Update on Neonicotinoid Pesticides and Bee Health

25 November 2014

Canada

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1.0 Bee Health

Over the past few years, there have been increasing reports of high overwintering losses and significant challenges in maintaining healthy bee colonies both in Canada and abroad. Bee health is a complex issue and is affected by many factors. According to Agriculture and Agri-food Canada, factors affecting the survival and health of honeybees include:

- Parasites, pests and pathogens: For example, *Varroa* mites, the parasite *Nosema ceranae*, and honeybee viruses impact bee health.
- Habitat loss and food supply: Bees restricted to foraging on crop monocultures may require supplementary feeding by beekeepers.
- Queen bee quality: Healthy, long-lived queens are important to maintaining vigorous, productive hives. Queen health can be compromised by factors such as inadequate selection and mating and exposure to pathogens and pesticides.
- Weather: Long, harsh winters or cool, long springs can result in higher levels of colony death.
- General hive management: Management techniques vary among beekeeping operations and can influence honeybee survival.
- Exposure to pesticides: Bees could be affected by unintentional exposure to agricultural pesticides used to protect crops and by pesticides used in hives to protect bees from parasitic mites.

Evidence suggests that bees are increasingly stressed by combinations of these factors. According to the Canadian Association of Professional Apiculturists, bee overwintering mortality has increased in Canada and the United States since 2006. Overwintering mortality or loss is a term for colonies that did not survive the winter, which includes colonies that are too weak to survive or died during the early spring. In Canada, national bee overwintering losses of colonies increased from a historical average of 10–15 percent to 35 percent in 2007/08. This was followed by somewhat lower overwintering losses from 2009/10 to 2013/14 which ranged from 15 to 29 percent. Many factors can affect overwintering loss. In 2014, beekeepers identified the main possible causes as: weather, poor queens, weak colonies in the fall, parasites and pesticides. It should be noted that overwintering mortality can differ from the national average by province and by beekeeper, and individual beekeeper losses can range from minimal to very high.[1]

Bee losses are sometimes attributed to “colony collapse disorder” (CCD), which refers to a specific condition with a specific set of attributes of a failed colony, and is not meant to refer to colony loss in general. CCD was first described in the United States in October of 2006 when some beekeepers began reporting unusually high losses of 30–90 percent of their hives. The main symptom of CCD, as explained by the United States Department of Agriculture Agricultural Research Service, is very low or no adult honeybees present in the hive but with a live queen and no dead honeybee bodies present. Often there is still honey in the hive, and immature bees (brood) are present. *Varroa* mites, a virus-transmitting parasite of honeybees,

[1] Canadian Association of Professional Apiculturists. Annual Colony Loss Reports. CAPA Statement on Honey Bee Wintering Losses in Canada (2014). http://www.capabees.com/content/uploads/2013/07/2014-CAPA-Statement-on-Honey-Bee-Wintering-Losses-in-Canada.pdf.

have frequently been found in hives affected by CCD. In the years since CCD began to be reported, winter losses in the United States have generally averaged around 33 percent, of which approximately one-third was attributed to CCD.[2]

To date, symptoms by which CCD is characterized in the United States have not been diagnosed by professional apiculturists in Canada. Rather, increased levels of colony mortality in Canada are associated with increased levels of overwinter loss, seen as direct mortality during winter or dwindling during the early spring.[3]

2.0 Neonicotinoid Pesticides (Imidacloprid, Thiamethoxam, Clothianidin)

General Information

Neonicotinoids are a class of pesticide that have been approved for use in Canada and around the world for many years. In Canada, a thorough human and environmental risk assessment and value assessment was carried out by Health Canada's Pest Management Regulatory Agency (PMRA) before the products were first approved over ten years ago.

The neonicotinoids were considered to be safer for human health due to their reduced risk to mammals compared to alternative insecticides at the time, such as organochlorines, organophosphates and carbamates. No human health concerns have been identified with the use of neonicotinoids to date.

Neonicotinoids were also considered safer for the environment compared to alternative insecticides at the time, due to their targeted toxicity to insects and lower toxicity to other non-target organisms, and their ability to be used in a more targeted manner at lower use rates. For example, neonicotinoids could be used as seed treatments targeting only the insects directly attacking the plants rather than as broad spectrum sprays at higher use rates like many of the alternatives.

Currently, neonicotinoid pesticides are approved for use as seed treatments, soil applications, and foliar sprays on a wide variety of agricultural crops such as oilseeds, grains, pulse crops (for example, peas and beans), fruits, vegetables, greenhouse crops (food and ornamental), ornamental plants, and Christmas trees. They also have approved uses on turf, as a tree injection, in structures and outdoor residential areas, and as pet care products.

[2] United States Department of Agriculture. Honey Bees and Colony Collapse Disorder. *CCD Progress Report*, 2012. http://www.ars.usda.gov/is/br/ccd/ccdprogressreport2012.pdf.

[3] Canadian Association of Professional Apiculturists. Annual Colony Loss Reports. http://www.capabees.com/2014/07/24/capa-statement-on-honey-bees/.

Risk to Bees

When neonicotinoid pesticides were first registered for use in Canada and in other countries around the world, the scientific information did not indicate they would pose unacceptable risks to bees or other pollinators.

There were no significant reports of bee mortalities or effects associated with these insecticides in Canada until the spring of 2012, when a large number of bee mortalities were first reported in some regions of Canada. In 2012, 2013 and 2014, reported incidents related to planting of treated corn and soybean seed were limited to intense corn-growing regions of southern Ontario, with fewer incidents in corn growing regions of Quebec and Manitoba (see Appendix I, Figures 1 and 2).

