Canadian Association of Professional Apiculturists

STATEMENT ON HONEY BEE WINTERING LOSSES IN CANADA FOR 2024

Prepared by CAPA National Survey Committee and Provincial Apiarists: Gabrielle Claing (co-chair), Julie Ferland (co-chair), Melanie Kempers, Paul Kozak, Paige Marchant, Chris Maund, Cameron Menzies, Derek Micholson, Nuria Morfin, Samantha Muirhead, Medhat Nasr, Sawyer Olmstead, Steve Pernal, Jason Sproule, Paul van Westendorp and Geoff Wilson

SUMMARY

The Canadian Association of Professional Apiculturists (CAPA) and Provincial Apiarists coordinated the annual honey bee wintering loss report for 2023-2024. As in previous years, the survey consisted of harmonized questions based on the national beekeeping industry, with Provincial Apiarists collecting survey data across all provinces. Respondents collectively wintered 384,104 honey bee colonies across Canada, representing 47% of all colonies operated in the country during 2023-2024. The national winter loss, including non-viable bee colonies, was 34.6% with provincial losses ranging from 9.8% to 61.3%. The national colony loss reported in 2024 is, again this year, higher than the average of annual losses reported between 2007-2023 (27.7%). However, the total number of colonies operated by Canadian beekeepers increased by 3.6% (27,467 colonies) during 2023-2024. Despite these recent losses, Statistics Canada reports that the total national colony count increased by 35% from 2007 to 2023, through the hard work and expense of beekeepers replacing dead or weak colonies.

Each province ranked the top four suspected causes of colony losses as reported by respondents. The reported causes varied between provinces this year. In 2023-24 impacts from weather/climate and poor queens seem to have been more important across the country. This was followed by weak colonies in the fall, *Varroa destructor* and associated viruses, and starvation.

Beekeepers also responded to questions about the management of four serious parasites and pathogens to beekeeping: *Varroa destructor*, *Nosema* spp., American Foulbrood (*Paenibacillus larvae)* and European Foulbrood *(Melissococcus plutonius)*. Beekeepers in most provinces reported that they monitored for varroa mites, however a large proportion of beekeepers in some provinces neglected to do so, depending upon the time of the year. The most reported varroa treatments were: amitraz, formic or oxalic acid treatments in early season; formic or oxalic acid in mid-season; and oxalic acid, formic acid or amitraz at the end of the season. Canadian beekeepers treated their colonies to manage the risk of nosemosis, as well as American foulbrood and European foulbrood. Across the country, registered antibiotics were the most commonly used treatments, with methods and timing of applications varying among provinces.

Provincial Apiarists, technology-transfer personnel, and researchers have been working with beekeepers across Canada to encourage them to monitor for honey bee pests, especially varroa mites, brood diseases, and nosema, and to adopt recommended integrated pest management (IPM) and best management practices (BMP) to keep these pests under control. CAPA members continue to collaborate through working groups encompassing diverse stakeholders to educate, develop and improve management options for beekeepers to keep healthy bees, and manage winter losses in Canada.

Disclaimer and Credits: Survey data were supplied by Provincial Apiarists (listed in Appendix A). Data were then compiled, further analyzed and an initial draft of this report written by Julie Ferland, Geoff Wilson, Gabrielle Claing and Medhat Nasr, with subsequent review by the CAPA National Survey Committee.

INTRODUCTION

For over a decade, many countries, including Canada, have surveyed beekeepers and reported overwintering mortality rates of honey bee colonies and management practices used for varroa mites, nosema, American foulbrood and more recently, European foulbrood. The Canadian Association of Professional Apiculturists (CAPA) has worked with the Provincial Apiarists on surveying beekeepers for winter 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 honey bee data across the country based on information collected through harmonized survey questions. The possible causes of winter loss, as reported by beekeepers, and information on pest surveillance and control are collated herein. The survey responses aid in identifying gaps in current management systems, developing strategies to mitigate colony losses, and provide guidance for improving bee health, biosecurity practices, and industry sustainability.

METHODOLOGY

In 2024, the Provincial Apiarists and the CAPA National Survey Committee members reviewed the questions used in the 2023 survey and made necessary revisions. Examples of these revisions include the addition of new treatments or strategies for beekeepers to manage pests and diseases as they are developed over the years, and adjustments to the questions regarding foulbrood and use of antibiotics. The result was an updated harmonized set of questions that was used in the 2024 survey (Appendix B). 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. The results of these regional questions are not included in this report but are discussed in the text. Further questions about results from a specific province may be accessed by contacting the Provincial Apiarist of the province in question (Appendix A).

Beekeepers that owned and operated a specified minimum number of colonies (Table 1) were included in the survey. This year, for the first time, the minimum number of colonies required to be included in the national report was set to 20 for Newfoundland and Labrador, Prince Edward Island and British Columbia. The survey reported data from full-sized producing honey bee colonies that were wintered in Canada, but not nucleus colonies. Thus, the information gathered provides a valid assessment of honey bee losses and commercial 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, 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, Saskatchewan and Newfoundland and Labrador).

The colony loss and management questionnaire was provided to producers using various methods of delivery including mail, email, online and a telephone survey; the method of delivery varied by jurisdiction (Table 1). In each province, data were collected, summarized and analyzed by the Provincial Apiarist. All reported provincial results were then analyzed and summarized at the national level. The national percent winter loss was calculated as follows:

$$Percentage\ Winter\ Loss = \left(\frac{Sum\ of\ the\ estimated\ total\ colony\ losses\ per\ province\ in\ spring\ 2024}{Sum\ of\ total\ colonies\ in\ operation\ in\ each\ province\ for\ 2023}\right) x\ 100$$

RESULTS

Response rates and global mortality

Throughout Canada, a total of 558 beekeepers responded to the 2024 survey. These respondents represented 39% of all the surveyed beekeepers. Respondents operated 47% of all registered colonies that were operated in all provinces in the 2023 season. The rate of participation and number of colonies continues to represent a substantial proportion of the commercial beekeeping industry in Canada.

The survey delivery methods, size of beekeeping operations, and response rate of beekeepers for each province are presented in **Table 1**. It is important to note that the total number of colonies operated in a province reported by this survey may vary slightly from Statistics Canada's official numbers. In some provinces, the data collection periods for the provincial database and the Statistics Canada report are at different times of year.

