Canadian Association of Professional Apiculturists
Statement on Honey Bee Wintering Losses in
Canada (2017)

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Summary

The Canadian Association of Professional Apiculturists (CAPA) coordinated the annual honey bee wintering loss report for 2016/2017 in Canada. Harmonized questions based on national beekeeping industry profiles were used in the survey as in previous years. The Provincial Apiculturists collected survey data. The respondents operated 413,342 honey bee colonies across Canada. This represents 53.8% of all colonies operated and wintered in Canada in 2016/2017. The national winter loss was 25.1% with provincial values ranging from 13.2% to 41.8%. The overall national colony loss reported in 2017 is in the middle of reported losses since 2006/2007. Despite higher than normal wintering losses during recent years, Canadian beekeepers have been successfully able to replace their annual dead colonies and increase the number of colonies. They increased the number of bee colonies from 589,254 in 2007 to 750,155 in 2016. This represents an increase of the total number of bee colonies by 27.3% during this period in Canada.

Respondents reported considerable variation in identifying and ranking the top 4 possible causes of colony losses across the country. The most frequently cited causes in order from high to low were: poor queens, followed by poor winter and spring weather, ineffective Varroa control and weak colonies in the fall.

Beekeepers responded to questions on management of three serious parasites and pathogens to beekeeping: Varroa mites, Nosema and American foulbrood. The majority of beekeepers in most provinces reported that they monitored for Varroa mites. Most beekeepers reported that they used Apivar® in spring, formic acid (Mite Away Quick Strip® (MAQS), repeated 40 ml formic acid treatments, or flash treatments) in the summer or fall and oxalic acid in late fall as Varroa treatments. Due to the long season of 2016, many beekeepers used spring and fall applications of Apivar® or Apivar® plus formic acid to keep mites under control. For preventing and treating nosemosis and American foulbrood, many beekeepers across Canada regularly used registered antibiotics but their methods and timing of application varied widely from province to province.

Overall, the survey responses indicate that Provincial Apiculturists, Tech-transfer agents and researchers have been successful working with beekeepers across Canada to encourage them to monitor honey bee pests, especially Varroa mites and Nosema, and adopt integrated pest management practices to keep these pests under control. CAPA members continue to work on development and improving management options for beekeepers to keep healthy bees through various working groups within the association and with various stakeholders. CAPA members are also actively involved in the Federal Bee Health Roundtable to develop strategies and work toward addressing the risks and opportunities for developing sustainable industry.

Introduction

Over the last decade, many countries, including Canada, have surveyed beekeepers and reported overwintering mortality of honey bee colonies. The Canadian Association of Professional Apiculturists (CAPA) has reported on wintering losses of honey bee colonies and possible causes of bee mortality in Canada since 2007. The objective of this national report is to harmonize data collection, to consolidate provincial losses for a national representation, to present the possible main causes of winter losses and to provide information on pest surveillance and control. These results provide information needed to identify gaps in current management systems, to develop strategies to mitigate colonies losses and to improve bee health, biosecurity practices, and industry sustainability.

Methodology

In 2017, the Provincial Apiculturists and the CAPA National Survey Committee members developed a harmonized set of questions (Appendix A). These questions took into account the large diversity of beekeeping industry profiles, management practices and seasonal activities within each province. Some provinces also included supplementary regional questions in their provincial questionnaire. Results of these regional questions are not summarized in this report but it can be accessed by directly contacting the Provincial Apiculturist of the province in question.

Commercial beekeepers and sideliners that owned and operated a specified minimum number of colonies (Table 1) were included in the survey. The survey reported data from full-sized producing bee colonies that were wintered in Canada, but not nucleus colonies. Thus, the information gathered provides a valid assessment of commercial wintering bee losses and management practices.