Despite the wide use pattern of neonicotinoid pesticides, other areas of Canada have not reported bee mortality incidents related to neonicotinoids, with the exception of a few cases of foliar spray application to a crop while bees were foraging (which is contrary to label directions). In western Canada, for example, the majority of canola seed is treated with neonicotinoids and yet beekeepers are not reporting any adverse effects.

Although neonicotinoid pesticides are currently used extensively on many crops in Canada, the only situation where high numbers of bee mortalities have been directly linked to neonicotinoid pesticide use is through exposure to dust from some types of planting equipment while planting neonicotinoid treated corn and soybean seeds.

Incident Reports: Bee Mortalities at Planting Time

Health Canada's PMRA, in collaboration with Health Canada's Regions and Programs Bureau and the provinces, conducted detailed inspections of the bee mortality incidents reported in 2012, 2013 and 2014. This included collecting samples for residue analysis and gathering information on agricultural and planting practices surrounding affected beeyards.

Based on a thorough evaluation, Health Canada's PMRA concluded that neonicotinoids present in dust generated during planting of treated corn and soybean seeds contributed to the reported bee mortalities in 2012 and 2013. The incident locations corresponded with corn growing areas of Canada, as indicated in Figures 1 and 2 in Appendix I. Agricultural information indicated there were bee mortalities that coincided with specific corn and soybean planting events. In addition, 70 percent of dead bees collected during the corn and soybean planting periods in 2012 and 2013 had neonicotinoid residues present, while the majority of live bees did not have residues present. The weight of evidence indicated that exposure to neonicotinoids during the corn and soybean planting period contributed to bee mortalities in 2012 and 2013. Analytical results for bee samples collected in 2014, and evaluations of inspection results, are pending.

These bee incidents were similar to reports from Europe where planting of treated corn seed also resulted in bee mortalities.

In response to these incidents, Health Canada's PMRA implemented a series of measures to reduce dust exposure to bees (see Section 3.0, Active Management of Risk to Pollinators).

A complete analysis is not yet available, but information to date indicates the number of incident reports associated with neonicotinoid pesticide use during the planting period in 2014 is 70 percent lower than in 2013. A direct correlation to the risk mitigation measures cannot be made because the cold wet spring in southwestern Ontario meant that corn was planted later and less intensively than in previous years, possibly influencing the reduction in the number of incidents. As well, the cold spring meant that there were differences in bee foraging activity and available forage relative to timing of corn planting

A thorough investigation of the 2014 incidents is ongoing and a large number of samples are being analysed for the presence of pesticides and bee viruses. Further details of the Canadian bee mortality incidents from 2012 to 2014 are found in Appendix II. An update will be provided once results from 2014 are evaluated.

Incident Reports: Later Season Effects on Colonies

In 2012, the majority of incidents reported were acute bee mortality incidents occurring around the time of corn and soybean planting. In 2013 and 2014, Health Canada's PMRA received an increase in incident reports of poorly performing hives later in the season.

At this time, it is unclear what factors may be responsible for these reports. It may be that beekeepers have become more vigilant in reporting unusual symptoms observed in their colonies, as well as more aware of the process of reporting these issues to Health Canada's PMRA and the Ontario Ministry of Agriculture and Food. In 2013, some of the colonies affected later in the season had pesticide residues present in the hives; whereas, some colonies did not have any measurable residues, making it difficult to determine whether or not pesticides were a contributing factor to the effects reported. It is also unclear how widespread these effects may be because a small number of beekeepers account for the majority of reported colony effects (in 2014, three beekeepers accounted for over 72 percent of the reported incidents – see Appendix II, Figure 4).

Long-term Effects on Pollinators

Recent scientific research shows long-term effects on pollinators can result from sub-lethal exposure levels. Sub-lethal exposure levels are lower levels of exposure that do not result in immediate mortality. Reported effects are varied and include changes in behaviour, loss of foragers, and effects on queens and on brood. However, studies have generally been conducted under laboratory situations or in the field with exposure to doses that are higher than may normally be encountered in the environment.

At this time, no conclusions can be drawn from this ongoing research as to whether or not long-term effects on pollinators could result from low-level exposure encountered in the environment through sources such as pollen and nectar.

New risk assessments on the neonicotinoid pesticides have been, and are being, conducted in many countries. Scientists have used similar data and come to different risk conclusions, likely resulting from considerations of the specific use patterns, exposures and bee health conditions in their geographical areas.

Some countries have determined acceptable risk to pollinators, while others have identified a potential for risk based on uncertainties. Risk assessments have also determined that some uses remain acceptable while others may pose higher risks to pollinators, for example, where potential for exposure is greater. Countries or regions have used various risk mitigation measures to address identified risks.

In order to address some of these outstanding questions, Health Canada's PMRA is reviewing the emerging body of scientific and monitoring data to assess whether risks to pollinators from neonicotinoids at the levels anticipated to be present in the Canadian environment continue to be acceptable. This includes working cooperatively with scientists from around the world.

Health Canada's PMRA is conducting a re-evaluation of the value of neonicotinoids and the potential for effects on pollinators from all agricultural uses of these pesticides, in collaboration with the United States Environmental Protection Agency (USEPA) and the California Department of Pesticide Regulation (CDPR). This assessment will use an improved pollinator risk assessment approach (including new pollinator risk assessment guidance developed in cooperation with the USEPA and CDPR) to better understand pollinator exposure to neonicotinoids and potential short- or long-term effects. Along with available scientific research, the re-evaluation will also consider new data being generated by the registrants on neonicotinoids in respect of pollinators, including measurement of actual exposure levels in pollen and nectar and the potential for long-term effects. Interim reports of significant findings and any proposed actions will be made available as soon as conclusions are reached. There will also be an interim report in 2015.

