The Inevitability of Contamination FROM GM ALFALFA RELEASE IN ONTARIO

THE CASE FOR PREVENTING THE INTRODUCTION OF ROUNDUP READY ALFALFA

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Canadian Biotechnology Action Network

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Report Overview/Purpose

This report explains the risk of contamination from genetically modified (GM) alfalfa, if it is released in Ontario/Eastern Canada. It also describes the status of alfalfa production in Ontario and Canada, and the regulatory status of Monsanto's GM glyphosate-tolerant Roundup Ready Alfalfa (RRA) in Canada.

The report presents an overview of the many potential means by which GM alfalfa will contaminate non-GM alfalfa and hay crops, if it is released in Ontario. Routes of GM alfalfa contamination are broadly understood in Western Canada, but remain unstudied in Eastern Canada.

Executive Summary

Alfalfa is an important crop in diverse farming systems, and is widely grown in Canada. In fact, alfalfa is one of the largest crops in the country by area. It is grown on almost 30% of Canada's cropland, and 22% of the cropland in Ontario. Alfalfa is used to produce high-quality hay or haylage for dairy and beef cattle, and grown as pasture. It is also included in crop rotations to help build nitrogen levels and maintain soil fertility. These latter uses are particularly important for organic farms, which do not use nitrogen fertilizers. Canada exports several alfalfa products, including hay, alfalfa seed, and processed products such as pellets, meal and cubes.

If GM alfalfa is introduced in Eastern Canada, contamination of non-GM alfalfa will be unavoidable. There are several ways in which this gene flow can occur. These may be broadly divided into three categories: seed escape, pollinator-mediated gene flow, and gene flow through volunteer and feral alfalfa.

The biological characteristics of alfalfa conspire to present a particularly potent risk of gene escape and, outside of considerations relating to the biology of alfalfa, the role of human error/behaviour in handling GM alfalfa seed and hay is a known risk.

Existing experiences with GM flax and GM canola in Canada further warn of the inevitability of gene flow and GM contamination, including the risk of contamination in certified seed.

The unintended presence of GM alfalfa will have widespread and negative impacts on family farms in Ontario, and across Canada. The only way to prevent contamination from GM alfalfa is to stop the market release of GM Roundup Ready alfalfa in Canada.

Acknowledgements

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Table of Contents

INTRODUCTION

The registration and commercialization of genetically modified (GM) Roundup Ready alfalfa (RRA) in Ontario will result in widespread GM contamination of non-GM alfalfa, with potentially serious negative economic impacts on a wide range of family farmers across the province and country.

Pollen-mediated gene flow and seed escape from GM alfalfa will result in the unintended presence of GM alfalfa in conventional, organic, and feral stands of alfalfa. Past experiences with GM flax and GM canola in Canada warn of the inevitability of gene flow and GM contamination, through various predictable and unexpected means. The biology of alfalfa and the realities of farming practices across Eastern Canada confirm that the only way to prevent contamination from GM alfalfa is to stop its release onto the market.

By way of introduction, this report begins with a description of the current status and use of alfalfa in Ontario and Canada, and outlines the current status of GM Roundup Ready alfalfa. The main section of the report explains the inevitability of contamination from GM to non-GM alfalfa, and describes each of the ways in which this contamination can occur.

Background on Alfalfa and Roundup Ready Alfalfa

STATUS OF ALFALFA PRODUCTION IN CANADA

Alfalfa, often called the "queen of forages," is the most important and widely grown forage crop in Canada.[1,2] It is also one of the largest crops in Canada by area. In 2011, alfalfa was produced on over 25 million acres across the country.[i] This accounts for almost 30% of Canada's cropland.[3] Over 80% of this acreage was in the three Prairie provinces, another 8% was in Ontario, and the rest was grown in Quebec and British Columbia (see figure 1).

i This acreage is based on calculations from the Census of Agriculture 2011, and includes pure stands and alfalfa mixes, seeded and tame pasture, and forage grown for seed. The census is available at: http://www.statcan.gc.ca/ca-ra2011/index-eng.htm. This area does not include native pasture.

Land use in Canada	Area (acres)
Alfalfa/alfalfa mixtures	11,230,105
Tame or seeded pasture	13,671,483
Forage seed for seed	326,526
Total	**25,228,114**

CANADA'S ALFALFA PRODUCTION IN 2011 (% BY PROVINCE)

