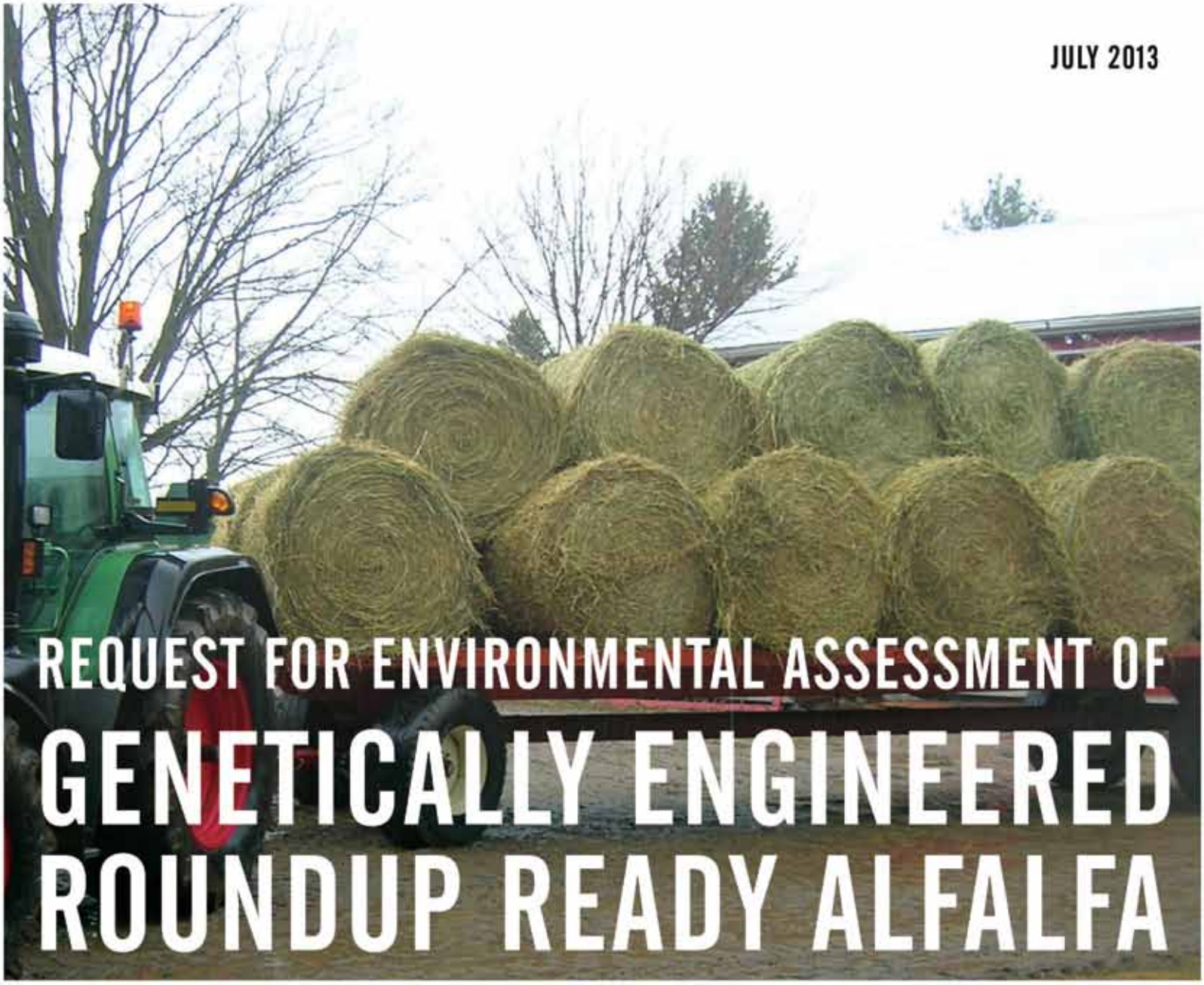
JULY 2013



REQUEST FOR ENVIRONMENTAL ASSESSMENT OF GENETICALLY ENGINEERED ROUNDUP READY ALFALFA

UNDER PART IV, ENVIRONMENTAL BILL OF RIGHTS, ONTARIO

QUESTION 4: A SUMMARY OF THE EVIDENCE THAT SUPPORTS OUR APPLICATION FOR REVIEW

SUBMITTED TO THE ENVIRONMENTAL COMMISSIONER OF ONTARIO

Request for Environmental Assessment of Genetically Engineered Roundup Ready Alfalfa

Under Part IV, Environmental Bill of Rights, Ontario

"Question 4: A summary of the evidence that supports our Application for Review"

Submitted to the Environmental Commissioner of Ontario

July 2013

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ATTACHED REPORTS:

"The Inevitability of Contamination from GM Alfalfa Release in Ontario", Canadian Biotechnology Action Network (CBAN), April 2013. www.cban.ca/alfalfaONreport

"The Canadian Seed Trade Association's so-called "Coexistence Plan" is a gateway to GM alfalfa contamination," Canadian Biotechnology Action Network (CBAN) and the National Farmers Union, July 2013. www.cban.ca/planrebuttal

"On the Practical Implications of Roundup Ready (RR) Alfalfa", E. Ann Clark, April 2012. www.cban.ca/content/view/full/1757

EXECUTIVE SUMMARY

APPLICATION FOR REVIEW, Question 3: We believe the ministry should undertake our Review to protect the environment because:

The distribution, sale, and use of Roundup Ready (glyphosate tolerant) genetically engineered (GE) alfalfa will adversely affect the environment, or might reasonably be expected to adversely affect the environment, in the following ways:

i) by contaminating non-GE alfalfa. Pollen-mediated gene flow and seed escape from GE alfalfa will unavoidably result in the unintended presence of GE alfalfa in pasture (mixed forage) and in conventional, organic, and feral populations of alfalfa;

ii) by adversely affecting biodiversity due to land use shifts to pure alfalfa stands and away from mixed forage, and as other farmers abandon alfalfa in an attempt to avoid contamination, diminishing the environmental services provided by alfalfa;

iii) through the unwanted presence of genetically engineered DNA in forage crops and pasture, posing a serious threat to organic farmers which will include putting at risk their entitlement to organic certification (which strictly forbids GE plants and products) and their access to markets that prohibit GE contaminated agricultural products, and posing a serious threat to producers of grassfed meats, putting at risk their markets that are sensitive to GE contamination;

iv) by imposing new production costs on farmers who do not wish to use GE alfalfa or have their crops and land contaminated by such organisms;

v) by imposing new production costs on farmers — conventional farmers would bear the costs of managing new herbicide resistant weeds and volunteer glyphosate tolerant alfalfa plants, and organic farmers would have to remove GE alfalfa plants from their farms;

vi) by increasing the use of glyphosate and thereby accelerating the development of glyphosate resistant weed biotypes. This would in turn further increase the use of glyphosate and other herbicides, including 2,4-D and dicamba; and

vii) proposed remediation strategies for addressing impacts have little if any prospect for success, and are inequitable.

The environmental affects of proposals to distribute, market and release GM alfalfa have not been properly assessed by the Federal government. The federal regulatory process that applies to GE Roundup Ready alfalfa did not assess the potential affects on sustainable agriculture and entirely ignored affects on the social, economic and cultural environment.

Moreover, unlike the requirements of the environmental assessment process under the Act, Federal regulation is not transparent or accountable. Indeed the approvals process for GE alfalfa is entirely shrouded in secrecy and claims to business confidentiality.

GE Roundup Ready alfalfa was approved by federal regulatory agencies in 2005 but the seeds were not legal to sell in Canada until one variety of the GE alfalfa was registered by the Canadian Food Inspection Agency on April 26, 2013. This issue is urgent because seed companies could now place this GE alfalfa variety on the market any time, and the company Forage Genetics International has identified Eastern Canada as its first market.

THE AGRONOMIC AND ECONOMIC IMPORTANCE OF ALFALFA

Alfalfa is a unique and uniquely important crop in Ontario. Its biological characteristics and the diverse ways that it is used in Ontario mean that the contamination risk with this crop is particularly high. Alfalfa's unique combination of agronomically important traits means it has diverse on-farm uses and is therefore deeply integrated into Ontario's whole food and farming system, with a high economic value as well as cultural and social importance.

Alfalfa, often called "Queen of the Forages," is the most important and widely grown forage crop[i] in Canada.[1,2] Alfalfa — including pure stands and alfalfa mixes, seeded and tame pasture, and forage grown for seed — is also one of the largest crops in Canada by area. In 2011, alfalfa was produced on over 25 million acres across the country.[3] This accounts for almost 30% of Canada's cropland.[4]

Alfalfa is grown on 22% of the cropland in Ontario and is an important crop in many different types of farming systems in the province.[5] Alfalfa accounts for 52 of the 100 forage varieties recommended in Ontario in 2012.[6] One of the most common forage mixtures used in Ontario is alfalfa and timothy. Together, alfalfa and timothy comprise nearly two-thirds of all recommended forage varieties in 2012 by the Ontario Forage Crops Committee.[7]

Alfalfa is used to produce high-quality hay or haylage for dairy and beef cattle as well as sheep and horses, or is grown as part of pasture for these same animals. Farmers also commonly use alfalfa in crop rotations to help build nitrogen levels in the soil/maintain soil fertility, which is particularly important for organic farms (vegetable and grain) that do not use chemical fertilizers. Additionally, some foods are directly produced from alfalfa, such as sprouts and dietary supplement products.