The common definitions of a honey bee colony and a commercially viable honey bee colony in spring were standardized as follows:

- Honey Bee Colony: A full-sized honey bee colony either in a single or double brood chamber, not including nucleus colonies (splits).
- Viable Honey Bee Colony in Spring: A honey bee colony that survived winter, in a standard 10-frame hive (Langstroth box), with a minimum of 4 frames with 75% of the comb area covered with bees on both sides on May 1st (British Columbia), May 15th (New Brunswick, Nova Scotia, Ontario, Prince-Edward-Island and Quebec) or May 21st (Alberta, Manitoba, and Saskatchewan).

The colony loss and management questionnaire was provided to producers using various methods of delivery including regular mail, email, or online while in some jurisdictions the survey was administered by telephone interview (Table 1). In each province, data was collected and analyzed by the Provincial Apiculturist. All reported provincial results were then analyzed and summarized at the national level. The national percent of winter loss was calculated as follows:

$$\text{Percentage Winter Loss} = \left(\frac{\text{Sum of the estimated total colony losses per province in spring 2017}}{\text{Sum of total colonies in operation in each province for 2016}}\right) \text{x } 100$$

Results

Throughout Canada, except Newfoundland, 587 sideliner and commercial beekeepers responded to the 2017 survey. These respondents represented 47.4% of the target surveyed beekeepers. They operated nearly 53.8% of all registered colonies that were put into winter in 2016. The survey delivery methods, operation size of beekeepers included in the survey, and the level of participation for beekeepers in each province are presented in Table 1. Accounting for live colonies that were considered commercially viable, survey results showed that the national level of wintering loss was 25.1% with individual provincial percentage ranging from 13.2% to 41.8%. The overall winter loss percentage for 2016/2017 was greater than 2015/2016 with loss rate of 16.8%.

The level of winter loss varied from province to province, within each province, and from beekeeping operation to operation. In general, most provinces reported higher mortality in 2016/2017 than the previous year, the exceptions being Nova Scotia and Manitoba reporting lower winter mortality than the previous year. In areas with higher winter mortality beekeepers cited weather as a more important concern than previous years. Prince Edward Island reported the highest winter losses of 41.8% in 2017 with poor queens cited by beekeepers as being the most frequent cause contributing to colony mortality. The lowest winter loss (13.2%) was reported in Nova Scotia.

For detailed information about winter losses in each province, please contact each province directly for a copy of its provincial report where available (Appendix B).

Table 1: Survey parameters and honey bee colony mortality by province

Province	Total number of colonies operated in 2016	Estimated number of colony lost based on the estimated provincial winter loss	Type of data collection	Number of beekeepers targeted by survey	Number of respondents	Size of beekeeping operations targeted by survey	Number of respondents' colonies that were wintered in fall 2016	Number of respondents' colonies that were alive and viable in spring 2017	Percentage of surveyed colonies to the total number of colonies in the province	Percentage of provincial winter loss
Newfoundland and Labrador	Data not available in 2017 from NF									
Prince Edward Island	8,429	3,523	Online Survey	46	35 (76.1%)	All beekeepers	8,008	3,347	95.0	41.8
Nova Scotia	25,189	3,325	Email	39	17 (43.6%)	50 col. and more	17,815	15,469	70.7	13.2
New Brunswick	15,488	2,726	Email, Post, Telephone	46	22 (47.8%)	30 col. and more	10,520	8,672	67.9	17.6
Québec	59,098	10,815	Email, Post	131	94 (71.8%)	50 col. and more	49,306	40,290	83.4	18.3
Ontario	97,342	26,185	Online Survey, Post, Telephone	179	98 (54.7%)	50 col. and more	44,183	32,294	45.4	26.9
Manitoba	102,030	18,263	Email, Post	202	58 (28.7%)	50 col. and more	36,067	29,601	35.3	17.9
Saskatchewan	112,000	26,208	Email	100	25 (25.0%)	100 col. and more	33,098	25,330	29.6	23.4
Alberta	305,000	87,840	Email, Post, Telephone	112	69 (61.6%)	400 col. and more	193,290	138,202	63.4	28.8
British Columbia	43,224	13,572	Online Survey	383	169 (44.1%)	10 col. and more	21,055	14,444	48.7	31.4
Canada	**767,800**	**192,457**		**1238**	**587 (47.4%)**		**413,342**	**307,649**	**53.8**	**25.1**

Contributing Factors as cited by beekeepers

Beekeepers were asked to rank possible contributing factors to colony losses. These responses are summarized in Table 2. In five provinces, poor queen quality was considered the number one or number two factor contributing to reported winter losses.