Value Assessment of Neonicotinoid Corn and Soybean Seed Treatments

As part of the re-evaluation of the neonicotinoid pesticides, the PMRA is conducting a value assessment of the use of neonicotinoids when used to treat corn and soybean seed. This assessment considers the current use pattern for neonicotinoid-treated soybean and corn seed, the contribution of these neonicotinoids to pest management practices, and the economic benefits of neonicotinoid seed treatments on these crops. The value assessment is based on information provided by provincial governments, grower associations, registrants and other stakeholders as well as proprietary use information and recently published reports by the Conference Board of Canada and the USEPA.

3.0 Mitigation, Research and Monitoring

Active Management of Risks to Pollinators

In response to mortality incidents that were reported in Canada in 2012 and 2013, Health Canada's PMRA took action to reduce pollinator exposure to dust generated during the planting of treated corn and soybean seed. The following mitigation measures were implemented in collaboration with all stakeholders including the provinces, growers, and seed treatment and chemical industries:

- The *New 2014 Requirement when using Treated Corn / Soybean Seed* of a dust-reducing seed flow lubricant.
- Best Management Practices for *Protecting Pollinators during Pesticide Spraying* and an update on best practices for *Pollinator Protection and Responsible Use of Treated Seed.*
- Enhanced warnings and directions on pesticide and seed package labels on how to protect bees.

Health Canada's PMRA will continue to closely monitor the effectiveness of the risk mitigation measures that have been implemented and, in collaboration with the provinces and stakeholder groups (grower groups, seed trade, pesticide registrants and equipment industry associations), continue to implement additional new measures, where appropriate, to further reduce the release of dust when planting treated seed.

Additional available dust reduction measures may include equipment modifications (addition of deflectors and new designs) and improved seed finishing polymers.

Health Canada's PMRA encourages growers to follow Integrated Pest Management practices, and supports the ongoing work in the provinces to develop tools and information to better understand when treated seed is necessary for crop protection, and to reduce the use of treated seed where it is not necessary.

Additionally, Health Canada's PMRA is improving labels for pesticide uses on other crops to help reduce pollinator exposures and better protect pollinators. The label improvements include statements restricting application of pesticides when the target crop is flowering and attractive to pollinators.

Working with Stakeholders in Canada and Internationally

Health Canada's PMRA is actively working with many stakeholders in Canada and internationally to address the global concern regarding bee health.

In addition to working collaboratively with the provinces during the incident investigations, Health Canada's PMRA, Health Canada's Regions and Programs Bureau, and some provinces are monitoring selected beeyards throughout the 2014 corn and soybean growing season. Selected beeyards are being monitored in Ontario, British Columbia, Manitoba, Quebec and the Atlantic region to help understand whether there are any differences between beeyards that have

incidents and those that do not when located close to corn or soybean fields. At each yard, bee samples, bee hive samples (pollen and nectar), environmental samples (vegetation, soil, water) and samples from an agricultural field (soil, vegetation) near the beeyard are collected for pesticide analysis. Agricultural surveys are also being conducted to provide a detailed analysis of the surrounding agricultural practices. Additionally, in Ontario, in cooperation with the province, an extensive bee health inspection is being conducted at each yard being monitored. This includes collecting samples for virus/disease analysis. The analytical results, the agricultural survey information and the results of the bee health inspection are pending.

Health Canada's PMRA is an active participant in Agriculture and Agri-food Canada's Bee Health Roundtable in which stakeholders (including grower and beekeeping groups, the seed trade, pesticide and equipment industry associations, and federal and provincial governments) work together to find comprehensive solutions that will improve pollinator health in Canada. This initiative looks broadly at all aspects of pollinator health, including agricultural pesticide use practices, with the goal of promoting pollinator health and positive interactions between the agricultural and beekeeping industries.

Health Canada's PMRA continues to be involved in international efforts to identify and reduce risks to pollinators. This includes participation in international working groups such as the Organisation for Economic Cooperation and Development working group on pesticides: Pesticide Effects on Insect Pollinators (co-led by Canada, the United States and Germany); and the International Commission for Plant-Pollinator Relationships Bee Protection Group. Within these groups, Health Canada's PMRA is working on various aspects dealing with pollinator risk, including communication of pollinator incidents, mitigation measures for pollinator risks and development of test guidelines and risk assessment guidance.

Support for Research

Health Canada's PMRA actively supports efforts to generate new research and monitoring information. This includes work by other federal departments, including Agriculture and Agri-food Canada, Environment Canada and the Department of Fisheries and Oceans, as well as the provinces, academia, and industry. This ongoing research aims to, among other things, gain additional monitoring data in soil, surface waters and other environment compartments; further characterise potential effects of neonicotinoids on pollinators and other organisms (such as aquatic organisms and birds); and better understand the state of bee health in Canada.

4.0 Conclusions and Next Steps

There is a relationship between reported bee mortalities and planting of neonicotinoid treated corn and soybean seed in the intense corn growing regions of Canada, as discussed in Section 2.0. However, there does not appear to be any impact in other areas where neonicotinoid pesticides are used extensively, such as canola growing regions. Mitigation measures have been implemented to reduce exposure to dust during planting of treated corn and soybean seed. Health Canada's PMRA continues to work with the provinces and stakeholder groups to further reduce pollinator exposure during planting of corn and soybeans. Pending results of this work,

additional regulatory measures may be taken, if warranted and if supported by the available science.