Survey results showed that the national level of wintering loss, including non-viable colonies, was 34.6% with individual provinces ranging from 9.8% to 61.3%. The overall winter loss for 2023-2024 was 2.4% greater than the 2022-2023 loss at 32.2%. The level of winter loss varied from province to province, and among beekeeping operations within each province. In general, all provinces reported higher mortality in 2023-2024 than the previous year, the exception being Newfoundland and Labrador, Saskatchewan and British Colombia which reported lower mortalities compared to the previous year. Prince Edward Island and Ontario reported the highest winter losses in 2023 (61.3% and 50,4%, respectively), with weak colonies in the fall and varroa mites and associated viruses, respectively, cited as the main causes of colony mortality in those provinces. The lowest reported winter loss was, again this year, by Newfoundland and Labrador (9.8%), where varroa mites have not been reported.

For detailed information about the winter losses in each province, please contact the office of the Provincial Apiarist directly (see contact information in **Appendix A**).

Table 1. Survey parameters and honey bee colony mortality (2023-2024) by province										
Province	**Total number of colonies operated in 2023**	**Estimated number of colonies lost based on the estimated provincial winter loss**	**Type of data collection**	**Number of beekeepers targeted by survey**	**Number of respondents (% of participation)**	**Minimum size of beekeeping operations targeted by survey (# of colonies)**	**Number of respondents' colonies that were wintered in fall 2023**	**Number of respondents' colonies that were alive and viable in spring 2024**	**Percentage of surveyed colonies as a proportion of the total number of colonies in the province**	**Provincial Winter Loss including Non-viable Colonies**
Newfoundland and Labrador	678	66	Email, phone	18	13 (72%)	20	622	561	92%	9.8%
Prince Edward Island	5 500	3 373	Email, phone	25	20 (80%)	20	4 616	1 785	84%	61.3%
Nova Scotia	29 830	9 415	Email	46	25 (54%)	50	19 476	13 329	65%	31.6%
New Brunswick	12 836	3 730	Email, postal, phone	31	22 (71%)	50	10 082	7 152	79%	29.1%
Quebec	70 022	28 185	Online	138	58 (42%)	50	37 194	22 223	53%	40.3%
Ontario	101 161	50 998	Online, phone	182	105 (58%)	50	50 803	25 192	50%	50.4%
Manitoba	114 015	44 738	Email, online, phone	208	71 (34%)	50	51 253	31 142	45%	39.2%
Saskatchewan	99 000	17 920	Online	200	89 (45%)	50	39 439	32 300	40%	18.1%
Alberta	308 200	105 478	Online, phone	165	69 (42%)	100	161 545	106 258	52%	34.2%
British Columbia	75 000	18 829	Online	433	86 (20%)	20	9 074	6 796	12%	25.1%
Canada	816 242	282 732		1 446	558 (39%)		384 104	246 738	47%	34.6%[1]

[1] This number is the total loss calculated over all colonies in Canada.

Overwintering methods

Overall, 67% of the colonies owned by respondents were wintered outdoors in fall 2023, with remaining colonies (33%) wintered indoors (**Table 2**). The highest percentages of colonies wintered indoors were in Quebec (76%) and Nova Scotia (61%), followed by Manitoba (57%) and New Brunswick (45%). Prince Edward Island had no colonies wintered indoors.

Table 2. Overwintering method by province

Province	Outdoors		Indoors	
	Number of colonies	Percent (%)	Number of colonies	Percent (%)
NL	619	100	3	0
PEI	4 616	100	0	0
NS	7 679	39	11 800	61
NB	5 522	55	4 560	45
QC	8 867	24	28 327	76
ON	33 494	66	17 309	34
MB	22 157	43	29 096	57
SK	34 399	87	5 040	13
AB	131 072	82	29 123	18
BC	7 947	99	93	1
Canada	256 372	67	125 351	33

Nationally, the mortality rate was slightly higher for colonies wintered indoors (40%) than outdoors (33%). The mortality rates for each province are presented in **Table 3.**

Table 3. Indoor and outdoor winter mortality by province

Province	Outdoors			Indoors		
	Total number of colonies in fall 2023	Total number of viable colonies in spring 2024	Percent of losses of colonies (%)	Total number of colonies in fall 2023	Total number of viable colonies in spring 2024	Percent losses of colonies (%)
NL	619	559	10	3	2	33
PEI	4 616	1 785	61	0	0	NA
NS	7 679	5 529	28	11 800	7 800	34
NB	5 522	4 349	21	4 560	2 803	39
QC	8 867	6 197	30	28 327	16 026	43
ON	33 494	19 367	42	17 309	5 825	66
MB	22 157	12 467	44	29 096	18 675	36
SK	34 399	29 140	15	5 040	3 160	37
AB	131 072	85 303	35	29 123	20 955	28
BC	7 947	6 030	24	93	73	22
Canada	256 372	170 726	33	125 351	75 319	40

Contributing factors as cited by beekeepers

Beekeepers were asked to rank possible contributing factors to colony mortality. These responses are summarized in **Table 4**. When the top four causes cited were compiled, taking into account their frequency and rank, impacts from weather/climate and poor queens were considered the most important factors for winter loss across the country in 2024. These causes were followed by weak colonies in the fall and varroa with its associated viruses.

Unusual and unpredictable weather during the 2023 season as well as the winter and early spring of 2024, was cited in the top four causes of winter losses for all provinces across Canada. In the prairie provinces (Manitoba, Saskatchewan and Alberta), dry weather during the summer resulted in an early end to honey and pollen flows, possibly resulting in lower nutrition for the development of winter bees. In the East, poor conditions for foraging (rain, wind, cloud and cold) were present during a substantial part of the summer of 2023, reducing access to nutrition for raising healthy bees. During the winter, fluctuating temperatures across the country had the potential to negatively affect wintering colonies. In the East, very low quantities of snow in many regions lead to poor protection of colonies against cold and wind. Additionally, colony build-up was hindered by a cold end of spring in some regions that caused surviving colonies to dwindle, increasing the number of non-viable colonies. Across many parts of the country, the length of the beekeeping season was longer than usual, leading to protracted brood production for colonies and the need to modify beekeeping practices, especially for mite control. Temperatures also affected the efficacy of some varroa treatments so weather may have an impact on varroa control and indirectly on survival and colony strength.

Poor queens were reported by nine provinces as an important contributing factor to winter losses this year. Poor queens can result in weakened colonies prior to winter, leading to an insufficient number of bees to survive. If a queen becomes infertile or dies during the winter, the colony will also perish as there is no opportunity for the beekeeper to replace the queen or for the colony to naturally re-queen itself. Poor and failing queens may be the result of many factors including inadequate rearing conditions, poor mating weather, reduced sperm viability, queen age, diseases or exposure to pesticides within the hive or from the environment (Amiri et al., 2017; Pettis et al., 2004; Pettis et al., 2016; Williams et al., 2015).