While commercial alfalfa seed production by Ontario farmers is significantly less than Prairie farmers, some Ontario farmers do harvest alfalfa seed for their own use, as well as for sale and exchange. Ontario produces 9% of Canada's alfalfa seed exports and 8% of national alfalfa meal and pellet exports (to the US).[8]

Alfalfa is grown for a number of direct and indirect economic benefits. In contrast to existing Roundup Ready cash crops in Ontario, many parts of the alfalfa plant are used for environmental and economic benefit: the leaves and stems (hay), roots (soil building), bacterial association (nitrogen), pollen and nectar (for honey bees), and the whole plant in combination with grasses and other forbs (pasture).

Alfalfa is commonly grown or occurs in mixed forage with other species of grasses, forbs and forage legumes.

i Forage, broadly defined, is herbaceous, high-fiber vegetation that may be consumed by grazers such as cattle and sheep. Forage crops are typically sown in species mixtures including grasses.

THE REGULATORY STATUS OF ROUNDUP READY ALFALFA

In 2005, Monsanto received Canadian regulatory approvals for genetically engineered glyphosate tolerant (Roundup Ready) alfalfa (GE events J101 and J163). The Canadian Food Inspection Agency and Health Canada approved Roundup Ready alfalfa (RRA) for environmental release, and animal feed and human consumption, respectively. Before new alfalfa varieties can be commercialized in Canada, however, they are subject to variety registration as outlined in the Seeds Act and governed by the Canadian Food Inspection Agency. Seed registration is required before new alfalfa varieties can be legally sold in Canada. Note, however, that the federal government has proposed to dramatically accelerate the process for registering forage seed varieties with changes to the Seed Variety Registration under the Seeds Act as noted in the Canada Gazette Part 1 and the notice of March 9, 2013. The changes would allow for virtually automatic registration of new varieties.[9]

Registration of one RRA variety was granted on April 26, 2013. There could be additional varieties of RRA currently in the variety registration process, but this is unknown because all aspects of the variety registration process are classified as "Confidential Business Information", meaning that there is no public notice of requests to register varieties, no public consultation, and no disclosure when the process is underway.

Monsanto has licensed the US seed company Forage Genetics International (FGI) to market and distribute its patented GE Roundup Ready trait in alfalfa varieties.

STATUS OF GENETICALLY ENGINEERED CROPS IN ONTARIO, CANADA AND GLOBALLY

Genetically engineered (GE, also commonly referred to as genetically modified or GM)[ii] herbicide tolerant canola was the first GE crop approved, in 1995. There are four GE crops currently grown in Canada, including Ontario: corn, canola, soy and white sugarbeet (for sugar processing). There are eight GE crops grown around the world currently: the aforementioned plus papaya (US, China), some varieties of squash (US), alfalfa (US), cotton (mainly in the US, India, and China). Plantings of Roundup Ready alfalfa were allowed in the US as of January 2011, after years of legal challenges.

Canada grows 6.8% of the world's GE crops. Nıne countries grow 97% of the global GE acres and, together, the US, Brazil, and Argentina grow 76.3% of the total.[10]

There are two main GE traits on the market globally – herbicide tolerant crops and insect resistant crops. These are the only two traits currently on the market in Ontario and across Canada.

1. Herbicide tolerant crops, such as Roundup Ready crops, are engineered to withstand sprayings from certain broad-spectrum herbicides, such that the crop plants will survive spraying that is intended to kill all weeds.

ii In order to be clear about the technology we are referring to, this document uses the term GE as per the Canadian Food Inspection Agency's definiton: An organism is considered genetically engineered if it was genetically modified using techniques that permit the direct transfer or removal of genes in that organism. Such techniques are also called recombinant DNA or rDNA techniques. ("Modern Biotechnology: A Brief Overview" http://www.inspection.gc.ca/plants/plants-with-novel-traits/general-public/fact-sheets/overview/eng/1337827503752/1337827590597)

2. Insect resistant (Bt) crops are engineered with genes from the soil bacterium *Bacillus thuringiensis* to be toxic to certain classes of insect.

85% of the world's GE crops are herbicide tolerant, 26% of which are "stacked" with one or more insect resistant trait.[11] 15% are engineered to be insect resistant. Less than 1% of all GE crops have a different trait: virus resistance (papaya in the US and China, and some squash varieties in the US).

EXPECTED ENVIRONMENTAL EFFECTS

1. CONTAMINATION

The facts of genetic contamination are clear. If RRA alfalfa is released onto the market, uncontrolled introduction of RR genes into non-GE alfalfa will be unavoidable. Pollen-mediated gene flow and seed escape from GE alfalfa will result in the unintended presence of GE alfalfa in conventional, organic, and feral stands of alfalfa. There are particular and pronounced risks of contamination with this perennial crop, though GE contamination is a consistent and predictable problem across crop types, as seen in the Canadian experience with GE canola and GE flax[12], contamination incidents across the world[13], and even the recent discovery of unapproved Roundup Ready wheat growing on a farm in Oregon.

Contamination from GE alfalfa can take place through several routes. These can be broadly divided into three categories: seed escape, pollinator-mediated gene flow, and gene flow through volunteer and feral alfalfa. Please refer to the attached April 2013 report "The Inevitability of Contamination from GM Alfalfa Release in Ontario" from the Canadian Biotechnology Action Network (CBAN), which details the contamination routes.

The biological characteristics of alfalfa converge to present a particularly potent risk of gene escape. Additionally, outside of the many important considerations relating to the biology of alfalfa, the role of predictably variable patterns of human behaviour in handling GE alfalfa seed is a known risk.

a) Contamination Via Seed Escape

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

SPILLAGE
There is a very high risk of inadvertent seed spillage during planting when seed is being poured into planting equipment or transferred from storage to transportation equipment, during harvest, and when seed is being hauled post-harvest. Even the most stringent efforts at separation can – and ultimately will – fail due to human fallibility.

EQUIPMENT CLEANING
Seeds may get left behind if hoppers, bins, and other seeding, harvesting and storage equipment is not sufficiently cleaned out. These seeds may then be transferred to other fields. Even if cleaning procedures are carefully followed, perfection is unreasonable to expect (alfalfa seeds are very small).

HAY TRANSPORT
Hay is commonly harvested, baled and transported in the open, along roadways from farm to farm and sometimes even across the country.[14] GE alfalfa seed could shake loose and fall out of the bales.

DORMANT SEED
Harvested alfalfa seed often contains some "hard seed," or seed that is unable to absorb water due its hard seed coat. Such seed may stay dormant after it is planted and germinate at a later time, possibly among fields of subsequent non-forage, or non-GE forage crops.

ANIMAL VECTORS
Birds and rodents can spread alfalfa seed via their droppings. In addition, livestock can spread it through manure if they feed on hay, feed or screenings that contains GE alfalfa seed.

VOLUNTEERS
Escaped seed can lead to volunteer GE alfalfa plants growing in fields, pastures, wasteland and ditches. These plants would continue to be a source of contamination – through seed production, as well as through cross pollination – for several years. If they grow in fields with another RR crop, such as soybean, canola or corn, they will not be killed when treated with Roundup. These persistent volunteers could bloom and set seed, exacerbating the risks of contamination through seed escape and pollination. In addition, seed from volunteer GM plants in hay fields cannot be separated from other tiny forage seeds such as sweet clover.

b) Pollinator Mediated Gene Flow

Alfalfa is an out-crossing perennial crop[iii], 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 bee species– 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.

Several native pollinators visit and pollinate alfalfa. These include wild bees from the genera *Bombus* and *Megachile*, as well as other wild solitary bee species.[15,16,17] 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.[18] High numbers of bees have also been found to "spill-over" and visit alfalfa flowers when they are very close to wildflowers.[19] Native pollinators are not well researched or well understood, but they may be the most important means of pollination for alfalfa contamination in Ontario.

In commercial seed production, alfalfa is pollinated primarily by leafcutter bees (*Megachile rotundata*). Studies in the US have shown that these bees can travel for distances up to 1000m. Leafcutter bees may travel beyond their usual ranges if blooming is delayed and they need to forage elsewhere.

