Canadian Association of Professional Apiculturists Statement on Honey Bee Wintering Losses in Canada (2016)

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Summary

The Canadian Association of Professional Apiculturists (CAPA) coordinated the annual honey bee wintering loss report for 2015/16 in Canada. Harmonized questions based on national beekeeping industry profiles were used in the survey as in previous years. In this year survey the province of Newfoundland and Labrador was included for the first time in the national survey. The Provincial Apiculturists collected survey data from beekeepers across Canada. The responded beekeepers operated 441 640 honey colonies. This represents 61.15 % of all colonies operated and wintered in Canada in 2015. The national percentage of colony winter loss was 16.8% with individual provincial percentage ranging from 7.7% to 24.4%. The overall national colony loss reported in 2016 is one of the lowest losses since 2006/07. Despite reported wintering losses in recent years across Canada, beekeepers have been able to replace their dead colonies and increase the number of colonies from 2007 to 2015 by 22.4%.

Respondents reported considerable variation in identifying and ranking the top 4 possible causes of colony losses across the country. The most cited cause was poor queens, followed by Varroa, weak colonies, and weather conditions.

Beekeepers responded to questions on management of three serious pests: 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 mainly used Apivar™ in spring, formic acid in the summer or fall and oxalic acid in late fall as Varroa treatments. Due to the long season of 2015, 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 adopt integrated pests management practices to keep these pests under control. CAPA members continue to address management options for beekeepers and issues of honey bee health 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 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. Thus, the beekeeping industry is able to maintain healthy honey bees to supply the needs for crop pollination across Canada.

Methodology

In 2016, 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 and seasonal activities within each province. Some provinces also included supplementary regional questions in their provincial questionnaire but these are not summarized in this report. Commercial beekeepers and sideliners that owned and operated a minimal number of colonies (which varies from province to province (see Table 1) were included in the survey. The survey covered all full-sized producing wintered colonies in Canada, but not nucleus colonies. Thus, the information gathered provides a valid assessment of 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 viable honey bee colony that survived winter, in a minimum of a standard 10-frame hive, 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, Newfoundland and Saskatchewan).

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

$$\text{Percentage Winter Loss} = \left(\frac{\text{Sum of the estimated total colony losses per province in spring 2016}}{\text{Sum of total colonies in operation in each province for 2015}}\right) \text{x100}$$

Results

Throughout Canada, 611 out of 2598 side-liner and commercial beekeepers responded to the 2016 survey. These beekeepers operated nearly 61.15% of all registered colonies that were wintered in 2015. This year's survey also included the province of Newfoundland and Labrador for the first time. 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 16.8% ranging from 7.69% to 24.37%. In comparison with 2014/2015 results, the overall winter loss percentage for 2016 is similar to losses (16.4%) reported in 2015. This year's loss is the third lowest loss percentage since the beginning of the national survey (2007).

The level of winter loss varied across the country from province to province, region to region within each province, and from operation to operation. The winter losses for the Maritime Provinces (NL, PE, NS, and NB), Central Canada (QC and ON), Western Canada (MB, SK, AB and BC) were 16.7%, 17.1% and 16.7%, respectively. In general most provinces that reported very low mortality in 2015/2016 had a mild winter and a relatively good spring. PE reported high winter losses of 24.37% in 2016 mainly due to colder winter and spring. The lowest winter loss (7.7%) was reported in Newfoundland and Labrador where Varroa mites have not been found yet.

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

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

	Total number of colonies operated in each province in 2015	Estimated total number of colony losses (using the provincial percent of winter loss)	Methods of data collection	Size of targeted beekeeping operations in the survey	No. of beekeepers targeted by the survey	No. of responders	No. of the responders' colonies that were wintered in fall 2015	Total number of the responders' colonies that were alive and viable in spring 2016	Percentage of bee colonies represented in the survey	Percentage of winter loss as based on the data of the responders (%)
Newfoundland and Labrador	500	38	Email	15 col. and more	6	4	234	216	46.80	7.69
Prince Edward Island	7 733	1 885	Online	All PEI beekeepers	45	25	7 817	5 912	100.	24.37
Nova Scotia	25 442	3 681	Email	50 col. and more	35	17	17 768	15 197	69.84	14.47
New Brunswick	11 716	1 952	Post / email / telephone	30 col. and more	37	22	10 427	8 690	89.00	16.66
Quebec	55 427	8 666	Email / post.	50 col. and more	115	86	46 838	39 515	84.50	15.63
Ontario	88 948	15 945	Post / email / telephone	50 col. and more	203	146	67 250	55 195	75.61	17.93
Manitoba	90 909	19 348	Email / post.	50 col. and more	203	57	44 525	35 049	48.98	21.28
Saskatchewan	101 000	15 554	Telephone	100 col. and more	75	22	43 909	37 147	43.47	15.40
Alberta	295 000	44 921	Post / email / Telephone	400 col. and more	106	74	192 952	163 570	65.41	15.23
British Columbia	45 571	9 133	Online	10 col. and more	1953	158	9 920	7 932	21.77	20.04
						611	441 640	368 423	61.15	
Canada	**722 246**	**121 122**								**16.8**