Weak colonies in the fall were also among the top four reported contributing factors to winter losses in seven provinces. There can be many causes for weak colonies such as lack of nutrition, environmental stressors (e.g. weather, intensive pollination management), late establishment of colonies, or even weakening of colonies by pathogens and diseases, like varroa, foulbrood, or nosemosis.

Varroa mites and associated viruses were reported as one of the top four contributing factors to winter colony loss in six provinces. Varroa mites and their impact on honey bee health is a serious issue for Canadian beekeepers, survey results indicate that many beekeepers are monitoring and applying multiple treatments per year. Unfortunately, some individual producers monitored and treated for varroa mites too late in the season, when, varroa and associated viruses levels were already at damaging thresholds; this resulted in wintering bees being less healthy. Monitoring varroa mite levels is becoming increasingly important especially as environmental factors such as climate and weather can impact colony growth as well as the efficacy of miticides used by beekeepers. Moreover, the possible emergence of resistance to Apivar® (active ingredient, amitraz) may limit the efficacy of this product. With lower efficacy, the ability of mite populations to rebound back to damaging levels is increased. In addition, reinfestation of varroa mites from neighbouring beekeeping operations may also occur after a treatment has been applied. Therefore, monitoring varroa levels frequently, before and after treatment (verifying treatment efficacy), testing for amitraz resistance and, selecting suitable alternative treatments are all necessary elements of an effective management strategy for this economically important pest.

Starvation was reported as a cause of winter mortality by beekeepers in six provinces. Starvation can result from the inability of bees in weak colonies to store enough food during the fall, the inability of bees to move to resources within the hive during winter, the rapid consumption of stored food because of early brood production or insufficient feed provided by the beekeeper in the fall or spring.

Some beekeepers reported that they did not know why their colonies perished, although this answer was not identified among the top four causes for losses among most provinces. Inability to identify a possible cause for colony mortality may be associated with lack of applying best management practices including monitoring for pests, diseases and other general colony health parameters during the season, or a multitude of underlying problems that cannot be identified without the assistance from specialists.

Table 4. Top four ranked possible causes of honey bee colony mortality by province

Province	Ranked 1st the most	Ranked 2nd the most	Ranked 3rd the most	Ranked 4th the most
NL[a]	Starvation	Weather/Climate (equal)	Weak colonies in the fall (equal)	
PEI	Weak colonies in the fall	Poor queens	Weather/Climate	Varroa and associated viruses
NS	Weather/Climate	Poor queens	Starvation	Weak colonies in the fall
NB	Weather/Climate	Weak colonies in the fall	Starvation	Poor queens
QC	Varroa and associated viruses	Weather/Climate	Poor queens	Weak colonies in the fall
ON	Varroa and associated viruses	Weak colonies in the fall	Poor queens	Weather/Climate
MB	Starvation	Poor queens	Weather/Climate	Don't' know
SK	Poor queens	Starvation	Varroa and associated viruses	Weather/Climate
AB	Varroa and associated viruses	Weather/Climate	Poor queens	Starvation
BC	Weak colonies in the fall	Poor queens	Varroa and associated viruses (equal)	Weather/Climate (equal)

[a] Varroa mites have not been reported in Newfoundland and Labrador.

Reported top four causes of winter loss for operations exceeding 25% mortality are presented in **Table 5**. When compiling the frequency and relative ranking of beekeeper's responses, weather/climate and impacts from varroa and associated viruses had more impact on winter losses in these operations. This was followed by poor queens, starvation and weak colonies in the fall.

Table 5. Top four ranked possible causes of bee colony mortality by province, as cited by beekeepers who reported greater than 25% losses				
Province	**Ranked 1st the most**	**Ranked 2nd the most**	**Ranked 3rd the most**	**Ranked 4th the most**
NL[a]	Starvation			
PEI	Weak colonies in the fall	Poor queens	Weather/Climate	Varroa and associated viruses
NS	Weather/Climate	Poor queens (equal)	Starvation (equal)	Weak colonies in the fall
NB	Weak colonies in the fall	Weather/Climate	Starvation	Varroa and associated viruses
QC	Varroa and associated viruses	Weather/Climate	Poor queens	Don't know
ON	Varroa and associated viruses	Weather/Climate	Other	Poor queens
MB	Poor queens	Starvation	Varroa and associated viruses	Don't know
SK	Other	Varroa and associated viruses	Weather/Climate	
AB	Varroa and associated viruses	Weather/Climate	Starvation	Poor queens
BC	ND	ND	ND	ND

[a] Varroa mites have not been reported in Newfoundland and Labrador.
[b] ND: no data.

Integrated Pest Management

Integrated Pest Management (IPM) has become widely used to maintain healthy honey bees. To successfully manage bee health, beekeepers must identify and monitor pests and diseases to take timely action in accordance with approved treatment methods. This survey focused on asking beekeepers questions about their management of four serious threats that may impact bee health, survivorship and productivity (**Appendix B**).

Varroa monitoring

The varroa mite continues to be considered by beekeepers and apicultural specialists as one of the main causes of honey bee colony mortality.

During the 2023 beekeeping season, alcohol washes, sugar shakes or ether rolls using 300 bees per colony were the preferred methods of detection in all provinces except Quebec, where beekeepers favoured the use of sticky boards (**Table 6**). The frequency of use for the alcohol wash technique ranged from 41% in Québec to 88% in Nova Scotia, while the frequency of use for the sticky board method ranged from 12% in Prince Edward Island and Nova Scotia to 72% in Quebec. Some beekeepers also used both methods to evaluate levels of mites. There are three main critical windows identified within the season where monitoring varroa mites is particularly important. The percentage of beekeepers who monitored at the beginning of the season ranged from 14% in New-Brunswick to 84% in Saskatchewan (**Table 7**). In the middle of the season, monitoring ranged from 33% in Newfoundland and Labrador to 76% in Nova Scotia, while at the end of the season rates varied from 25% in Newfoundland and Labrador to 90% in Alberta.

Table 6. Varroa monitoring methods by province		
Province	**% of beekeepers using Mite fall/Sticky boards**	**% of beekeepers using Alcohol wash (or Sugar shake/Ether roll)**
NL[a]	25	58
PEI	12	65
NS	12	88
NB	18	68
QC	72	41
ON	15	76
MB	17	81
SK	18	72
AB	43	85
BC	20	50

[a] Varroa mites have not been reported in Newfoundland and Labrador.

