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Control of Pesticide Exposure Working Group (CPWG):

Work Plan for Outside-the-Hive Exposure

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Background

The Control of Pesticide Exposure Working Group (CPWG) is a sub-committee of Agriculture and Agri-food Canada's Bee Health Roundtable (BHRT). This working group was appointed by Agriculture and Agri-food Canada and is made up of representatives from 11 bee and agricultural industry and government stakeholder groups from across Canada. The working group has spent considerable time developing its terms of reference, and the overall goal stated in these terms of reference is "to identify tools already in place to strengthen bee health and increase bee populations in Canada by actively identifying and promoting ways to reduce exposure of bees to pesticides both inside and outside the hive. The CPWG will also identify gaps and make recommendations on how to address the missing information/tools."

The activities set out for the CPWG are then split into two categories:

1. The CPWG will undertake a "literature and information review" to identify existing **pest pressure** monitoring tools and activities that currently support the goal of reducing exposure of bees to pesticides. The CPWG intends to identify existing pest pressure monitoring tools and activities with a goal of identifying consistencies, deviations, gaps and BMP's and will work toward national consistency and acceptance of the tools and activities

2. The CPWG will undertake a "literature and information review" to identify existing **risk reduction** technologies, activities and tools that support the goal of reducing exposure of bees to pesticides. It is the CPWG intent to gain a better understanding of the tools, initiatives and activities in place and ensure awareness while identifying gaps.

Project Activities

This objective of this project is to assist the CPWG with developing a detailed work plan to accomplish the goals and activities listed above. This project is focused only on pesticide-related bee incidents that occur outside of the hive (not in-hive treatments). In-hive treatments will be covered separately by the CPWG.

The steps undertaken in this project were:

- Phone discussions with committee co-chairs to start the project and periodic updates
- Phone interviews with over 10 stakeholders (CPWG members plus other members of the Canadian Honey Council).
- Review and analysis of a Compendium of ongoing bee health projects and activities that was developed by the BHRT members
- Review of incident reports involving bee health and pesticides from 2012 to 2015 according to: the Health Canada website, the 2015-07-15 PMRA Incident Update report to Bee Health Roundtable, and the Evaluation of Canadian Bee Mortalities coinciding with Corn Planting-2012 report

Other sources of information that have been reviewed as part of this project include the Senate Standing Committee report (The Importance of Bee Health to Sustainable Food Production in Canada) May 2015, and Honey Bee Best Management Practices: Canadian Industry Gap Analysis and Harmonization, Eccles *et al*. (2015)

This interim report provides an update on the process to develop the work plan and initial recommendations for discussion with the CPWG.

Logic Model to Develop Work Plan

The following method (logic model) was used to identify needs and gaps, and develop the CPWG work plan:

The following is a basic description of questions for analysis and information sources in each of the five steps:

1. **Where are honeybee-pesticide exposures occurring?**
    a. Use Health Canada (PMRA) incident reports (2010 to 2015) and beekeeper feedback to develop a summary of possible bee/pesticide related issues. Consider factors such as severity of incident, application type (seed applied or foliar), crop and region.

2. **What existing tools & activities can help mitigate the risk of exposure?**
    a. Consult other sources to capture issues or events not reported to the PMRA, including interviews with beekeepers.
    b. Use the Compendium of activities and projects as an initial source of information on existing tools and activities that are in place.
    c. Separate the activities and projects into the two categories set out in the terms of reference:
        i. Pest pressure monitoring tools, activities
        ii. Risk reduction technologies, activities, tools
    d. Reference other reports of existing tools and activities, as listed throughout the document

3. **Are these existing tools & activities effective?**
    a. Where possible, determine whether the current tools are deemed to be effective, widely implemented and working well, or whether there are still areas that require more development and/or awareness and communication efforts.
    b. Given that many of these projects are relatively new, the ratings may be subjective but will still provide an initial indication of areas that require more work.

4. What are the gaps?

a. Based on the previous steps, determine any gaps that exist considering the type of project/activity, crops, regions, etc.
b. Recommend whether a formal literature review is necessary in addition to the compendium and other existing reports.

5. CPWG Work Plan

a. Based on the gaps identified in this report, a work plan of next steps can be developed to the address these needs.

Step 1 - Where are honeybee-pesticide exposures occurring?