Often, Varroa was reported as the second, third or fourth possible contributing factor to winter colony loss specifically in Western provinces, but at less frequency than in previous years. While this still highlights the seriousness of Varroa mites and their impacts on the honey bee health, it may indicate that beekeepers are becoming more accustomed to dealing with mites and are doing a better job keeping the mites under control. High Varroa mite levels in the fall of 2016 in some regions, may be associated with very mild winter in 2015/2016 and warmer than normal spring in 2016. The production season of 2016 was longer than normal and enabled mites to increase their populations to a point that required a fall treatment. Many beekeepers treated a second time (in fall) and were better able to protect their bees in comparison to the winter of 2015/2016. Unfortunately, some producers treated too late; beekeepers with winter mortality greater than 30% frequently reported mites as a primary concern.

Starvation was reported by beekeepers as the second or third possible cause of winterkill in several regions across Canada. Starvation can be the result from the inability of bees in weak colonies to store enough stored food during the fall, the inability of bees to move to new resources within the hive during winter, the rapid consumption of stored food because of early brood production, or insufficient feeding of colonies by beekeepers in the fall or spring.

Another contributing factor also identified across Canada was weak colonies in the fall. This could be caused by some beekeeping operations making splits late in the season to increase numbers of colonies. Such colonies do not have sufficient populations to survive through the winter or to collect and store enough food in the fall to last the winter.

Weather was considered a major factor for winter loss in BC, AB, SK and QC, likely reflecting the long cold spring in these regions. Beekeepers in Western provinces reported that most of bee colonies died in April which was one of the coldest, wettest/snowiest Aprils in years.

Several beekeepers in different provinces reported that they did not know why their colonies perished. Inability to identify a possible cause for colony mortality may be associated with lack of monitoring for pests, diseases and other general colony health parameters during the season, or multitude of underlying problems that cannot be identified without specialists.

Table 2: Top four ranked possible main causes of honey bee colony mortality by province, as cited by beekeepers who responded to the 2016/2017 winter loss survey.

Province	1st.	2nd.	3rd.	4th.
NL	NA	NA	NA	NA
PE	Poor queens	Weak colonies in the fall	Starvation	Other
NS	Poor queens	Weak colonies in the fall	Starvation	Don’t know
NB	Don't know	Starvation	Weak colonies in the fall	Other
QC	Poor queens	Weak colonies in the fall	Weather	Starvation
ON	Poor queens	Starvation	Weak colonies in the fall	Ineffective Varroa control
MB	Weak colonies in the fall	Poor queens	Starvation	Don’t know
SK	Winter weather	Ineffective Varroa control	Nosema	Poor queens
AB	Ineffective Varroa control	Winter weather	Nosema	Poor queens
BC	Weather	Starvation	Poor queens	Weak colonies in the fall

Bee Pest Management Practices

In recent years, integrated pest management has become the most important widespread practice by beekeepers to keep healthy honey bees. To successfully manage bee health, beekeepers must identify and monitor pests and diseases to take timely action in accordance with approved methods. Therefore, this survey focused on asking beekeepers questions about management of three serious threats that may impact bee health, survivorship and productivity (Appendix A).

A. Varroa monitoring and control

Varroa mite infestation continues to be considered by beekeepers and apiculture specialists as one of the main causes of honey bee colony mortality.

During the 2016 production season, a large majority of surveyed beekeepers monitored Varroa mite infestations (for more details, check Table 3). The alcohol wash of a sample of 300 bees per colony was the most preferred technique in all provinces, except New Brunswick, Quebec and British Columbia where beekeepers favoured the use of sticky boards. The frequency of use of the alcohol wash technique by beekeepers in various provinces ranged from 25% to 100%. The frequency of use of the sticky board method ranged from 3.4% to 47.1%. Some beekeepers used both sticky boards and alcohol wash methods to evaluate mites.