Although Health Canada's PMRA is concerned about the reported later season colony effects in corn and soybean growing regions, more investigation into these reported effects is required. At this time Health Canada's PMRA does not have sufficient information to draw conclusions regarding a link between these colony effects and potential neonicotinoid exposure.

The available science indicates pollinator effects can result from sub-lethal exposure to neonicotinoids, but no conclusions can be drawn that actual environmental exposures from some uses are at levels that may result in effects. More work is needed in this area, and all available information will be considered in the neonicotinoid re-evaluation.

Health Canada's PMRA is continuing its re-evaluation of this class of pesticides in collaboration with the USEPA and California Department of Pesticide Regulation. The potential for both acute and sub-lethal effects on pollinators will be assessed, considering available information from scientists and researchers as well as new studies being generated by the registrants to specifically address these questions. Health Canada's PMRA will produce an interim report in 2015.

As part of the re-evaluation, a consultation document with the detailed value assessment for neonicotinoid corn and soybean seed treatments will be published on the Pesticides and Pest Management portion of Health Canada's website in the near future. Stakeholders will be invited to provide comments and additional information to help finalize the assessment.

There is a need for further research on the contribution of all the factors outlined in Section 1.0 that may affect bee health. Both Federal and Provincial Governments have made recent investments in research to better understand and maintain healthy bee populations, including recent federal funding for a national survey on bee health and for research geared towards optimizing the profitability of honeybee colonies and maintaining healthy bee populations. As the federal authority for pesticide regulation, Health Canada's PMRA is contributing to these efforts by working with federal and provincial partners, international regulatory agencies and other partners to assess the emerging body of scientific data related to neonicotinoid insecticides and pollinators.

Appendix I Maps of Incident Locations and Crop Growing Regions

Figure 1 Location of Reported Honeybee Incidents Across Canada, 2013

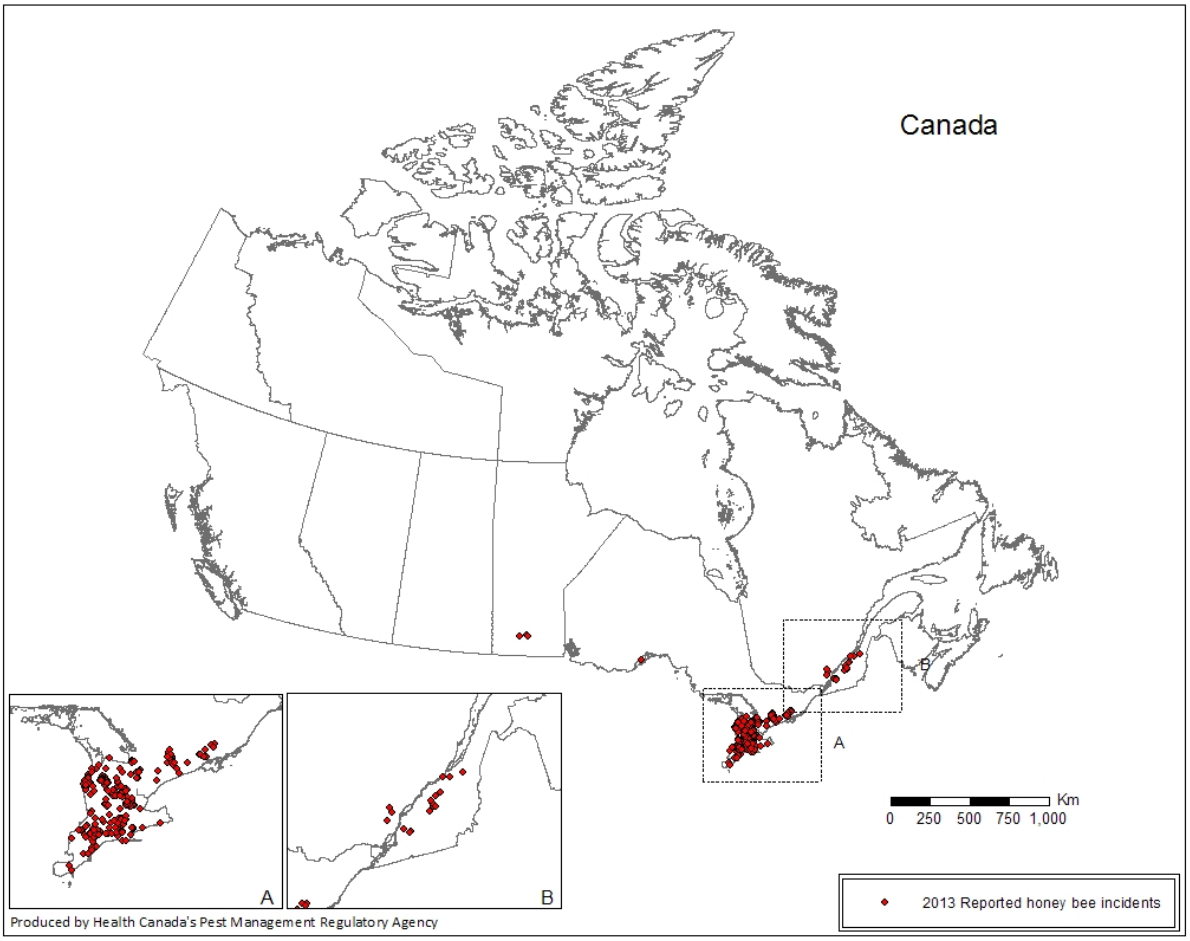
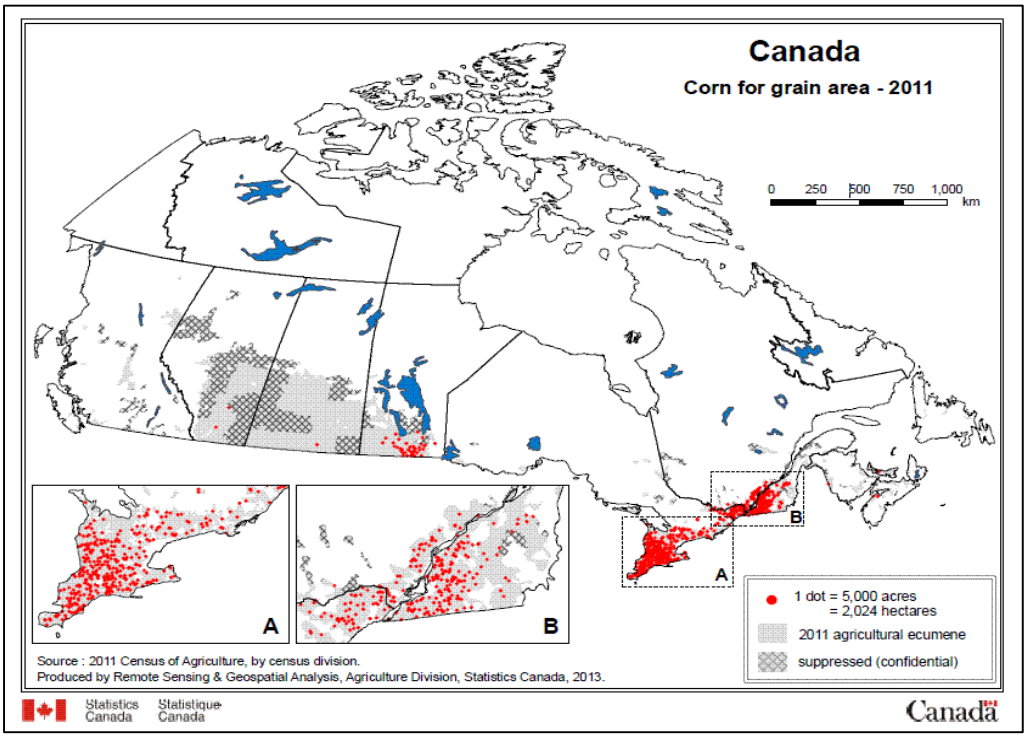