A number of factors are seen as potential reasons for bee colony issues in Canada, including loss of habitat and food sources, diseases, viruses and pests, as well as pesticide exposure. This analysis is focused only on pesticide and bee-related issues that occur outside of the hive.

The first step in the project was to determine which active ingredients and use patterns are being reported, either formally or informally, in pesticide and bee issues. The information sources for this step included using Health Canada (PMRA) voluntary incident reports.

According to PMRA, a bee incident submitted through the voluntary reporting system is defined as “atypical effects observed in a honey bee colony reported by a beekeeper, and suspected by the beekeeper to be related to pesticide exposure”. These incidents should not be interpreted as a conclusive determination of cause; further analysis needs to be conducted to determine the causality of each individual incident report. It should also be noted that the active ingredients implicated in voluntary reports have not been verified and, as such, may or may not be accurate.

In addition to PMRA reports beekeeper feedback from interviews was used to determine which regions and use patterns are implicated in pesticide-bee issues.

For each incident, factors such as severity of the incident, application type (seed applied or foliar) and region were considered.

Honey Bee Incidents Reported to PMRA

A summary report recently issued by PMRA to the Bee Health Roundtable summarized the total number of bee yards with reported incidents from 2012 to 2015 (up to July 14, 2015). A detailed summary of the report can be found in Appendix C. The following points are some key highlights from the report that can help inform and direct the CPWG work plan:

- The majority of reported incidents in 2015 occurred in Ontario, in corn and soybean growing-regions
- The majority of incidents in corn and soybean-growing regions report low to very low levels of bee death, while 27% of these incidents report show medium to high numbers of dead bees.
- 87% of the spray-related incidents from 2012-2014 show medium or high numbers of dead bees

For incidents reported to involve foliar application, pesticides mentioned include: dimethoate, phosmet, carbaryl, chlorpyrifos, diazinon, clothianidin, permethrin, pyridaben and spinosad. For incidents reported to involve foliar application, crops mentioned include: canola, alfalfa, cereal crops, cranberries, strawberries, apple, soybean and wheat. For the full details of honey bee incident reports, please see the PMRA update report (July 15, 2015)

Incident Report Summary

To add further detail, the following is a summary of the insecticide active ingredients listed in incident reports from 2010 to 2013. This list is not meant to be a conclusive or exhaustive analysis; this is simply a summary to guide the CPWG in developing the work plan.

Active ingredients of insecticides mentioned in the incident reports are as follows:

- Neonicotinoids (Clothianidin, Thiamethoxam, Thiacloprid[1], Acetamiprid[2])[3]
    - Numerically, this class of insecticides is implicated in the highest number of incidents reported to the PMRA
    - Several of the reported incidents listed neonicotinoids in combination with other active ingredients (e.g., fungicides, in-hive treatments)
    - Most incidents were in Eastern Canada (corn and soybean growing regions)
    - Most incidents reported involved seed-applied insecticides (seed treatments)
- Organophosphates (e.g., Chlorpyrifos, Diazinon, Phosmet, Dimethoate)
    - This class of insecticides also had several incidents reported, but fewer than neonicotinoids
    - Incidents were both in Eastern and Western Canada
    - The only major incidents occurred in Western Canada in 2012
    - These insecticides are foliar applied (sprayed on a crop)
- Pyrethroids (e.g., Cyhalothrin, Permethrin)
    - A few incidents were reported for this class of insecticides, all were in Eastern Canada
    - These insecticides are foliar applied (sprayed on a crop)

Note: Several in-hive treatments were also listed in the incident reports (Formic Acid, Coumaphos, Tau-fluvalinate, and Iprodione) but the focus of this project is on outside-of-hive treatments.
A summary of the PMRA incident reports from 2010 to 2013 is included in the appendix of this report.

Beekeeper Feedback

Several beekeepers and apiarists were contacted as part of this project and the information gathered in these interviews is included in the relevant sections throughout the report. Although the information provided was largely anecdotal and lacked detail, these interviews highlighted several potential issues related to pesticides and bee health which may warrant additional analysis:

[1] Thiacloprid is not seed applied (it is foliar applied)
[2] Acetamiprid is not seed applied (it is foliar applied)
[3] Imidacloprid is also a widely-used registered neonicotinoid, but it has not been implicated in any Canadian incident reports listed in the PMRA database.