Honeybees may also be used to pollinate alfalfa, or be present near alfalfa fields while pollinating other crops or producing honey. Though mature honeybees do not often pollinate alfalfa because they do not like the crop's "tripping" mechanism, juvenile honeybees that have not yet learned this behaviour may pollinate alfalfa flowers. Honeybees can carry pollen for up to 10 km.[20] Researchers

iii There are two types of pollination. Flowers of plants such 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.

at Colorado State University found that bees had transmitted pollen from Roundup Ready alfalfa fields in the US to 83% of the sites tested, and to the most distant tested site at 1.7 miles from the source of pollen. Honeybees were responsible for a majority of the pollen transfer, while leafcutter and alkali bees contributed to a lesser extent.[21]

The biotechnology industry contends that farmers will cut RR alfalfa stands being grown for hay before the plants bloom. However, alfalfa for hay production is often cut after blooming starts. Farmers are advised to cut alfalfa at or before 10% bloom (i.e. when 10% of the plants in the alfalfa stand have bloomed. 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 because 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 plants bloom 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 produced for beef. However, any alfalfa field that cannot be cut due to weather, equipment breakdown, farmer illness, or other unanticipated factors, can and will set seed if not harvested in time. Since they flower multiple times, the risk of genetic contamination in such perennial crops is significantly higher than in annual crops.[22] There is additional variability in harvest time due to differing farm management practices. Beef and dairy farmers, for instance, harvest alfalfa for hay at different times in the season, and may take a different number of cuts. Even when harvested as planned, fields may not be completely cleared. Small sections of the stand may be left unharvested on the margins of fields, for example.

c) Feral and Volunteer GE Alfalfa

GE alfalfa can lead to the establishment of GE populations of feral and volunteer alfalfa. Both increase the risk of contamination from GE to non-GE alfalfa. Feral populations will act as a "bridge" to facilitate long-distance gene flow among cropped and non-cropped alfalfa populations.[23]

Alfalfa adapts well to resource-poor environments such as road verges, and survives well as a feral plant in the wild.[24] 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.

Preliminary results from a US Department of Agriculture study of feral alfalfa populations in California and Idaho found high levels of RRA contamination in roadside feral alfalfa populations.[25] The results suggest that both alfalfa seed and hay production is 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 contaminated feral populations were found along main arterial roads.[26]

Given the inherent capacity of alfalfa to persist in feral populations, and the results of surveys in US and Western Canada, it is very likely that feral RRA would also persist in Ontario. However, feral alfalfa populations in Ontario have not been mapped.

d) Stewardship Agreements and "Coexistence" Plans Cannot Contain RRA

The biotechnology industry is currently arguing that containment of GM alfalfa in Eastern Canada would be possible through reliance on a (voluntary) "coexistence plan" that includes "Best Management Practices."[27] However, such a plan - any plan - would be unable to stop GE alfalfa from contaminating farmers' fields, and the implementation of such a plan would impose new costs on farmers in the attempt. For an analysis of the proposed "coexistence plan" for RRA in Eastern Canada please see the attached report "The Canadian Seed Trade Association's so-called "Coexistence Plan" is a gateway to GM alfalfa contamination," from the Canadian Biotechnology Action Network and the National Farmers Union, July 2013. The conclusions of this report are supported by the 2001 Royal Society of Canada's Expert Panel on the Future of Food Biotechnology which stated that "industry argues that as long as "good farming practices" are followed, these problems [contamination] should not occur. This perspective may be unduly naïve. Environmental assessments associated with the release of GM crops should take account of the fact that in the real world human error and expediency may often compromise guidelines for the growing of such crops."[28]

SUMMARY

The biological characteristics of alfalfa converge to present a particularly potent risk of gene escape and, in addition to the many important considerations relating to the biology of alfalfa, the role of human behaviour in handling GE alfalfa seed is a known risk.

2. INCREASED HERBICIDE USE

The introduction of Roundup Ready alfalfa into the Ontario agro-ecosystem will expand problems already documented with the current use of RR crops: the adoption of RRA will increase the use of glyphosate in Ontario and thereby accelerate the development of herbicide resistant weeds, that will in turn lead to further increased use of glyphosate and other herbicides including 2,4-D and dicamba.

In 2012, the Environmental Commissioner of Ontario expressed concern over the long-term sustainability of the partnership of genetically modified crops and glyphosate herbicides.[29]

a) Increased Use of Glyphosate Due to RRA Adoption

Roundup is the brand name of Monsanto's broad-spectrum herbicide formulation based on the active ingredient glyphosate, and it is the most widely sold pesticide in the world. In the US, approximately 94% of soy and 72% of corn is now GE herbicide tolerant, and the overwhelming majority of these are glyphosate tolerant[30] – the Canadian government does not keep statistics on GE crop acreage.

While the biotechnology industry promised that GE crops would reduce the use of chemical pesticides, pesticide use has, in fact, increased. The Environmental Commissioner of Ontario predicted this possibility in 1999/2000[31] and has since recognized that the adoption of GE crops has resulted in "a huge increase in the application of glyphosate to agricultural soils."[32] An analysis of US Department of

Agriculture data by Charles Benbrook shows that over the first six years of adoption of GE herbicide tolerant and insect resistant crops (1996-2001) pesticide use was reduced in the US by about 2%, compared to what it likely would have been in the absence of GE crops.[33] However, by 2011, overall pesticide use was about 20% higher on each acre planted to a GE crop, compared non-GE crops. The total volume of glyphosate used on corn, cotton and soybeans - the three biggest GE crops – in the US increased 10-fold from 15 million pounds in 1996, to 159 million pounds in 2012.[34] There has been a 50-fold increase in allowable glyphosate residues on "corn, field, grain" in the US since 1996.[35]

Glyphosate is the most widely used herbicide in Canada and, as of 2008, the most recent year for which data are available, glyphosate accounted for roughly 55% of all the active ingredient applied to all Ontario crops.[36] Glyphosate use in Ontario increased between 1998 and 2008, from 0.1 to 0.75 kg/ha in corn.[37] As of 2008, more than 2 million kg of glyphosate were applied annually in Ontario agriculture, mostly to corn and soybeans.[38] Between 1993 (just prior to release of GM crops) and 2008, glyphosate use in corn in Ontario increased 30-fold, from 17,210 to 527,952 kg, and 7.6-fold in soybean, from 164,784 to 1,253,773 kg.[39]

The commercial formula of the herbicide Roundup includes glyphosate, as well as various other compounds, including adjuvants described as "inerts", to improve herbicide spreading, sticking and penetration, and thereby heighten the glyphosate toxicity. Many adjuvants are unidentified, as they are "Confidential Business Information", and are untested. A recent experiment identified at least one of these as more toxic than glyphosate itself.[40]

A 2012 survey of the scientific literature concluded that industry's own studies, conducted in the 1980s and 1990s, showed that glyphosate/Roundup causes birth defects in experimental animals, including at environmentally relevant doses.[41] These findings are consistent with human studies suggesting increased miscarriages and premature births, such as one among Ontario farmers exposed to glyphosate-containing herbicides.[42] The first life-long rat feeding study found increased liver damage and tumours, and shortened lifespan in animals fed Roundup.[43] Both endocrine disruption and DNA damage attributed to the herbicide may contribute to these outcomes.[44] Both glyphosate and phenoxy herbicide exposures are associated with increased odds of developing non-Hodgkin's lymphoma.[45]

A 2010 report of malformations in frog and chicken embryos, at dilutions much lower than those used in agriculture,[46] and a 2013 recent study of the effects of low levels of glyphosate on the aquatic invertebrate *Daphnia magna* concluded that its toxicity to aquatic invertebrates has been underestimated.[47] These studies support the "emerging concern" about glyphosate's impacts on aquatic ecosystems and amphibians that was flagged in 2012 by the Environmental Commissioner of Ontario.[48]

Observations of glyphosate animal toxicity have been downplayed on theoretical grounds because the chemical inhibits a plant enzyme that does not occur in animal cells. Humans, however, actually have more bacterial cells in their body than human cells, bacterial cells *do* rely upon the glyphosate -inhibited biochemical pathway. Shifts in intestinal bacterial populations are linked to myriad ill effects.[49] Glyphosate also inhibits enzymes that detoxify common substances, an enzyme that affects hormone levels,[50] and key signalling during development,[51] potentially impairing fertility, pregnancy outcomes, development, and digestion/metabolism.

In Canada, herbicide use in alfalfa is currently limited to spraying prior to seeding or after harvest to burn down (kill) the alfalfa in preparation for planting another crop. Alfalfa is most commonly grown without pesticides because it is grown in a mix with other species that would also be killed by the sprayings. The initial adoption of RRA in Ontario is therefore expected be limited to those farmers who grow, or want to grow, pure alfalfa stands and can thereby exploit the usefulness of the RR trait. However there are a few reasons why the adoption of RRA and related use of glyphosate on alfalfa could increase over time:

1. Corporations are encouraging Ontario farmers to shift to pure alfalfa stands/new production practices that favour the use of RRA.[52]
2. There may be a gradual reduction in the availability of non-GE alfalfa seeds or in the availability of seeds guaranteed to be GE-free, as was seen in canola.[53]
3. Fear of liability for patent infringement due to unwanted RRA contamination could lead some farmers to adopt RRA in order to avoid litigation[54] or to incorporate the GE trait into farming practice and take advantage of the GE trait where possible rather than attempt to remove RRA plants.