Figure 2 Principal Growing Regions of Corn in Canada, 2011



Appendix II Analysis of Canadian Honeybee Incidents to Date

In 2012 and 2013, Health Canada's PMRA received numerous reports of honeybee mortality incidents (see Table 1). These incidents occurred mainly in intense corn growing regions of Ontario, with fewer in corn growing regions of Quebec and Manitoba. A vast amount of information was evaluated, collected through beekeeper questionnaires, symptom observation, samples collected for pesticide residue analysis, Ontario Ministry of Agriculture and Food bee health inspections, and surveys of detailed agricultural practice information surrounding affected beeyards. The incident locations corresponded with corn growing areas of Canada, as indicated in Figures 1 and 2 in Appendix I. Agricultural information indicated there were bee mortalities that coincided with specific corn and soybean planting events. As well, 70 percent of dead bees collected during the corn and soybean planting periods in 2012 and 2013 had neonicotinoid residues present, confirming exposure occurred, while the majority of live bees did not have residues present.

The weight of evidence indicated that exposure to dust generated during planting of neonicotinoid treated corn and soybean seed contributed to bee mortalities in 2012 and 2013. Summary reports were published.[4]

In response to these incidents, Health Canada's PMRA announced the following measures to reduce pollinator exposure to dust generated during the planting of treated corn and soybean seed:

- The New 2014 Requirement when using Treated Corn / Soybean Seed of a dust-reducing seed flow lubricant.
- Best Management Practices for Protecting Pollinators during Pesticide Spraying and an update on best practices for Pollinator Protection and Responsible Use of Treated Seed.
- Enhanced warnings and directions on pesticide and seed package labels on how to protect bees.

Before the 2014 planting season began, Health Canada's PMRA, the Ontario Ministry of Agriculture and Food, the Canadian Seed Trade Association, CropLife Canada, and pesticide registrants collaborated to help ensure risk mitigation measures were communicated to growers across Canada and that the dust-reducing lubricant was readily available. This outreach campaign was successful. Seed dealers/retailers verified that the new lubricant, seed tags, labels and best management practices were provided to growers when they purchased treated seed, and sales and distribution data suggest the fluency agent was used extensively.

[4] Health Canada. *Evaluation of Canadian Bee Mortalities that Coincided with Corn Planting in Spring 2012* (http://www.hc-sc.gc.ca/cps-spc/alt_formats/pdf/pubs/pest/decisions/bee_corn-mort-abeille_mais/bee_corn-mort-abeille_mais-eng.pdf); and *Evaluation of Canadian Bee Mortalities in 2013 Related to Neonicotinoid Pesticides- Interim Report as of September 26, 2013* (http://www.hc-sc.gc.ca/cps-spc/alt_formats/pdf/pubs/pest/_fact-fiche/bee_mortality-mortalite_abeille-eng.pdf).