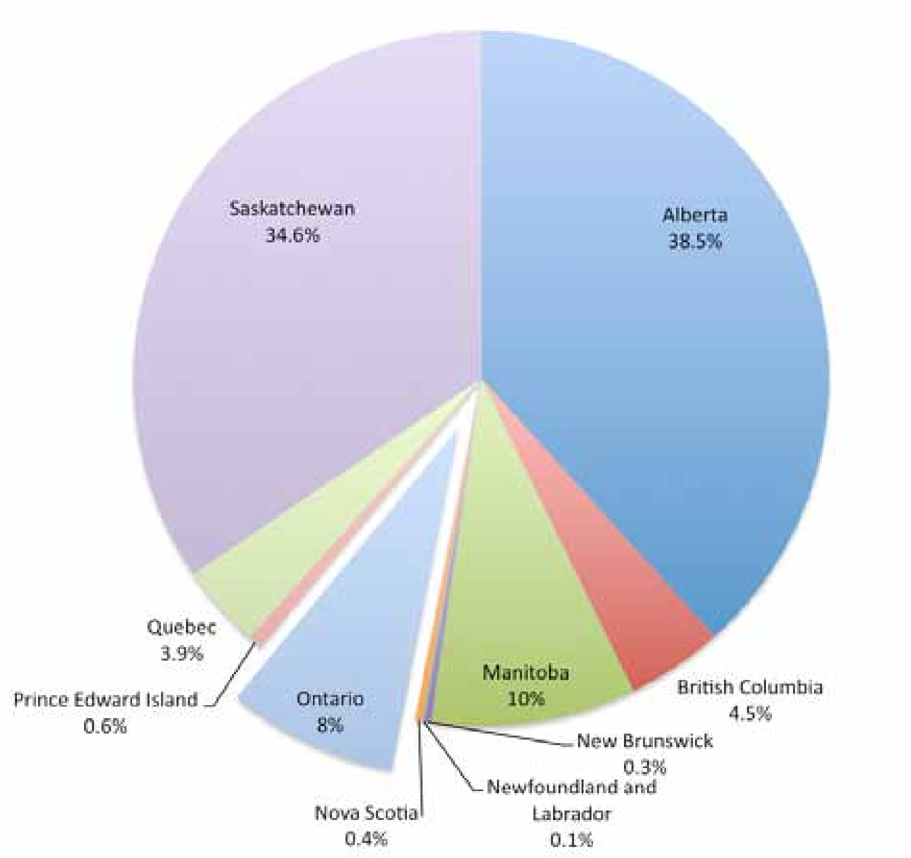

FIGURE 1

Alfalfa is grown to serve a variety of functions in farming systems. It is most commonly planted in stands mixed with grass species, and is harvested and stored as high-quality hay or haylage for dairy and beef cattle,[4] as well as for sheep, or grown as pasture. It is also included in crop rotations to help build nitrogen levels, maintain soil fertility, prevent erosion, increase soil aeration, and/or outcompete weeds. These latter uses are particularly important for organic farms, which do not use chemical herbicides or nitrogen fertilizers. In 2009, alfalfa was likely grown organically on 654,844 acres across the country.[5] This represents 38% of total organic acreage in the country.[ii] When it is planted in pure stands, alfalfa is often grown for seed production, or for the production of dehydrated processed products. In 2011, 326,526 acres were planted with forage for seed production across the country.[iii] On average, there have been 53,847 acres a year under certified alfalfa seed production in Canada over the past 8 years.[iv,6]

Canadian alfalfa seed and processed products both have large and important export markets. Canada's alfalfa dehydration industry is one of the world's five largest exporters of alfalfa pellets and cubes.[7] Processed and baled hay are exported primarily to the US, Japan, the United Arab Emirates, South Korea, and Taiwan.[8] Total alfalfa exports (including pellets, meal, cubes, seed and loose or baled hay) have been worth $79.5-million a year, averaged over the past five years. Seed export has averaged $37-million a year over the same period.[9,10] The primary markets for seed exports are US, Germany, China, Netherlands, Argentina, UK, Italy and Spain.[11] In 2009, alfalfa accounted for over 28% of forage exports and 38% of seed exports by dollar value.[12]

STATUS OF ALFALFA PRODUCTION IN ONTARIO

Although the largest proportion of Canada's alfalfa acreage is in the prairies (80%), it is a very important crop for growers in Ontario as well. Over 22% of cropland in the province (over 2 million acres) is planted with alfalfa.[v] Most of this acreage is planted with a mix of alfalfa and 10-30% perennial grasses, which helps improve harvestability, palatability, stand persistence, and feed value.[13] While the area under seed production in Ontario is not large, it accounts for 2.3% of Canada's total alfalfa seed production, and covers 7,536 acres. Ontario accounts for 8% of Canada's total alfalfa acreage.[14]

Alfalfa accounts for 52 of the 100 forage varieties recommended in Ontario in 2012.[15] One of the most common forage mixtures used in Ontario – alfalfa and timothy – accounts for nearly two-thirds of all recommended forage varieties in 2012.[16]

The organic sector in Ontario also uses alfalfa for several purposes. As in conventional agriculture, it is used as feed for livestock, and is particularly important for the organic dairy sector. It is also grown in crop rotations on both crop and livestock farms. Alfalfa is particularly important for organic farmers since it is used as green manure, or plow-down. This refers to a crop that is grown to be turned back into the soil, to add organic matter and

ii This acreage is based on calculations from Macey, 2010. This report is available at: http://www.cog.ca/uploads/Certified%20Organic%20Statistics%20Canada%202009.pdf. Last accessed March 23, 2013

Land Use (Organic)	Area (acres)
Alfalfa/alfalfa & grass	26,835
Hay/pasture/forage crops	527,903
Green manure/plowdown	100,106
Total	**654,844**

iii The category "Forage seed for seed" in the census of agriculture includes other non-alfalfa forage seed as well.

iv The total area under alfalfa seed production is certainly higher, as this figure does not include acreage of non-certified under common alfalfa seed production.

v This acreage is based on calculations from the Census of Agriculture 2011, and includes pure stands and alfalfa mixes, seeded and tame pasture, and forage grown for seed. The census is available at: http://www.statcan.gc.ca/ca-ra2011/index-eng.htm. This area does not include native pasture.

