Response to the Nuffield Council on Bioethics
Emerging Biotechnologies Consultation Paper

Stuart Smyth and Peter Phillips

University of Saskatchewan

David Castle

University of Edinburgh

Webster's Dictionary (1976) has three entries for the word 'emerge'. First, to rise from a body of liquid; second, to become apparent or known; and third, "to develop or evolve as something new, improved, etc." (p. 457). The third definition of emerge is the one that would be most relevant to the discussion on emerging biotechnologies. This definition is the most appropriate when responding to the Emerging Biotechnologies Consultation Paper since the focus is on biotechnologies that are very new to societies; otherwise why consider them under the rubric of 'emerging?

With this definition of 'emerging' in mind, it is quite baffling as to why genetically modified (GM) crops would be included among emerging technologies.
The first commercial planting of a GM crop was in China in 1992 (James and Krattiger, 1996), involving 100 acres of transgenic tobacco for the purpose of seed multiplication. The first commercial production of a GM crop for food purposes occurred in 1994 in the United States by Calgene, with 10,000 acres of their transgenic, delayed-ripening tomato, FlavrSavr™. By 1995, other crops were introduced, including cotton, canola, potatoes and maize. Research in this area now covers a wide range of GM varieties, from cereals and oilseeds to fruits and vegetables. In 2010, 148 million hectares were globally planted to transgenic crops (Peng, 2010).
Just because a technology is not widely adopted in Europe does not mean that it is emerging. The GM crops that are being planted in 2011 represent the 20th year of continuous GM crop production since the production of GM tobacco in China in 1992. In 2010, GM crops were grown in 29 different countries (James, 2010). The reality of the global status, in terms of both adoption scale and scope, indicates very clearly that GM crops are no longer 'emerging'.

While numerous studies exist on the benefits of GM crop adoption, this response will focus on the benefits of GM canola adoption in Western Canada. Three benefits will be discussed and quantified in this submission. While the risks of GM crops are still widely discussed, they have yet to surpass a regulatory threshold that would cause their withdrawal from the market. In light of the on-farm benefits of GM canola described here, GM crops are likely here to stay.

Following the limited and controlled introduction of genetically modified herbicide tolerant (GMHT) canola in 1995 and 1996, unrestricted commercial production began in

1997. Producers in Western Canada rapidly adopted the agricultural innovation with the initial year adoption rate reaching 25%; it then rose to 84% by 2002 and 98% by 2007. From 2002-2007, the percentage of GMHT canola planted in Canada exceeded 90%.

The economic benefits of GMHT canola involve changes in weed management practices, control of volunteer canola and spill-over impacts on subsequent crops.

Weed management practices have substantially benefited from the combination of GMHT canola and minimum or zero tillage. In 1999, the Canola Council of Canada estimated that only 11% of canola acres were produced under zero or min-till conditions. This increased to 65% in 2007 (Gusta *et al*., 2011). For those producers that still till, the cost of tillage per acre has dropped from $10.74/acre in 1999 to $2.86/acre in 2007. In all, 76% of producers found weed control to be the same or easier than it was prior to GMHT canola. Three-quarters of producers found that the control of volunteer canola did not change with the use of GMHT canola varieties. The direct benefits of GMHT canola production were estimated to be C$11.14/acre by Phillips (2003). Gusta *et al*., (2011) identified a second year, spill-over benefit of C$15.05/acre. When all of the benefits are calculated over the 2005-2007 crops, the total annual economic benefit is estimated to be between C$1.06-1.19 billion.

Survey data indicates that the most important environmental benefit from GMHT canola is producer use of minimum or zero tillage practices arising from very high levels of weed control in fields seeded with GMHT canola (Canola Council of Canada, 2000). The reduction in intensive tillage of land and the move to zero and minimum tillage with GMHT canola allows producers to seed GMHT canola with a minimum of soil disturbance, thereby reducing the soil's exposure to wind and improving soil structure. Eighty-three percent of producers indicate greater soil moisture and 86% of producers identified that they have reduced soil erosion (Smyth *et al*., 2011a). Continuous planting of crops sequesters carbon at a calculable rate (McConkey, *et al*., 2007). When the value of minimum and zero tillage practices are combined, the value of carbon sequestration is C$2.36 million, while the volume of carbon being sequestered is 470,000 tonnes. It is also possible to value and measure the carbon no longer released through tillage, which is estimated to be 520,000 tonnes, worth C$2.6 million. When these measure and values are combined, nearly one million tonnes of carbon is sequestered or no longer released, worth an estimated C$5 million. Jointly, these environmental benefits indicate that GMHT canola offer significant environmental benefits.