Table 7. Percentage of beekeepers monitoring for varroa mites according to the time of year by province			
Province	**Beginning of beekeeping season**	**Mid beekeeping season**	**End of beekeeping season**
NL[a]	58	33	25
PEI	71	53	65
NS	40	76	60
NB	14	55	36
QC	70	74	72
ON	ND[b]	ND	ND
MB	72	38	75
SK	84	36	63
AB	83	55	90
BC	ND	ND	ND

[a] Varroa mites have not been reported in Newfoundland and Labrador.

[b] ND: no data

The timing of sampling is important. Sampling prior to treatment windows can inform beekeepers as to whether treatments are needed, while sampling after treatments determines whether applications were efficacious. The percentage of beekeepers that always sampled before treatment varied from 18% in New Brunswick to 69% in Alberta, while beekeepers that never sampled before treatment varied from 6% in Alberta to 47% in Prince Edward Island (**Table 8**). The percentage of beekeepers that always tested after treatment applications ranged from 12% in Prince Edward Island to 62% in Alberta, while beekeepers that never tested post treatment varied from 6% in Alberta to 59% in New Brunswick.

Table 8. Percentage of beekeepers monitoring before and after treatment by province						
Province	**Always before treatment**	**Sometimes before treatment**	**Never before treatment**	**Always after treatment**	**Sometimes after treatment**	**Never after treatment**
NL[a]	NA[b]	NA	NA	NA	NA	NA
PEI	24	29	47	12	41	47
NS	48	28	24	52	16	32
NB	18	36	46	14	27	59
QC	55	31	14	36	38	26
ON	ND[c]	ND	ND	ND	ND	ND
MB	38	43	19	34	41	25
SK	46	40	14	29	25	46
AB	69	25	6	62	32	6
BC	ND	ND	ND	ND	ND	ND

[a] Varroa mites have not been reported in Newfoundland and Labrador.

[b] NA: not applicable.

[c] ND: no data.

These results demonstrate that many Canadian beekeepers recognize the value of monitoring for varroa. Nevertheless, the desired goal is to have **all beekeepers regularly monitor** for varroa populations throughout the beekeeping season, particularly prior to treatment application windows, as well as after treatment to verify efficacy. Such sampling will ensure optimal timing of treatments and selection of the most effective treatment options for varroa control. While education and extension programs delivered to Canadian beekeepers have facilitated the adoption of recommended practices for managing varroa, ongoing innovation and improvement must continue.

Varroa control

In Canada, there are a variety of registered miticides available to beekeepers for mite control. Beekeepers are encouraged to use the most effective miticide that suits their region, season and operation. Beekeepers 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 2023 season". Beekeeper's responses are summarized in **Table 9**. Rankings were compiled per treatment, but also per active ingredient. Because multiple commercially available treatments may use the same active ingredient, rankings may differ between treatment and active ingredient.

Table 9. Varroa control methods and compounds used at the beginning of the season by province			
Province	% of Beekeepers who treated	Main treatment methods[a]	Main active ingredients
NL[b]	NA[c]	NA	NA
PEI	65	Apivar (amitraz)	Amitraz
NS	96	Apivar (amitraz), tie between Formic Pro (formic acid) and Apistan (fluvalinate)	Amitraz, Formic acid and Fluvalinate
NB	45	Apivar (amitraz), Oxalic acid – sublimation, 65% Formic acid – 40 mL multiple applications	Amitraz, Oxalic acid, Formic acid
QC	78	65% Formic acid - 40mL multiple applications, Oxalic acid – sublimation, Oxalic acid drip	Formic acid, Oxalic acid, Amitraz
ON	85	Oxalic acid, Apivar (amitraz), Formic Pro (formic acid)	Oxalic acid, Amitraz, Formic acid
MB	99	Apivar (amitraz), Oxalic acid - sublimation, Oxalic acid - drip	Amitraz, Oxalic acid, Formic acid
SK	94	Apivar (amitraz), Oxalic acid - sublimation, Formic Pro (formic acid)	Amitraz, Oxalic acid, Formic acid
AB	96	Apivar (amitraz), Oxalic acid - sublimation, 65% Formic acid - 40mL multiple applications	Amitraz, Oxalic acid, Formic acid
BC	84	Formic Pro (formic acid), Apivar (amitraz), Oxalic acid - sublimation	Formic acid, Amitraz, Oxalic acid

[a] Treatments and active ingredients listed from most to least used.
[b] Varroa mites have not been reported in Newfoundland and Labrador.
[c] NA: not applicable.

In the spring of 2023, the percentage of beekeepers who treated with chemical methods ranged from 45% to 99% in provinces where the mite is present. New Brunswick had the lowest percentage of beekeepers (respondents) who treated for varroa in the spring (45%) (fall treatments are more common in this province, see Table 11.) For Canadian beekeepers who did treat in the spring, the main miticide used for spring varroa control was Apivar® (active ingredient: amitraz). The second most common treatment was formic acid in various forms, followed by oxalic acid (Table 9). However, in Québec, Ontario and British Columbia, formic or oxalic acid treatments were more widely used than amitraz in the Spring.

Except for Nova Scotia, from 5% to 87% of beekeepers have started to use a mid-season treatment for varroa control (**Table 10**). The number of products that can be used while honey supers are in place are limited to Formic Pro® and HopGuard® to safeguard honey quality. For other products (e.g., other formic or oxalic acid applications, and amitraz), honey supers must be absent from the hive or removed before and during the application of the product.

Table 10: Varroa treatment methods and compounds used at mid season (honeyflow) by province			
Province	**% of Beekeepers who treated**	**Main treatment methods[a]**	**Main active ingredients**
NL[b]	NA[c]	NA	NA
PEI	29	65% Formic acid - 40mL multiple applications, Formic pro (formic acid), Apivar (amitraz)	Amitraz, Formic acid
NS	0	NA	NA
NB	23	Formic Pro (formic acid), 65% Formic acid - 40mL multiple applications, Oxalic acid - sublimation	Formic acid, Oxalic acid
QC	76	65% Formic acid - 40mL multiple applications, Formic Pro (formic acid), Oxalic acid - drip	Formic acid, Oxalic acid, Hop compounds
ON	87	Formic Pro (formic acid), Other, MAQS (formic acid)	Formic acid, Oxalic acid, Amitraz
MB	16	Formic Pro (formic acid), Hopguard II (Hop compounds), Oxalic acid - drip	Formic acid, Oxalic acid, Hop compounds
SK	5	Formic Pro (formic acid)	Formic acid
AB	29	Oxalic acid - sublimation, Formic Pro (formic acid), Other	Oxalic acid, Formic acid, Other
BC	ND[d]	Formic Pro, (formic acid), 65% Formic acid – 250 mL single application (Mite Wipes)	Formic acid

[a] Treatments and active ingredients listed from most used to least used.
[b] Varroa mites have not been reported in Newfoundland and Labrador.
[c] NA: not applicable.
[d] ND: no data.