With these measures in place, the numbers and severity of incidents being reported in 2014 during planting are lower than in 2012 and 2013, with a 70 percent reduction in incidents during planting in 2014 compared to 2013 (see Table 2). However, the following factors related to the very wet, cold spring in southwestern Ontario may also have contributed to the decrease:

- An extended time period for corn planting in 2014 as opposed to the more usual intensive planting over a short time-period in 2012 and 2013.
- Changes in timing of bee foraging activity and available forage relative to timing of corn planting.

As in 2012 and 2013, each incident reported in 2014 is being investigated through a collaborative effort between Health Canada's PMRA, Health Canada's Regions and Programs Bureau, and the provinces. Each investigation included evaluating hive health, collecting samples (dead bees, pollen and nectar) for pesticide residue analysis, and gathering as much information as possible about the beeyard management practices and the surrounding agriculture. The assessment of these incidents is ongoing, and the samples collected are being analysed for pesticide residues and bee viruses.

Analysis of Results to Date: 2012–2014

Over the three years, the timing of bee incidents has varied. Corn and soybean planting practices and timing are highly dependent on weather. For example:

- In 2012, Ontario experienced an early, warm and dry spring, and corn was planted early.
- The spring of 2013 saw more typical temperatures and precipitation, and corn was planted in a concentrated two-week period in May.
- Spring 2014 in Ontario was wet and cool, and the start of corn planting was delayed until mid-May and continued intermittently to early June with some growers switching to soybeans as they were unable to work their land in time to plant corn.

Table 2 shows the number of beeyards and beekeepers reporting incidents in all three years per month, with the corn planting months emphasized.

The symptoms reported differed over the three years of reporting as follows (Figures 3–5):

- In 2012, the majority of incidents involved high numbers of dead bees and symptoms of pesticide poisoning (twitching, paralysis, etc.).
- In 2013, while symptoms of pesticide poisoning continued to be reported, many incidents involved lower numbers of dead bees. Beekeepers began to report colony effects (lack of foragers, loss of population, lack of honey production, etc.), especially in the later months of the beekeeping season.

- In 2014, most incidents involved low numbers of dead bees but included colony effects or queen losses. These types of incidents were reported throughout the 2014 season, with an increase in these reports in the later months of the beekeeping season.

Since 2012, beekeepers have become more aware of the unusual symptoms observed in their colonies and the process for reporting these issues to Health Canada's PMRA and the Ontario Ministry of Agriculture and Food, which may have contributed to the increase in reporting of these types of effects in 2013 and 2014.

In 2014, the number of yards reporting dead bees at the time of planting was significantly lower than 2012 and 2013 (Figure 4). This could be due to mitigation and/or weather-related effects. Ongoing efforts continue to further reduce exposure to dust during planting of treated seed.

Figure 5 shows an increase in reported colony effects (including loss of foragers, queen effects, colonies dwindling) post-planting in 2013 and 2014. However, it is noted that in 2014, 72 percent of the beeyards reporting post-planting colony effects were reported by three beekeepers, which contributed significantly to the number of yards reported during that timeframe.

While Health Canada's PMRA has concluded that exposure to neonicotinoid contaminated seed dust contributed to honeybee mortality incidents reported around the time of planting, the contribution of pesticides to the later season mortality reports and effects other than mortality is not clear, and is still under assessment.

Additionally, the measured residue levels from reported incidents are still being assessed. Residues were detectable in some 2013 later-season reports but not others. Residue levels from 2014 reports are pending. Without detectable residues, it is difficult to determine the likelihood that pesticides contributed to the effects reported. It is also noted that residues in the hive may not be detectable in the later season, even where an exposure may have been demonstrated earlier in the season, due to dilution or degradation of residues in the hive. The incident inspections occur at a single point in time, making an understanding of exposure levels throughout the season difficult.

Table 1 Number of Incidents, by Beeyards and Beekeepers, Reported to Health Canada's PMRA (2012–2014) (as of 17 October 2014)

Province	Beeyards reporting incidents in 2012[1]	Beekeepers reporting incidents in 2012	Beeyards reporting incidents in 2013[2]	Beekeepers reporting incidents in 2013	Beeyards reporting incidents in 2014[3]	Beekeepers reporting incidents in 2014
Ontario	240	40	395	76	322	52
Quebec	17	2	15	11	13	8
Alberta	2	2	---	---	---	---
Saskatchewan	16	6	---	---	---	---
Manitoba	1	1	10	4	6	3
Nova Scotia	2	2	---	---	2	2
Total of all provinces[4]	278	53	420	91	343	65

1 Investigation of the 2012 incidents indicated mortalities were related to corn and soybean planting in 239 beeyards (33 beekeepers). Reasons why some incidents reports were considered not related to corn planting included pests and diseases, and spray incidents in other crops.

Incidents related to corn/soybean occurred in Ontario and Quebec.

2 Investigation of the 2013 incidents indicated mortalities were related to corn and soybean planting in the majority of the beeyards reported; final causality assessment pending. Reasons why some reports were considered not related to corn planting included pests and diseases, spray incidents in other crops and, insufficient information to assess the potential causality.

Incidents related to corn/soybean occurred in Ontario, Quebec and Manitoba.

3 Investigation of the 2014 incidents, and the number that may be related to corn and soybean planting, is in progress. These numbers are as of October 2014.