- Foliar applied pesticides, including tank mixes, were mentioned by several beekeepers to be a potential concern. The pesticides of concern mentioned during the interviews were organophosphates, but no specific active ingredient or incident information was provided.
- The main crop mentioned included canola and aerial application. In addition, questions about wheat and barley were raised because, while these are not viewed as pollinator attractive crops, they are often adjacent to canola or in the vicinity of hives. Improper pesticide application in these crops could also have a negative impact on bees.
- Tank mixes of pesticides (both insecticides and fungicides) were mentioned as a possible source of issues with bees, but no specific active ingredients or incidents were provided.

Summary

For the purposes of developing a work plan for the CPWG, our analysis of the incident report data and beekeeper interviews is as follows:

- Seed applied neonicotinoid pesticides used in the corn and soybean regions, found either alone or in combination with other pesticides, have been implicated in the majority of bee incident reports filed with the PMRA. While high in number, these incidents tend to be minor to moderate in severity. To be clear, these incident reports do not prove these pesticides are the cause; further analysis needs to be conducted into each report to determine causality.
- Some foliar applied non-neonicotinoid pesticides, such as organophosphates and pyrethroids, are also implicated in incident reports in several regions of Canada and involving several other field and horticulture crops. These incidents tend to have a higher severity (moderate to major). While there are far fewer reported incidents, this area should be investigated further. As mentioned above, these incident reports do not prove these pesticides are the cause; further analysis needs to be conducted into each report to determine causality.

Step 2 - What tools & activities exist?

Compendium Analysis

A compendium of activities has been compiled by the BHRT members and includes over 108 entries of activities or projects related to bee health in Canada. The list does include some overlap, for example an activity may be reported by two separate groups and therefore listed twice, but it does show that a great deal of work has already been accomplished or started in this area.

Our analysis of the compendium shows that 58% of the activities relate to outside-of-hive issues, 28% relate to in-hive and 13% include both (in- and out-of-hive combined). Pesticides are mentioned in 72% of the activities or projects, indicating that there is considerable effort ongoing on pesticide-related issues.

From a geographic standpoint one-third (33%) of the activities are national in scope, 58% are specific for Eastern Canada and 10% focused in Western Canada. For crop specific activities, corn and soybeans are the most common crops cited. Canola and horticultural crops also have several entries in the compendium, but are represented in less than 30% of the activities.

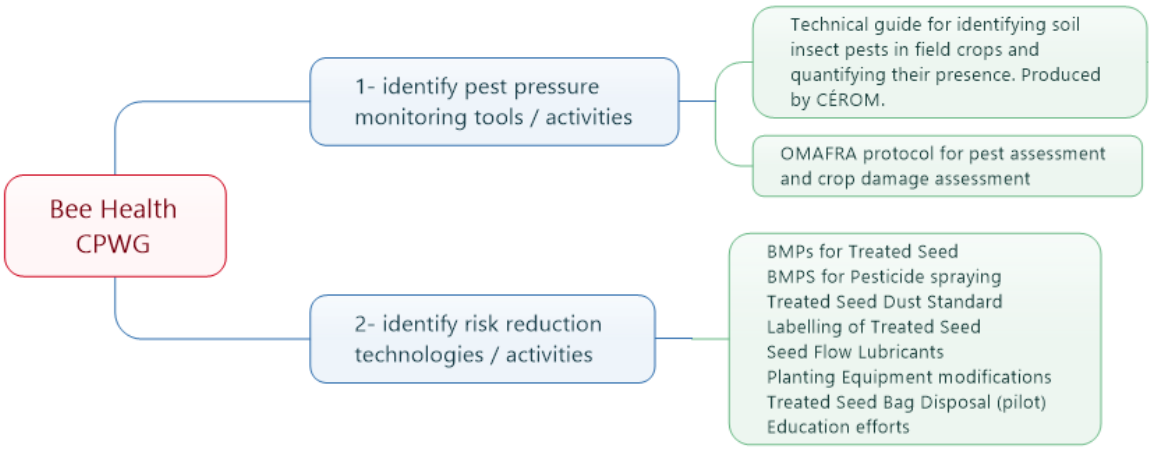
A summary of the most common categories or type of work:

Category / Type of Activity*	Percent of the Activities / Projects
Information Sharing and Education activities	48%
Best Management Practices for Farmers	36%
Monitoring and/or Surveillance	27%
Best Management Practices for Beekeepers	25%
Research projects	23%

* Note: Some projects fit into multiple categories.