In fall of 2023, most Canadian beekeepers (85% to 100% depending on province) treated their colonies for varroa. The main miticides used at this time of year were oxalic acid, formic acid, and Apivar® (**Table 11**). It was noted that some beekeepers used Apivar® twice in the same year in 2023, once in spring and again in fall. In some provinces, a greater number of beekeepers have started to combine Apivar® with formic or oxalic acid during the fall for keeping control of mite populations.

Few beekeepers used Apistan® (a synthetic miticide with the active ingredient tau-fluvalinate) or Checkmite+® (a synthetic miticide with the active ingredient coumaphos). Beekeepers may be wary of these products because of previously reported resistance to these active ingredients in Canada. Bayvarol® (a synthetic miticide with the active ingredient flumethrin) was also rarely used; there have been concerns and reports from beekeepers about the limitations in the efficacy of this product, which have been confirmed by research projects in Canadian provinces (Currie et al., 2010; Morfin et al., 2022; Olmstead et al., 2019). Thymovar® (a miticide with the active ingredient thymol) was also reported used in some provinces.

Table 11: Varroa control methods and compounds used at the end of the season by province			
Province	**% of Beekeepers who treated**	**Main treatment methods[a]**	**Main active ingredients**
NL[b]	NA[c]	NA	NA
PEI	88	Oxalic acid - sublimation, Oxalic acid – drip, Apivar (amitraz)	Oxalic acid, Amitraz
NS	100	Oxalic acid - sublimation, Formic Pro (formic acid), Apivar (amitraz)	Oxalic acid, Formic acid, Amitraz
NB	100	Apivar (amitraz), Oxalic acid - sublimation), Formic Pro (formic acid)	Amitraz, Oxalic acid, Formic acid
QC	100	65% Formic acid - 40mL multiple applications, Oxalic acid - sublimation, Thymovar (thymol)	Oxalic acid, Formic acid, Thymol (w/or w/o other essential oils)
ON	94	Oxalic acid, Apivar (amitraz), 65% Formic acid - 40mL multiple applications (formic acid)	Oxalic acid, Amitraz, Formic acid
MB	99	Oxalic acid - sublimation, Apivar (amitraz), Thymovar (thymol)	Oxalic acid, Amitraz, Formic acid
SK	89	Oxalic acid - sublimation, Apivar (amitraz), Formic Pro (formic acid)	Oxalic acid, Amitraz, Formic acid
AB	87	Oxalic acid - sublimation, 65% Formic acid - 40mL multiple applications, Apivar (amitraz)	Oxalic acid, Formic acid, Amitraz
BC	85	Oxalic acid - sublimation, Apivar (amitraz), Other	ND[d]

[a] Treatments and active ingredients listed from most used to least used.
[b] Varroa mites have not been reported in Newfoundland and Labrador.
[c] NA: not applicable.
[d] ND: no data.

Figure 1 summarizes miticide applications by season. Although almost every beekeeper treats in the fall, and many do so in the spring, treatments during the mid-season honey flow are scarce. In addition, nectar flows may also occur late in the season in some provinces (ON, QC) necessitating mite treatments being applied while honey is still being produced. Treatments applied while honey is being produced must be labelled for this purpose; otherwise, they may only be applied outside of the flow or to non honey-producing colonies, such as nuclei. Some beekeepers receiving revenue from pollination services may also not produce surplus honey.

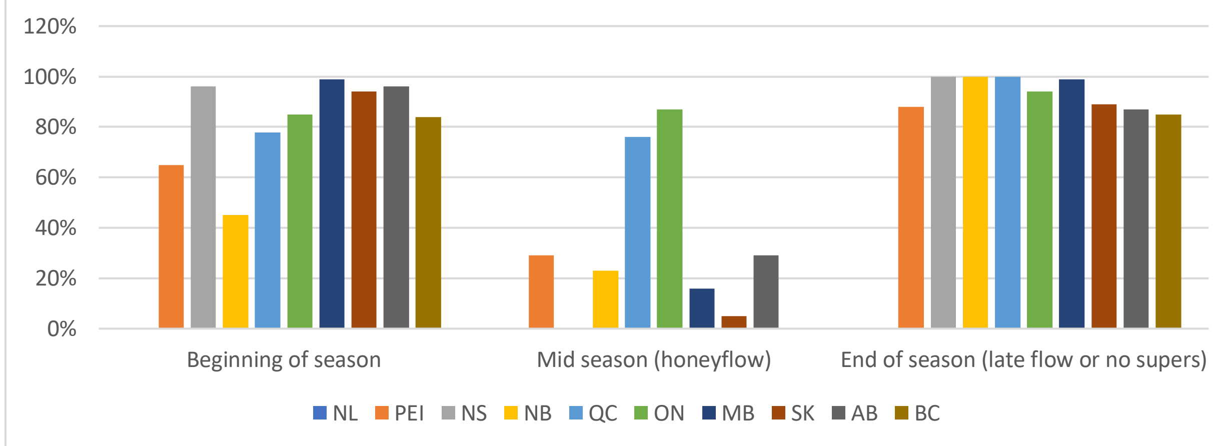

Figure 1. Percentages of beekeepers treating for varroa throughout the season

Once again, these surveys show that Apivar® is one of the most used miticides for treating varroa in Canada but there is an increasing use of organic acids in many provinces. Because of the repeated use of Apivar®, it is a matter of time before the development of resistance to this miticide. Findings of decreased efficacy have been documented in some provinces. It is becoming increasingly important that beekeepers become aware of the principles associated with resistance development and the importance of monitoring the efficacy of all treatments, particularly Apivar®. This will help to mitigate abrupt and widespread failures of treatments before mites cause irreparable damage to bees. Beekeepers are also encouraged to incorporate resistance management practices such as using appropriate thresholds for treatment, following label instructions, never leaving treatments in the hive beyond the appropriate treatment period or reusing chemical strips, and alternating miticides with different modes of action in their varroa treatment programs. Having a wide suite of legally registered treatments with different modes of action and methods of application is critical for maintaining a successful IPM strategy in Canada.