Land use in Ontario	Area (acres)
Alfalfa/alfalfa mixtures	1,346,210
Tame or seeded pasture	658,748
Forage seed for seed	7,536
Total	**2,002,504**

other nutrients. Alfalfa is a very important nitrogen-fixer for soil, especially on organic farms, where nitrogen fertilizers are not used. The area under organic alfalfa production in Ontario adds up to 43,357 acres,[vi,17] which represents 7% of the total organic alfalfa production in Canada.

Some farmers in Ontario, both conventional and organic, save alfalfa seed for their own use, as well as to sell.[vii]

REGULATORY STATUS OF ROUNDUP READY ALFALFA (RRA) IN CANADA

In 2005, Monsanto received regulatory approvals for glyphosate-tolerant (Roundup Ready) Alfalfa (GM events J101 and J163) in Canada: The Canadian Food Inspection Agency (CFIA) and Health Canada approved RRA for environmental release, animal feed, and human consumption. For the crop to be commercialized in Canada, however, seed varieties need to also be registered according to the variety registration process outlined in the Seeds Act and governed by the CFIA. Variety registration of the new alfalfa varieties is required before the seeds can be sold in the marketplace.

A timeline for the possible registration of RRA is unknown, as all aspects of the variety registration process in Canada are classified as "Confidential Business Information." This means that there is no public notice of requests to register varieties, no public consultation, and no disclosure as to when the process is underway.

The US seed company Forage Genetics International (FGI) holds marketing and distribution rights for the application of Monsanto's GM Roundup Ready trait to alfalfa varieties.

Plantings of RRA were allowed in the US as of January 2011, after years of legal challenges.

Variety Registration

- Not all crops require variety registration. Alfalfa and flax require variety registration, but corn, for example, does not.
- Variety registration was initially set up to protect farmers from unscrupulous seed dealers, to improve seed stocks by ensuring new varieties had better disease resistance, yield, and/or other qualities, and to ensure that Canada's export markets could rely on high quality standards when purchasing our products. Variety registration does not deal with questions of possible market impact or with issues explicitly relating to genetic modification. In fact, no regulatory mechanism currently allows for or requires consideration of potential economic harm in decision-making over GM crop approvals.
- The variety registration system has recently been radically changed such that some crops can be moved into new categories for easier, quicker registration. A proposal to do exactly this with alfalfa was published on February 28, 2013. Proposed Amendments to the Seeds Regulations were pre-published in the Canada Gazette, Part I, for a 75-day public comment period. The proposed changes would move forage species (as well as oilseed soybeans) into a new category in the revised variety registration process, making variety registration for alfalfa and other forage crops an almost-instantaneous process.

vi This acreage is based on calculations from Macey, 2011.
The report is available at: http://www.organiccouncil.ca/wordpress/wp-content/uploads/2012/08/certified_organic_production_ontario.pdf

Land use in Ontario (Organic)	Area (acres)
Hay/pasture	33,498.60
Pasture	2,407.53
Hay	3,935.00
Green manure/plowdown	3,516.06
Total	**43,357.19**

vii Initial research by Ann Slater of the National Farmers Union-Ontario indicates that farmers in Ontario save alfalfa seed in Lambton, Huron, Grey, Perth and Renfrew counties.

The Impossibility of Preventing Contamination

If GM Roundup Ready alfalfa is registered and commercialized in Eastern Canada, the flow of genes and traits from GM to non-GM alfalfa will be unavoidable. Canadian farmers who grow non-GM alfalfa, use non-GM alfalfa products, or sell their alfalfa products to markets that do not accept GM crops will therefore be negatively affected by the commercialization of RRA. If commercialized, alfalfa would be the first genetically modified perennial crop introduced in Canada.

There are several ways in which non-GM alfalfa may be contaminated by GM alfalfa. These may be divided into three broad categories, as follows:

1. Seed escape

2. Pollinator-mediated contamination

3. Contamination through feral and volunteer alfalfa

If GM Roundup Ready alfalfa is registered and commercialized in Eastern Canada, the flow of genes and traits from GM to non-GM alfalfa will be unavoidable

1. SEED ESCAPE

There are a number of ways in which seeds of non-GM and GM alfalfa can mix, resulting in contamination of non-GM crops and fields.

1.1 CONTAMINATION IN PURCHASED SEED

A number of seed companies no longer guarantee the GM-free status of non-GM seed lots. GM contamination may occur as early as when a farmer purchases seed – even if they are purchasing non-GM seed.