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 seven provinces, poor queen quality was considered the number one or number two factor contributing to reported winter losses. Beekeepers cited Varroa as the second or third possible contributing factor to winter colony loss specifically in Western provinces. These reports highlighted the seriousness of Varroa mites and their impacts on the honey bee health. High Varroa mite levels in the fall of 2015 may be associated with very mild winter and warmer than normal spring of 2015. The 2015 long production season enabled mites to increase their populations to a point that required a fall treatment. By the time beekeepers recognized the need for a second treatment in fall it was too late to treat or winter bees were already damaged by mites; consequently, winter mortality as high as 30% or more was reported in some operations.

Starvation can be caused by the lack of enough stored food caused by weak colonies in the fall not able to store enough feed, inability of honey bees to move to new resources within the hive during winter, consumption of stored food due to early brood production, or not enough fed by beekeepers in the fall or spring. Starvation was reported by beekeepers as the second or third possible cause of winterkill in several regions across Canada. Many beekeepers in Eastern and central Canada reported that weak colonies and increased consumption of food due to cold winter could be implicated in starvation. However in Western Canada, starvation was most likely caused by early brood production during the spring of 2016 that led to high consumption of stored food, before beekeepers could provide supplementary feed.

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. These colonies did not have enough population levels to survive through the winter or enough stored food in the fall to last the winter. Weather was not considered a major factor for winter loss across Canada in 2016 except in PE and NL. Furthermore, several beekeepers in different provinces reported that they did not know why their colonies died. If beekeepers were unable to identify a possible cause for the mortality of their colonies, it may be because of lack of monitoring bee pests and colony health during the season or multitude of underlying problems that cannot be identified.

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 pest populations to take a timely action to control these pests. Therefore, this survey focused on asking beekeepers questions about management of three identified serious pests that could impact bee health, survivorship and productivity (Appendix A).

Table 2: Top four ranked possible main causes of honey bee colony mortality by province, as cited by beekeepers who responded to the 2015-16 winter loss survey.

Province	1st	2nd	3rd	4th
NL	Starvation	Weather	Weak colonies in fall	Poor queens
PE	Weather	Poor queens	Starvation	Weak colonies in fall
NS	Weak colonies in fall	Poor queens	Starvation	Weather
NB	Poor queens	Don't know	Starvation	Weather
QC	Poor queens	Starvation	Weak colonies in fall	Weather
ON	Poor queens	Starvation	Weak colonies in fall	Don't know
MB	Weak colonies in fall	Varroa	Poor queens	Don't know
SK	Poor queens	Varroa	Starvation	Nosema
AB	Poor queens	Varroa	Nosema	Starvation
BC	Don't know	Weak colonies in fall	Poor queens	Varroa

A. **Varroa monitoring and control**[1]

Varroa mite infestation continues to be considered by beekeepers and apiculture specialists as one of the main causes of honey bee colony mortality. Although very few concerns regarding Varroa were cited by beekeepers in the 2014/2015 survey, beekeepers reported Varroa as the second greatest cause of reported high winter losses in 2016.

During the 2015 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 Quebec and British Columbia where beekeepers favoured the use of sticky boards and Nova Scotia where the use of alcohol wash and sticky boards was equal. The frequency of use of the alcohol wash technique by beekeepers in various provinces ranged from 15% to 95%. The frequency of use of the sticky board method ranged from 0% to 52%.

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[1] Newfoundland and Labrador is not included in this part of the report due to no *Varroa* found in the province.

These results demonstrate that Canadian beekeepers recognize the value of surveillance and monitoring of Varroa mites. The educational programs delivered to beekeepers in Canada have made a difference in the application of proper management practices for Varroa mites. Thus, these beekeepers are positioned to successfully adopt the Integrated Pest Management (IPM) program by determining the right timing and select the best treatment options for Varroa mite control.