As illustrated above, information sharing and education is the most common activity at 48% of the total. Best Management Practices (BMPs) are also a significant share of the work along with monitoring and research projects. Other main topics included in-hive treatments, bee nutrition and pest predictor tools for farmers.

The CPWG terms of reference indicated two separate categories of activity; pest pressure monitoring and risk reduction. The following is a summary of the main activities and projects listed in the Compendium separated into the two categories.



Pest pressure monitoring tools, activities

The only pest pressure monitoring tools identified in the compendium and during the interviews include:

- Technical guide for identifying soil insect pests in field crops and quantifying their presence. Produced by CÉROM.
- OMAFRA pest assessment:
  - http://www.omafra.gov.on.ca/english/crops/scout-pest-field.htm
- OMAFRA field scouting recommendations:
  - http://www.omafra.gov.on.ca/english/crops/reduceneonics.html
- Each province provides growers with a crop production guide and recommendations for pest control. Some of these guides provide threshold information.

It was noted the Canola Council of Canada has done significant work in the area of insect monitoring and forecasting (for example, flea beetle) and may be able to offer “lessons learned” in this area.

Risk reduction technologies, activities, tools

There were many risk reduction technologies and activities mentioned in the compendium and during the interviews. The following is a summary list of the main items:

- BMPs for Treated Seed
- BMPS for Pesticide spraying
- Treated Seed Dust Standard
- Labelling of Treated Seed
- Seed Flow Lubricants

- Planting Equipment modifications
- Treated Seed Bag Disposal (pilot)
- Education efforts with growers and seed dealers
- Driftwatch website (Saskatchewan only)
- BeeConnected website/app

Step 3 - Are the tools & activities effective?

The next step in our analysis is to determine, where possible, whether the current tools are deemed to be effective and working well or whether there are still areas that require more focus and development. General BMPs for pesticide usage are in place on a national level. In addition, many new of these activities and tools have been made available in the last 12-18 months. Due to the recent launch, it has been difficult to find any conclusive indicators as to whether the tools are effective, practical and working well. Still, for the purposes of directing future work and projects for the CPWG, this analysis can help to direct future effort until more data can be collected and evaluated.

Pest pressure monitoring tools, activities

Pest pressure monitoring tools, field scouting protocols and decision support tools (action thresholds) have been developed in Ontario and Quebec and are focused on in-ground corn insects. These tools have not been field tested on a wide scale yet, so it is unknown as to whether they will be effective and provide repeatable results. Our assessment is that there does not appear to be any data to indicate that the tools do work, nor is there data to indicate that they do not work. The effectiveness of these tools is unknown at this point.

In addition, some comments raised indicate that the timing of the scouting and assessment protocol is not practical for growers and may not accurately predict insect pressure in time to make seed purchase decisions.

Risk reduction technologies, activities, tools

In addition to the general BMPs that exist nationally, risk reduction technologies and activities, in particular for corn and soybeans, is an area that has seen much activity and focus by many groups (governments, companies, and associations). The risk reduction tools and activities have likely contributed to the reduction in bee colony incidents reported for 2015; this is a step in the right direction.

The following table (page 14) is a summary of the anecdotal comments on the effectiveness of current technologies and activities. Many of the tools and activities identified are too new to have quantitative data for evaluation, so an effectiveness rating system was used. These ratings were based mainly on the expert feedback from the working group interviews. Although subjective and anecdotal, this rating system provides the most up-to-date snapshot of current tools and activities available.

Snapshot of Current Tools and Activities

The following table is based on anecdotal comments from the working group and expert interviews. There is no quantitative data for evaluation of recently launched tools. These rating are subjective but do provide a base rating of their effectiveness.