1.2 SPILLAGE DURING PLANTING, HARVEST AND TRANSPORT

There is a high likelihood of inadvertent seed spillage during planting, and as seed is poured into seed drills and other planting equipment. There is also a high risk of spillage during harvest and when seeds are being hauled. Seed may not be covered or tarped sufficiently to prevent escape, hopper gates may be leaky or broken, and seed may spill when being transferred from storage to transportation equipment. Even the most stringent efforts at separation can – and ultimately will – fail due to human error. Seed escape during transportation, for example, is a proven source of GM contamination in the case of canola in Canada.[18]

1.3 CLEANING

Hoppers, bins, seeding and planting equipment, and other harvesting and storage equipment may not be sufficiently cleaned out after a crop of GM alfalfa is harvested. Seeds from GM alfalfa plants may be left behind in the equipment, and transferred to other fields. Even if cleaning procedures are carefully followed, the possibility of human error must be recognized. In addition, volunteer GM alfalfa may also be harvested with other grains, and be left behind in equipment, or blown back out of the combine. A number of studies have quantified the grain left in combines, bins and planters after they have been cleaned out.[19] For instance, researchers have found that even after a combine has been made to run empty for several minutes, it can hold large amounts of residual grain, which may then contaminate the next crop.[20] Alfalfa seed may be left behind in equipment on its own, or when harvested with other crops.

1.4 HAY TRANSPORT

Transportation of hay also poses a contamination route. Hay is commonly harvested, baled and transported in the open, along roadways from farm to farm. GM alfalfa seed can shake and fall out of the bales. There is nothing to prevent hay produced in one region from being shipped to another. In drought times, for instance, farmers from western Canada have donated hay to eastern farmers and vice versa. There is evidence that such neighbourly activities have inadvertently introduced new weeds. GM alfalfa seed could be spread across Canada in a similar fashion.

1.5 DORMANT SEED

Harvested alfalfa seed often contains "hard seed," or seed that is unable to absorb water due to its hard seed coat. Such seed may remain dormant after it is planted for up to a few years. Such seeds may then germinate at a later time, possibly among fields of subsequent non-forage or non-GM forage crops. This risk of germination in future years from earlier seed drop is one of many reasons why alfalfa is more vulnerable to contamination than many annual crops.

1.6 ANIMAL VECTORS

Birds and animals, such as rodents, can spread seed from storage bins. They often also feed on ripe alfalfa pods, further increasing the risk of inadvertent contamination. Livestock manure, wild animal droppings, and hoof action can also spread GM alfalfa seed. Hard seeds can pass through the ruminant gut. If an animal therefore ingests hay that includes seed heads with viable seeds, some of the seed can pass through the digestive tract, and be present in manure, where it may germinate. Cattle grazing on fields adjoining alfalfa fields may also spread seeds from GM alfalfa volunteers.

1.7 VOLUNTEERS

Alfalfa seed is encased in a pod. These pods can shatter, and seed can germinate, leading to volunteer GM alfalfa growth. These volunteers then may flower and set their own seed. The risk of contamination is heightened by the fact that volunteers often grow in fields that are not being harvested regularly for forage. (For further details on contamination through volunteer alfalfa plants, see pages 9 to 10).

A number of farmers in Ontario also save alfalfa seed for their own use and to sell to other farmers (See page 4). The risk of contamination, even in non-seed producing regions, is very high.

2. POLLINATOR MEDIATED GENE FLOW

2.1 Alfalfa's pollinators

Alfalfa is an out-crossing perennial crop,[viii] and is pollinated by a wide variety of pollinators. These include a number of native pollinators, as well as two better-known and widely studied bees – the leafcutter bee and the honeybee. A number of these pollinators travel great distances. Their ranges can neither be controlled nor predicted with complete certainty.

2.1.1 NATIVE POLLINATORS

A number of native pollinators visit and pollinate alfalfa. These include wild bees from the genera *Bombus* and *Megachile*, as well as other wild, solitary bee species.[21,22,23] These wild pollinators have been found to forage in alfalfa stands, especially when the stands are isolated from other suitable pollen sources, and alfalfa flowers provide the only forage within flight distances.[24] High numbers of bees have also been found to "spill-over" and visit alfalfa flowers when they are very close to wildflowers.[25]

Native pollinators are not well researched or well understood, but they may be the most important source of pollination for alfalfa contamination in Eastern Canada. Information on wild bee foraging ranges is limited, but recent studies and new research methods are finding that previous data may have underestimated the distances wild bees will travel to forage.[26,27]

viii There are two types of pollination. Flowers of plants such as soybeans are largely self-pollinating, which means pollen is transferred from the anthers to the stigma of the same flower, or from one flower to another on the same plant. Others, such as alfalfa, cross-pollinate, or are fertilized when pollen moves from one plant to another.