4 The following are the available numbers of beekeepers and honeybee colonies in Canada for 2012 and 2013 as reported by Statistics Canada. Beekeepers: 2012: 8,312; 2013: 8,483. Colonies: 2012: 690,037; 2013: 672,094. [Source: Statistics Canada. http://www5.statcan.gc.ca/cansim/pick-choisir?lang=eng&p2=33&id=0010007

Table 2 Number of Incidents Reported in Ontario During or Following Corn and Soybean Planting Based on the Month the Adverse Effects Were Noted (2012–2014) (as of 17 October 2014)

Note: For each year, the corn planting months are represented by bolded values.[1]

Month	Beeyards reported per month in 2012[2]	Beekeepers reporting per month in 2012	Beeyards reported per month in 2013[3]	Beekeepers reporting per month in 2013	Beeyards reported per month in 2014[4]	Beekeepers reporting per month in 2014
April	**123**	**21**	4	2	6	3
May	**114**	**20**	**244**	**50**	**51**	**27**
June	3	2	17	10	**25**	**13**
July	2	2	33	12	39	20
August	---	---	91	21	184	27
September	---	---	30	10	64	16
October	---	---	3	2	5	2
Entire Season[5]	240	40	395	76	322	52

1 Ontario corn planting begins prior to soybean planting. Soybean planting can extend into June.

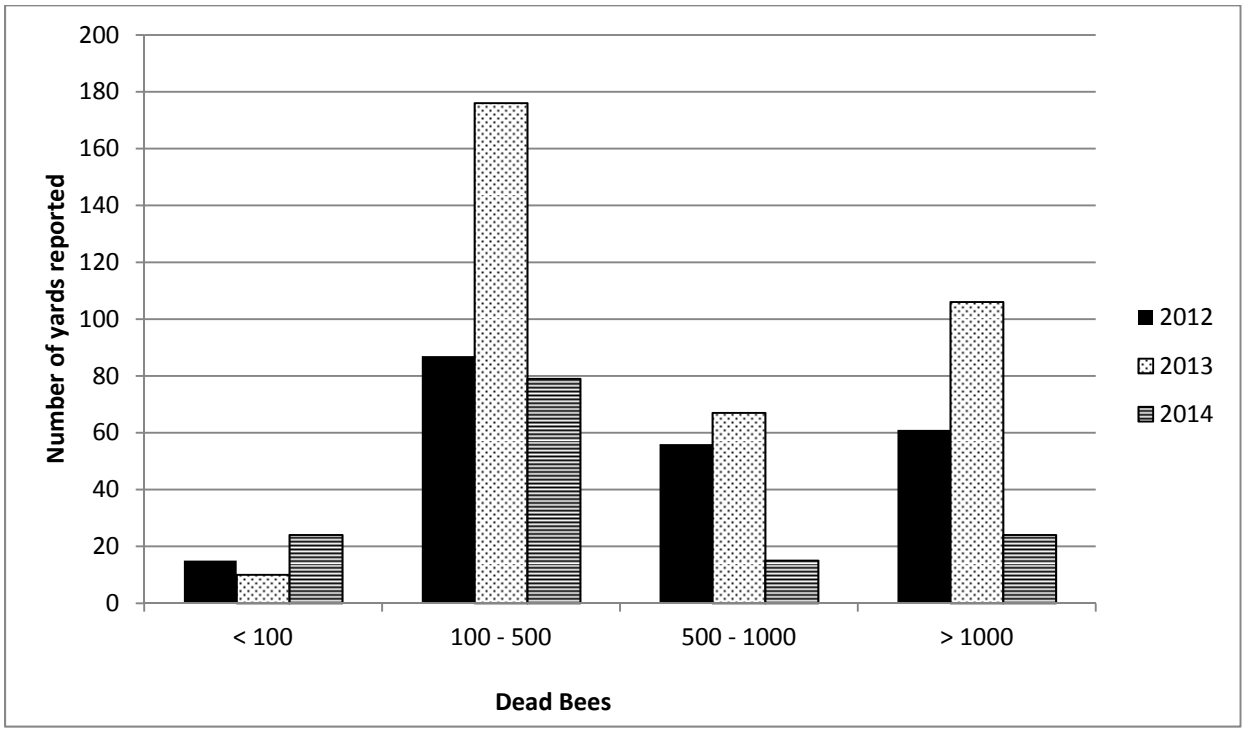
2 In 2012, corn planting began in early April and continued through the first half of May (by May 5 corn planting was virtually complete)

3 In 2013, corn planting occurred primarily during the month of May with the majority of the planting occurring in the first two weeks of May; some planting started at the very end of April

4 In 2014, corn planting started in mid-May and continued intermittently through the beginning of June with some farmers switching to soybeans due to the delay.

5 Some yards were reported more than once during different months, hence the number of beekeepers and yards for the entire season differs from the total by month.