Tool / Activity	Comments on gaps / needs			
	Unknown	Working well, needs more effort	Adequate	
Pest pressure monitoring and decision support tools	X			Identified gap due to limited number and recent launch; need for pest pressure monitoring in some regions; need for testing and developing additional tools
BMPs for Treated Seed		X		Reportedly working well; but can use continued communication and education
BMPs for Pesticide spraying		X		General BMPs are in place and reportedly working well, but not as well-known as the treated seed BMPs; industry can benefit from additional education
Treated Seed Dust Standard			X	In place and working
Labelling of Treated Seed			X	In place and working
Seed Flow Lubricants			X	In place and working well
ISO 17962: Standard for fugitive dust control in planting equipment	X*			Standard published in July 2015. First use of planters under this standard is Spring 2016. Compliance is voluntary, but it was developed with major manufacturers
Planting Equipment modifications	X*			Working well when in use, but the rate of installation on planters is unknown
Treated Seed Bag Disposal (pilot)	X*			Need to understand success of pilot and expansion plans for this program
Education efforts with growers and seed dealers		X		Reportedly working well; but can use continued communications and education. In particular for foliar application.
DriftWatch website (SK only)	X*			Many bee hive locations in SK are listed, but uptake and effectiveness of the program is unknown at this time
BeeConnected website/app	X*			Launched in fall 2015; full deployment in 2016.

Note: *Further investigation or analysis for the topics that are rated as “unknown” will be recommended as part of the work plan for the CPWG

Step 4 - What are the gaps?

Pest pressure monitoring tools, activities

- A major gap exists in pest pressure monitoring and decision support tools and activities**.** Few tools currently exist for growers, and new tools and methods for both pest pressure monitoring and for decision support (for integrated pest management and action thresholds) need to be further developed for several pests and crops.
    - There also appears to be a gap in overall pest pressure monitoring in some Provinces. Some areas, such as Alberta, reportedly do have pest pressure monitoring systems, however other areas do not have this information available.
- The effectiveness of existing pre-plant pest monitoring tools and protocols must be determined, including whether the tools are practical and accurate for producers to make seed purchase decisions.

Risk reduction technologies, activities, tools

- BMPs for pesticide spraying are missing for some crops. In order to prioritize the development of new BMPs, the correlation between specific crops, their BMPs and the number of reported incidents should be analyzed. This data will indicate the areas of highest need for BMP development for pesticide spraying.
- BMPs for crop rotations need to be developed. For example, BMPs for the rotation of cereal crops with bee-friendly crops
- Market research is needed to determine the uptake, usage, and effectiveness of planting equipment design and modifications.
- The success of the Treated Seed Bag pilot program should be evaluated. The expansion of the program to Western Canada and into other crops should be determined.
- There is a need to develop thresholds for pesticide spraying on key crops (cereals, canola, and horticultural crops). These could include action thresholds and economic thresholds. Any threshold tools that do exist must be evaluated for usefulness and efficiency.
- The uptake and effectiveness of the DriftWatch website with both growers and beekeepers needs to be evaluated and potentially expanded across provinces.

Other gaps

- Currently no comprehensive information exists for grower benchmarking across Canada. Potential topics for benchmarking include: attitudes, perceptions and practices related to bee health and pesticides, including

uptake of BMPs and percent of acreage following bee health BMPs. This data would help to identify and prioritize areas for grower education and awareness efforts regarding bee health and pesticides.

- During the interviews with beekeepers and apiarists conducted during this project, much of the information provided was anecdotal and lacked sufficient detail to pinpoint specific active ingredients of concern. Increased awareness about the importance of detailed data collection and reporting may enhance the ability of the working group (and others) to identify and prioritize risk reduction efforts.

In addition to the compendium, a report of the Canadian BMPs Gap Analysis[3] was reviewed. Gaps identified in the report are as follows:

- Differences between provinces were identified as a gap in the report: *The amount and availability of information varies between provinces for BMPs with regards to the exposure of honey bees to pesticides*.
- Communication and education was also identified as a gap: *Availability, education, and promotion of communications materials to growers are likely the biggest gaps in ensuring BMPs aid in reducing any pesticide exposure to honey bee colonies*.
- DriftWatch, a website and program available in Saskatchewan was also identified in the report: *Saskatchewan is the only province that has integrated this [Driftwatch] program into their BMPS.*

Emerging and potential gaps

In addition to the gaps stated above, gaps may emerge resulting from changes to agricultural practices. For example, changes in seeding equipment or the emergence of new pest threats may alter production practices and create new concerns for pesticide use related to bee health.