These results demonstrate that Canadian beekeepers recognize the value of surveillance and monitoring of Varroa mites. The education and extension programs delivered to beekeepers in Canada have helped in adoption of proper management practices for Varroa mites. Monitoring Varroa mite population, determining the right timing and select the best treatment options for Varroa mite control have become frequently used practices in their day to day beekeeping management.

Most beekeepers in Canada manage Varroa mites using a combination of chemical and non-chemical control measures. Non-chemical methods include: using bee stocks with genetic traits that increase tolerance to Varroa, trapping Varroa using drone combs, trapping Varroa using screened bottom boards fitted with sticky boards, and the division of colonies (e.g. splits).

There are a variety of registered miticides available to beekeepers for mite control. Beekeepers are encouraged to use the most effective miticide that fits their region, season and operation. They are also encouraged to rotate miticides to prevent the development of resistance to these products. In the current survey of bee winter losses, beekeepers were asked “what chemical treatment was used for Varroa control during the 2016 season”. The beekeepers’ response is summarized in Table 3. In the spring of 2016, the percentage of beekeepers that treated with chemical methods ranged from 18% in British Columbia to 100% in Saskatchewan. Throughout Canada, the main miticide used for spring Varroa control was Apivar® (a synthetic miticide with the active ingredient amitraz). The second most common treatment is formic acid in late spring, followed by oxalic acid. In fall of 2016, most Canadian beekeepers ranging from 30% in British Columbia to 95% in Quebec treated their colonies for Varroa. The main miticides used at this time of the year were Apivar®, formic acid and oxalic acid. It was noted that there some beekeepers used Apivar® two times in the same year in 2016. One treatment was in spring and the other treatment was in fall. Due to an early spring and a long fall in 2016, Varroa mites were able to rebuild their populations through the season and reach high levels that warranted a fall treatment. Most beekeepers were reluctant to use Apistan® (a synthetic miticide with the active ingredient fluvalinate) and Checkmite® (a synthetic miticide with the active ingredient coumaphos) because of known resistance of mites to these active ingredients.

Once again, these surveys tend to show that Apivar® (amitraz) is the most commonly used miticide for treatment for Varroa in Canada. However, due to the repeated use of Apivar®, it may only be a matter of time before we see the development of resistance to this miticide. Therefore, beekeepers’ awareness of these principles and monitoring the efficacy of Apiva® (amitraz) after treatment are important to avoid any unforeseen failures of treatments. Beekeepers are also encouraged to incorporate resistance management practices such as monitoring, using appropriate thresholds for treatment, alternating of miticides with different modes of action, as well as good biosecurity and food safety practices. This type of information is the focus of many extension and educational programs offered by various provincial apiculture programs, which will keep the Canadian honey bee industry healthy and sustainable.

Table 3: Varroa monitoring and chemical control methods as cited by the respondents of the 2016/2017 winter loss survey. Chemical treatment is in order from most to least commonly used.