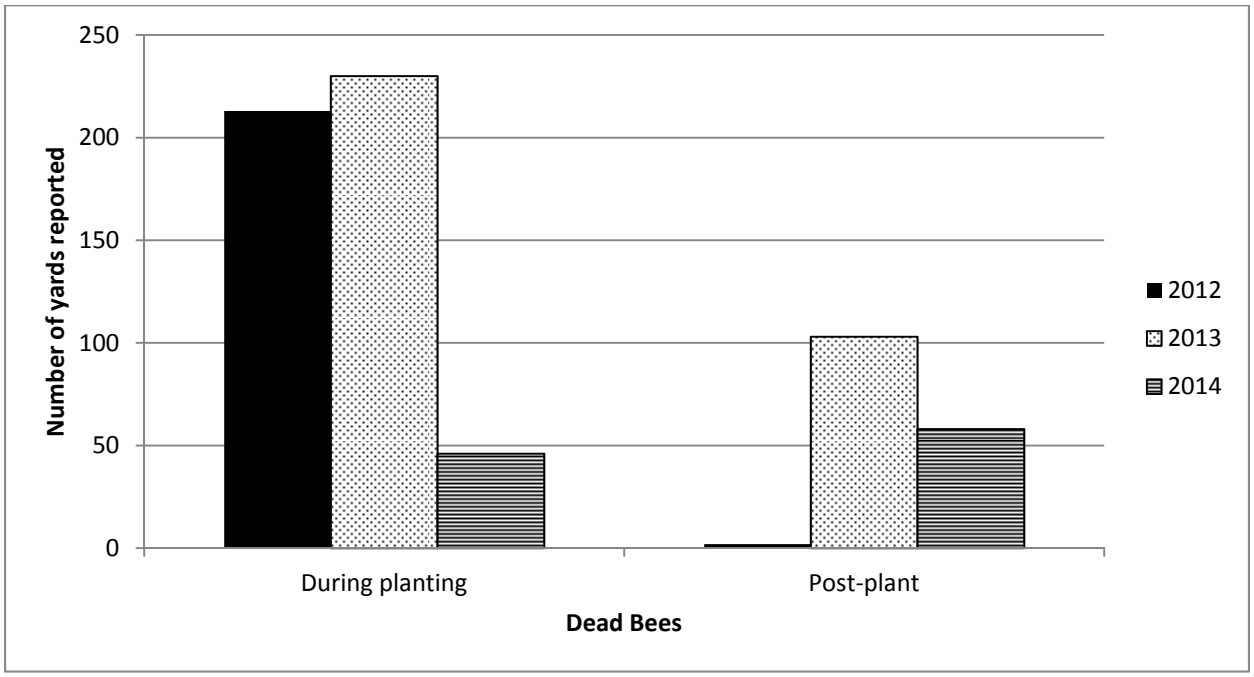
Figure 3 The Number of Dead Bees in Beeyards across Canada Reported During and Post-planting (as of 17 October 2014)



Note:

- "Dead bees" represents the estimated number of dead bees observed in front of affected colonies in an individual beeyard.

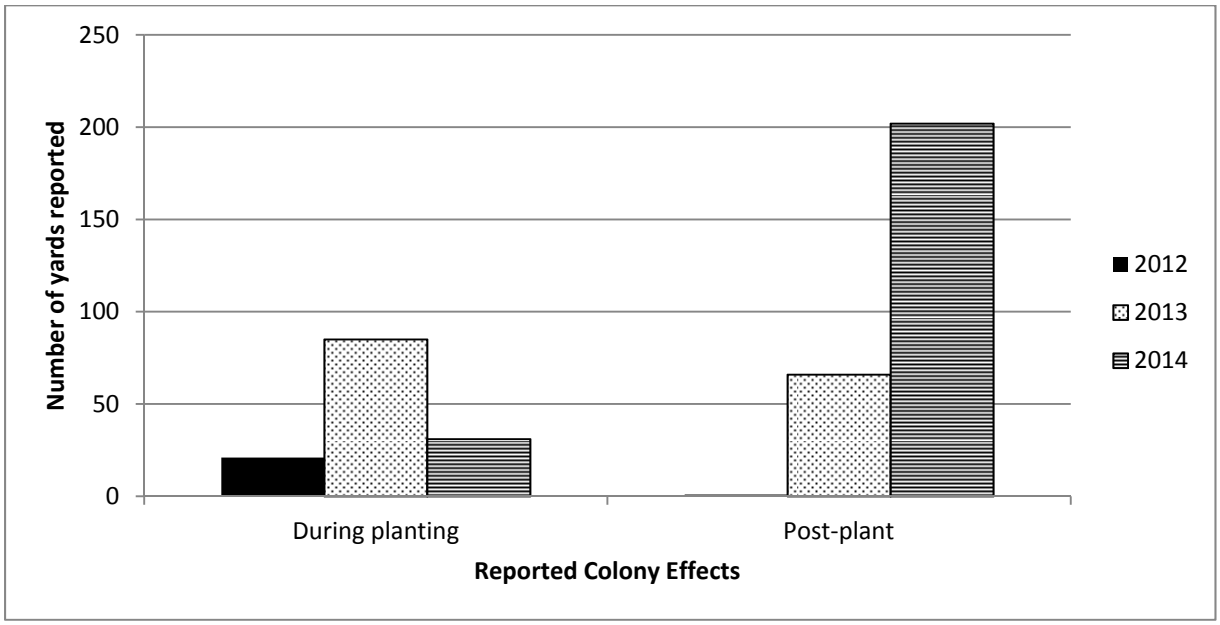
Figure 4 The Number of Beeyards Reported during Planting and Post-planting with Dead Bees (as of 17 October 2014)



Notes:

- During planting: Includes both corn and soybean planting and covers the months of April, May and June for the three years.
- Post-plant: The post-plant period was determined to be July through to October.

Figure 5 The Number of Beeyards Reported during Planting and Post-planting with Reported Colony Effects (as of 17 October 2014)



Notes:

- Colony effects: one or more of the following symptoms observed: colony not developing as expected, colonies dwindling, low population, low number of foragers, loss of population but generally no large number of dead bees, queen loss, on-going effects in yard.
- During planting: Includes both corn and soybean planting and covers the months of April, May and June for the three years.
- Post-plant: The post-plant period was determined to be July through to October.
- In 2014, 72 percent of the beeyards reported with colony effects post-planting was reported by three beekeepers.