Nosemosis management practices

Nosema is a fungal parasite that infects honey bees. *Nosema ceranae* has gradually replaced *Nosema apis* to become the most frequently found nosema species in Canada (Copley et al., 2012; Emsen et al., 2016). The role of *N. ceranae* affecting honey bee colony survival during winter may vary by climatic region and bee populations in Canada. Several studies from central Canada have demonstrated that *N. ceranae* did not impact winter mortality, however the parasite was found to potentially impact the development of honey bee colonies in early spring (Emsen *et al*., 2016; Emsen *et al*., 2020; Guzman *et al*., 2010). Recently, a study from the Canadian Prairies (Punko 2021; Punko *et al*., 2021) has found that Nosema can increase colony mortality. The impact of Nosema was not cited by Canadian beekeepers in the top four possible cause of colony mortality during the 2023-2024 winter loss survey.

Table 12. Antibiotic (fumagillin) and alternative treatments usage (% of beekeepers) for nosemosis by province						
Province	**Beginning of season**			**End of season**		
	Fumagillin	**Other product**	**Main alternative products**	**Fumagillin**	**Other product**	**Main alternative products**
NL	0	0	NA[a]	8	0	NA
PEI	0	0	NA	12	6	Hive Alive
NS	8	0	NA	16	0	NA
NB	5	0	NA	14	5	Hive Alive
QC	0	20	Dietary supplement	2	30	Dietary supplements, Apple cider vinegar
ON	5	5	Probiotics, Essential oils	7	5	Probiotics, Essential oils
MB	28	4	Bee Tea, Super DFM, Nozevit	35	3	Bee Tea, Probiotics
SK	36	5	Hive alive	35	5	Hive alive
AB	40	1	Bee Optimal, Nozevit	53	1	Bee Optimal
BC	6	0	NA	10	0	NA

[a] NA: not applicable.

In the survey, beekeepers reported the use of fumagillin for the treatment of nosemosis in spring and/or in fall of 2023 (**Table 12**). The percentage of beekeepers that reported using this antibiotic varied widely from province to province. Beekeepers were also asked to report all alternative treatments that they used during the spring or the fall to control nosemosis. Fumagilin-B® is the only product registered by Health Canada for nosema treatment. Any other products mentioned by beekeepers are not currently registered for the treatment of this disease, though some are marketed and used as general promoters of honey bee health. It is also worth noting that there are some regions of Canada where Fumagilin-B® is not used by most beekeepers. This may be due varying seasonal patterns of nosema abundance among regions and the need to better refine predictors for nosema-related mortality (Punko et al. 2021). Overall, nosemosis is still an issue impacting bee health and further research is required to understand its role in colony population build up, honey production and colony loss throughout Canada.

American and European foulbrood management practices

American foulbrood (AFB) is an endemic bacterial disease of brood in Canada caused by *Paenibacillus larvae*. It is also of great concern to beekeepers as active infections may result in large-scale loss of bees and equipment and can spread within regions if proper steps are not taken to eliminate infective colonies and equipment. In recent years, some beekeepers have reported an increasing impact of and difficulty controlling European foulbrood (EFB) in their operation, a bacterial brood disease caused by *Melissococcus plutonius*. Oxytetracycline, tylosin, and lincomycin are all antibiotics registered for treating AFB in Canada, with the latter two used for treating strains of the bacterium resistant to oxytetracycline. Oxytetracycline is the only registered treatment against EFB. The pattern of use for these antibiotics, as reported by beekeepers, is presented in **Table 13 and 14**.

Table 13. Antibiotic treatments for American foulbrood (oxytetracycline, tylosin and lincomycin) at the beginning of the season by province				
Province	**Use of foulbrood treatments (% of respondents) at the beginning of season**			
	Oxytetracycline*	**Tylosin***	**Lincomycin***	**No Treatment**
NL	0	0	0	100
PEI	24	0	0	76
NS	32	0	0	68
NB	41	0	0	59
QC	9	0	0	91
ON	47	1	0	49
MB	43	0	0	57
SK	38	0	0	62
AB	32	1	0	68
BC	6	1	0	0

*These categories are not mutually exclusive; therefore the total may be greater than 100.

Table 14. Antibiotic treatments for American foulbrood (oxytetracycline, tylosin and lincomycin) at the end of the season by province				
Province	**Use of foulbrood treatments (% of respondents) at the end of season**			
	Oxytetracycline*	**Tylosin***	**Lincomycin***	**No Treatment**
NL	0	0	0	100
PEI	18	0	0	82
NS	20	0	0	80
NB	18	0	0	82
QC	0	0	0	100
ON	39	1	0	51
MB	29	4	0	67
SK	42	2	0	56
AB	18	0	0	82
BC	5	3	0	ND[a]

*These categories are not mutually exclusive; therefore the total may be greater than 100.
[a] ND: no data.

Oxytetracycline was the most frequently used antibiotic by beekeepers in the spring and in the fall, the spring use of oxytetracycline is more frequent than the fall use in all provinces except Saskatchewan (**Table 13 and 14**). Provincial recommendations on antibiotic use (e.g., prophylactic vs metaphylactic vs therapeutic) vary across the country. Among beekeepers using antibiotics, percentage of them using it for prevention, as therapy, or for both reasons are presented by province in **Table 15**. Among beekeepers using antibiotics therapeutically, EFB seems to be the more frequently observed than AFB (**Table 16**). In some cases, beekeepers using antibiotics for treating a brood disease are not sure of which disease is present.

Table 15. Antibiotic usage (preventive vs curative) for the management of foulbrood diseases during the 2023 season by province			
Province	**Use of antibiotics for foulbrood (% of respondents)**		
	To prevent disease (prevention)	**To treat observed disease (therapeutic)**	**To treat and prevent disease**
NL	0	0	0
PEI	24	18	12
NS	40	40	20
NB	36	9	5
QC	50	25	0
ON	92	2	6
MB	88	3	9
SK	93	0	7
AB	27	73	0
BC	0	10	0

Table 16. Curative uses of antibiotics according to targeted diseases during the 2023 season by province			
Province	**Curative use of antibiotics for foulbrood (% of respondents)**		
	AFB	**EFB**	**Unsure**
NL	0	0	0
PEI	0	80	20
NS	0	83	17
NB	0	14	0
QC	0	100	0
ON	2	11	13
MB	67	33	0
SK	0	50	0
AB	42	54	0
BC	15	0	0

Honey Bee Winter Loss and Population in Canada Since 2007

Reported winter loss has been variable from year to year in Canada since the start of these annual surveys in 2007. In 2024, the reported winter mortality averaged 34.6%. This is higher than the long-term suggested baseline for winter losses of 15%, suggesting that acceptable levels of loss have never been obtained during this period. As can be seen in **Figure 2,** from 2007 to 2024, national winter losses ranged from 15.3% to 45.5%, averaging 27.7%. In spite of these losses, between 2007 and 2023, Statistics Canada reports show that total number of colonies in Canada increased by 35%.