SUMMARY

Roundup Ready alfalfa is explicitly tied to the use of Roundup/glyphosate and will increase the use of this herbicide in Ontario. Research shows that the toxicity of Roundup/glyphosate at low doses may have been underestimated. The Environmental Commissioner of Ontario has recently commented on toxicity questions with glyphosate and stated that, "emerging issues associated with the use of glyphosate raise significant questions with respect to the sustainability of the existing weed management paradigm."[55]

b) Increased Use of Other Herbicides Due to RRA Volunteers and Herbicide Resistant Weeds

Heavy reliance on glyphosate has put pressure on weed populations such that many are now resistant to the herbicide. The introduction of a fifth Roundup Ready crop to Ontario would accelerate the development of herbicide resistant weeds in the province. The introduction of RR alfalfa is now proposed despite the unambiguous failure of Roundup Ready technology in other crops. This failure is manifested in the proliferation of glyphosate resistant weed biotypes and in the corporate response to engineer crops for tolerance to other, more toxic, herbicides.[56]

Southern Ontario is host to three of the four glyphosate-resistant weeds now found in Canada: Giant ragweed (2008), Canada Fleabane (2010) and Common ragweed (2012).[57] There are now biotypes resistant to glyphosate in 24 weed species globally (there were none in 1995), with a 9-fold increase in 3 years (2007-2010).[58] Results of recent online survey of farmers found that more than one million acres of Canadian farmland have glyphosate-resistant weeds growing on them.[59]

The rising incidence of herbicide resistant weeds accounts for the bulk of increased use of pesticides in the US.[60] Charles Benbrook estimated that the presence of resistant weeds drives up herbicide use by 25% to 50%.[61] He observes that related shifts in weed communities and the emergence of herbicide resistant weeds have forced farmers to incrementally increase herbicide application rates, spray more often, and add other herbicides that work through an alternate mode-of-action to spray tanks. Benbrook concludes that, "Each of these responses has, and will continue to contribute to the steady rise in the volume of herbicides applied per acre" on herbicide tolerant GE corn, cotton, and soybean crops. Penn State University (US) Extension's "Guidelines for Weed Management in Roundup Ready Alfalfa" acknowledges this problem in their recommendation that, "fields that are consistently planted to other Roundup Ready crops where glyphosate is routinely used should not be planted to Roundup Ready alfalfa to avoid the selection for glyphosate-resistant weeds,"[62]

In addition to the challenge of managing herbicide-resistant weeds, the RRA plants themselves (volunteers) will become herbicide-resistant weeds. A weed is any plant that a farmer does not want in their crop.Volunteer plants are those that grow on their own from previous plantings and have not been sown intentionally. Volunteer RR alfalfa will present a weed management problem. Hand weeding of alfalfa plants is not possible due to field scale and the root structure of alfalfa. To remove glyphosate resistant weeds and/or RRA volunteers farmers will resort to altering rotations, increased tillage, increased spraying, using pesticide mixes, and/or the use of non-glyphosate pesticides, 2,4-D and dicamba in particular.

Companies confirm the move (back) to (more toxic) non-glyphosate pesticides with the development of new GE crops that are tolerant to 2,4-D and dicamba to replace or augment the GE glyphosate-tolerant trait. In October 2012, the CFIA approved two genetically engineered 2,4-D tolerant crops from Dow AgroSciences (a corn with increased tolerance to 2,4-D and a soybean with tolerance to both 2,4-D and glufosinate) as well as a GE dicamba-resistant soybean from Monsanto. Just as these crops were being approved, the Environmental Commissioner of Ontario published an analysis that stated, "If these new GM plants are approved in Canada, Ontario may see a lot more 2,4-D applied to agricultural fields in years to come."[63]

A National Water Research Institute study has already found that all surface waters tested in Alberta, Saskatchewan and Manitoba had detectable levels of 2,4-D.[64] 2,4-D (2,4-Dichlorophenoxyacetic acid) was a major ingredient in Agent Orange alongside its chemically similar relative, 2,4,5-T. In November 2012, civil society groups Équiterre, Nature Québec, the Canadian Association of Physicians for the Environment, Prevent Cancer Now, the Canadian Biotechnology Action Network, and Vigilance OGM denounced the regulatory approval of Canada's first crop plants genetically engineered to tolerate 2,4-D, saying that they will lead to increased herbicide use, with more toxic pesticides in the environment and our food.[65] This warning is confirmed by Charles Benbrook who calculates the introduction of 2,4-D tolerant corn could mean a 30-fold increase in the use of 2,4-D in the US (from 2010 levels) with (based on a projection that 55% of the corn acres planted by 2019 would be 2,4-D tolerant corn).[66]

Due to manufacturing processes, 2,4-D is often contaminated with dioxins, a group of highly toxic chemical compounds that bioaccumulate up the food chain. The US Environmental Protection Agency reports that 2,4-D is the seventh largest source of dioxins in the US, while Environment Canada identified that phenoxy herbicides are the highest source of "lower chlorinated" dioxins in the environment.[67] Adverse health effects may arise from 2,4-D itself, its breakdown products, dioxin

contamination, or from a combination of these substances. Exposure to 2,4-D has been linked to serious health problems that include cancer (especially non-Hodgkin's lymphoma), lowered sperm counts, liver disease and Parkinson's disease. The balance of epidemiological research suggests that 2,4-D can be persuasively linked to cancers, neurological impairment and reproductive problems.[68] The International Agency for Research on Cancer classifies 2,4-D as "possibly carcinogenic to humans." The European Union Strategy for Endocrine Disrupters classifies 2,4-D in Category II on its priority list of suspected endocrine disrupting chemicals. 2,4-D has been found in urine and semen, and chlorophenoxy herbicides have been linked to sperm abnormalities, increased miscarriage rates, difficulties conceiving and bearing children, and birth defects.[69] Sweden, Denmark and Norway have discontinued registration of 2,4-D.

SUMMARY

The development of glyphosate resistant weeds is a growing problem in Ontario, and so far, the weed management response is to increase glyphosate use and use older, more toxic chemicals such as 2,4-D and dicamba.

3. THE IMPACTS ON BIODVERSITY

In 2001, the Royal Society of Canada's Expert Panel on the Future of Food Biotechnology pointed out that, "Agricultural land in North America is also important for wildlife (Best et al., 1995; Boutin et al., 1999) and stated that "detailed studies are urgently needed to assess the impact of the large-scale growing of GM crops on the maintenance of biodiversity in agricultural ecosystems."[70] The Panel noted that, "In Europe, many species are adapted to the habitats associated with agricultural practices such as hedgerows, ditches, hayfields and meadows. The widespread use of broad-spectrum herbicides associated with herbicide-resistant crops could potentially reduce plant biodiversity with direct and indirect influences on vertebrate and invertebrate species."[71] Entomologists have charted a major decline of Common Milkweed, the primary food plant of Monarch butterfly larve, in corn and soya fields since the introduction of RR crops in the 1990s.[72] The Panel concluded that, "conserving biodiversity is an essential part of sustainable agriculture that is beneficial from both an economic and ecological perspective. Agroecosystems that are sterile wastelands not only have little aesthetic appeal but are unlikely to be ecologically sustainable over the long term."[73]

Land use changes in Ontario due to the introduction of RRA could include:

1. A shift to pure stands of alfalfa, that is, monocropping of alfalfa, which would reduce biodiversity on farmland in Ontario.
2. Reduction in the use of alfalfa, diminishing the environmental services provided by alfalfa.

a) Biodiversity Impacts Due to Shift to Pure Stand Alfalfa Production

Alfalfa is usually grown in mixed stands with grasses and other broad-leafed plants, but RRA is designed for use in pure alfalfa stands, as glyphosate would kill the other grasses along with the targeted weeds. Forages are the only modern crop type that includes genetic diversity both within and among species in the same field at the same time.[74] Mixed forage stands by virtue of being a mix of legumes and grasses provide both a biodiverse ecosystem and an economic and agronomic benefit to farmers. As RRA is designed for pure alfalfa stands, a move to RRA would eliminate this biodiverse ecosystem found on farms across the province and move more Ontario farmland into monocropping.

Mixed stands provide habitat for wildlife in Ontario, including the threatened Eastern Meadowlark and the Bobolink, provided the stand is left long enough into the season before it is cut for hay. The Ontario Ministry of Natural Resources observes that there are several probable factors responsible for driving Eastern Meadowlark and Bobolink population declines in Ontario but "chief among them is loss of breeding habitat, especially pasturelands and hayfields which have been converted to other crops. In addition, there have been changes in hayfield composition and management that affect habitat quality, (e.g., a decrease in the proportion of grass cover as a result of an increase in the amount of alfalfa planted)."[75] The Ministry states that the various issues of concern are "ultimately driven by market forces affecting the livestock industry in Ontario, particularly dairy and beef cattle."[76] The 2013 survey from Birdlife International found that 1 in 8 bird species globally are threatened and the report concluded that unsustainable agricultural practices are the greatest threat.[77]

Changing use of forage crops could also have an impact on insect/pollinator diversity as wild pollinators and other insects also make use of this habitat. Forage, which typically includes alfalfa, can provide particularly suitable habitat to a very large diversity of insect species, primarily because, unlike annual crops, they can provide a sustainable food source, moisture and dense foliage.