Province	Beekeepers monitoring Varroa mites (%)		Beekeepers who treated Varroa and method of treatment			
			Varroa treatment in Spring 2016		Varroa treatment in Summer/Fall 2016	
	Sticky boards	Alcohol wash	% of beekeepers	Methods of treatment	% of beekeepers	Methods of treatment
NL	NA	NA	NA	NA	NA	NA
PE	19.4	25.8	55.6	None, Apivar®, Formic Acid	86.7	Oxalic acid, Apivar®, Formic acid (MAQS®)
NS	47.1	58.8	64.7	Apivar®, Oxalic acid, Drone removal	94.1	Apivar®, Formic acid (MAQS®), Oxalic acid
NB	41.0	23.0	50.0	Oxalic acid, Apivar®	82.0	Apivar, Oxalic acid
QC	39.0	21.0	44.0	Formic acid (65% -flash method), Formic acid (MAQS®), Thymol, Oxalic acid	95.0	Formic acid (65% -flash method), Oxalic acid, Apivar®
ON	18.4	42.9	67.4	Apivar®, Formic acid (65%- 40 ml multiple application), Formic acid (MAQS®), Apistan®	92.9	Apivar®, Oxalic acid, Formic acid (MAQS®), Formic acid (65%- 40 ml multiple application)
MB	3.4	48.3	93.1	Apivar®, Oxalic acid, Formic acid (MAQS®)	89.7	Apivar®, Oxalic acid, Formic acid (MAQS®)
SK	5.0	100.0	100.0	Apivar®, Apistan®	75.0	Apivar®, Formic acid, Oxalic acid
AB	24.2	90.9	66.7	Apivar®, Formic acid (40 ml multiple application)	45.5	Apivar®, Formic acid (40ml multiple application), Oxalic acid
BC	46.0	25.0	18.0	Formic acid, Apivar®, Oxalic acid	30.0	Formic acid, Oxalic acid, Apivar®

B. Nosemosis management practices:

Nosema is a fungal pathogen that infects the honey bees. It is considered a serious pathogen that may impact honey bee colony survival during winter and spring build-up in certain regions in Canada. However, it was rarely cited as a possible cause of colony mortality during the 2016/2017 winter loss survey, except in Saskatchewan and Alberta. In the survey, beekeepers reported their use of fumagillin for the treatment of nosemosis either in spring or in fall of 2016 (Table 4). The percent of beekeepers reporting using this drug varied widely from province to province.

C. American foulbrood management practices

American foulbrood (AFB) is a bacterial disease of brood caused by *Paenibacillus larvae*. AFB is considered endemic in Canada, and it has been of great concern to beekeepers. Oxytetracycline and more recently tylosin are antibiotics currently registered for treating AFB in Canada. The pattern of use for these antibiotics, as reported by beekeepers is presented in Table 4. Oxytetracycline was more frequently used by beekeepers in spring and fall than tylosin.

Table 4: Antibiotic treatments for nosemosis (fumagillin) and American foulbrood (oxytetracycline and tylosin) as cited by the respondents of the 2016/2017 winter loss survey.

Province	**Use of Fumagillin (% of respondents)**		**Use of American foulbrood treatments (% of respondents)**			
	Spring	Fall	Spring treatment with oxytetracycline	Spring treatment with tylosin	Summer/Fall treatment with oxytetracycline	Summer/Fall treatment with tylosin
NL	NA	NA	NA	NA	NA	NA
PE	12.1	20.7	19.4	5.3	10.0	0.0
NS	47.1	64.7	64.7	0.0	70.6	0.0
NB	27.0	73.0	55.0	0.0	36.0	0.0
QC	2.0	15.0	8.0	0.0	5.0	0.0
ON	16.3	21.4	72.5	1.0	71.4	1.0
MB	25.9	41.4	77.6	0.0	67.2	6.9
SK	52.0	60.0	80.0	0.0	92.0	0.0
AB	81.8	81.8	51.5	3.0	54.5	21.1
BC	26.0	24.0	11.0	1.0	7.0	1.0

Honey Bee Winter Loss and Population in Canada since 2007

In Canada, winter losses had shown a declining trend since 2007. The national overwinter losses were highest from 2007 to 2009 and ranged from 29.0% to 35.0% (average 32.6%). From 2010 to 2017, the national overwinter losses ranged from 15.3% to 29.3% (average 22.2%). This year, all provinces reported overwinter mortality above the long term acceptable threshold of 15%, with the exception of Nova Scotia.

