer reduction in genetic variability. When crops are subjected to the biotechnology of genetic engineering, only a small number of

individuals are successfully engineered (accept the inserted alien DNA). These then become the basis of the genetically engineered line. This engineered line consequently possesses reduced genetic variability.

Because farmers cannot use the seed from their own fields to plant the following year, they have to return annually to the same genetically engineered stocks with their reduced genetic variability. The result is reduced genetic variability among the crops being planted. This renders the crop populations less able to withstand environmental change and pest infestations.

<http://thegeneticengineeringdebate.blogspot.com/2012/10/genetic-diversity-and-food-security.html>

Since climate change will impose serious environmental perturbation on crops, it is critical that rather than reducing genetic diversity we should be doing whatever we can to enhance it.

<http://www.landesbioscience.com/journals/gmcrops/CarpenterGMC2-1.pdf>

Unfortunately, industrial agriculture leads to extensive monocultures of genetically similar crops. The U.N Food and Agriculture Organization reported that 75% of plant genetic diversity has been lost since 1900, clearly most of this prior even to the appearance of GEOs (in the 1990s). However, the drive for high-yielding genetically engineered crops has enhanced monoculture and increased vulnerability to climate change and pests. Efforts to introduce or reintroduce heirloom seeds into plantings represent an attempt to rebuild genetic variability in crops.

<http://gmo-journal.com/2011/06/17/loss-of-biodiversity-and-genetically-modified-crops/>

<http://agroeco.org/wp-content/uploads/2010/09/garcia-altieri.pdf>

<http://www.fao.org/docrep/007/y5609e/y5609e02.htm>

Genetically simplified crops present as easy evolutionary hurdle for evolving crop pests with the result that evolved resistance by the pests to the treatment can spread rapidly and destroy vast areas of genetically identical crops very quickly. As vulnerability to pests increases, farmers will necessarily adopt increased pesticide use.

Genetic simplification constitutes a threat to the ability of agricultural systems both to Adapt to climate change (causing reduced evolutionary potential), and Mitigate climate change (causing reduced ability to withstand pest organisms and thus requiring increased pesticide treatment).

3. The Health question. This remains the most difficult for me to evaluate. Although GEO promoters claim there is no evidence of detrimental health effects from GEO crops, this claim demands critical examination. Some of my concerns are:

- a. Studies of health effects are largely conducted by the companies producing the GEOs and are purely voluntary.
- b. Health studies conducted over very short-term (<90 day) periods allow no assessment of potential long-term consequences.

- c. Unlike researchers in climate change and tobacco, where the subject of their research is readily available, Geo researchers must obtain seeds from the GEO companies thus needing permission from the patent holding company. The agreement stipulates that any results and conclusions must be submitted to the company for review and approval before they can be published. With such restrictions, it is difficult to undertake and publish unbiased research
- d. Reminiscent of the behavior of tobacco companies when the first indications were appearing in the literature that smoking might have negative health effects, there is evidence that GEO companies finance campaigns to discredit and vilify researchers who produce contrary results.
- e. The best publicized example of questionable research suggesting harmful GEO effects (the Séralini study of Roundup on rats) was lambasted in the media and retracted by the journal after it had undergone peer-review and been published. Subsequent reports suggest, however, that this study not only followed standard protocols for this kind of study but was actually even more rigorous than the original Monsanto research purporting to demonstrate safety.

<http://www.greenamerica.org/pubs/greenamerican/articles/JanFeb2014/GMOs-and-the-case-for-precaution.cfm>

<http://www.greenamerica.org/pubs/greenamerican/articles/JanFeb2014/Seralini.cfm>

<http://www.greenamerica.org/pubs/greenamerican/articles/JanFeb2014/Farmers-vs-Corporate-Seed-Police.cfm>

<http://www.greenamerica.org/pubs/greenamerican/articles/JanFeb2014/GMO-Problems.cfm>

In reviewing the GEO issue in comparison to the historical tobacco issue and the current climate change issue, I see tremendous parallels. The main parallel is one of corporate entities exerting their financial power to mislead the public and suppress whenever possible research that might provide evidence undermining their profitable enterprise.

There is evidence that the prevailing view spread by GEO proponents that GE crops are increasing yield while reducing pesticide use and helping developing nations address the problems of feeding burgeoning populations as climate change trends unfold is, at best, overstated. Since much of the research on GE crops is undertaken by the companies themselves or by researchers contracted to those companies, it seems reasonable that we demand independent research be conducted on these crops before we can trust the claims of GEO proponents.

As a result of these considerations, I propose that SOCAN adopt the following position:

SOCAN has grave reservations about the role of Genetically Engineered Organisms in terms of their potential negative impacts on our ability to address climate change. In particular, SOCAN favors a moratorium on GEO crops until **independent** research is conducted demonstrating an absence of negative impact of GEOs on yield, drought tolerance, water use efficiency, genetic diversity among crops, fertilizer and pesticide use, carbon storage, and long term health effects.