Identified Risks in Canada of Coexistence between GM and Non-GM Farm Systems

Ralph Martin, Rene Van Acker
and Nancy McLean

Nova Scotia Agricultural College

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Linking Organic Knowledge
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Organic Agriculture Centre of Canada

Progress with GMOs?

(Ann Clark, pers.comm. 2004)

- 30 years of intense effort
- thousands of person-years of scarce research time
- billions of Canadian and US taxpayer dollars

Results

- 2 commercial traits - herbicide tolerance and Bt
- in 4 crops - canola, corn, soy, and cotton
- collectively on 99% of global GM land

Adoption

- Bio-technology embraced by US, Argentina, Canada (90% of all hectares sown to GM crops, 99% with China, Brazil, South Africa)

Of use to farmers and consumers?

- No provincial or federal surveys in Canada to determine if GM crops yield more, reduce biocide use, or increase farm profits.
- USDA surveys show little if any benefit to farmers, the environment, or society.
- Why defend crops sold by force (WTO challenges) or subterfuge (denial of mandatory labels)?

Escape of the Transgenes

- **Two realities (Marvier and Van Acker (2005)**

1) Transgenes will move beyond their intended destinations.

2) Once they have escaped, transgenes will probably not be retracted.

- Pollen-mediated gene flow of canola was detected nearly 3 km from a source field (Reiger et al. 2003).

- Gene flow from genetically modified creeping bentgrass occurred over 21 km from the source (Watrud et al. 2004).

- The National Research Council (NRC 2004) reviewed "bioconfinement" tools and concluded that no method is likely to be 100% effective.

Violations of safety protocols of GM crops not approved for commercial production.

- Nov. 02 - ProdiGene fined $250,000 for not destroying volunteer corn plants in the subsequent growing season. In Nebraska, the volunteer corn was shredded and mixed among soybean at a grain elevator and 500,000 bushels of soybean was destroyed. In Iowa, 155 acres of corn surrounding a test site were destroyed because of possible contamination via pollen from volunteer plants. (Gillis 2002b, 2003c).

- Dec. 02 - Dow AgroSciences fined for not establishing proper barriers and windbreaks around a GM cornfield (Gillis 2002a).
  Dec.02 - Pioneer fined for growing GM corn too near to another corn field, potentially allowing cross-pollination (Gillis 2002a).

- Mar. 03 - Pioneer fined for not reporting detected contamination among neighboring corn fields within allotted time (Gillis 2003a).
- Oct. 03 - Monsanto fined for violations in 2001 field trials of GM corn and cotton (Gillis 2003b).

- To maintain organic certification, farmers must test frequently and discard contaminated seed. Genetic purity testing for individual seedlots costs about $500.

- Human and environmental safety of GM traits is uncertain and it is prudent to maintain GM-free seed lineages to establish GM-free crops.
- There could be serious health consequences if transgenes coding for certain pharmaceutical and industrial proteins escaped into crops grown for food or feed and thus USDA requires strict confinement during the cultivation, processing, and transport of these varieties.

- Over 200 field trials conducted for GM crops producing pharmaceutical or industrial products, and 75% involved corn – a wind pollinated and outcrossing crop that is a staple food (Union of Concerned Scientists 2003).

- The wisdom of the use of corn for pharmaceutical products was challenged by the editorial board of Nature Biotechnology (2004). “It seems that an industry in which the PhD is the intellectual norm is either incapable of learning a simple lesson from the past or cannot bring itself to act appropriately despite what it has learned previously.”

Can we put the genie back in the bottle?

- Transgenes with a selective advantage (e.g. herbicide resistance for a frequently used herbicide) can persist in a gene pool for many generations (Van Acker et al. 2003) and even neutral or slightly detrimental genes can persist for long periods (Ellstrand et al. 1999).

- Despite extraordinary efforts to recover Starlink seed, the cry9 transgenes still persisted at detectable levels in US corn after 3 years (USDA 2003b).