Despite reported wintering losses in recent years across Canada and recently reported winter losses of 25.1%, the number of colonies in Canada has increased by 27.3% from 2007 until 2016. This shows that beekeepers are resilient and adapting to the pressures of overwinter mortality and continue to successfully raise honey bees. Since 2007, beekeepers have been facing challenges in keeping healthy bees that include pest management, climatic condition, bee nutrition, bee exposure to pesticides in hives and environment. Even though responses from this annual survey have provided evidence that beekeepers from various regions across Canada have been successfully managing bee health issues; it appears that stress caused by parasites and a combination of other stressors warrants further studies to provide alternative management practices to maintain honey bee health throughout the year. For example, at this time, beekeepers have access to few effective products to control Varroa mites and Nosema. If resistance develops to Apivar® and fumagillin, beekeepers will suffer serious consequences. Ultimately, beekeepers will need more effective and additional options of treatment (miticides, antibiotics and non-chemicals) in their "tool box" if they are to continue an integrated pest management approach to maintain healthy bees.

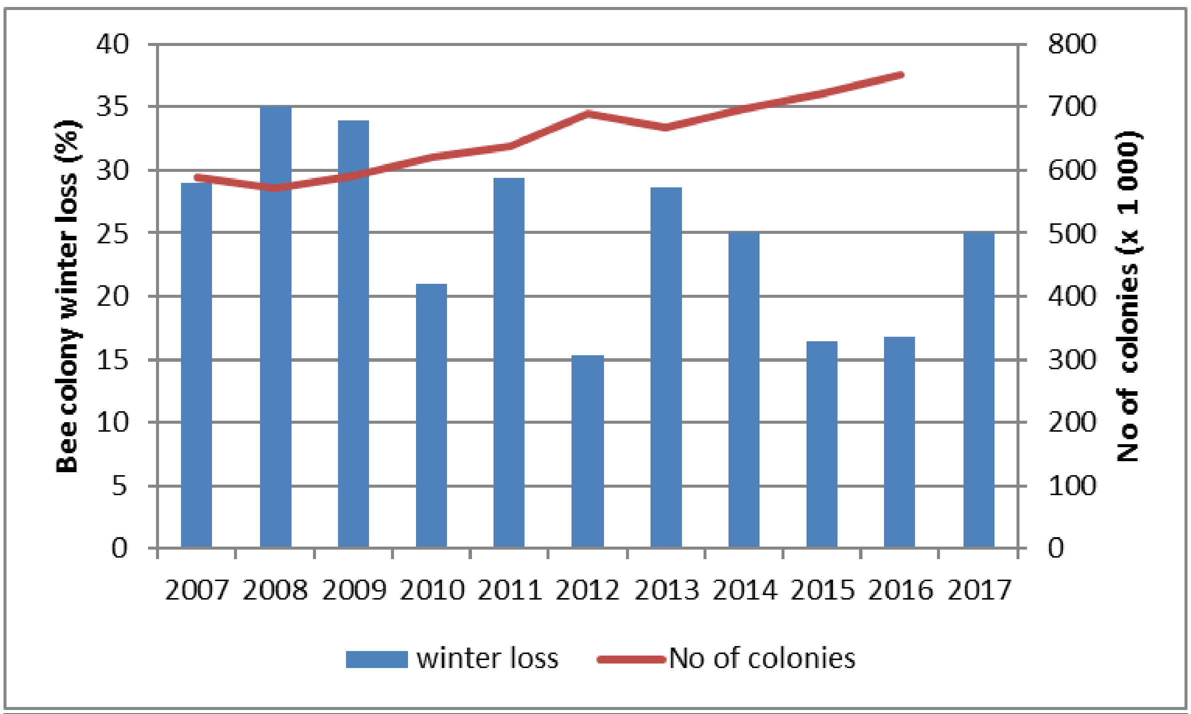

Figure 1. Summary of bee colony numbers and bee losses in Canada from 2007-2017.

Further Work

CAPA members continue to work closely with industry stakeholders, the Bee Health Roundtable and provincial working groups to address bee losses and bee health. Members of CAPA and provincial apiculturists have also been actively involved in conducting surveillance programs at the provincial levels and across the country to monitor the status of bee health including the emerging pest, the small hive beetle. They are also involved in developing policies for antimicrobial use in beekeeping and conducting outreach and extension programs to promote IPM and biosecurity practices to beekeepers. Researchers within CAPA are active in evaluating alternative control options for Varroa mites and Nosema and developing genetic stocks more tolerant to pests which will hopefully enhance the integrated pest management (IPM) practices and address the honey bee health sustainability.