Summary

Our observations on the gaps in tools and activities in Canada are as follows:

- Pest pressure monitoring tools and activities are limited and not field tested at this point, thus additional work to test existing tools and develop additional methods/tools is recommended. Currently this appears to be the biggest gap.
- Decision support tools and activities that support Integrated Pest Management (IPM) can also be further developed for several pests and crops to provide growers with a clearer assessment of whether pesticides are needed (ex: action thresholds)

[3] Honey Bee Best Management Practices: Canadian Industry Gap Analysis and Harmonization, Produced by: Les Eccles, Melanie Kempers, Daniel Thurston, Raquel Mijares Gonzalez (2015)

- Risk reduction technologies, in particular in corn and soybeans, have been a big focus of the current effort with many new technologies or practices already in place.
    - Continued communication and education on BMPs for treated seed are recommended
    - Increased communication and education efforts for BMPs for pesticide spraying is recommended in particular for Western Canada (both in canola and cereal crops) for foliar application (including growers as well as aerial and custom applicators)
- Other gaps include
    - The differences in BMPs between provinces
    - A lack of information about grower attitudes and practices

Step 5 - CPWG Work Plan

In conclusion, a detailed work plan of projects and next steps is listed below. The working group should consider the prioritization of next steps, based on the information presented in this report.

1. Education on Foliar Application BMPs

Increased communication and education efforts for BMPs for pesticide spraying is recommended for foliar application (including growers as well as aerial and custom applicators). This recommendation is applicable across Canada including Western Canada (both in canola and cereal crops). Suggestions on activities could be:

- Training program for custom and aerial applicators
- Communication / education campaign for growers
    - Perhaps building on current activities of Canola Council?
    - Expand to other crops – wheat and barley, potatoes
- More involvement from horticulture sector is needed to determine gaps in regional or crop specific BMPs (if any) in the horticulture sector (such as crop and region-specific gaps)

2. Determine effectiveness of current tools and activities

There are several activities and tools that are listed in this report as “unknown” in terms of their effectiveness. There is a need to investigate these items to determine, if possible, how effective they are and whether there are any further developments that can reduce pesticide exposure risks. The four items are:

- Planting Equipment modifications – determine actual uptake with growers, manufacturers
- Treated Seed Bag Disposal (pilot) – determine effectiveness and future plans for expansion beyond the pilot
- Driftwatch website – determine usage, effectiveness and possible expansion plans for other provinces
- BeeConnected website/app – determine full launch timing

3. Pest Predictor Models and Decision Support Tools

Developing pest predictor models and decision support tools (as well as test existing tools that in Ontario and Quebec) should be a major focus for the CPWG (or other groups). While projects in this area should start as soon as possible, this area will require long term study to properly test and validate methods and tools. Initial steps for this area include:

- Determine what the is being done to validate or test the effectiveness of existing pest predictor tools and decision support tools

- As part of that effort, talk to Canola Council regarding lessons learned in flea beetle pest monitoring and predictor method development
- Determine whether any new projects could be started to jointly develop improved pest predictor tools
- Determine whether any new projects could be started of jointly developed for pesticide use decision support (such as easy ways to determine action thresholds for specific crops/pests)

4. Grower Benchmarking Market Research

In order to assess attitudes, perceptions, and BMP uptake, a grower benchmarking survey could be established to gather information. The information gathered in the survey could be used to prioritize specific education and awareness efforts regarding pesticide use and bee health. Ideally this benchmarking survey would be repeated annually or every two years to track changes in BMP usage, pest pressure monitoring and decision tool uptake as well as grower perceptions and attitudes toward beekeepers and pollinator protection.

5. Bee Keeper - Grower Communication

Increased communication between growers and bee keepers is needed. The recent launch of the Bee Connected website (www.beeconnected.ca) should help enable bee keepers and growers to communicate more and work together. It will provide awareness of hive locations and pesticide activities, so that beekeepers, growers, and pesticide applicators can be aware and manage appropriately. If this website platform is the solution, an action for the work plan could be to determine how the CPWG can work together to improve understanding and usage of this tool and other solutions that enhance grower/beekeeper communications.

Gap areas identified that have recent developments:

Research Co-ordination: Based on interviews conducted throughout this project, some interviewees reported that initiating and coordinating research projects has been challenging., The activities of the BHRT research working group are focused on improving a bee health research strategy, thus do not need to be a focus of this working group.

Literature Review: The CPWG terms of reference states that a “literature review” should be conducted. There are several lists of publications on pesticide and bee issues (for example, the Pollinator Partnership aggregated list). The compendium assembled by the BHRT is a list of activities. While this list is useful, it does not replace a formal literature review. A potential next step could be a literature review related to pest pressure monitoring and predictor/forecasting methods. The BHRT has recently launched a bee health research landscape review project will is expected to serve this need.