2.1.2 LEAFCUTTER BEES (*Megachile rotundata*)

Alfalfa is pollinated primarily by leafcutter bees in commercial alfalfa seed production. Alfalfa seed producers place bee huts at intervals in their fields to promote pollination. Leafcutter bees are an integral part of the alfalfa seed business. Studies in the US have proven that leafcutter bee species can disperse pollen from alfalfa fields for distances up to 1000m.[28] They are usually placed in nests in alfalfa fields at a minimum rate of 20,000 bees per acre,[29] some of which may not return to their shelters. They may travel further over time to search for better bloom, and may be blown much further (two or more miles) in strong winds and storms.[30] This is especially true if alfalfa stands are not blooming when the bees are ready to fly and need food in order to keep their hives alive. Even with best planning, blooming may be delayed due to weather conditions, forcing the bees to forage elsewhere. Existing data from the US suggests that complete containment of genes from GE alfalfa seed or hay production fields, using current production practices, is very unlikely.[31]

2.1.3 HONEYBEES (*Apis sp*)

Honeybees may also be used to pollinate alfalfa, or be placed near alfalfa fields while pollinating other crops and producing honey. Alfalfa flowers have a pollen-carrying “keel,” which trips insects when they visit the flower, and hits them on the head. This action transfers the pollen to the insect. Mature honeybees tend not to pollinate alfalfa at high rates, since they do not like being “tripped” by the flower.[32] However, this is a learned behaviour, and juvenile honeybees may pollinate alfalfa flowers. Honeybees can carry pollen for up to 10 km.[33]

Researchers at Colorado State University found that bees had transmitted pollen from Roundup Ready alfalfa fields to 83% of the sites tested, and to the most distant tested site at 1.7 miles from the source of pollen.[ix] Honeybees were responsible for a majority of the pollen transfer, while leafcutter and alkali bees contributed to a lesser extent.[34] The challenges of preventing GM contamination in field conditions has been described by a number of researchers.[35,36,37,38,39]

Since they flower multiple times, the risk of genetic contamination in such perennial crops is significantly higher than in annual crops

2.2 Opportunities for cross-pollination

Alfalfa for hay production is often cut after blooming starts. In fact, farmers are advised to cut alfalfa at or before 10% bloom (i.e. when 10% of the plants in the alfalfa stand have bloomed). The quality of alfalfa hay is optimal at this stage of first flower. While this blooming rate is not very high, it gives bees and other pollinating insects a clear opportunity to transfer pollen from the GM alfalfa crop to non-GM plants. While alfalfa cut for hay or dehydrated products may be at lower risk of gene flow than alfalfa produced for seed as it is harvested earlier, the risk of contamination is still high, and can take place in a number of situations.

Like most other leguminous plants, alfalfa blooms and may set seed two or three times in a season. This is most likely in older, less tightly managed stands, such as pasture or in hay cut for beef. However, any alfalfa field that cannot be cut due to weather, farmer illness, or other unintended factors, can and will

ix It is possible that honeybees are able to carry RRA pollen even further, but this information cannot be assessed from this study because the bees reached the furthest test site at 1.7 miles.

set seed if not harvested in a timely way. Since they flower multiple times, the risk of genetic contamination in such perennial crops is significantly higher than in annual crops.[40]

2.2.1 FARM MANAGEMENT VARIABILITY

The realities of farming mean that there is tremendous variability in actual harvest time. Farm management practices differ across different farm types. Beef farmers, for instance, may cut hay later than dairy farmers, because they do not need as high a protein level in their feed. Dairy farms commonly take three cuts of hay in a season, while beef producers may take two. In addition, the number of cuts also varies with latitude and with farm management practices. In northern Ontario, for example, it is common for farmers to cut their hay once in a season. In warmer areas, a greater number of cuts is possible. Importantly, farmers are not always able to manage their operations in exact accordance with recommended practices.

2.2.2 DELAYED HARVEST

Many factors can delay hay harvest until a later flowering stage, increasing the number of blooms susceptible to, and contributing to, cross pollination.

- Rain may encourage flowering in alfalfa stands, at the same time as it prevents farmers from being able to harvest their crop.
- Breakdowns in harvesting and baling equipment, a reality on any farm, can also delay harvest times. Sickness or other personal issues as well as labour issues can delay harvest time.
- With a longer season, most farmers in Ontario manage alfalfa stands to get three or more cuts of hay, so the potential for cross-pollination and contamination during blooming can exist more than once in a season.
- There is a critical period (usually in August and/or September) in stand development when alfalfa cannot be harvested, so that the plants are able to store enough energy to survive through the winter. If farmers are not able to take a second or third cut before this period (due to any of the reasons mentioned above), they may choose to leave the stand uncut, in which case plants bloom and mature. This circumstance again increases the potential for contamination.
- Heat waves can lead to sudden blooms in alfalfa fields after the first cut, and before the stand is high enough for a second cut. Again, farmers may choose to leave the stand uncut in this situation, or if there are other farm tasks that are higher priority at the time, which would allow the plants to bloom and mature.

2.2.3 UNPLANNED GROWTH

Re-growth of alfalfa can create another route for contamination. An unexpectedly long growing season can result in an unplanned crop of alfalfa. The costs and/or timing of haying could make it too expensive or unrewarding to cut this growth – often a third or even fourth cut – before blooming, thus creating a flush of viable seed. In this situation, alfalfa may be allowed to re-grow and be left to set seed rather than be harvested as a third hay crop. Poor alfalfa yields may similarly lead to farmers deciding not to harvest their crop in early blooming stages.