For more information about this report, please contact:

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Appendix A: CAPA - 2017 Core winter loss survey questions.

The followings are the core questions that will be used in 2017 by each provincial apiarist for reporting the colony winter losses at the national level. As it has been since 2007, the objective is to estimate the winter kills with a simple and standardized method while taking into account the large diversity of situations around the country. This is a survey so these questions are to be answered by the beekeepers.

1. How many full sized colonies[1] were put into winter in fall 2016?

Outdoor wintering	**Indoor wintering**	**Total**

2. How many full sized colonies[1] survived the 2016/2017 winter and were considered viable[2] on May 1st (British Columbia), May 15th (Ontario, Quebec and Maritimes) or May 21st (Alberta, Manitoba, Newfoundland and Saskatchewan)?

Outdoor wintering	**Indoor wintering**	**Total**

3. Which method of treatment did you use for varroa control in **spring 2016**? What percent of hives were treated? *(Choose all that apply)*

	Treatment	**Percent of hives treated (%)**
☐	Apistan (fluvalinate)	
☐	CheckMite+ (coumaphos)	
☐	Apivar (amitraz)	
☐	Thymovar (thymol)	
☐	65% formic acid – 40 ml multiple application	
☐	65% formic acid – 250 ml single application	
☐	Mite Away Quick Strips (formic acid)	
☐	Oxalic acid	
☐	Other *(please specify)* ________________________	
☐	None	

[1] Does not include nucleus colonies

[2] Viable : A viable colony, in a standard 10-frame hive, is defined has having 4 frames or more being 75% bee-covered on both sides.

4. Which method of treatment did you use for varroa control in late **summer/fall 2016**? What percent of hives were treated? *(Choose all that apply)*

	Treatment	**Percent of hives treated (%)**
☐	Apistan (fluvalinate)	
☐	CheckMite+ (coumaphos)	
☐	Apivar (amitraz)	
☐	Thymovar (thymol)	
☐	65% formic acid – 40 ml multiple application	
☐	65% formic acid – 250 ml single application	
☐	Mite Away Quick Strips (formic acid)	
☐	Oxalic acid	
☐	Other *(please specify)* ________________________	
☐	None	

5. Have you monitored your colonies for Varroa during the 2016 season?
   - ○ Yes – sticky board
   - ○ Yes – alcohol wash
   - ○ Yes – other (*please specify*) ______________________________
   - ○ No

6. Which method of treatment did you use for **nosema** control in **spring 2016**? What percent of hives were treated?

	Treatment	**Percent of hives treated (%)**
☐	Fumagillin	
☐	None	

7. Which method of treatment did you use for **nosema** control in **fall 2016**? What percent of hives were treated?

	Treatment	**Percent of hives treated (%)**
☐	Fumagillin	
☐	None	

8. Which method of treatment did you use for **American foulbrood** control in **spring** 2016? What percent of hives were treated? *(Choose all that apply)*

	Treatment	**Percent of hives treated (%)**
☐	Oxytetracycline	
☐	Tylosin	
☐	None	

9. Which method of treatment did you use for **American foulbrood** control in **fall 2016**? What percent of hives were treated? *(Choose all that apply)*

	Treatment	**Percent of hives treated (%)**
☐	Oxytetracycline	
☐	Tylosin	
☐	None	

10. To what do you attribute the main cause of death of your colonies? (Please check every suspected cause and rank the causes according to their relative importance.)

	Cause of death	**Rank (1 = the most important)**
☐	Don’t know	
☐	Starvation	
☐	Poor queens	
☐	Ineffective Varroa control	
☐	Nosema	
☐	Weather	
☐	Weak colonies in the fall	
☐	Other (Please specify) ________________________	
☐	Other (Please specify) ________________________	
☐	Other (Please specify) ________________________	

Appendix B: List of Canada's Provincial Apiculturists.

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