Alfalfa acts is an important primary producer, which feeds several species of insects and other herbivores. These species are then preyed on by other wildlife, such as birds, hunting mammals, and snakes, making alfalfa the first link in a large food chain. The crop's canopy provides nesting and burrowing habitat, while the roots provide habitat for several other burrowing insects and mammals. Bats, which often feed in alfalfa fields, control pests that may otherwise harm field crops. Barn owls and several other bird species also frequently feed on rodents in alfalfa fields.

b) Threat to Environmental Services Provided by Alfalfa

Some farmers may abandon growing alfalfa because of RRA contamination or the threat of contamination. In addition to contamination concerns, the legal precedent set by *Monsanto Canada Inc v. Schmieser* means that some farmers may fear litigation by Monsanto for patent infringement if RRA is found in their fields.

Alfalfa provides a range of important environmental services in Ontario's agro-ecosystem.[78] Ann Clark writes that, "While we think of perennial forages primarily as livestock feed, they perform a broader range of services to whole farm management and land stewardship, including the addition of nitrogen to the land. For this reason, the fate - financial and agronomic viability – of perennial forages bears not simply on the livestock sector but on agriculture and the environment as a whole.

Should a significant fraction of producers foreswear alfalfa, to avoid some of the kinds of risks and liabilities discussed in this and other reports, effects on environmental sustainability would be expected."[79]

Alfalfa is the most commonly used legume in Ontario forage crops. Forages play multiple roles in whole farm management.[80] For example, forage legumes are included in crop rotations to help build nitrogen levels in the soil, maintain soil fertility, prevent erosion, and increase soil aeration. Sites unsuited to arable cropping can be left as permanent pasture or hay crops, to minimize risk of erosion.[81] Manure from animals fed alfalfa is also highly productive, thus some Ontario farmers maintain limited animal agriculture in association with alfalfa for this benefit.

Alfalfa is used as fertilizer and to increase soil organic matter. At the end of the rotation, alfalfa is plowed into the soil where it slowly decomposes, forming humus. This results in additional carbon sequestration and improved moisture holding ability which makes the soil tolerant to both drought and excess moisture. Perennial forages have an important role in carbon sequestration and green-house gas (GHG) abatement. For example, in Ontario, alfalfa significantly reduces GHG emissions compared to corn rotations, and sequesters carbon at a higher rate.[82]

Ann Clark summarizes that, "Forage crops are an essential component of ecologically based farming systems. Forages are the glue that holds together and sustains arable agriculture. Forages serve many purposes, whether for livestock feed, soil improvement, and N [nitrogen] fixation, or for biodiversity, weed and pest management, and GHG abatement…Diversity is central to the capacity of forages to serve and sustain agriculture. Forages are the only crop type in contemporary farming that relies intrinsically on mixtures of species to buffer against the vagaries of weather and the heterogeneity of the growing landscape."[83]

SUMMARY

The systemic impacts of RRA on biodiversity and sustainable agriculture in Ontario need to be assessed. Land use changes in Ontario due to the introduction of RRA could include a shift to pure stands of alfalfa with an impact on Ontario's biodiversity and a reduction in the use of alfalfa that would diminish the environmental services provided by alfalfa.

4. THE INCREASED PRODUCTION COSTS FOR ONTARIO FARMERS

a) Increased Costs of Weed Management

Managing new herbicide resistant weeds and the loss of the usefulness of glyphosate will generate new costs for Ontario farmers. Charles Benbrook concluded that, "The presence of resistant weeds drives up herbicide use by 25% to 50%, and increases farmer weed-control costs by at least as much."[84] In the US, the cost of herbicide resistant weeds, due to reduced yields and increased production costs, ranges from $12 to $50 per acre.[85] "The wholly predictable outcome of overdependence on

a single herbicide - a trend which would be further exacerbated by the introduction of RR alfalfa – is the skyrocketing costs to producers of controlling weed biotypes resistant to glyphosate." [86]

The unintended presence of volunteer RRA plants in farmers' fields will have widespread, negative impacts on a range of farms in Ontario, both where RRA is adopted and where it is not. RRA volunteers pose a long-term clean-up challenge. As a perennial crop with deep roots, some alfalfa plants will likely survive cultivation and become volunteer 'weeds' in subsequent RR soy and corn fields. Those farmers who currently use glyphosate to clean up volunteer alfalfa plants will need to resort to other non-glyphosate herbicides or tank mixes.

- Currently, to end the alfalfa phase of a crop rotation, many farmers use glyphosate to burn down (kill) the alfalfa stand and make it easier to disc or plough, or direct seed a crop into its stubble. The introduction of Roundup Ready alfalfa could eliminate the use of Roundup for those farmers who use glyphosate, and add the cost of additional herbicides.
- Neighbouring farmers could be exposed to additional costs associated with increased use of 2,4-D and dicamba (synthetic auxins), as any broadleaf plant, such as soybean, cotton, and alfalfa, vegetables, fruit trees/bushes and other trees, are extremely vulnerable to injury from spray drift.[87]

b) Loss of Seed Saving

Ontario farmers produce a limited amount of seed and alfalfa products for export (9% and 8% of national exports respectively), mostly to the US market, and the National Farmers Union Ontario has identified members and neighbours who save alfalfa seed in Renfrew, Grey, Perth, Huron and Lambton counties.[88] A farmer's stock of saved seed that becomes contaminated with RRA will need to be abandoned along with the practice of saving alfalfa seed. This will result in the new cost of alfalfa seed purchase as well as the loss of any particular agronomic, market or regionally adapted benefits of those lost varieties. At least one Ontario farmer lost his own flax seed due to a national GE flax contamination in 2009.[89]

If a patented gene sequence is found in farm-saved seed, the farmer risks being sued by the seed company, in this case Monsanto, that holds the patent. Farmers also risk losing markets for non-GE alfalfa seed or other alfalfa products grown from the seed. Ontario could lose the potential to diversify export markets for alfalfa seed and products in the future, beyond our current market reliance on the US which has approved RRA.

SUMMARY

The release of RRA will increase production costs for Ontario farmers. Glyphosate resistant weeds and RRA volunteers will require new weed management strategies such as the purchase of more glyphosate and new herbicide mixes. The increased use of non-glyphosate herbicides such as 2,4-D is also likely to increase incidents of crop damage due to spray drift from neighbouring farms. Alfalfa seed saving in Ontario will also be at risk, with associated costs.

c) Impact on Organic/Non-GE Farmers

RRA contamination is a direct threat to organic certification as the rules of organic production practice, as set out in regulations governing the Canada Organic Standard, prohibit the use of GE seeds and GE animal feed. Contamination is also a threat to the markets in Ontario for pasture-raised meats. Farmers, both conventional and organic, who wish to delay/limit RRA contamination may take on the extra costs of establishing buffer zones and other contamination mitigation techniques, including the costs of testing for RRA contamination.[90] If these strategies fail, farmers may be vulnerable to litigation over possible patent infringement.

As the stakes are so high with RRA contamination, organic farmers are likely to abandon alfalfa just as organic grain growers in the Prairies abandoned canola due to RR canola contamination, and as some Ontario farmers have stopped growing corn due to concerns over possible GM corn contamination. However, since alfalfa is a perennial it would be more difficult to remove it altogether.

RRA contamination is a particular concern to those farmers who serve organic or non-GE markets and depend on pasture for dairy and meat production. Elimination of GE alfalfa from pasture would be extremely difficult, as alfalfa plants often appear as volunteers regardless of the forage seed mix planted. Individual plants cannot be hand-weeded due to root structure, and herbicide treatment would kill desired pasture plants along with the alfalfa, and could not be applied in organic practice. It is difficult to imagine how the grassfed meat sector could be find feed without RRA contamination, whether on the farmer's own pasture, homegrown feed or purchased hay.[91]

Organic dairy would also be adversely affected because organic milk production relies on alfalfa as the main source of forage. If RRA is introduced, organic dairy farmers will lose an important high-protein animal feed. Dairy farms arguably account for the lion's share of alfalfa seed sales because dairy herd rations rely heavily on alfalfa and because alfalfa is re-seeded much more often on dairy than on beef or sheep farms. The Canada Organic Standard requires animal feed to be organic (no GE feed) and mandates forage-based rations, with an emphasis on pasture.[92] The standard requires that all cows should have daily free access to pasture, paddocks or runways and throughout the growing season, cows must be able to graze outdoors. At least 30% of their dry matter requirement must come from pasture.[93] If RRA is released it will be difficult to ensure pasture is free of volunteer alfalfa, making it virtually impossible for organic dairy producers to meet the Standard.

Milk represents 25% of all organic sales of domestic products (product of /made in/packaged in Canada) and production of organic milk in Canada is increasing steadily; the volume is 89% higher than it was five years ago.[94] Additionally, milk, yogurt, ice cream and cheese are the most popular categories of finished organic dairy products in Canada.[95] Ontario is the second largest organic dairy producer in Canada, after Quebec.

The strength of organic dairy is central to the strength of the whole of the organic sector in Ontario, and beyond. Organic dairy is a particularly strong anchor of the organic sector in Ontario, thus impacts on organic dairy would be felt through the entire organic food chain in Ontario. The nature of organic farming means that many organic businesses rely on the strengths of different parts of this emerging sector.