Just as it is impossible to fully control the range of pollinators, it is impossible to entirely control the bloom on a forage stand

2.2.4 INCOMPLETE CLEARING DURING HARVEST

Even when they are harvested at a planned time (usually at 10% bloom), alfalfa fields are not usually completely cleared. Harvesting equipment may leave strips of unharvested plants on the margins of fields. These plants may be cross-pollinated and may set seed that then leads to the presence of volunteer and feral alfalfa. Pastures may also be allowed to get well into bloom before livestock is grazed on them, intentionally or otherwise.

Pollinators that visit GM alfalfa fields that are allowed to come into bloom can contaminate fields several miles away. Just as it is impossible to fully control the range of pollinators, it is impossible to entirely control the bloom on a forage stand.

3. FERAL AND VOLUNTEER GM ALFALFA

GM alfalfa can lead to the establishment of feral and volunteer alfalfa. Both increase the risk of contamination from GM to non-GM alfalfa.

3.1 FERAL ALFALFA

The biology and ecology of alfalfa favours its persistence in unmanaged habitats. Field studies investigating the nature and dynamics of feral alfalfa populations in Western Canada, and their role in long-distance, pollen-mediated gene flow, have found that alfalfa produces persistent and hardy feral populations. Feral alfalfa populations act as a “bridge,” facilitating long-distance gene flow among cropped and non-cropped alfalfa populations within farming regions.[41] Escaped alfalfa grows in ditches and on roadsides, and commonly flowers synchronously with nearby hay and seed fields,[42] greatly increasing the risk of cross-contamination. Studies have also found that feral alfalfa has substantial seed production capability, and that even with management practices in place, it can take up to 7 years for the seedbank to be completely exhausted.[43]

Similar behaviour has been seen with other crops. Escaped roadside populations of canola, for example, were found to accumulate, and act as a source and sink, for unintended transgenes.[44]

A preliminary study of feral alfalfa populations in California and Idaho found high levels of contamination in roadside feral alfalfa populations.[45] Surveys were taken in three counties in the two states. Researchers found that 15% of the sites in two counties, and 7% of sites in the third, had feral RRA. These results were found in areas where alfalfa seed production was taking place, as well as elsewhere, suggesting that hay production is also a source of feral RRA. The results also indicate that the RRA transgene can persist in the environment, and that seed-mediated gene flow may be significant, since the feral populations were found along main arterial roads.[46]

Given the inherent capacity of alfalfa to persist in feral populations, and the results of surveys in the US and Western Canada, it is very likely that feral RRA will also persist in Ontario. However, there is currently no map of feral alfalfa populations in Ontario.

3.2 VOLUNTEER ALFALFA

Volunteer GM alfalfa[x] (either produced from roots, from plants that have gone to seed during seed production, or in hay fields, pastures, wasteland or ditches) will be a source of contamination for several years after harvest of any GM alfalfa field.

This is a particularly significant threat because alfalfa produces a percentage of hard seed that can germinate several years after the field has been ploughed up. This would mean that a GM alfalfa seed crop would have the potential of contaminating non-GM alfalfa crops planted even a few years later.

The risk of contamination through volunteer alfalfa is heightened because farmers are not generally concerned if alfalfa plants volunteer in hay or pasture fields, especially due to the resultant soil advantage. Pasture land is usually less intensively managed than area under hay, and alfalfa seed and volunteers can easily persist in these fields.

x Volunteer plants refer to plants that grow on their own, instead of being intentionally planted.

A GM alfalfa seed crop would have the potential of contaminating non-GM alfalfa crops planted even a few years later

RRA volunteer crops can also grow in other Roundup Resistant crop fields, such as soybean, corn and canola. Since any volunteer RRA, from roots or seeds, will not be killed when glyphosate is used as weed control, the plants will bloom and may set seed. Pollinators visiting these fields could carry pollen from the volunteer RRA plants, and seeds may spread through the methods mentioned above. Further, if RRA seeds from these plants are then harvested along with the crop, they would go through a cleaning process, and be removed with weed seeds. These seeds, or "screenings" are often to sold to poultry and livestock producers as feed. If the screenings are not crushed, there would be viable GM alfalfa seed in this feed, that could then spread further via manure.

Volunteer GM alfalfa that establishes due to contamination from neighbouring RRA fields poses a particularly serious threat and long-term cleanup challenge. However, hand-removal of volunteer alfalfa plants is unrealistic because the alfalfa plants cannot be fully pulled up from their roots. In addition, seed from volunteer GM plants in hay fields cannot be separated from other tiny forage seeds such as sweet clover.

CONCLUSION

Alfalfa is grown widely across Canada, and in Ontario, for a variety of purposes. It is used as high quality feed for livestock, and in crop rotations to build soil fertility. When grown for hay or haylage, it usually planted with other grasses. Canada also produces alfalfa seed, primarily in the prairie provinces, for domestic and export use. However, Ontario farmers do save alfalfa seed, for their own use, or to sell to other farmers. Other important alfalfa exports include alfalfa pellets, meal and cubes.