Appendix

Appendix A: Pesticide Incident Report Summary

The following table is a summary of data gathered from the PMRA incident reports involving bees and pesticides. Multiple incidents of the same active ingredients have been combined together. Fungicides have been removed from the list in order to simplify analysis and because fungicides are not the initial focus of the working group.

Year	Active Ingredient	Severity	Use Pattern	Province	In / Out of Hive
2013	Cyhalothrin	Minor	Foliar	ON	Out
	Formic acid	Minor - Moderate	Hive	SK, QC, NS	In
	Thiamethoxam	Minor	Seed	ON	Out
2012	Carbofuran	Minor	Foliar	NS	Out
	Formic acid	Major	Hive	AB, QC, ON	In
	Clothianidin Some reports also included: Thiamethoxam, Thiacloprid	Minor - Major	Seed	QC, ON, AB	Out
	Chlorpyrifos	Minor - Major	Foliar	SK	Out
	Dimethoate	Moderate - Major	Foliar	SK	Out
	Coumaphos	Minor -Moderate	Hive	ON	In
	Tau-fluvalinate Iprodione	Minor	Hive	ON	In
	Phosmet	Minor - Moderate	Foliar	ON	Out
	Dimethoate	Minor - Major	Foliar	ON, MB	Out
	Clothianidin Permethrin	Minor	Unknown	ON	Out
	Acetamiprid, Clothianidin	Minor	Seed	ON	In, Out
2011	Clothianidin, Some reports also included: Fenitrothion, Thiamethoxam	Major	Seed	QC	Out
2010	Clothianidin Thiamethoxam	Moderate - Major	Seed	QC	Out
	Diazinon	Major	Foliar	QC	Out

Appendix B: Honey Bee Best Management Practices Report Excerpts

Excerpts From: Honey Bee Best Management Practices: Canadian Industry Gap Analysis and Harmonization, Produced by: Les Eccles, Melanie Kempers, Daniel Thurston, Raquel Mijares Gonzalez

This report includes an overview of BMPs for various bee health related topics in several countries including Canada. The following are excerpts from the report related to Canada and agricultural pesticides:

Pesticide Exposure Prevention

Practice	Document/Website	Topics Covered	Topics Missing
Agricultural	43. BC - Strengthening Farming, Right to Farm – Farming Practice, Pesticides 17. AB - Beekeeping 93. SK - Driftwatch - Specialty Crop Site Registry 65. NB - Managing Honey Bee Hives for the Pollination of Wild Blueberries 68. ON - Code of Practice to Prevent Bee Poisoning in Fresh Market Sweet Corn 75. ON - Analysis of Honeybees for Pesticide Residue 82. ON - Pollination and Bee Poisoning Prevention 2. QC - Empoisonnements Suspectés de Colonies D'abeilles par des Pesticides 5. QC - Appliquez-vous des insecticides sur vos cultures? Utilisez-vous des semences traitées aux insecticides? 92. QC - Pollination Contract – Hive Location 51. NAT - Protecting Bees When Growing Canola 54. NAT - Protecting Pollinators During Pesticide Spraying 55. NAT - Pollinator Protection – Reducing Risk From Treated Seed	43. Proper equipment, calibration, communication 17. Avoid spraying between the hours of 7am to 7pm 93. Mapping Interface for registered hives 65. Avoid use of insecticides during flowering, don't introduce hives if spraying is expected 68. Be aware of crops within forage range, notify growers where your hives are (including pollination areas, provide supplemental water) 75. Submit honey bees for pesticide testing 82. No insecticides while fruit trees in bloom, applications in the evening are the safest (early morning is the next best), remove honeybee colonies as soon as pollination is complete, clip cover crops prior to spraying 2. Identifying and addressing a suspected pesticide kill 5. Routes of exposure ,acute/chronic poisoning, know your surroundings, increase communication, IPM should be practiced, choose alternative chemicals, time applications appropriately, follow labels, reduce risk of drift, provide favourable pollinator habitats 92. Example of a pollination contract – emphasis on communication and understandings of each party 51. Before applying a pesticide, advise beekeepers to move colonies out 54. Check weather conditions, pay attention to wind speed/direction, tell applicator where hives are, spray only when it will increase profits 55. IPM for sustainable pest control (discourage pests, ID pests, threshold), know where beehives are located, communication with growers, avoid drift, locate hives upwind, observe pollinator activity, follow pesticide label instructions, avoid spraying when crops are in bloom, time applications to minimize bee exposure, apply pesticides early morning or in the evening, use equipment that reduces drift, treat only target area, avoid contamination of plants, water and soil	
In-Hive	8. QC - Loque Américaine le Transvasement: Étape par Étape	8. licensing required for antibiotic use	- minimizing the buildup of chemicals within the hive, beekeeper applied treatments - the effects of chemical buildup in the wax - interactions with environmental contaminants