The organic market in Canada has tripled in the six years since 2006, making it a clear leader and success for agriculture. The national market is now worth $3.7 billion, $3 billion in food alone, with Ontario responsible for approximately $1 billion in annual food and beverage sales.[96] The forecast for growth is also substantial: 98% of Ontario consumers surveyed in 2012 expect to increase or maintain their spending next year on organic fruits and vegetables, organic/free-range meat or poultry and organic dairy. In 2009, MacRae et al. estimated that the number of organic farmers in Ontario will need to increase more than 10-fold over the next 15 years, just to keep up with projected demand for organic food.[97]

The risks that GE alfalfa presents to the organic sector were discussed by the Organic Value Chain Roundtable in the 2012 study "Challenges and approaches in mitigating risks associated with the adventitious presence of GM products in organic crop production in Canada". [98] The conclusions of this study relative to the implications of the release of GE alfalfa for the organic sector were pointed out in a July 2013 letter to the CFIA from the Canadian Organic Trade Association:

> *"A study undertaken on the behalf of Agriculture and Agri-Food Canada's Organic Value Chain Roundtable has provided extremely worrisome data on the possible impact to farmers of the release from GE alfalfa. Though it was deemed too sensitive by the federal government for full public release, to our knowledge it remains the only third-party assessment of its kind and therefore the paper warrants full review and the issue further study before any such crops are released. Specifically, the study concludes that the introduction of GE alfalfa would be a "very high-risk" situation for Canadian farmers, and result in a loss for Canada's organic farmers of approximately $3.3 Million in annual sales, impacting over 50% of the national organic alfalfa crop. The study concludes the introduction of GE alfalfa "would cause major economic impacts for a large majority of organic farmers, as well as for the organic dairy industry and the organic seed industry more specifically." It follows that the impact on non-organic non-GE growers would be significantly higher."*[99]

GE alfalfa contamination also risks the market base for non-GM farmers, grassfed beef and lamb producers in particular. The demand for organic meat is growing faster than the overall market, with a demand that exceeds the market current capacity.[100] Ontario has one of the highest market shares for organic fresh meat in the country and there is an increasing demand for grassfed beef and lamb in Ontario to help meet the consumer demand for meat produced without the use of GE feed. The grassfed meat consumer tends to have very strong values regarding human health and ecological integrity. RRA would be contrary to those values, thus grassfed meat producers would be faced with the challenge of eliminating alfalfa from their pastures or forgoing these customers.

RRA could reduce the number and extent of organic farms in Ontario by making it more difficult and more expensive to maintain organic certification. The loss of alfalfa in organic rotation would impair the resilience of organic farmers, compromising their capacity to deal with future challenges. Alfalfa is used as a nitrogen-fixer for soil by organic farmers who do not, in accordance with the Canada Organic Standard, use synthetic nitrogen fertilizers. While cash-crop hay is becoming more common in conventional agriculture, organic farmers grow forage largely for on-farm use, with manure recycled back out to the land.[101]

Forages are the backbone of organic systems[102] and organic agriculture provides important environmental benefits across a range of environmental indicators.[103] Not only does organic farming reduce the toxic load on the environment from agriculture, but it also provides for healthy soil and on-farm biodiversity. Organic farming can lead to greater biodiversity by increasing the number and type of plants, birds, pollinators and insect predators, earthworms and soil microorganisms.[104] Organic farms also sequester carbon through the use of environmentally friendly practices, annually reducing 3,175kg of C02 per acre according to The Rodale Institute.[105]

SUMMARY

The growing organic sector in Ontario, organic dairy and meats in particular, will be adversely affected by the introduction of GE alfalfa. RRA contamination poses a threat to organic certification and would therefore generate major costs to organic farmers. Pasture-based production is at also risk, including the growing consumer markets for non-GM grassfed beef and lamb in Ontario.

5. THE LIMITED AND DIFFICULT PROSPECTS FOR REMEDIATION

An environmental assessment of genetically engineered Roundup Ready alfalfa that includes the social, economic and cultural impacts is necessary because the impacts of environmental contamination in particular would extend not only to farmers who choose not to grow the crop, but also to farmers who must exclude the plant from their farms in order to maintain their existing means of livelihood. The intrusive nature of RRA, combined with the lack of any practical recourse for these farmers makes a pro-active assessment all the more urgent. Many Ontario residents expect that injured parties should be eligible for compensation if harmed through no fault of their own, reflecting a shared value of fairness. However, in the case of RRA, prevention of harm is virtually impossible, and the option of seeking legal recourse against a well-resourced corporation is entirely out of reach for most farmers.

a) GE Alfalfa is Unique

GE alfalfa is unlike other regulated substances because it combines the autonomy of a living organism, alfalfa, with legally protected corporate property, in this case Monsanto's patented herbicide tolerant (Roundup Ready) gene construct.

GE RR Alfalfa is propagated under the alfalfa plant's own initiative according to biological imperatives and in relationship with other organisms in the ecosystem, including pollinators, animals, and humans. The gene sequence inserted into the plant cells is patented. Each time the plant reproduces it also reproduces the patented gene sequence. The GE alfalfa plant not only multiplies but also distributes itself throughout the environment. Wherever alfalfa grows, the patented gene may also grow.

Farmers who do not want GE alfalfa on their land may not be able to prevent contamination. Alfalfa is persistent, able to regrow from roots – producing seed each year – potentially for decades. Since RRA and non-GE alfalfa are visually indistinguishable, farmers cannot identify and cull RRA plants (though the gene sequence can be detected by laboratory testing). Incursion of GE alfalfa onto farmers' land can result in market loss and/or price discounts for farmers whose customers reject GE products. It can jeopardize the certification of organic farms. The presence of GE RRA genes may expose farmers who have not signed a Technology Use Agreement to risk of litigation for patent infringement.

b) Mitigation Strategies are Limited

Many farmers are aware of the contamination risks and would seek to avoid them. However, once RRA appears on the land, elimination of GE alfalfa from fields is difficult to impossible, particularly for farmers who want to maintain organic certification and thus cannot use herbicides. Simple avoidance will not be an option if RRA is commercially released into the Ontario environment.

The benefit of RRA accrues to Forage Genetics International and Monsanto and to those farmers The benefits of patented GE products accrue to their proprietors and possibly to those farmers who choose to grow them, while their disbenefits may fall on third parties, in this case farmers who wish to avoid GE organisms. Monsanto requires its customers to sign a contract, known as a "Technology Use Agreement" which sets out conditions for seed use, along with a "Technology Use Guide" that outlines requirements and non-binding recommendations for best practices. The biotechnology industry suggests that farmers' adherence to these contracts and guidelines would be sufficient to prevent the unintended spread of RRA, but as outlined in the report "*The Canadian Seed Trade Association's so-called "Coexistence Plan" is a gateway to GM alfalfa contamination*" requirements are inadequate and unenforceable.[106] At best they can reduce, but not eliminate, contamination risks.

Farmers whose livelihoods will be harmed by RRA contamination have the most incentive to prevent the spread of RRA genes, but have little power to do so. These farmers are at the mercy of others' decisions regarding the location of planted fields, timing of harvest, transport of products, security of storage facilities, behaviour of animals, cleanliness of equipment, etc. Conscientious farmers could invest a great deal of money, time and effort into prevention and still experience contamination and its consequences.

Farmers and others, such as truckers and retailers for example, who are indifferent to RRA contamination represent a high degree of contamination risk. There is no civil authority charged with preventing the unwanted spread of GE plants, and no other effective means for ensuring that such parties adopt best practices to avoid environmental contamination.

c) The Legal Framework is Contradictory and Unbalanced

The Canadian Organic Standard and its regulatory framework forbid the use of GE products in organic farming, yet there is no liability regime in Canada to support compensation of organic farmers when GE products infiltrate their lands and crops. Clearly, this is an unbalanced situation.

Canada's legal system confers property rights upon patent holders of genes that are used in agricultural crops, yet does not counterweigh this privilege with corresponding responsibility for the impact when this property is found unwanted on others' land, interfering with their rights and livelihood.

In 2004, in *Monsanto Canada Inc. v Schmeiser* the Supreme Court of Canada ruled in a split (5-4) decision that the occurrence of a patented gene in plants growing on a farm constituted patent infringement regardless of how the plant got into the field or whether the GE trait was utilized.

Because compensation and liability regimes do not exist, prevention is the only way to protect the interests of organic and non-GM farmers and their customers. The precautionary principle provides a foundation for such an approach.

d) The Precautionary Principle is Needed

The precautionary principle is customary international law and the precautionary approach has been formally adopted by Canada in several international treaties, including the 1992 United Nations Conference on Environment and Development (UNCED) in 1992, also known as the Rio Earth Summit. Principle #15 of the Rio Declaration, which Canada signed, states:

> "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." — *Principle #15 of the Rio Declaration, United Nations Conference on Environment and Development (UNCED), 1992*.[iv]

Precaution is advisable because the introduction of GE RRA into the Ontario environment would be irreversible – once released into the environment it cannot be recalled. Canada's federal regulatory process does not investigate all dimensions of environmental release of GMOs, and thus cannot be considered a comprehensive statement of safety. As outlined, there are many dimensions of potential environmental impacts that require assessment. The precautionary principle permits governments to take prudent action to prevent harm, even if all scientific evidence is not available, especially if that harm is irreversible.

iv Rio Declaration on Environment and Development, United Nations Environment Programme, June 1992. http://www.unep.org/documents.multilingual/default.asp?documentid=78&articleid=1163

FAILURE OF FEDERAL REGULATION

The federal government regulates products of genetic engineering under regulations that cover what the government has more broadly defined as Plants with Novel Traits (PNTs): "Plants with novel traits can include plants produced through biotechnology, genetic engineering or conventional breeding techniques." The Canadian Food Inspection Agency (CFIA) is responsible for the safety assessment of PNTs used as livestock feed and released into the environment. In 2005, the CFIA approved RRA for "unconfined release", which is "the release into the environment with limited or no restrictions, generally towards commercialization."