Roundup Ready Alfalfa (RRA) has been given approval for environmental release and human consumption in Canada, but cannot be released in the market until it also receives variety registration. If it is released, gene flow from RRA to non-GM alfalfa is unavoidable, and can take place through seed escape of GM alfalfa, pollinator-mediated gene flow, and feral and volunteer alfalfa.

The unintended presence of GM alfalfa will have widespread and negative impacts on family farms in Ontario, and across Canada. Farmers who need to replace their alfalfa crop in order to avoid or minimize GE alfalfa volunteers will face management challenges and increased costs during transition. Organic farmers will lose an important high-protein animal feed, and nitrogen fixer for soils. The addition of one more glyphosate tolerant crop in Ontario risks accelerating the development of glyphosate-resistant weeds. Additionally, the introduction of Roundup Ready alfalfa could eliminate the use of Roundup for those farmers who use glyphosate to burn down alfalfa.

The only way to prevent contamination from GM alfalfa is to stop the market release of GM Roundup Ready alfalfa in Canada.

APPENDICES

APPENDIX I: THE LESSONS OF FLAX CONTAMINATION

The 2009 crisis of GM flax contamination in Canada offers significant warnings relevant to the question of expected contamination from GM alfalfa, and its potential economic consequences.

The GM flax called "CDC Triffid" (tolerant to "Glean" herbicide residues in soil) was developed at the Crop Development Centre (CDC) at the University of Saskatchewan. The CDC Triffid was approved for environmental release and human consumption, and the variety was registered for sale by the Canadian government in 1998. However, flax farmers, represented by the Flax Council of Canada and the Saskatchewan Flax Development Commission, were deeply concerned that GM flax would contaminate exports bound for the European market that had not, and still has not, approved the GM flax. In order to avoid this predicted market rejection, flax farmers successfully convinced the University of Saskatchewan to de-register the GM flax variety in 2001, making it illegal to sell the flax seeds from that point on, and effectively removing it from the market. Seed was being prepared to sell to farmers at this point; about 40 seed growers had multiplied around 200,000 bushels of the GM flax seed for future use, but these stocks were ordered crushed. Despite these measures, in September 2009, Canadian flax exports were tested and CDC Triffid was discovered in export shipments that reached 35 countries.

- In 2009, about 3.5% of the farmer and elevator flax samples tested positive for CDC Triffid at or above 0.01% (one seed in 10,000). Ten to 15% of the rail shipments tested positive and 7% of the vessel holds.
- Two varieties of certified seed stocks were found contaminated. This occurred in a stringently controlled, small breeding center where flax breeders were well aware of the negative consequences of GM contamination. Even in these circumstances, contamination was not avoided and the certified seed from these programs added to the contamination problem.
- The source of GM flax contamination has not been established and may never be identified.

Economic Consequences

Canada is the world's leader in the production and export of flax – flax is one of Canada's five major cash crops, along with wheat, barley, oats and canola. In September 2009, our European market – 60% of our flax exports – was closed. Contamination from CDC Triffid was found in exports to 35 countries that had not approved GM flax for human consumption or environmental release and could therefore not tolerate contamination.

DECLINE IN FLAX BIDS

Cash bids for flax in Manitoba were $9.90CND to $9.92CND per bushel, but dropped to $6.78CND a bushel, even before contamination was confirmed, based just on rumour. This was a fall in price of 32%.

DECLINE IN FLAX ACREAGE AND EXPORTS

Canadian farmers grew 518,200 tonnes of flaxseed in 2012, compared with the 930,000 tonnes grown in 2009, prior to the contamination incident.[47]

NEW COSTS OF TESTING SEED

In 2010, the federal government pledged up to $1.9 million to assist companies (not farmers) pay to test flax seed. As of January 1, 2011, approved labs were providing farmers with a discount of 50% of the regular cost of testing pedigreed and farm-saved seed up to a maximum of $100 per sample. The labs were reimbursed by the Flax Council of Canada, using funds provided by the federal Government under the Canadian Agricultural Adaptation Program (CAAP).[48]

NEW COSTS OF BUYING CERTIFIED SEED AND LOSING FARM-SAVED VARIETIES

Farmers are bearing the long-term cost of GM flax contamination as the price of testing seed for contamination before planting and/or buying new, certified seed. The price of buying certified seed can also be the loss of farm-saved, older varieties that may no longer be easily available and which were adapted to specific local conditions and/or particular market demands. Under the auspices of cleaning up the contamination, grain company Viterra attempted, but failed, to require flax farmers to buy and plant only certified seed for the 2010 crop destined for sale to the EU market. Part of the reason farmers were ultimately not required to buy certified seed was due to the discovery of Triffid in pedigree and breeder seed. However, in 2013, the flax industry released its "Reconstituted Flax Seed Program," which encourages farmers to buy certified seed, from certified re-constituted supplies, for 2014 planting. About 75% of Canada's flax farmers use farm-saved seed.