The adoption of GMHT canola has resulted in a 54% decrease in the ecological impact from herbicide use and a 56% decrease in farmer exposure (Smyth *et al*., 2011b). Herbicide use has changed dramatically and there is a 1.3 million kg decrease in terms of active ingredient applied when comparing 1995 against 2006. The adoption of GMHT canola has resulted in a 53% drop in the environmental impact of herbicides, which is significantly larger than the 36.8% estimate by Brimner, *et al*., (2005) and over double the 20.7% decrease estimated by Brooks and Barfoot (2005).

In short, GMHT canola is possibly the most environmentally friendly crop technology utilized in global agriculture. The amount of chemical active ingredient has decreased and the toxicity of the chemicals being applied is substantially reduced. The correlation between GMHT canola and minimum or zero tillage land management practices result in the economic value of GMHT canola being increased by carbon sequestering.

Based on the above evidence about GM crops in general, and the benefits associated with the use of GM crops like GMHT canola, it is no longer feasible to consider GM crops as emerging.

References

Brimner, T., G. Gallivan, and G. Stephenson. 2005. Influence of herbicide-resistant canola on the environmental impact of weed management. *Pest Management Science* 61: 47-52.

Brookes, G. and P. Barfoot. 2005. GM Crops: The global socio-economic and environmental impact – the first nine years 1996-2004. *AgBioForum* 8: 2/3: 187-196.

Canola Council of Canada. 2000. Final Report on the Pest Management Study Conducted on Behalf of the Canola Council of Canada. Available online at: http://www.canolacouncil.org/contents10.aspx.

Gusta, M., S. J. Smyth, K. Belcher, P. W. B. Phillips and D. Castle. 2011. Economic benefits of genetically-modified herbicide-tolerant canola for producers. *AgBioForum* 14: 1: 1-13.

James, C. 2010. Global status of commercialized biotech/GM crops: 2010. *ISAAA Briefs* 42. Ithaca, N.Y: ISAAA.

James, C. and Krattiger, A. F. 1996. Global review of the field testing and commercialization of transgenic plants, 1986-1995: The first decade of crop biotechnology. *ISAAA Briefs* 1. Ithaca, N.Y: ISAAA.

McConkey, B., Angers, D., Bentham, M., Boehm, M., Brierley, T., Cerkowniak, D., Liang, C., Collas, P., de Gooijer, H., Desjardins, R., Gameda, S., Grant, B., Huffman, T., Hutchinson, J., Hill, L., Krug, P., Martin, T., Patterson, G., Rochette, P., Smith, W., VandenBygaart, B., Vergé, X., and Worth, D. 2007. Canadian Agricultural Greenhouse Gas Monitoring Accounting and Reporting System: Methodology and greenhouse gas estimates for agricultural land in the LULUCF sector for NIR 2006. Agriculture and Agri-Food Canada, Ottawa, ON.

Peng, W. 2010. GM crop cultivation surges, but novel traits languish. *Nature Biotechnology* 29: 4: 302.

Phillips, P. W. B. 2003. The economic impact of herbicide tolerant canola in Canada. In N. Kalaitzandonakes (ed.) *The Economic and Environmental Impacts of Agbiotech: A Global Perspective*. New York: Klewer Academic Publishers. 119-140.

Smyth, S. J., M. Gusta, K. Belcher, P. W. B. Phillips and D. Castle. 2011a. Environmental impacts from herbicide tolerant canola production in Western Canada. *Agricultural Systems* 104: 403-410.

Smyth, S. J., M. Gusta, K. Belcher, P. W. B. Phillips and D. Castle. 2011b Changes in herbicide use following the adoption of HR canola in Western Canada. *Weed Technology* 25: 492-500.

Webster's. 1976. *Webster's New World Dictionary*. Toronto: Nelson, Foster & Scott.