It is important to note that various Canadian public interest groups have long criticized the federal regulatory framework for PNTs and the particulars of regulation as secretive and woefully inadequate.[107] Various gaps and problems in the regulatory system were identified by the 2001 Royal Society of Canada's Expert Panel on the Future of Food Biotechnology which was commissioned by the relevant government departments and concluded with 58 recommendations for reform that remain unaddressed.[108]

1. LIMITATIONS OF FEDERAL ENVIRONMENTAL ASSESSMENT OF "PLANTS WITH NOVEL TRAITS"

It is not Environment Canada but the Canadian Food Inspection Agency (Plant Biosafety Office or PBO) under Agriculture and Agri-Food Canada that has the mandate to assess the safety of GE crops for unconfined release. There are two major limitations in this environmental assessment:

1. The environmental impacts of PNTs are evaluated by the CFIA in secret and rely on information provided by the proponent. The lack of public access to documentation/data behind decisions to approve PNTs means that there is no way to know how the CFIA considers risk questions, how thoroughly, or based on what data. It is not possible to know how, or how fully, the CFIA assessed the environmental impact of RRA. The CFIA releases "Decision Documents" that summarize PNT approval decisions but these do not provide data or any details (For RRA, see Decision Document DD2005-54[109]).
2. There is a serious deficit in federal environmental assessment of GE crops as a result of the absence of any consideration for potential social, economic and cultural impacts. The lack of regulatory mandate to assess socio-economic considerations narrows the scientific evaluation of possible environmental impacts. For example, the CFIA did not fully evaluate the risk of contamination nor systemic impacts of adoption.

a) Secrecy and Lack of Independent Science

The CFIA's environmental safety assessment of PNTs "takes into account: the potential of the plant to become a weed; the potential of a plant to create a weed by cross-pollinating with another plant; and the potential impact on biodiversity" as elaborated below[v]:

1. Weediness potential: Is there an increased potential that the plant will become a weed of agriculture or be invasive in the Canadian environment?
2. Gene flow: Are there negative consequences to environmental safety resulting from the production of hybrids between the plant and any domestic or wild sexually compatible relatives that are present in Canada?
3. Plant pest potential: Does the plant have increased potential to harbour and/or facilitate the spread of a pest or pathogen of the Canadian environment?
4. Potential negative impact on non-target organisms: Could the plant have negative impacts on non-target organisms interacting directly or indirectly with it, including humans as workers or bystanders?
5. Other potential negative impacts on biodiversity: Does the plant have any other potential negative impacts on biodiversity, including changes to environmentally sustainable crop management practices?

However, the Plant Biosafety Office performs this environmental safety assessment using only two sets of information: a companion biology document that provides baseline information for the plant species and information submitted by the applicant.

The CFIA provides broad guidance and largely leaves the proponent to define what the "anticipated or known" impacts on the environment will be. The CFIA asks the applicant to address "the identity and origin of the PNT; the properties of the novel gene and gene products; the relative phenotypic expression of the PNT compared to a similar counterpart, where differences are anticipated; and, anticipated or known relative effects on the environment resulting from the release." The exact questions considered in any particular review are unknown. The CFIA provides six sample evaluations but the purpose of these examples is "to assist proponents in determining whether or not their products are PNTs and regulated under Part V of the *Seeds Regulations.*"[110]

v The entirety of regulation and guidance is the following five documents:
Directive 94-08: Assessment Criteria for Determining Environmental Safety of Plants with Novel Traits
http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/eng/1304475469806/1304475550733;
Biology Documents (Companion Documents for Dir94-08)
http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-94-08/biology-documents/eng/1330723572623/1330723704097;
Directive 2009-09: Plants with novel traits regulated under Part V of the Seeds Regulations: Guidelines for determining when to notify the CFIADirective 2009-09: Plants with novel traits regulated under Part V of the Seeds Regulations: Guidelines for determining when to notify the CFIA
http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/directive-2009-09/eng/1304466419931/1304466812439;
Fee Submission http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/fees/eng/1338788035556/1338788916877;
CFIA Detection and Identification Method Criteria
http://www.inspection.gc.ca/plants/plants-with-novel-traits/applicants/detection-and-identification/eng/1338224521085/1338229770701

The CFIA relies on documentation from the proponent, including any testing: "The PBO [Plant Biosafety Office] will consider the information provided by the applicant to determine if the PNT poses risks to the environment." The CFIA describes that "Directive 94-08, *Assessment Criteria for Determining Environmental Safety of Plants with Novel Traits*, outlines the environmental safety requirements that must be addressed in an application for unconfined environmental release of a PNT. The proponent has flexibility in the means by which these elements are addressed. For example, information elements may be addressed using experimental data, sound scientific rationale, and/or peer-reviewed literature, where appropriate." For any given GE crop approval, we do not know what means were used.

The data package evaluated by CFIA staff remains classified as "Confidential Business Information" and it is therefore not accessible to the public or to independent scientists, nor is it available upon request via Access to Information. This secrecy means that the quality of data submitted by the proponent is unknown. The CFIA states that, "The quality of information in the data package should be equivalent to that provided for peer reviewed publications"[111] however this equivalency can only be determined by peer review itself. The Royal Society of Canada's Expert Panel concluded that, "CFIA directives indicate that statistically valid experimental designs are required for testing plants with novel traits, and that all such work is to be of the standard required for peer-reviewed research publications. In the absence of independent peer review, however, the Decision Document is in no sense equivalent to a peer-reviewed scientific paper, and in the Panel's view, the decision-making process in general lacks transparency, and thus credibility."[112]

The Expert Panel summarized this problem and its implications as follows: "The information that CFIA makes available to the public regarding their approval decisions explains the basis for approval of unconfined release of a GM plant into the environment, such as the criteria to be addressed in deciding whether environmental safety is threatened, but neither the design of the experiments on which the assessment was based, nor their results, are included in the public Decision Document… Although they are not revealed to the public, these data are evidently collected, since the CFIA regulatory directive of July 10, 2000 reminds applicants that "experiments should generate data which can be used to address the five key criteria of environmental safety assessments" (CFIA 2000)." For example, the Panel noted that, "Industry submissions often satisfy current guidelines through reliance on literature reviews without collecting their own experimental data on ecological impacts."[113]

In 2004, the Auditor General (AG) conducted an audit of the federal government's regulatory activities to manage the environmental risks of plants with novel traits and the AG concluded that, "from our review of the documentary evidence in the files for unconfined release, it was not transparent how the Agency evaluates the long-term environmental effects before authorizing unconfined release as legally required."[114] The AG recommended that the CFIA "define more explicitly how its evaluation process considers the long-term effects on the environment" and "ensure that it has documentary evidence in its files showing how it is evaluating the environmental effects of plants with novel traits, including the long-term effects."

b) Responsibility for long term environmental effects is offloaded

In its assessment criteria, the CFIA acknowledges the "longer term environmental effects" of herbicide tolerance but leaves that critical question to be resolved by industry management plans: "As part of the PBO's assessment of a PNT's environmental safety, in particular, of its assessment

of longer term environmental effects, the PBO's decision with regards to authorizing the release of a PNT expressing either a novel herbicide tolerance or a novel insect resistance will take into consideration whether or not the applicant has provided a stewardship plan addressing the need for the responsible deployment of the novel crop into the environment."[115] The CFIA outlines that: "The development of an HTM [herbicide tolerance management] plan is the applicant's responsibility and should contain elements that address:

1. the control of volunteers, more specifically, any changes in usual agronomic practices that may arise from the novel herbicide tolerance and which could result in reduced sustainability or have significant impacts on soil conservation;
2. the selection of herbicide tolerance in weeds resulting from the potential continued application of the same herbicide in subsequent rotations;
3. the introgression of novel trait into related species;
4. the management of the herbicide tolerant crop during the growing season, particularly where multiple herbicide tolerances, due to cross pollination, could arise in subsequent growing seasons;
5. communication to growers as well as an efficient mechanism allowing growers to report problems to developer;
6. the monitoring of effectiveness of the stewardship plan."[116]

It is important to note that stewardship plans are voluntary except where certain required and recommended measures are incorporated into corporate Technology Use Agreements signed by farmers, thus the environmental stewardship of GE crops is offloaded to the farmers. In the 2004 Audit, the Auditor General recommended that the CFIA "should complete its efforts to develop, implement, and monitor the "herbicide tolerant crop stewardship plans" to ensure the approach is resulting in satisfactory management of herbicide-tolerant plants with novel traits."