Honey Bee Best Management Practices, page 3

Pesticide Exposure Prevention

The amount and availability of information varies between provinces for BMPs in regards to the exposure of honey bees to pesticides. General guides are available that instruct pesticide applicators to follow label instructions in order to prevent pesticide incidents from occurring. Availability, education, and promotion of these materials to growers are likely the biggest gaps in ensuring BMPs aid in reducing any pesticide exposure to honey bee colonies. DriftWatch is a well-established program in the United States, but Saskatchewan is the only province that has integrated this program into their BMPS. This program could be useful if implemented in other provinces by facilitating communication between growers and beekeepers to prevent indirect or direct contact of pesticide application with honey bee colonies.

The PMRA has specialized materials newly available to provide BMPs for the use of seed treatments, specifically for neonicotinoid seed treatment on corn and soybeans. The PMRA continually assesses the impact of pesticide

applications and BMPs on pollinators, in order to adapt to risks that can arise after a pesticide has been registered for use in the field.
A major gap in Canada's beekeeping BMPs is information related to in-hive pesticides. Minimizing the buildup of chemicals through in-hive applications by the beekeeper is an important management concern. Understanding the effect of pesticide residues and build up in wax, and the chemical interaction with other environmental contaminants is especially important for the maintenance of bee health. Australia provides additional BMPs for beekeepers whose colonies have been affected by pesticide exposure, outlining actions that can be employed to aid colonies in their recovery. They also provide information sheets that inform beekeepers about pesticides used on specific crops in order to help beekeepers assess risk of their apiary location and take mitigating action.
These BMPs could be developed for Canadian beekeepers to reduce the risk of honey bee exposure to pesticides, and provide instruction on management to recover from pesticide incidents.

[Honey Bee Best Management Practices, page 9]

Appendix C: Summary of PMRA update report (July 15, 2015)

- Table 1 in the report shows that 101 incidents have been reported in 2015 (2 in Manitoba, 92 in Ontario, 4 in Quebec and 3 in Alberta).
- Table 2 in the report indicates that majority of the reported incidents in 2015 are in the corn and soybean growing regions.
    - The number of Unique[4] Bee Yards reporting incidents in 2015 is 98 (92 in Ontario down from 370 in 2014, 4 in Quebec down from 14 in 2014, and 2 in Manitoba down from 6 in 2014).
    - Timing of the incident reporting was highest in May (48 reports), which is a key time for crop planting. Overwintering was also mentioned as a significant time period (31 reports).
- Table 3 of the report shows reported incidents associated with pesticide spray events (foliar applications) from 2012 to 2015. The data show no incidents reports for 2015 (as of July 14) but it does show 18 incidents in 2014, 3 in 2013 and 31 in 2012.
    - Pesticides mentioned in these incident reports include dimethoate, phosmet, carbaryl, chlorpyrifos, diazinon, clothianidin, permethrin, pyridaben and spinosad
    - Crops mentioned in these incident reports include canola, alfalfa, cereal crops, cranberries, strawberries, apple, soybean and wheat
- Table 4 and 4b of the report indicate that 27% of the incidents in the corn and soybean region (21 of 79 incidents in 2015) show symptoms of medium to high number of dead bees[5]. The majority show a low or very low number of dead bees per colony[6].
- Table 5 of the report shows that 87% of the spray related incidents (45 of 52 total incidents from 2012 to 2014) show medium or high number of dead bees.

[4] The number of unique bee yards means a yard was counted once during the specific time period
[5] Medium number of dead bees is classified as 500 – 1000 dead bees per colony and High number of dead bees is classified as > 1000 dead bees per colony
[6] Very low classified as < 100 dead bees per colony, Low classified as 100 to 500 dead bees per colony