Most beekeepers in Canada manage Varroa mites using a combination of non-chemical and 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. In the 2015/2016 bee winter loss survey, beekeepers were asked "what chemical treatment was used for Varroa control during the 2015 season". The beekeepers' response is summarized in Table 3. In the spring of 2015, the percentage of beekeepers that treated with chemical methods ranged from 41% in Quebec to 100% in Saskatchewan. Throughout Canada, the main miticide used for spring Varroa control was Apivar™ (a synthetic miticide in which the active ingredient is amitraz). The second most common treatment is formic acid in late spring. In fall of 2015, most Canadian beekeepers ranging from 14% in Saskatchewan to 100% in New Brunswick 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™ in spring and fall for treatment within the same year. Due to mild winter and early spring in 2015, 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™ (active ingredient: fluvalinate) and Checkmite+™ (active ingredient: coumaphos) because of 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 Apivar™ (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 responders of the 2015-16 winter loss survey.

Province	Beekeepers monitoring Varroa mites (%)		Beekeepers who treated Varroa and method of treatment*			
			Spring 2015		Summer/fall 2015	
	sticky boards	alcohol wash	% of Beekeepers	Main chemical control methods**	% of Beekeepers	Main chemical control methods**
NL*	-	-	-	-	-	-
PE	14	36	62	Apivar, Oxalic Acid, Formic Acid	92	Oxalic Acid, Apivar, Formic Acid
NS	47	47	71	Apivar, Apistan	82	Apivar, Formic Acid
NB	23	32	46	Apivar, Apistan, Formic Acid	100	Apivar, Oxalic Acid, Thymovar
QC	34	15	41	Formic Acid, Apivar, Oxalic Acid	97	Formic Acid, Oxalic Acid, Thymovar, Apivar
ON	15	40	82	Formic Acid, Apivar	97	Apivar, Formic Acid, Oxalic Acid
MB	19	69	81	Apivar, Thymovar, Oxalic Acid	77	Apivar, Oxalic Acid, Formic Acid
SK	0	95	100	Apivar, Apistan	14	Apivar, Formic Acid, Oxalic Acid
AB	7	93	96	Apivar, Formic acid	71	Formic Acid, Apivar, Oxalic Acid,
BC	52	15	57	Formic Acid, Apivar, Oxalic Acid	88	Formic Acid, Oxalic Acid, Apivar

* NL is not included in this reporting due to no Varroa found in the province.
** Chemical treatment is in order from most to least commonly used chemical for Varroa treatment.

B. Nosemosis management practices:

Nosema is a fungal pathogen that infects the honey bees. It is considered a serious pathogen that can impact honey bee colony survival during winter and spring build-up. However, it was rarely cited as a possible cause of colony mortality during the 2015-2016 winter loss survey, perhaps due to mild winter and the common use of fumagillin for prevention and control of nosemosis. In the survey, beekeepers reported their use of fumagillin for the treatment of nosemosis either in spring or in fall of 2015 (Table 4). The percent of beekeepers reporting using this drug varied widely from province to province. Beekeepers from Alberta and Saskatchewan reported the highest use of fumagillin. Some used two applications of fumagillin, one in the spring and one in the fall.

Table 4: Antibiotic treatments for nosemosis (fumagillin) and American foulbrood (oxytetracycline and tylosin) as cited by the respondents of the 2015-16 winter loss survey.

	Beekeepers (%) who applied Fumagillin in 2015		Beekeepers (%) who applied treatments for American foulbrood in 2015			
	Spring	Fall	Spring oxytetracycline treatment	Spring tylosin treatment	Fall oxytetracycline treatment	Fall tylosin treatment
NL	0	0	0	0	0	0
PE	15	17	30	0	13	4
NS	53	71	71	0	65	0
NB	36	68	77	0	40	0
QC	2	18	5	0	11	0
ON	15	22	72	1	67	1
MB	26	42	77	0	70	2
SK	82	68	68	0	82	9
AB	84	92	79	9	47	23
BC	47	20	8	1	14	1

C. American foulbrood management practices

American foulbrood (AFB) is a bacterial disease of brood caused by *Paenibacillus larvae*. Although AFB is considered endemic in Canada, 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 to tylosin.