In its Decision Document for RRA, the CFIA acknowledged that herbicide tolerant volunteers "could result in the loss of the use of these herbicides and any of their potential benefits" but leaves the issue to management plans drafted by companies:

> *"A longer term consideration, if there is general adoption of several different crop species and specific herbicide weed management systems (ie. numerous combinations of crop species and tolerances to different herbicides), is the potential development of crop volunteers with a combination of novel tolerances to different herbicides. This could result in the loss of the use of these herbicides and any of their potential benefits. Therefore, Monsanto Canada Inc. will make their stewardship plan readily available to growers and agriculture extension personnel, in both private and public sectors, to promote the careful management practices, such as use of alternate control tools as appropriate to achieve complete control, recommended to help minimize the development of resistant weed populations." [117]*

The CFIA said that, "The agronomic stewardship plan, which contains a herbicide tolerance management plan, submitted by Monsanto Canada Inc. was evaluated by the CFIA and determined to be satisfactory." It is important to note that this determination was made in 2005, before the discovery of herbicide resistant weeds in Ontario, and the obvious failure of industry management plans to prevent them.

As early as 2000, environmental groups in Canada warned about the development of herbicide resistant weeds or "superweeds."[118] This warning was validated by the Royal Society of Canada's Expert Panel on the Future of Food Biotechnology in 2001, at which time Canada already had a relevant experience with canola volunteers that were tolerant to multiple herbicides. In its 2005 decision to approve RRA, the CFIA signals the anticipated future use of non-glyphosate herbicides to manage RRA volunteers and presumably concluded that this is an acceptable practice that would not significantly change environmentally sustainable weed management practices: "Volunteer alfalfa containing glyphosate tolerance, originating from previous crop years or cross pollination (i.e. wind or bee mediated), can still be managed by growers through the use of alternative herbicides with different modes of action, or cultivation practices which do not involve the use of herbicides."[119] The CFIA asks proponents, "Will the cultivation practices (land preparation, weed and pest control, harvest, and post-harvest protocols) involved in growing the PNT vary from those traditionally used?" The proponent is asked to provide information showing the effect of these changes on sustainability, especially with respect to pesticide use, frequency of tillage, soil erosion and consequential changes in energy and soil conservation. Will volunteer plants of the PNT result in altered cultivation practices for succeeding crops?"[120] Despite having flagged this potential impact, it did not impinge upon the CFIA's decision to approve RRA.

Furthermore, the lack of regulatory consideration for possible cultural, social and economic impacts of GE crops means that the scope of scientific evaluation is narrowed. For example, the risk of contamination is not fully evaluated, nor are the system impacts of the use of a GE crop in the environment, agriculture or food system, such as the impact of RRA on pollinators. While the CFIA did not express concern, Ontario needs to assess the broader and systemic ecological impacts of RRA, especially considering the potential economic impacts of widespread genetic contamination.

There are significant grounds to reassess the federal governments' approval of RRA for unconfined release. In addition, there are grounds for an Ontario-specific analysis of this crop and its impacts.

The CFIA has recently approved two 2,4-D tolerant crops and one dicamba tolerant crop that were developed as a response to the problem of herbicide resistant weeds. Yet the CFIA has evidently not re-evaluated their need to assess the long-term impacts of approving herbicide tolerant crops in the context of these herbicide resistant weeds. New GE 2,4-D tolerant crops will obviously increase the use of this particular herbicide and raise the question of future herbicide resistance to 2,4-D.[121] The CFIA is approving new GE crops that will accelerate the problem and continue this spiral of ecological impact. The CFIA maintains, "A PNT with a novel herbicide tolerance that could be introgressed to related species, resulting in hybrids that have no effective or sustainable control options, will not be authorized" and yet the lack of sustainable control options now greets all RR crops.

In 1999/2000, the Environmental Commissioner commented that, on GMOs (genetically modified organisms) there were "important environmental issues to be considered. Currently those issues are not part of any public debate in Ontario, perhaps due in part to the limited information on ecosystem impacts"[122] and recommended that:

- the Ontario government establish a provincial advocate for ecosystem protection capable of addressing GMO issues. This provincial advocate should be independent of OMAFRA and MEST. (Recommendation 18)
- the Ontario government fund independent research and thinking on some of the fundamental ecological questions related to genetically modified organisms. (Recommendation 19)

2. NO CONSIDERATION OF CULTURAL, SOCIAL AND ECONOMIC IMPACTS

There are no mechanisms for considering any cultural, social or economic impact at any stage of federal regulation of GM crops, foods or animals. This includes the absence of consultations with the public or farmers. At no point in the process to approve and register RRA, have any of the cultural, social or economic impacts been evaluated. The CFIA is clear that, "the regulatory assessment process is focussed on the safety of the plant product. The process does not assess the commercial aspects of plants with novel traits such as potential market impacts."[123]

This depth of political commitment to excluding economic criteria in the approval process was made clear by the 2011 defeat of Private Members Bill C-474 that would have required the federal government to include assessment of export market harm before any GE crop was introduced. In the debate over the Bill, farmer organizations reiterated the need for the inclusion of economic, particularly market, considerations before the release of GE alfalfa in particular. Kelvin Einarson, Director and Secretary Treasurer of the Manitoba Forage Seed Association Inc. told the House of Commons Agriculture Committee that, "Bill C-474 is the first step in offering some protection in the future for Canadian family farms. Market acceptance must be made part of the evaluation process and incorporated into the Seeds Regulation Act." Jim Lintott, Chairman of the Manitoba Forage Council said, "…the point is that from the producer's point of view, we have attempted to express our need to stop Roundup Ready alfalfa. Clearly, the regulations and the laws in place fail miserably on this point. We need a regulation that gets us there. We have been searching for that. This is from us, from producers."[124]

There is one pre-approval public information point provided by the CFIA but rather than providing transparency, this step actually stresses the lack of consultation and lack of public information. The government established its "Biotechnology Notices of Submission Project" through an informal agreement[125] with the industry lobby group CropLife whereby company members of CropLife are invited, on a voluntary basis, to allow the CFIA to post a notice when they have submitted a request for approval for a GE product. There are three fundamental problems with the Notices of Submission:

1. The notices are posted at the discretion of companies. CFIA says, "It is important to note that in Canada there is no legal requirement for developers to participate in the Notice of Submission process nor any ability for the CFIA to require developers to participate"[126] The notices of submission are not therefore necessarily representative of all the GE crops submitted for approval. Furthermore, any company that falls outside of CropLife membership would not be covered (as is the case with GE animals for example).

2. A Notice of Submission is accompanied by a summary of the product, typically 1-2 pages, as well as an invitation from the CFIA for the public to send comments within a 60-day window. This should not be mistaken for a consultation as there is no data or any significant information provided on which to comment.

3. The CFIA's description of the ability of the public to comment misrepresents the federal evaluation process to the public. The CFIA Biotechnology Notices of Submission website states that, "**Scientific questions or information** will be forwarded to CFIA and Health Canada evaluators for consideration in the assessment. **Non-scientific input** will be evaluated and appropriate ways of addressing it will be explored."[127] The mention of non-scientific input is misleading as there is no mechanism for the evaluation of this input by regulators. In fact, the CFIA has recently clarified in email correspondence with the National Farmers Union that "The Notice of Submission project was not designed to provide a mandatory public consultation process for individual novel product submissions. All comments received in response to the Notice of Submission are reviewed by the Government of Canada (GoC) although only those comments providing science-based evidence are considered by the GoC as part of the assessment of the novel product."[128]

In 2000, the Ontario Ministry of Agriculture and Food informed the Environmental Commissioner of Ontario, that it would "continue to participate in, and to advocate for, open public consultations on all LMO and GMO issues."[129]

SUMMARY

Federal regulation provides a secret, limited assessment of the environmental impacts of GE crops and provides no assessment of cultural, social or economic impacts. The federal approval of RRA in 2005, and the subsequent registration of one RRA variety in April 2013, did not include an assessment of the impact of RRA on sustainable agriculture, and did not assess questions in relation to Ontario's environment and economy.

EVIDENCE CONCLUSION

There is opposition to the commercial release of genetically engineered Roundup Ready alfalfa in many farming communities in Ontario, as well as across Canada and in the broader public. Since its approval in 2005, opposition to RRA alfalfa has been ongoing in the Prairies where alfalfa is grown for a lucrative export market that would be jeopardized by GE contamination. Now the biotech industry is focused on introducing RRA in Eastern Canada. The most recent and visible manifestation of farmer and consumer opposition was the April 9 2013 Day of Action to "Stop GM Alfalfa" where people rallied outside MP offices and the office of the Canadian Food Inspection Agency in Ottawa. Rallies happened in 38 communities across Canada, 17 of which were in Ontario and most of which were farmer-led (For articles, photos and videos please see www.cban.ca/april9gallery).

The release of this particular GE crop requires an assessment under Ontario's Environmental Assessment Act because the risks that accompany it are unique and the current federal regulatory governance is not equipped to address them. The risks to the Ontario environment and economy were not assessed by the Canadian Food Inspection Agency, which approved RRA without any consideration of economic impact, and without an assessment of the full impact on sustainable agriculture.

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