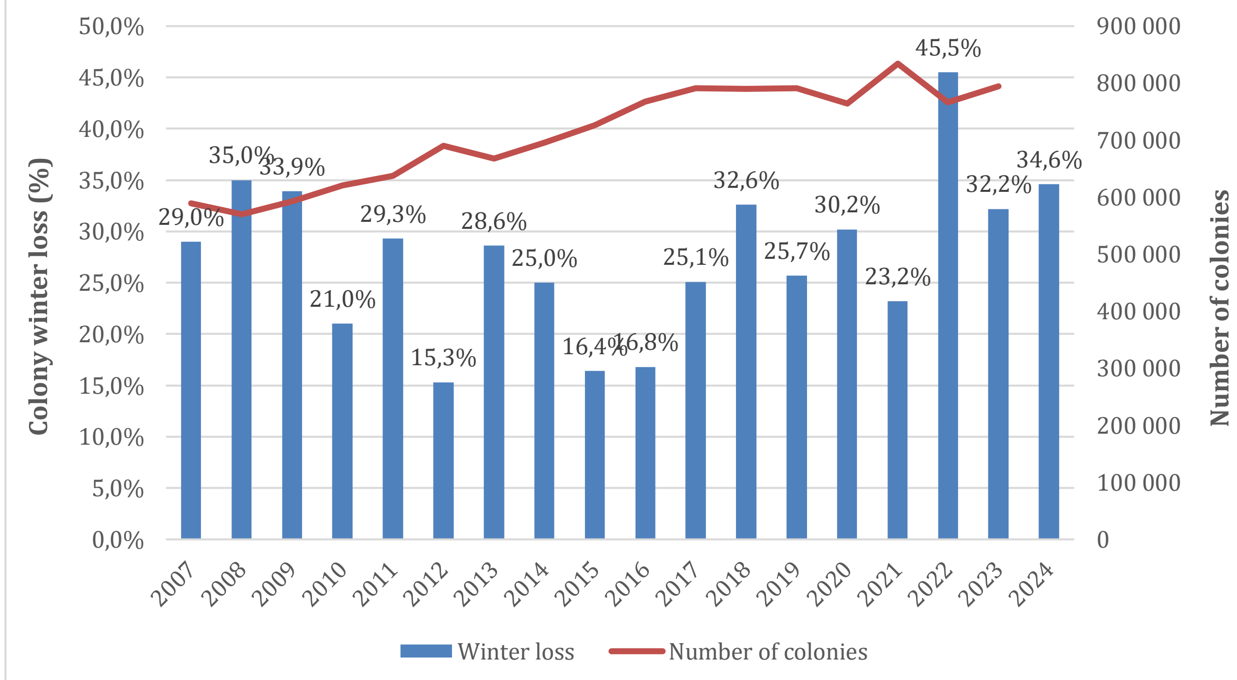

Figure 2. Summary of bee colony numbers (based on data as reported by Stats Canada) and bee losses in Canada from 2007-2024. *Note that the number of colonies as reported by Stats Canada is not available for the current year.*

Beekeepers must be vigilant and practice IPM and BMP for serious pests endemic to the honey bee population in Canada (e.g. varroa mites). A changing climate must be considered due to impacts on bee growth, varroa population development, treatment type and frequency of application. Beekeepers must also consider nutrition, and pesticide exposure within hives and from the environment as well as the added challenge of the economics of beekeeping which include variable honey prices and increasing costs of production. Individual beekeepers experiencing high winter losses face considerable expenses replacing dead colonies. These increased expenses greatly affect profitability and productivity and can put some beekeeping operations at risk of insolvency. Moreover, this survey and report do not take into account mid-season losses of honey bee colonies or queens that beekeepers may be experiencing throughout the beekeeping season. Nevertheless, the Canadian beekeeping industry has been resilient and able to grow, as proven by the overall increase in the number of bee colonies since 2007 (**Figure 2**), despite the difficulties faced every winter. While provincial estimates demonstrate regional trends in winter loss, results vary within provinces and beekeeping operations. While there are operations that have been highly successful, there is a real risk of losing large proportions of colonies in Canada, and continued vigilance is required to maintain bee health, profitable beekeeping operations, and enough stock to meet the demand for pollination services.

Although responses to this annual survey provide evidence that many beekeepers are using recommended practices for monitoring and managing honey bee pests and diseases, there are always opportunities for improvements. As such, the detailed management data from beekeepers summarised in this report has been used by some apiary and extension programs to focus on education, training, and communication efforts to beekeepers on improvement of management for honey bee pests.

It would appear that stress caused by parasites in combination with other stressors warrant further study to provide alternative management practices for maintaining honey bee health. At this time, beekeepers have a limited number of products to control varroa and other diseases, and all of these options have their limitations. New options are important to mitigate the risk of developing resistance. When resistance develops to primary treatments, beekeepers could experience even greater and likely extreme difficulties keeping their bees alive. Ultimately, beekeepers will need more effective and additional options (miticides, antibiotics, and non-chemical management options) in their “tool box” if they are to continue effective IPM and BMP to maintain healthy bees.

Further Work

CAPA members continue to work closely with industry stakeholders and provincial working groups to address bee health and industry economics. Members of CAPA and Provincial Apiarists have also been involved in conducting surveillance programs at the provincial levels and across the country to monitor the status of bee health including emerging pests. CAPA members, the Provincial Apiarists, and Technology Transfer Programs are involved in conducting outreach and extension programs to promote IPM, BMP, 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 enhance IPM practices and address honey bee health sustainability.

For more information about this report, please contact:

Dr. Julie Ferland, Co-Chair of the CAPA National Survey Committee
Julie.Ferland2@mapaq.gouv.qc.ca Tel : 418 380-2100 Ext. 2067

Dr. Ernesto Guzman, President of Canadian Association of Professional Apiculturists (CAPA)
eguzman@uoguelph.ca Tel: 519 824-4120 Ext. 53609

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APPENDIX A: LIST OF CANADA'S PROVINCIAL APIARISTS

NEWFOUNDLAND AND LABRADOR
Paige Marchant
Provincial Apiarist
Dept. of Fisheries, Forestry and Agriculture
P.O. Box 2006, 192 Wheelers Road
Corner Brook, Newfoundland and Labrador A2H 6J8
(709)637-2662
provincialapiarist@gov.nl.ca
https://www.gov.nl.ca/

PRINCE EDWARD ISLAND
Cameron Menzies
Provincial Apiarist/Berry Crop Development Officer
PEI Department of Agriculture and Fisheries
Jones Building, 5th Floor
11 Kent Street, Charlottetown PE, C1A 7N8
902 314-0816
crmenzies@gov.pe.ca
https://www.princeedwardisland.ca/en/topic/agriculture-and-fisheries