Conventional Manure on Organic Farms

- In Canada, manure from conventional farms can be used on organic farms as a source of nutrients

- Do transgenes from genetically modified (GM) corn and soybean fed to animals, survive in manure and composted manure samples? (McLean et al. 2004)

- Feed and manure from 4 different farms:

1) conventional dairy 2) organic dairy

3) conventional poultry 4) organic poultry

- Manure samples composted by standard and vermi-composting methods

- Composting lasted 16 weeks and samples collected every 4 weeks for DNA analysis.

- DNA was extracted from feed, manure and compost

- Polymerase chain reaction (PCR) was used to amplify
  - a 101 base pair sequence unique to the 35S promoter (from cauliflower mosaic virus)
  - a 151 base pair sequence unique to the nos terminator (from Agrobacterium)

Both sequences are found in most GM plants

- As expected, both GM DNA sequences were detectable in 100% of the conventional feed samples
- Unexpectedly, feed samples from an organic poultry farm showed that 6 of 8 tested samples, amplified one of the GM sequences.
- There were similar results in 4 of 7 feed samples from other organic farms.

- In manure, the DNA from feed was not always degraded. The 101 bp sequence from the 35S promoter region was amplified in 3 of 9 poultry samples and in 1 of 4 dairy manure samples.

- In poultry manure, it was possible that the GM DNA originated from uneaten feed that was spilled onto manure.

- However, the dairy manure was collected directly from the cow.

- In compost, GM DNA sequences were not detected in any of the dairy compost samples.

- However, 3 of 15 poultry compost samples had low levels of the 35S promoter sequence of DNA. Two of these were from 3 month compost and one from a 2 month compost.
- Poultry vermicompost also tested positive for the 35S sequence at 4 months.
- Further tests could determine if these segments are part of functional genes.
- Manure contaminated by feed might be more resistant to degradation during composting. This is a concern for organic farmers wanting to compost conventional poultry manure.

RR Canola and Wheat on the Canadian Prairies

- The commercial release of Round-Up Ready (RR) canola on the Canadian prairies resulted in the movement of transgenes from RR canola to non-GMO canola such that few organic farmers are now isolated enough to grow organic canola (Friesen et al. 2003).

- In western Canada, after only two seasons of commercial cultivation of GM herbicide tolerant canola types, volunteer canola plants carrying GM resistance traits were found in many non-GM seeded fields.

- Original GM canola had either glyphosate tolerance or glufosinate tolerance and later, individual plants of volunteer canola had both forms of resistance (Hall et al. 2000).

- After 6 years of GM canola commercial production, non-GM canola grown in western Canada contained foreign transgenes above 0.01% in:
- 32 of 33 lots (Friesen et al. 2003),
- 41 of 70 lots Downey and Beckie (2002)

- Contamination was possible from inadvertent mechanical mixing of certified seedlots during handling, or from pollen mediated gene flow in earlier generations of pedigreed seed (i.e., Breeder or Foundation).

- Even stringent segregation systems were not sufficient to deliver pure non-GM canola seed.
- Furthermore, RR canola has become a weed in subsequent crops.

- The use of Round-up created a selective advantage for RR canola volunteers and increased the frequency of the RR transgene within the volunteer canola population.

- The RR trait is now in a high proportion of non-RR canola.

- Concern that RR wheat, if released, will also increase the frequency of the RR transgene within the volunteer wheat population.
- Both organic and conventional farmers fear contamination of non-GMO wheat and lost sales
- RR wheat could also lead to more Round-up resistant weed bio-types.
- Farmers will be less able to keep RR-free wheat seed for low disturbance direct seeding systems.

Summary

Transgenes will move beyond their intended destinations.

Once they have escaped, transgenes will probably not be retracted.

Some feed samples from organic farms were contaminated with GMOs.

Modified DNA from feed was not always degraded in manure and compost.

Due to GMO contamination, few prairie organic farmers can grow canola.

- If RR wheat is released, both organic and conventional farmers fear contamination of non-GMO wheat and lost sales.

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