<u>Honey Bee Winter Loss and Population in Canada since 2007</u>

In Canada, winter losses show a declining trend since 2010 (Fig 1). The winter losses were highest from 2007 to 2009 ranging from 29.0% to 35% (average 32.6%). From 2010 to 2016, losses ranged from 15.3% to 29.3% (average 22.6%). It should be noted that the reported winter loss in 2015/16 was in most of the provinces close to the acceptable long term targeted winter loss by beekeepers.

The trend for number of honey bee colonies from 2007 to 2015 is presented in Fig. 1. It is important to note that the number of colonies in Canada has increased by 22.4 % during this period. These reports of multi-year surveys have provided evidence that beekeepers from various regions across Canada have been successfully addressing bee health issues. The main challenge that is faced by most beekeepers is to maintain honey bee health throughout the year. This challenge is not only limited to pest management, but it includes proper nutrition and reduced exposure to pesticides in hives and environment.

At this time, beekeepers have access to few effective products to control Varroa mite and Nosema. If resistance develops to Apivar™ and fumagillin today, beekeepers will suffer serious consequences. Ultimately, beekeepers will need more effective and additional options of treatment (mitcides, antibiotics and non-chemicals) in their "tool box" if they are to continue an integrated pest management approach to maintain healthy bees.

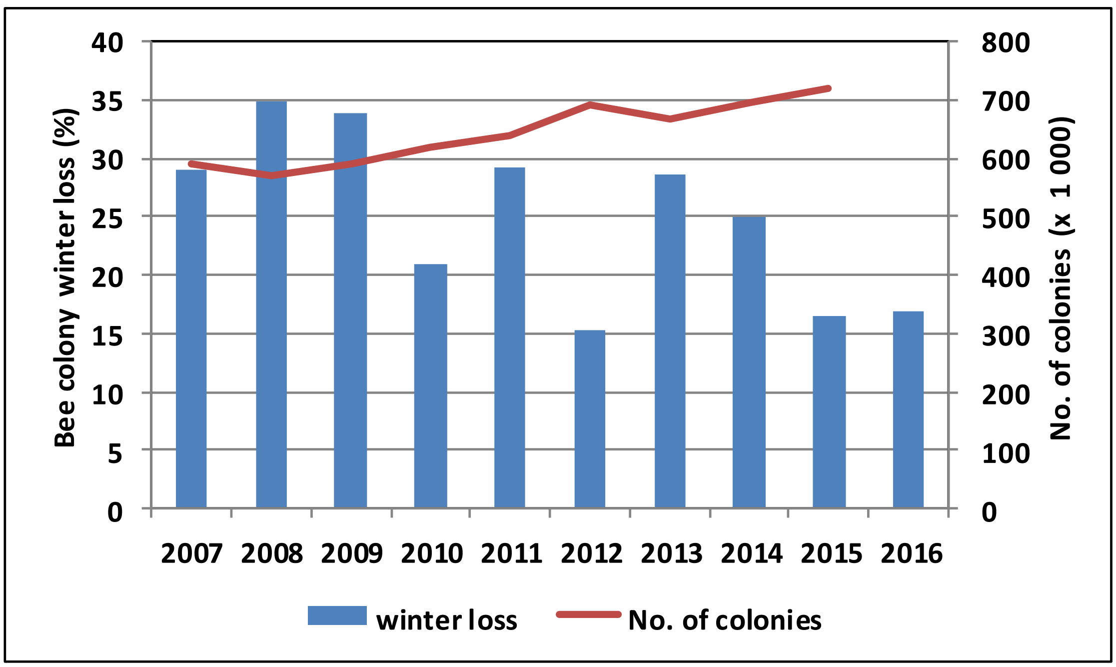

Fig 1. Honey bee colony losses (%) and number of bee colonies in Canada (source: Statistics Canada) from 2007 to 2016.

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.

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Appendix A: CAPA - 2016 Core Winter loss survey questions

The followings are the core questions that have been used in 2016 by each provincial apiarist for reporting the colony winter losses at the national level. As it has been since 2007, the objective was 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[2] were put into winter in fall 2015?

   ____

2. How many full sized colonies[1] survived the 2015/2016 winter and were considered viable[3] on May 1st (British Columbia), May 15th (Ontario, Quebec and Maritimes) or May 21st (Alberta, Manitoba, Newfoundland and Saskatchewan) ?

   ____

3. Which method of treatment did you use for varroa control in **spring 2015**? 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	

[2] Does not include nucleus colonies

[3] 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 2015**? 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 2015 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 2015**? 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 2015**? 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** 2015? 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 2015**? 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) ________________________	