NOVA SCOTIA
Sawyer Olmstead
Provincial Apiculturist
Nova Scotia Department of Agriculture
Agriculture Protection
74 Research Drive
Bible Hill, Nova Scotia
B6L 2R2
Tel: 1-902 890-3377
Fax: 902 893-2757
Sawyer.Olmstead@novascotia.ca
https://novascotia.ca/agri/programs-and-services/industry-protection/#bees

NEW BRUNSWICK
Chris Maund M.Sc. P. Ag.
Integrated Pest Management Specialist (Entomologist) and Provincial Apiarist
New Brunswick Department of Agriculture,
Aquaculture and Fisheries
Crop Sector Development
Hugh John Flemming Complex
1350 Regent Street, P.O. Box 6000
Fredericton, NB, E3B 5H1
506-453-3477
chris.maund@gnb.ca
http://www2.gnb.ca/content/gnb/en/departments/10/agriculture/content/bees.html

QUÉBEC
Julie Ferland, DMV
Responsable provinciale en apiculture
Direction de la santé animale
Ministère de l'Agriculture, des Pêcheries et de l'Alimentation
200, chemin Sainte-Foy, 11e étage
Québec (Québec) G1R 4X6
418 380-2100, poste 2067
Julie.Ferland2@mapaq.gouv.qc.ca
Réseau apicole (abeilles) | Gouvernement du Québec

ONTARIO
Paul Kozak M.Sc.
Provincial Apiarist
Ministry of Agriculture, Food and Rural Affairs
Animal Health and Welfare Branch
1 Stone Road West, 5th Floor NW
Guelph, ON, N1G 4Y2
519-820-0821
Paul.Kozak@ontario.ca
https://www.ontario.ca/page/apiculture

MANITOBA
Derek Micholson M.Sc. P.Ag.
Provincial Apiarist
Manitoba Agriculture
Ag. Services Complex Bldg. 204-545 University Cres.
Winnipeg, MB, R3T 5S6
204-791-0124
Derek.Micholson@gov.mb.ca
http://gov.mb.ca

SASKATCHEWAN
Geoff Wilson M.Sc. P.Ag.
Provincial Specialist, Apiculture
Saskatchewan Ministry of Agriculture
800 Central Ave, Box 3003
Prince Albert, SK, S6V 6G1
306-980-6198
Geoff.Wilson@gov.sk.ca
https://www.saskatchewan.ca/

ALBERTA
Samantha Muirhead
Provincial Apiculturist
Alberta Agriculture and Forestry
Crop Diversification Centre North
17505 Fort Road NW
Edmonton, AB, T5Y 6H3
780-415-2309
Sam.Muirhead@gov.ab.ca
https://www.alberta.ca/bees-and-apiculture.aspx

BRITISH COLUMBIA
Paul van Westendorp
Provincial Apiarist
BC Ministry of Agriculture
1767 Angus Campbell Road
Abbotsford, B.C., V3G 2M3
604-556-3129
Paul.vanWestendorp@gov.bc.ca
https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/animals-and-crops/animal-production/bees

APPENDIX B: 2024 WINTER LOSS SURVEY CORE QUESTIONS

The followings are the core questions that will be used in 2024 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 2023?

Outdoor wintering	Indoor wintering	Total

2. How many full sized colonies[1] survived the 2023/2024 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

[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.

NB: You must not include in this data new colonies created by division or purchased in spring 2022. You must however include overwintered colonies that would have been sold before 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 **2023**? *(Choose all that apply)*

Treatment	Beginning of beekeeping season	Mid beekeeping season (honey flow)	End of beekeeping season (late flow or no supers)
Apistan (Fluvalinate)	☐	☐	☐
CheckMite+ (Coumaphos)	☐	☐	☐
Apivar (Amitraz)	☐	☐	☐

Bayvarol (Flumethrin)	☐	☐	☐
Thymovar (Thymol)	☐	☐	☐
ApiLifeVar (Thymol)	☐	☐	☐
65% formic acid – 40 mL multiple applications	☐	☐	☐
65% formic acid – 250 mL single application (Mite Wipe)	☐	☐	☐
MAQS (formic acid)	☐	☐	☐
Formic Pro (formic acid)	☐	☐	☐
Oxalic acid – drip	☐	☐	☐
Oxalic acid – sublimation	☐	☐	☐
Hopguard II and 3 (Hop compounds)	☐	☐	☐
Other *(please specify)* ____________________	☐	☐	☐
None	☐	☐	☐

4. Which monitoring methods did you use for **varroa monitoring** in 2023?

Monitoring method	**Beginning of beekeeping season**	**Mid beekeeping season (honey flow)**	**End of beekeeping season (late flow or no supers)**
Mite fall/sticky board	☐	☐	☐
Alcohol wash	☐	☐	☐
Sugar shake	☐	☐	☐
CO2 roll	☐	☐	☐
Other	☐	☐	☐
None	☐	☐	☐

5. Did you monitor for varroa **before and after treatment** in 2023? *(Choose all that apply)*

	Before treatment	**After treatment**
Always	☐	☐

Sometimes	☐	☐
No	☐	☐

6. Which method of treatment did you use for **nosema** control in 2023? *(Choose all that apply)*

Treatment	Beginning of beekeeping season	End of beekeeping season
Fumagillin (antibiotic)	☐	☐
Other (*please specify*) _______________	☐	☐
None	☐	☐

7. Did you apply the following **antibiotics** (prescription drugs) in 2023 for foulbrood diseases control? *(Choose all that apply)*

Treatment	Beginning of beekeeping season	End of beekeeping season
Oxytetracycline	☐	☐
Tylosin	☐	☐
Lincomycin	☐	☐
None	☐	☐

For those who applied an antibiotic for foulbrood:

1. Why did you apply an antibiotic for the control of **foulbrood** in your colonies in 2023? *(Choose all that apply)*
   - ○ To prevent foulbrood diseases
   - ○ To treat observed disease
   - ○ Both

For those who choose either "To treat observed disease" or "Both":

2. Which disease did you observe?
   - ○ Signs of AFB
   - ○ Signs of EFB
   - ○ Unsure which foulbrood disease

8. To what do you attribute the main cause of death of your colonies in 2023-2024? (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	
☐	Varroa and associated viruses	
☐	Nosema	
☐	Weather/climate	
☐	Weak colonies in the fall	
☐	Other (*Please specify*) ________________________	
☐	Other (*Please specify*) ________________________	
☐	Other (*Please specify*) ________________________	