APPENDIX II. THE LESSONS OF CANOLA CONTAMINATION

The widespread and uncontrolled contamination of non-GM canola with GM canola in Canada is a strong cautionary tale.

GM canola was first grown in Canada in 1995. The early adoption of GM canola in Canada was high, as was contamination. By 1998, GM traits were already present in volunteer canola plants, and by 2007 GM traits were documented in escaped, and possibly feral, roadside populations of canola.[49] 97.5% of Canada's canola is now GM.[50]

Pollen-mediated gene flow of canola has been detected nearly 3 km from a source field.[51]

CONTAMINATION OF CERTIFIED SEED STOCKS:

Seed purity itself was – and still is – an issue with canola. Friesen et al (2003) tested certified canola seed stocks for the presence of unintended transgenes.[52] Of the 27 unique, commercial certified canola seedlot samples, 14 had contamination levels above 0.25% and therefore failed the 99.75% cultivar purity guideline for certified canola seed. Three seedlots had glyphosate resistance contamination levels in excess of 2.0%. Some lots were tolerant to both glyphosate and glufosinate. The objective of this study was to survey pedigreed canola seedlots for contaminating herbicide resistance traits. This was because of complaints from farmers regarding glyphosate-resistant canola volunteers occurring unexpectedly in their fields at densities and in patterns that suggested that pollen-mediated gene flow from neighboring fields in previous years was not the source of contamination. Friesen et al concluded that unexpected contamination (even at 0.25%) can cause problems for producers that practice direct seeding and depend on glyphosate for nonselective, broad-spectrum weed control.[53] They stated that, "To avoid unexpected problems and costs, it is important that farmers are cognizant of the high probability that pedigreed canola seedlots are cross-contaminated with the various herbicide resistance traits."[54] A level of contamination over 0.25% is understood to most likely be the result of inadvertent mechanical mixing of certified seed during harvest or handling.[55]

A year prior to the study by Friesen et al., Drs. Downie and Beckie from the federal government department Agriculture and Agri-Food Canada collected 70 certified canola seed lots in Saskatchewan and examined them using a laboratory Petri dish assay.[56] They found 59% of the seed lots had unintended transgene contamination and that 25% of the seedlots had contamination levels exceeding the maximum acceptable standard for certified seeds.

Unintended presence from GM canola reached such a point in Canada that most, if not all, pedigreed seed growers in Saskatchewan would not guarantee their canola seed to be GM-free and most, if not all, grain farmers in Saskatchewan could not guarantee their canola crop, even if planted with GM-free seeds, to be free of GM contamination.[57] The case of canola indicates that, even with the pedigreed seed sector's strict varietal purity management control systems and the economic incentive to ensure that these controls work, the seed industry is not able to prevent unwanted presence of GM traits in non-GM canola seed varieties. If professional seed growers cannot avoid the unintended presence of GM in their seed, it is not reasonable to expect the general population of farmers to succeed in doing so.

SHIFTING ISOLATION DISTANCES

The Canadian Food Inspection Agency requires a distance of 200 meters separation between fields growing certified seeds from any other Brassica, and a distance of 50 meters from weedy relatives. However Canadian producers of hybrid canola seed have required a separation of 2 kilometers from a Brassica crop, in recognition that pollen from a Brassica crop may travel as far as a kilometer or more, and that government-determined isolation distances are not adequate. The inability of Canadian government agencies to predict sufficient isolation distances was also observed in the matter of government field-testing for GM wheat, where buffer zones were repeatedly increased in response to new understandings of risk.[58]

ECONOMIC CONSEQUENCES

While canola exports from Canada did not decrease with the adoption of GM canola, the option of growing canola has been lost to most, if not all, organic grain farmers in Canada.

MOST ORGANIC FARMERS LOST THE USE OF CANOLA

After it was approved in 1995, GM canola from neighbouring farms increasingly appeared as weeds or volunteers in certified organic fields, where other crops such as wheat, oats or peas were being grown. In order to maintain or re-establish certified organic status for the crop, field or farm, organic farmers had to manually remove the GM canola plants, as well as implement additional ongoing measures to avoid contamination of current or future crops, the costs of which were born by the affected farmers.[xi] The unintended presence of GM canola in organic canola fields was not detectable before harvest, nor could it be prevented due to the prevalence of GM canola on prairie farms. Buyers in the organic market tested for the presence of GM canola and did not accept contaminated lots. Seed contamination also quickly became an issue.

Ultimately, except for a few in isolated areas where other farmers do not grow canola, certified organic grain growers abandoned canola in their crop rotations. This was due to considerations such as:

- the prevalence and severity of the problem of unintended presence in the Prairies and the inability of the organic market to accept this unintended GM presence,
- the risks and costs of contamination,
- and the inability to seek legal recourse/ compensation.

> “Every organic grain farmer has lost the right to grow organic canola free of GMO contamination risk. Every organic grain farmer has lost the ability to sell organic canola into Europe.[59]”
>
> — Saskatchewan Organic Directorate. “The Appellants Factum” May 29, 2006.

xi In the case of alfalfa, the manual removal of GM volunteer alfalfa plants would not be possible because of the nature of the plant’s root system.

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